ISECON '99

Information Systems Education Conference: October 14-17, 1999

Bringing Industry and Education Together--
Closing the IS Resource Gap

PROCEEDINGS

ISECON '99

INFORMATION SYSTEMS EDUCATION CONFERENCE

BRINGING INDUSTRY and EDUCATION TOGETHER
Closing the IS Resource Gap

Chicago, Illinois
October 14 – 17, 1999

William Owen, Editor
University of South Alabama

ISECON '99
Chicago

WELCOME TO ISECON '99

THE SIXTEENTH ANNUAL CONFERENCE FOR INFORMATION SYSTEMS' EDUCATORS

Welcome to Chicago where we are "Bringing Industry and Education Together to Close the IS Resource Gap." We are here together as information systems educators to share our ideas and experiences so that we can continue to improve the educational experience of our students. What an exciting time to be in this dynamic field where change is the only constant. In organizing this year's conference we have included different formats and events so that there will be something of value for everyone. We are also reviving an old tradition of running our annual meeting in parallel with the annual AITP meting so we can better interact with the leaders from the organizations that hire our students and implement the results of our research.

We have 108 authors/panelists giving 53 papers, 5 workshops and 7 panels providing a rich environment from which to choose. A special part of the program is the Distinguished Speaker Forum with four outstanding professionals from industry and academe. Vendors will review their newest technology and publications.

Chicago is an exciting and dynamic city. It is a suitable host for this important event. Join your colleagues for the joint luncheon and reception with AITP on Friday and the ISECON reception on Saturday evening. As we get ready to greet the new millennium help us make this the biggest and best ISECON ever; just be careful not to disturb Mrs. O'Leary's cow!

David Feinstein
ISECON '99 Conference Chair

ISECON '99
Chicago

ISECON 99 will prove to be a premier event with relevant and robust presentations from top-notch IS professionals and educators from across the country. EDSIG has played a major role in the promoting and implementing of ISECON 99. Dr. David Feinstein, Conference Chair must be commended in putting together another great conference. Thanks go out to Sharon Vest and Michael Doran for all their hard work and attention to detail. Thanks to Bill Tastle and Roy Daigle for their hard work with papers and programs. Thanks to William Owen III for his untiring efforts with the Proceedings. Thanks to Rob Ryder and David Langan for their hard work on Registration and Vendors. Thanks also go out to Bruce White and Keith Lynn for their hard work in putting together a great ISECON home page. This staff has done a marvelous job at making sure this year's ISECON is even bigger than last year's conference in San Antonio.

EDSIG now has the Affiliate Membership in place so that any attendee of ISECON is now a member of EDSIG and can receive the JISE publication as well. With the growing number of EDSIG members along with the growing number of Affiliate Members, I can see great opportunities for EDSIG as it continues to publish a quality JISE (Journal of Information Systems Education). Kevin Elder, JISE Editor, continues to outdo himself each and every issue of JISE. Thanks to his hard work, JISE is back! Please help make JISE even more successful by authoring a quality article for the journal. Have a great conference!

EDSIG President,

Jack Russell, Ph.D., CCP
Professor
Northwestern State University

ISECON '99
Chicago

Welcome to the last ISECON in the 20th century. It is an honor for The Education Foundation to Co-Produce this event with EDSIG.

This is a great opportunity to not only welcome you to ISECON, but to also say "Thank You" to several individuals who worked very hard to make this conference a success.

Dr. Brian Reithel, from the Education Foundation, had the task of keeping us on budget and on time. Many CIOs lose their jobs because they cannot accomplish these criteria, so we all know this is not an easy task. Dr. Reithel has been working very closely with Dr. David Feinstein who is the Chair the conference for the 2nd straight year. He promises us an even better event than last year's, which wasn't too bad. While there are many other people who devoted time and energy to insure the success of this conference, no one has give more than Dr. Jack Russell, your EDSIG President. His gift of time, energy and wisdom will be missed next year when he steps down as President. EDSIG is surely in much better condition now than when he took over as President. We all owe him a debt of gratitude for what he has done in our behalves.

This is also an opportunity to invite all of you to partake in the AITP conference, which is being held just down the street and coincides with ISECON. There are several events that you can attend. Some are social and one in particular is a joint event, the Paul Pair luncheon. Mary Fran Johnson, the newly elected Editor of Computerworld will be our guest speaker at this event. Computerworld has been a long standing supporter of EDSIG, so do not miss her insights as to the future of the I.T. Profession.

Take the time to review the other AITP events and functions and come and join them. You are invited to attend and as a matter of fact, encouraged to do so.

Once again, thanks for your attendance to this event. We hope you plan to keep ISECON in your future for the next millennium.

Alan Strong, CDP

President
Education Foundation

ISECON ' 99
Information Systems Education Conference
Bringing Industry and Education Together:
Closing the IS Resource Gap

Program and Table of Contents

Thursday, October 14, 1999

8:00 AM - 12:00 PM – Workshops

1:30 PM - 5:30 PM –Workshops

Friday, October 15, 1999

ISECON OPENING SESSION AND AWARDS Distinguished Speaker:
Kevin W. Bowyer

9:45 AM – 11:45 AM Friday Morning Sessions

Track 1: Theme: IS-CURRICULUM

Track 2: Theme: IS-INDUSTRY

Track 3: Theme: IS-CURRICULUM

Track 4: Theme: PANELS

12:00 Noon – 3:00 PM : Joint Luncheon with AITP in honor of Paul Pair
Distinguished Speaker: Maryfran Johnson

3:30 PM - 5:30 PM Friday Afternoon Sessions

Track 1: Theme: IS-CURRICULUM

Track 2: Theme: INTERNET COURSE/DELIVERY

Track 3: Theme: IS-CURRICULUM

Track 4: Theme: PANELS

Saturday, October 16, 1999

8:30 AM – 9:30 AM ISECON GENERAL SESSION Distinguished Speaker: C. Dianne Martin

9:45 AM – 11:45 AM Saturday Morning Sessions

Track 1: Theme: IS-CURRICULUM

Track 2: Theme: IS-INDUSTRY

Track 3: Theme: IS-CURRICULUM

Track 4: Theme: PANELS

2:00 – 3:00 PM—ISECON SESSION
Distinguished Speaker: Joel R. Hodes

3:30 PM - 5:30 PM Saturday Afternoon Sessions

Track 1: Theme: IS-CURRICULUM

Track 2: Theme: WOMEN/MINORITIES IN COMPUTING

Track 3: Theme: IS-CURRICULUM

Track 4: Theme: PANELS

Sunday, October 17, 1999

8:30AM -10:30AM Sunday Morning Sessions

Track 1: Theme: LEADING EDGE

Track 2: Theme: IS-CURRICULUM

See you at ISECON 2000 in Philadelphia!

Using Web Technology To Reduce Administrative Load And Increase Learning Opportunities In Class. What We Have Learned During The Past Year

Geoffrey Steinberg[1]
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Abstract

Instructors are faced with increasing management of classes and the desire for more communication and interaction with students. A Computer Mediated Communication (CMC) system has now completed its third year of implementation at a large state related university. In its third year the system has undergone changes to better meet student needs especially in the area of increased communications, as well as more assistance to faculty members in managing the class. This topic will discuss the learning pedagogy incorporated into the system as well as the results of a survey by 745 students on the use and benefit of the system.

Keywords: Computer mediated communications (CMC), instructional technology, large-size classes, student satisfaction, class management

Workshop Agenda:

1) Overview and need for an integrated system
    (a) Administrative Features
    (b) Student Features
    (c) Feedback Features
2) What has been added to the system during this academic year
    (a) Communications Board, FAQ's Live Chat
3) What are the research and data collection features that this system provides an educator
4) Benefits of a web-based systems
5) Demonstration of features
6) Discussion of the Academic Community Needs

Intended Audience:

- Instructors who are faced with the challenge to provide high quality teacher while managing large sized classes
- Instructors who want to use web technology to improve the communications between faculty and student

Workshop Goals:

1. Provide the audience with a think piece on how the computer can assist in managing large scale classes
2. Provide a forum to discuss what communications features should be included in a computer mediated communications system
3. Relate the opinions of student participants in the experiment
4. Demonstrate an actual 'live' working system
5. Demonstrate the automatic grading, test giving, and communications features.

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Multimedia Development on a Modest Budget

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and

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Abstract

The purpose of this workshop is to investigate compatible software and hardware components that can be used to create multimedia-based modules for use in information systems courses. A suitable collection of software components can be assembled inexpensively by making judicious use of educational discounts, inexpensive shareware, and freeware. Participants in this workshop will receive an annotated list of the resources that are discussed in the workshop together with a list of relevant web sites.

The primary focus of this workshop is on the software necessary to establish a multimedia development environment. Selected software components, at varying levels of cost and sophistication, will be discussed and demonstrated. Multimedia-based modules, designed for classes at all levels, will be used to demonstrate the capabilities of the hardware and software under discussion. Hands-on experiences will allow the participants to work with selected software. Each major unit in the workshop will begin with discussion and demonstration and finish with a structured practium.

In addition to software considerations, this workshop contains a brief discussion of some of the issues to consider when selecting peripheral devices to digitize externally produced items such as photographs, art work, narrations, audio clips, and video segments. Software that is bundled with these devices can become an integral part of the software collection, but compatibility with other software components and quality of the digitized items, are important considerations.

Keywords: Multimedia

Workshop Overview
Each unit in this outline consists of discussion and demonstration followed by a structured practicum.

1. Images
2. Audio
3. Animation
4. Video
5. Authoring Tools
6. Web Considerations

Intended Audience
This workshop is intended for two groups of individuals (1) educators who want to learn about and practice with sophisticated, but modestly priced, tools for developing multimedia-based modules, and (2) individuals planning to establish a multimedia development environment. No prior experience in multimedia development is required.

Workshop Goals
At the end of this workshop, each participant should:

- be familiar with some of the criteria for selecting software and hardware components for a modestly priced multimedia development environment, and
- have some experience working with selected software tools for developing multimedia-based modules.

Internet-Enabled Learning: Tools and Techniques for Electronic Interaction, Collaboration, and Curriculum Delivery

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Abstract

The dramatic increase in use of the Internet has created opportunities for instructors to deliver their curriculum and to promote and enhance student-to-instructor and student-to-student interaction in ways not possible as recently as five years ago. Additionally, the increase in part-time and non-traditional students at colleges and universities has created a need for interaction beyond the traditional classroom setting. This workshop will introduce participants to current technologies, both commercially produced and user-supported, to promote interaction, collaboration, and curriculum delivery via the Internet. Also included will be techniques to encourage participation by students and discussion content management issues and potential barriers to success. This workshop is especially suitable for those participants who teach courses in evening and continuing education programs where there are traditionally less regular class meetings, and students often have limitations on meeting outside of class at arranged times due to work or other commitments as well as for participants who wish to encourage student interaction and learning outside of the traditional classroom setting.

Keywords: Electronic learning tools, electronic collaboration, Internet curriculum delivery, Internet technologies

Workshop Overview

This workshop will include the following topics

- an introduction to the range of technologies available to support electronic collaboration, interaction, and curriculum delivery in an academic setting and demonstration of the practical application of these technologies
- a discussion of relevant social and technical issues related to the use of these technologies
- a discussion of student reactions and impressions of the efficacy of these technologies in enhancing learning
- an informal information sharing session to allow participants to share their experiences.

Intended Audience

- Educators who are interested in utilizing electronic tools for enhancing their courses and encouraging electronic interaction between students and between students and faculty
- Educators who teach courses where frequent interaction between students outside the class is not feasible (e.g., evening programs) and who wish to encourage collaboration and interaction between students

Workshop Goals

The primary goals of this workshop are

- to introduce participants to commercial and user-supported technologies that facilitate collaboration, interaction, and electronic curriculum delivery via the Internet as a supplement to classroom instruction
- to explore the uses and limitations of these technologies as a constructive adjunct to traditional classroom learning, especially as a means to increase student-to-teacher and student-to-student interaction
- to provide participants with practical examples and demonstrations of how technology-assisted interaction and curriculum delivery can enhance learning.

Developing Dynamic Internet Applications with Active Server Pages

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Abstract

As more campuses move to courses utilizing the Internet and to courses related to electronic commerce, the methods change from static web pages to dynamic web pages. One of the techniques to create dynamic Internet applications is with Active Server Pages. Active Server pages run on a server computer and take data from users / clients and process that information on the server. Some advantages of using the server for processing is through databases residing on the server, through the receiving and processing of data from client's web sessions.

Keywords: Active Server Pages, Interactive Internet Applications

Workshop Overview

This workshop will cover four topics:
1) Introductory concepts of active server pages
2) Server side scripting as compared to client side scripting
3) Development of active server pages and the related statements and commands to create dynamic Internet applications
4) Interaction with databases and an overview of how this can be used with electronic commerce.

Intended Audience:
- Educators using the Internet and wanting to move to the next level
- Educators looking for dynamic applications for the Internet – including interactive testing and electronic commerce

Workshop Goals:
- Introduction and exposure to dynamic Internet Applications
- Server side scripting techniques and methods
- Introductory database concepts for Internet applications

Planned Activities:
The presenter will:
- Explain the concepts behind client side Internet applications
- Demonstrate developing interactive Internet applications using active server pages.
- Though computer displays and handouts, give several examples of active server page scripting, including examples for:
  - Internet interactive quizzes and tests
  - Database development and interfacing with active server pages
  - Foundations of active server pages with electronic commerce
- Answer questions relating to client side scripting

While it would be best to be connected to the Internet and to a server to develop dynamic applications with active server pages, the presenter will demonstrate the techniques with a laptop computer and a projection system, and through handouts.

ICCP Professional Certifications and IS Education

by Lynn J. McKell, Ph.D., CCP – Brigham Young University

This workshop will explain the CCP (Certified Computing Professional), ACP (Associate Computing Professional), and Specialty certifications granted by the ICCP. Particularly, the ACP and Specialty certifications do not require an experience component and could serve as a capstone focal point for CIS students or as standard outcome evaluations for CIS related programs and courses with the significant benefit of respected ICCP endorsement.

Integrating the Information Systems Core Curriculum

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Abstract

The Marriott School at Brigham Young University, like many educational institutions, has witnessed a strong enrollment increase in information systems (IS) programs. This has been accompanied by curriculum changes intended to strengthen the program offerings. In undergraduate (business management) and masters curricula (Accountancy, MBA and Information Systems Management), students can pursue an IS emphasis through the business school; thus the introductory IS courses may contain a mix of students from both undergraduate and graduate levels, and from a variety of functional majors such as accounting, business management, etc. The curriculum is designed for students to take three Acore courses simultaneously during their first semester in the IS major: (1) Principles of Business Programming, (2) Information Systems Analysis, and (3) Database Systems. Though not recommended, some students may take only one or two of the three courses.

During curriculum planning, the faculty acknowledged the need to integrate the subject matter of the core courses so that students would understand how each skill complements systems development and recognize the continuity of the process. With this end in mind, the last week of class sessions are canceled in the three core courses and the time is dedicated to a comprehensive cross functional integrative exercise (INTEX) which requires student teams to apply IS skills as well as other business subjects, such as accounting, finance, operations, communications and team building. The deliverables are a formal presentation of an IS solution, a packet of documentation, and a working prototype of a system solution module. Obviously, there is far more work to be done than one person can accomplish; team work is essential to achieve acceptable results.

This paper explains the structure of the INTEX, including:

- Approach used to organize student teams.
- A brief description of the cases used.
- A description of material given to the student teams.
- A discussion of how other business (eg. Finance, Accounting, Operations) concepts are integrated in the case.
- A description of deliverable expectations - including the team presentation.
- A description of the evaluation forms and process which includes faculty and professional evaluations and student peer evaluations.
- A summary of follow-up feedback from the students.

Though students find the INTEX to be an intense educational experience, feedback derived from graduation exit interviews suggests that it is one of their most valuable learning opportunities.

Key words: IS integrated case, IS comprehensive case, systems development case

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1. INTRODUCTION

As the name INTEX (INTegrative EXercise) suggests, this project is intended to encourage students to look at the big picture of the systems development process. It is the culmination of three core areas - normally taught in tandem: Business Programming (using MS Visual Basic), Systems Analysis and Design, and Database Systems. Students are advised at the beginning of each of these courses and reminded periodically that the final week of the course (with significant impact on their grade) will consist of the INTEX project. Using both hard copy and the internet, general information (including the assignment of student teams) is distributed a week prior to beginning the INTEX so that student teams can meet and work out schedules.

INTEX is constrained to be performed between Monday afternoon and Saturday morning. The case and related instructions are distributed at a general information meeting is held on Monday afternoon. Teams are directed to hand in their Project Dictionary and three copies of their presentation notes at 7:00 am on Saturday morning. This mitigates any perceived advantage for teams scheduled to present later in the morning.

The INTEX case describes the operations of a small company with various problems. During the week teams analyze the assigned case - including economic and feasibility analysis, formulate a development project, perform general and detailed design, program a prototype for a segment of the solution, and prepare the documentation and final presentation.

INTEX student groups are viewed as consulting teams, and the context of the presentation is the consulting team giving a major "professional dress" An INTEX case describes operational aspects of a small company with various problems. For example, a recent case described a dehydrated food processing company, which had problems in accounts payable, accounts receivable and inventory management. Case descriptions include financial statements and industry averages for various financial ratios. Identifying some problems depends upon properly analyzing the financial statements to establish that the corporate ratios are out of line with industry averages - suggesting that something could be done to improve company performance. Case materials contain considerable descriptive detail about operating procedures, forms and their distribution, personnel and their job descriptions, current file contents, operational reports, etc. The detail is sufficient for teams to do extensive DFDs, ERDs, object modeling, etc.

presentation of a proposed solution to corporate management. Corporate management is an evaluation group consisting of professors, advanced graduate students, and professional IT people (generally one of each in each evaluation group). Evaluators use a common score sheet to record their ratings of the presentation and documentation. The faculty reviews the scores, and awards are announced on Monday afternoon. INTEX score results constitute 10% of the grade for each student in each course. In addition, all presentations are taped so students can review and learn from their presentation. It should be noted core courses are followed by others (e.g. Networking Concepts, Fourth Generation Languages, etc.) for students who choose IS as an emphasis or a major.

2. ORGANIZING STUDENT TEAMS

Because we are dealing with approximately 260 students in any given semester, one of the challenges is to achieve some balance in the make-up of student teams. Even though these are introductory core courses, there are both undergraduate and graduate business students in the courses. Most undergraduates are in the information systems major, while most graduate students are seeking an information systems emphasis in either the Master of Accountancy (MAcc) or MBA degree programs. Care is taken to assign students to teams in a balanced way so that each team has a mixture of majors, class levels (MBA and undergraduate), genders, nationalities, etc. - thus students experience working with those of differing backgrounds, and various talents are spread around. Some students take only one or two courses. This, also, is considered in assigning students to teams, and in the peer evaluation scheme.

3. CASE DESCRIPTION

Securing cases with the right structure and appropriate amount of detail is perhaps the most difficult administrative aspect of the INTEX. We have used cases developed from consulting projects done earlier by faculty or student groups. It is important to have several cases (at least three or four - more preferred) available to rotate each year with enough intervening time so that case solutions are not passed down to younger classmates.

Student Handouts

Prior to beginning INTEX, students are given a Preliminary Information sheet containing:

A general brief overview of the INTEX process.
Reminder of grading implications.
Schedule of meetings students should attend - including the final presentation.
Information about student assignments to teams.

Recommendation for teams to meet prior to the INTEX launch.

At the INTEX launching meeting students are given a packet containing:

Information on the scheduling/timing parameters.

General charge including - a brief description of expectations and deliverables.

A reminder of the various evaluations.

A copy of the Peer Evaluation Form to be completed and turned in at the end.

A copy of the case.

3. MULTIDIMENSIONAL INTEGRATION

- Certain Human Resource considerations may play in considering organizational structure, job descriptions and the personnel pressures.
- Team work, coordination, communication, conflict resolution, leadership, etc. are aspects of the team assignments.
- Writing skills are practiced in preparing the final report/documentation.
- Communication skills are used in preparation and delivery of the presentation.
- Project management skills are used in doing INTEX and in the proposed solution.
- Peer Evaluation provides exposure to another aspect of the real world.

5. DELIVERABLES

From the foregoing descriptions it should be obvious that the INTEX is a comprehensive exposure to a relatively real world problem. In the total package of deliverables, teams are expected to show strong evidence of the following work:

1. Significant Economic Feasibility Analysis. By analyzing financial statements using standard financial ratios, and comparing the case company with industry averages it is possible to identify areas of weak performance where improved information systems could improve profitability.
2. Thorough analysis of current operations. DFDs and ERDs of current operations are helpful in understanding the existing system.

Although INTEX is a capstone project for three IS courses, successful teams needed to draw upon skills from many business and information systems related disciplines. For example:

- Finance and accounting skills are necessary in analyzing financial statements.
- Accounting skills are useful in understanding various cycles (sales-receipt, acquisition-payment, production) and the details of various information operations.
- Operations Management knowledge is helpful in understanding, analyzing and developing alternatives for production and inventory management.
- Logistics considerations: acquisition, storing and distribution issues.

3. Comprehensive proposed solution. DFDs, ERDs and object models of the proposed system provide a general framework for understanding a new solution. This is augmented with prototypes of forms, input screens, reports, control/menu screens, data structures, data bases, etc.
4. Prototype system. Teams are required to demonstrate a live prototype for some subsystem of the proposed solution, developed using visual basic – thus demonstrating the linkage between analysis, design and construction. A complete solution live prototype is not expected.
5. Project Management and Implementation Plan. Though generally limited, teams often use PERT charts and text to describe the implementation and conversion process and time frame.
6. Each team's solution is presented in a one hour time period: 25 minutes for the presentation; 10 minutes for questions; 10 minutes for evaluators deliberation (the team is dismissed during this activity); and 10 minutes for feedback. Five minutes are allowed for one team to exit and the next team to set up. Presentation rooms are equipped with an LCD projector.
7. Every student privately completes and submits two documents. One is the INTEX Overall Evaluation Form. (See the attachment.) This form requests general feedback about the INTEX experience, including comments on problems, team dynamics, learning experience, number of hours spent on the project, etc. The second document is the INTEX Peer Evaluation Form. (See the attachment.) This form allows students to differentiate individual performance levels by allocating participation points to each member of their group.

6. GRADING PROCESS AND TEAM AWARDS

There are actually two sets of grading data derived in the evaluation process. First, each team receives an overall team score from their evaluation group. Second, each individual team member receives an individual score, derived from peer evaluation data.

Team Score: The team score is determined by the evaluation group based on the presentation and the project documentation and using the INTEX Team Project Evaluation Form as a guide. Recent team scores ranged from 73 to 96 (100 points possible) with the average being 88.

Individual Score: Teams had members taking one, two or three courses, necessitating different participation level expectations. As the INTEX Peer Evaluation Form explains, this problem is addressed by providing each team a pool of team points based on 10 points for each course taken by each student on the team. Students allocate these points according to an individual's relative contribution to the project effort. For example, a student who took only one course would add only 10 points to the pool; two courses - 20 points; three courses - 30 points. For a typical seven member team the pool may contain around 150 points to be allocated.

As each student allocates points from the pool, a given team member may receive either more or fewer points than his/her contribution to the pool. For example, consider Student 5 shown on the attached EXAMPLE STUDENT AINTEX Peer Evaluation Form. Student 5, by taking two courses, supplied 20 points (2 @ 10 points each) to the pool, but was allocated 22 points by the Example Student. This would imply that Student 4 was perceived as having done more than expected for someone taking only two courses (actually 10% more). These allocated peer points were then averaged for each student, and were used along with the team's case score by course instructors in the grading process. Instructors had flexibility as to
7. Students spent an average of 26.11 hours on the case. Students who took all three core classes averaged 32 hours; two classes - nearly 27 hours, and only one class - almost 18 hours. Obviously, student effort was not directly proportional to the number of classes taken.

7. SUMMARY AND CONCLUSION

INTEX has been a part of the BYU IS curriculum for two years. As noted above, INTEX received a favorable rating by students even though it was generally considered to be an ordeal. Consistent with this assessment, the faculty and professionals involved also felt that INTEX was a valuable experience, and its continuation with comparable cases is planned for use in the future. IS faculty are confident that INTEX not only yields greater understanding of the information systems development process, but also gives deeper insight into other business functions, procedures and ways of analysis. Even with these

how to apply the grading information, though it was expected to count about 10% of the grade in each course.

Team Awards: Subsequent to the presentations, faculty and professionals meet together to ladder the team scoring results - referring where necessary to project dictionaries to insure consistency. A meeting is held Monday afternoon to announce the top three teams and distribute awards. Recent awards consisted of a certificate and a prize: a sweatshirt for members of the first place team, a T-shirt for second place, and a sleeve of golf balls for the third place team members. A professional firm who assisted with the evaluations donated the prizes and guaranteed a job interview to first place team members.

Student Feedback Results

Students complete an INTEX Overall Evaluation Form. which provides valuable information for assessing the INTEX effectiveness and securing ideas for future improvements. Summary results presented in the INTEX Feedback Summary attachment include:

1. Students felt the team experience was very helpful.
2. Students were most frustrated with group scheduling problems.
3. Students would have liked more specific guidance and more time.
[Author comment: both guidance and time were intentionally limited.]
4. Many groups wished they would have spent more time on the presentation.
5. Concentrated team/group work was a valuable learning experience.
6. 82% felt the INTEX was a valuable learning experience.

benefits forthcoming, the administrative tasks for involved faculty should not be underestimated.

INTEX Team Project Evaluation Form

Group #:_____ Members: 1. ____________ Score:____________
2. ____________ r11/30/98
3. ____________
4. ____________
5. ____________
6. ____________
7. ____________

Systems Analysis/SDLC (25)________

Analysis of Problems/Opportunities (Inv., A/R, A/P cost reductions; Customer service, Marketing, Mgt. Control)
Current Operations, Logical Needs Identification/Specification
Re-engineering - Target Process/Behavioral Model (DFD, OO)
Feasibility (Economic, Technical, Operational, Scheduling, Legal)
Implementation Recommendation (Steps, Schedule, Cost)
Input/Output/Interface design. INTEGRATION/Consistency.

Data Model/Data Base (25)________

Conceptual Model, Entities/Objects, Relationships (ERD), Cardinalities, Attributes, Subsets and Aggregates.
Relational Model, Keys, Foreign Keys. Data types

Target System Prototype (25)________

VB5, Passive Prototype
VB5, Active Prototype - one aspect.
Proper Use of Programming Concepts, documentation.
Proper Use of Controls. Screen Design/Layout

Presentation Skills (15)________

Introduction, Handout, Media, Clarity of Expression, Summary/Conclusion, Professional Appearance, Smooth Transitions, Response to questions

Project Report (Documentation) (10)________

Structure (Table of Contents, Tabs), Professional Appearance, Use of Diagraming and Documentation Software

TOTAL SCORE (100)________

Your Name____EXAMPLE STUDENT__________ Group Number____

r11/3

INTEX PEER EVALUATION FORM

Use this form to PRIVATELY record the relative contribution of group members to the integrative exercise. It is recognized that there may be a different level of expectation for each group member. Some group members are taking all three core classes, some only two, some just one. It is reasonable to expect that a group member ' s contribution in the exercise should be approximately proportional to the number of core courses in which they are enrolled. Your subjective evaluation of each member ' s contribution should be recorded on this form by allocating points among group members. The total number of points to be allocated is determined by the number of group members and the number of core courses taken by each person. Information from the completed forms will be given to your instructor(s). Use of this information is up to each individual instructor.

Write your name and group number on the top of this form.
Column A: List all group members in the **same order they appear on your group list**.
Columns B and C: Fill in Columns B and C.
Column D: Calculate the Standard points generated by each person ' s enrollments (Column C x 10).
Total (Sum) Column D: Calculate the total number of standard points available for your entire group.
Column E: After the Exercise, allocate points to each group member proportional to her/his relative effort. (NOTE: The sum of allocated points in column E must be equal to the sum of standard points in column D).
Complete and return this form to 510 TNRB by 5:00 December 7, 1998. Failure to submit this form will result in a lower grade.

A Group Member Names (please print clearly) **SAME ORDER AS ON GROUP LIST**	B Check box if Enrolled in ISys...	C # of Courses Checked in Column B	D Standard Points Col.C x 10	E Points You Allocated	F % of Std. (E/D)
1. Student 1	4409, 6/4439, 6/4459	3	30	36	120%
2. Student 2	4409, 6/4439, 6/4459	3	30	30	100%
3. Example Student (self)	4409, 6/4439, 6/4459	3	30	25	83%
4. Student 4	4409, 6/4439, 6/4459	2	20	14	70%
5. Student 5	4409, 6/4439, 6/4459	2	20	22	110%
6. Student 6	4409, 6/4439, 6/4459	1	10	11	110%
7. Student 7	4409, 6/4439, 6/4459	1	10	12	120%
		TOTALS:	150	150	

Your Name____________________________ Group Number______ r11/24/98

INTEX OVERALL EVALUATION FORM

Please review your presentation VHS tape, then **PRIVATELY** complete this evaluation form and turn it in to room 510 by 5:00 December 10, 1998. (Use the back side of the form if necessary.)

13. What worked well?

14. What were the problems (i.e. what didn't work so well)?

15. What are your suggestions for improving future similar exercises?

16. In hind sight, what could you and your group have done differently to perform better?

17. What else did you learn from this exercise?

18. Overall, although intensive, do you feel this was a worthwhile exercise? Explain?

INTEX FEEDBACK SUMMARY

What worked well?

Count	%	Comment
65	41%	Group experience was good - we worked well together
26	16%	We presented well
23	14%	Dividing our group up and assigning parts
19	12%	Mix of backgrounds among group members
15	9%	We were well organized

What were the problems (i.e. what didn't work so well)?

Count	%	Comment
33	21%	Schedules between group members -- finding time to meet as a group
33	21%	We could have made a better presentation - not enough time to prepare presentation
24	15%	Hard to have even workloads among group members according to # of classes enrolled in
20	13%	Need more time for the project
17	11%	Vague direction from case and from professors
16	10%	Computers in presentation rooms
13	8%	Projectors in presentation rooms

What are your suggestions for improving future exercises?

Count	%	Comment
41	26%	More guidelines as to what is expected of the students (i.e. handouts, financial aspects)
40	25%	Allot more time for the project
32	20%	Make evaluation consistent (i.e. some evaluators focused on financial, some were easier than others)
24	15%	Ensure everyone has all 3 classes
12	8%	More time to test equipment in presentation rooms

What could your group have done better?

Count	%	Comment
68	43%	Focus more on the presentation
19	12%	Better group communication within group
17	11%	Group's time management
17	11%	Defined each person's tasks better
14	9%	Identify and focus on case's main issues
9	6%	Group members could have put in more time

What did you learn from this exercise?

Count	%	Comment
35	22%	Teamwork is important for success
33	21%	How to work better in a group
18	11%	How all the Isys classes come together
8	5%	Importance of group coordination and communication
8	5%	A better idea of what an Isys career involves

Do you feel this was a worthwhile exercise?

Count	%	Comment
140	82%	Yes
28	16%	No
5	3%	Not Sure

Hours spent on INTEX by individuals

Number of classes taken	3 Classes	2 Classes	1 Class	?? Classes
Average # of hours	32.06	26.67	17.72	29.38

Average Hours Per Student **26.1**

An Interdisciplinary Approach to Information Systems Intelligent System Curriculum

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Abstract

This paper articulates the need for information system curricula (e. g., a minor, a certificate program) in intelligent systems for education or training environments. Artificial intelligence has advanced to the point where its techniques have become main stream in intelligent systems. The availability and use of artificial intelligence tools have spread through disciplines and applications of disciplines. We describe a high level template or plan for systematic development of a concentration of study to meet these needs. The description calls for an interdisciplinary effort to systematically determine requirements, make a design, and implement a study in intelligent systems in education/training environments. We introduce intelligent system education or training which meets the changing paradigms of business and commerce. The authors are working to implement the plan and description at their organization. We think this paper enables communication and debate.

Keywords: Artificial intelligence, intelligent systems, themes, interdisciplinary

1. INTRODUTION AND MOTIVATION

Artificial intelligence (AI) is a group of technologies that attempts to emulate certain aspects of human behavior, such as reasoning and communication, as well as to mimic biological sciences, including seeing and learning. Specific technologies include expert systems (also called knowledge-based systems), natural language, neural networks, machine translation, and speech recognition. AI is the branch of computer science that is concerned with developing computer systems capable of simulating human reasoning and sensation. It involves using computers and software that, like the human mind, use stored knowledge to make decisions, involving judgment or ambiguity (Webster's, 1992). This paper views artificial intelligence, in its applied character, as more interdisciplinary. This may be controversial, but we articulate this view here by proposing a methodology for developing an interdisciplinary, intelligent system study concentration (minor).

Artificial intelligence's time as a discipline and as an area in which to prepare people for work and careers in which to apply skills and knowledge has come or is eminent. Intelligent systems are important to commerce, business processes, and modern progress. The real value of intelligent systems is in their ability to increase productivity of work and services. Intelligent systems, which are embedded in application systems, cause such systems (people, hardware, software, etc.) to do more, with more value, enabling commerce and profits..

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the proposal is another, value-added characteristic that each implementing institution or organization can feature, each in its own way.

Both top-down and bottom-up approaches can be incorporated into the curriculum as needs and resources dictate. In addition, we believe that using the real world, as a test-bed for the various artificial intelligence and machine-learning algorithms and other disciplinary and interdisciplinary techniques is preferable to using computer-simulated environments. To that effect, we propose real life themes throughout the curriculum for a possibility as one implementation. We have tried this with mobile robots as both a theme and as a test-bed for working out the learning and application of artificial intelligence (Fendrich, 1998; Fendrich and Nikolopoulos, 1999). Possible themes for the curriculum of this proposal include: robots (mobile robots, for instance), natural language, machine learning, various paradigms, visioning systems, case studies, searching, practical problems, project-based learning, and more. We look at this as an experiment with the ideas of this proposal. Such experiments have included fundamental artificial intelligence techniques, such as search algorithms, machine learning. Plans call for the experimentation with applying other techniques of artificial intelligence, including the evolutionary approaches (Genetic Algorithms), the cognitive approach (neural networks), and the symbolic approach (logic programming and expert systems). We hope to continue to report on these forays into possible implementations of this proposal.

3. DISCIPLINES INVOLVED

The disciplines involved include a wide-ranging collection. This is expected. It is required by the need for people who complete the program to be able to employ artificial intelligence in a wide range of domains in order to gain the value-added characteristics for products and services in the world. Disciplines, which could be included, depending on the resources of the institutions or organizations that might implement the proposal of this paper in some value-added form, are: computer science, information systems, software engineering, systems engineering, mechanical engineering, manufacturing and industrial engineering, psychology, biology, mathematics, statistics, electrical engineering. Undoubtedly, there are others. Of course, disciplines of business are also involved.

The interdisciplinary organization could be to have an interdisciplinary committee with administrative leadership only. Various other organizations could supplement this, or be instead of this. Drivers of the organization make-up and structure could be local politics, interested representatives from disciplines involved, the particular value-added features that might be enabled by a particular organizational structure, etc. There could be lots of ways of working this out. Because of local traditions and politics such a concentration could be developed out of existing courses in existing disciplines within an institution or organization. The main thing would be to not lose sight of the goals and requirements for the program that should result.

4. COURSES OF STUDY

The idea here is to have all new courses. A strategy could be to make a requirements document for each course of study, as well as the total program of study. Then implementers could use a interdisciplinary strategy and use interdisciplinary resources to design, build, and implement each course in an interdisciplinary, coherent, interlocking fashion. An idea could be not to use existing courses within disciplines, but rather to just concentrate or focus on what is perceived to be required by the interdisciplinary strategy and resources..

Here is a generic discussion of the courses of study in the proposal of this paper. The theme of autonomous, mobile robots is present and propagates through the whole course sequence.

1. Breadth-first view of the foundations of the applications of intelligent systems and foundations of the intelligent systems concentration. This is the starting course.
2. Artificial intelligence programming. There are introductions to declarative programming languages, functional programming languages, productive systems languages, etc. This is the artificial intelligence programming course.
3. Logic-based, knowledge-based view of intelligent systems giving a symbolic approach, including logic programming, knowledge representations, knowledge acquisition, validation, verification, autonomous agents, uncertainty. This involves all disciplines, but especially computer science and information systems, psychology, statistics, and engineering.

4. Cognitive-based view of intelligent systems, including natural language processing, visual recognition, pattern recognition, neural networks, and autonomous, mobile robots. This, too, is involves all disciplines, but especially computer science and information systems, psychology, linguistics, mathematics, engineering.
5. Evolutionary-based view of intelligent systems, including genetic algorithms, evolutionary feedback systems. This study too involves all disciplines, but especially computer science and information systems and biology.
6. Capstone courses to apply intelligent systems to the development and delivery of significant, practical, real-life problem solutions. These problems could include those in natural language, visual recognition and pattern recognition, and mobile, autonomous robots. A deeper, richer curriculum than we propose here might include specific courses in natural language, visual recognition and pattern recognition, and mobile, autonomous robots. Such courses could lie between courses 3, 4, 5 and the capstone course 6.

We give a couple of possible paradigms for two first layer courses in the two following paragraphs.

As with all other courses, all disciplines would be involved in everything to do with the starting course of study (course 1, above). This would include requirements determination, designing a course of study to meet those requirements, course of study development, course of study presentation, course of study evaluation, course of study improvement, etc. This course of study could include the following components: introduction to applications, introduction to concepts and strategies of later courses, introduction to disciplines.

A second, first-level, possible artificial intelligence programming course (course 2, above) involves all disciplines. Possible programming includes training, education, and experience in artificial intelligence programming tools such as: LISP, Prolog, OPS5, CLIPS, JAVA – JESS, conventional programming languages, Internet programming languages, etc. Presently, most introductory artificial intelligence programming courses, concentrate on just one language. The proposed course is different in being a survey and study of various artificial intelligence programming paradigms. For example, logic programming (prolog), functional programming (lisp), productive systems (OPS5, CLIPS), and others.

The total number of hours in such a collection of courses of study could be 24 hours, for instance, in a semester-based system. However, the authors do not think of this curriculum proposal as being tied to a traditional, fixed, college, academic environment. Alternative, value-added ways of implementing the curriculum are envisioned. Certificate programs of study are instances of other ways.

5. LABORATORY

The laboratory setting for this proposal is described here. There should be rooms for interaction, collaboration, communication, and team-based activities. Such rooms should include an environment as well as equipment to facilitate the same at any time. There should be laboratories with equipment and technology. There should be continuing support. We do not give specifics in terms of equipment and software here, as this depends oh the approach taken, the themes chosen, etc. For example, in addition to the generic computing equipment required, if the autonomous, mobile theme is adopted, refer to (CS 403 Requirements Documents for Autonomous, Mobile Projects, May, 1998 – May, 1999 and May, 1999 – May, 2000) for descriptions of additional needs. The authors and an interdisciplinary group have initiated this at their location with a modest-sized laboratory/classroom that is interdisciplinary. We think of this as an intelligent systems center with plans for collaboration with other centers, sources of industrial and commercial projects, and other disciplines. Again there is opportunity for taking this idea to fruition in various, value-added ways. This again is a feature of the richness of this proposal and ways it might be carried out.

6. SUMMARY, DEBATE, AND REFLECTION

We have presented a concept of concentrations of study in information systems for intelligent systems. The presented plan calls for work and contribution from disciplines, not from any one discipline. The proposal calls for innovation. It does not call for the construction of a concentration of study by the aggregation of components from existing courses within disciplines that develop the concentration of study. Rather, it calls for a minor or concentration of study engineered to meet the needs and requirements recognized by the disciplines. The concentration of study would be engineered to meet needs as recognized by individual markets. The concentration of study would be engineered to prepare people, who are trained and educated to make intelligent systems that are recognized as being needed currently and into the near future.

We think this may provoke debate and reflection. We think this discussion and debate will be good for determining plans and directions for information systems education, concentrating on intelligent system education. This is a rich area for work. It attempts to meet what we perceive is required.

The concentration of study, which is discussed in this paper, is open-ended and open as to what actually might be built and constructed at institutions or organizations. Moreover, it is open on what the disciplines within an organization or institution might provide. The proposed information systems curriculum allows for innovating implementations within guidelines and conceptual paradigms. Reflection is enabled because there is opportunity to observe and review and study the different implementations that might result. Debate is possible because there is opportunity for different implementation ways to compete, economically with products (people) they produce, and in scholarly ways, exhibiting ideal or optimal pedagogical results or measurements of the degree to which perceived requirements for programs of study are met.

The paper articulates an outstanding problem in information systems education. That outstanding problem is the training and education of people prepared to apply intelligent systems concepts, tools, and techniques to enable organizations, companies, and individuals to build value-added services which enable organizations, companies, and individuals to survive and grow. This paper provides an opportunity for reflection, debate, and further ideas and proposals on curriculum developments to attempt to solve that problem.

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Developing an Integrated Information Technology Management Undergraduate Curriculum

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Abstract

This paper describes a new Bachelor in Commerce degree program in information technology management designed to combine core business knowledge and skills with a broad understanding of information technology systems and processes. The focus of the program is developing graduates with the skills needed to match technology solutions to business requirements. Program specialization is available in one of three emerging areas: applications development, telecommunications and networks, and multimedia. Liberal studies courses provide students with understanding and appreciation for the social context.

The curriculum development process included review of model curricula, such as the Information Systems (IS) 97 guidelines, review of the International Communications Associations guidelines for telecommunications education, and a review of Canadian and United States undergraduate business programs with Information Systems Specializations. Extensive consultation with industry leaders and potential employers was an integral part of the development process. The internal organizational development process involved ongoing consultation with several departments and communication updates and feedback sessions with faculty. This process culminated in the reorganization of two programs into one new school.

Keywords: Information technology education, information systems, management education, strategy

1. INTRODUCTION

Information technology's importance to virtually every societal sector, and, indeed, to world economic development, has been documented extensively (International Telecommunications Union, 1995). The global industry is worth about 1.9 trillion dollars and is expected to grow to about 7.8 trillion dollars by 2005 (ITAC, 1998). The study by the International Telecommunications Union (1995) underscores the link between telecommunications infrastructure and global economic development. Canada is no exception, as its information technology and telecommunications (ITT) sectors make a significant and growing contribution to Canadian economic prosperity, accounting for 7% of GDP in 1995 and 7.5% of Canada's total manufacturing exports, employing 3% of the labour force. The sector is also robust with a compound annual growth of 9.1% for the 1990-95 period (Kormylo, et. al, 1997). Regardless of sector, ITT is critical to business effectiveness.

Literature stresses the importance of linking ITT strategy to corporate strategy (Chan et. al., 1997). A recent survey of Chief Executives from 213 companies in 11 industry sectors, notes that 90% rated information technology as essential or very important to corporate success (A.T. Kearney, 1998). Data processing, telecommunications and content (media) are converging; growth technologies include the Internet, networks, ecommerce and multimedia (A.T. Kearney, 1998; Tapscott, 1996; Ontario, 1997). The Program Advisory Committee of one of the academic programs discussed in this paper (AIM) as well as a panel of industry experts, emphasized the importance of service management, outsourcing and wireless communication. These are also trends identified by a number of industry reports and market researchers (see for example, Yankee Group, 1998).

In Canada and elsewhere, considerable attention has focused on the need to increase the supply of engineers and computer scientists to meet the growing demand for skilled professionals in the sector. (CATA, 1997). Others have argued the need for managers of technology and a number of institutions have responded (Badawy, 1998). In addition, there is a growing demand for dual perspective professionals who understand both the technology and its applications. Recent studies have confirmed the Canadian demand for professionals with analytical and management skills in these sectors (ITAC et.al. 1998). Information systems management, while related to both computer science and business management, is a distinct discipline (Lee et. al, 1995).

A review of post secondary institutions in Canada shows there are few institutions, which provide management programs with much emphasis on information technology. Even fewer have a focus on telecommunications, digital media or e-commerce (Hueser and Cukier, 1997).

2. RYERSON POLYTECHNIC UNIVERSITY

Ryerson Polytechnic University, a predominantly undergraduate university, has a history of merging theory and applied learning. It is large by Canadian standards, 10,000 full-time and 30,000 part time students with the largest undergraduate business school in the country. Within the university, several programs address aspects of information technology. The Faculty of Engineering and Applied Science houses both applied computer science and engineering programs. The Faculty of Business includes the School of Administration and Information Management (AIM) with an emphasis on information technology and telecommunications as well as the School of Business Management with a specialization in Business Information Systems (BIS) and a focus on applications development. Both the AIM and BIS programs have well-developed curricula and strong student demand. A 1997 Ryerson survey of AIM and BIS graduates shows that current programs served students well in obtaining positions as analysts, managers, programmers, network administrators, marketers and trainers. Over two thirds of AIM respondents indicated they were working in their field or a closely related field compared to over 80% of BIS graduates. BIS graduates were more likely to have employment as programmers or applications developers and AIM graduates were more likely to have positions in the telecommunications sector (Ryerson, 1998).

The AIM program had the highest concentration of women students and faculty among information technology related programs at the university and possibly in the country (See Table 1 and Ryerson, 1997). This may be due, to AIM's historical roots in office administration coupled with the interdisciplinary emphasis on application of technology, rather than the technology itself. In light of recent efforts to address women in technology, this was considered to be important.

Table 1: Respondents to 1996 Ryerson Alumni Survey

Program	Employed in field or closely related field	Percentage of Women
Administration and Information Management, Bachelor of Applied Arts BAA) n=63/158	67.2%	76.9%
Business Information Systems Option, Bachelor of Business Management (BBM) n=25/63	81.8%	29.2%
Computer Science, Bachelor of Technology	80%	18.5%
Electrical Engineering, Bachelor of Engineering n=35/99	65.6%	14.3%

N=respondents/graduates

A committee struck by the Vice-President, Academic and the Dean, Faculty of Business, was charged with the task of examining overlap and duplication between the AIM and BIS courses. The committee was multi-disciplinary and included faculty members with backgrounds in engineering, computer science, management, organizational design and education theory.

The committee rapidly reached consensus on the extent of commonalty, shared objectives and overlap. It then moved to the question of "what would the best possible undergraduate program in the management of information technology look like?" The committee recognized the need to anticipate and respond to competitors in the academic arena and to position Ryerson more clearly in the information systems and telecommunications management sector.

3. INFORMATION TECHNOLOGY MANAGEMENT

The committee's first step was an attempt to define the discipline. While information technology management includes subject areas such as programming, data communications and systems design of computer science and engineering, the focus of Information Systems Management (ITM) is different. Information Systems Management was considered as a discrete discipline focused both on the technologies themselves as well as on an understanding of how to develop and use them to support management objectives. There has been a shift in skills and knowledge needed in IS professionals, with increasing emphasis on business operations knowledge, management and interpersonal skills to effectively lead organizational integration and process reengineering activities. Requirements for IS professionals are becoming more demanding with less emphasis on programming and more emphasis in multiple dimensions, particularly in areas of business functional knowledge and interpersonal management skills. In addition, with the shift to distributed processing, the rise of the Internet and multimedia applications, required technology skills are also changing (Lee, et. al., 1995). Recommendations to address this problem range from shifting the program's structure to increased emphasis on case analysis.

Studies have revealed a lack of alignment between university business schools in general and the needs of business and, in particular, gaps in the area of information technology (AACSB, 1997). The importance of new business practices and technologies such as Total Quality Management (TQM), Re-engineering, and managing technology have been emphasized. In fact, AACSB judged the state of awareness of new technology, multidisciplinary approaches, new pedagogy and innovative" big leap" research to be unacceptable relative to industry needs. The causes of this misalignment are complex but include a lack of awareness among faculty of global economic and technological environments, the rapid rate of change and the lack of interdisciplinary faculty with recent private sector experience (AACSB, 1997).

This misalignment also applies to Information Systems curricula (Lee, et. al., 1995) as well as telecommunications management education. For example, it is often difficult to find instructors with the necessary educational qualifications that include both a functional discipline and an organizational support technology such as telecommunications and information systems (Erbschloe, 1996). At the same time, evidence suggests that while businesses, at one level, recognize the strategic importance of information technology (AT Kearney, 1998) it is often not well integrated into their internal planning processes. Senior managers often know less about technology than they should. As MIT's Tom Malone said "I do not think a competent CEO or manager would say 'I don't know anything about finance, I delegate to my CFO' in the same way information technology is too important to be left to the technologists" (Cited in Whitford, 1999, p.192).

4. CURRICULUM MODELS AND COMPARISONS WITH OTHER PROGRAMS

In an effort to retain academic rigour while addressing environmental changes, the committee considered curriculum models, a wide range of sources related to industry trends, and advice from the program's industry advisory committee.

A wide range of proposed curricular models are relevant to this discussion. The IS'97 Model Curriculum Guidelines for Programs in Information Systems from 1996, produced by the Association for Computing Machinery (ACM), the Association for Information Systems (AIS), and the Association of Information Technology Professionals (AITP) provided one model (Davis et. al., 1997). The Software Occupational Skills Profiles Reference Model produced by the Software Human Resource Council (SHRC, 1998) developed a skills profile for specific positions. In addition, the Ryerson committee examined programs in telecommunications management, and emerging area in the International Communications Association / Canadian Business Telecommunications Association Directory of Academic Programs (Hueser and Cukier, 1997), and models for Management of Technology (Badawy, 1998).

The IS 97, unquestionably provides a good starting point with core skill requirements in key areas defined below. The growing emphasis on management issues and the shift from traditional programming is evident when comparing the IS 97 guidelines to the IS 95 guidelines (Cougar, et. al., 1995) (See Table 2). In addition, increased emphasis on networks and database technologies is clear.

However, even the IS'97 model curriculum still places relatively little emphasis on telecommunications and network management and makes little reference to emerging areas such as the Internet, multimedia or ecommerce. Currently AIM is the only Canadian program deemed to meet the requirements for an undergraduate program in telecommunications for affiliate status with the International Communications Association (Hueser and Cukier, 1997). Given the importance of telecommunications and networks, there was interest in preserving these elements.

Table 2. Comparison of IS'95 and IS'97 model curricula

Significant Subareas in IS Curriculum	Depth of Knowledge/Competency Levels for Majors	
	IS'95	IS'97
End User Applications	4	na
IS concepts and functions/literacy in computers and IS	4	4
Knowledge work software packages	Na	4
Systems theory and quality	na	4
Decision-making	na	3
Information Systems planning	na	3
IT and organizational systems	na	4
Computer Systems hardware	2	3
Computer Systems software	2	3
Networking and Telecommunications	3	4
Programming languages and implementation	4	3
Algorithmic design and data, object and file structures	4	3
File techniques	4	na
Utilities, code generators, report writing	4	na
Software development	2	3
Database modeling, construction, tools	2	4
Information systems analysis, design, implementation	4	4
Teams, personal and interpersonal skills	4	4
Project management	na	3
IS support services	na	2
Systems integration	3	3

Management of IS function	3	2
Information resource management	na	2

Hardware/software was one category in 1995.

In addition, there were broader issues related to the management of technology, such as those identified by the National Research Council (NRC, 1991) which included:

- How to integrate technology into a firm's overall strategic objectives.
- How to get into and out of technologies faster and more efficiently.
- How to assess/evaluate technology more efficiently.
- How to accomplish technology transfer.
- How to reduce new product development time.
- How to manage large, complex and interdisciplinary or inter organizational projects/systems.
- How to manage organizations' internal use of technology.
- How to leverage the effectiveness of technical professionals.

While these issues apply to the management of technology generally, they also have relevance to the management of information systems in particular.

Finally, given that the program was to be designated as a Bachelor of Commerce and would reside in the Faculty of Business, there were core business courses to consider.

Based on a wide range review of industry and government documents on trends in industry and employment, as well as the model curriculum mentioned above, the Ryerson committee determined that both AIM and BIS had many elements needed for a unique and excellent program.

5. PROGRAM GOALS AND OBJECTIVES

The committee's shared goal was to establish an outstanding undergraduate degree program in the management of information technology.

The program's objectives included:

- To respond to societal needs and emerging trends in information technology management.
- To develop graduates with the blend of theory and practical skills to plan, design and administer information technology including:
  1. An understanding of the role of information in organizations and ways in which information systems can support organizational objectives.
  2. A strong foundation in information systems including applications development, distributed systems and emerging technologies.
  3. A focus on specific technologies (applications development, telecommunications management or multimedia management) and management areas (such as training, marketing, human resources management).
  4. A thorough understanding of the management and organizational issues needed to use information systems effectively.
  5. The communication and interpersonal skills needed to work with both technical and non-technical users of information and to participate effectively in teams.
  6. The skills needed to plan develop, operate and administer information systems.
  7. Providing students with a better understanding of the broader social context through liberal studies.

6. TEACHING AND LEARNING STRATEGY

The revised program retained key elements of the two existing programs. These include a co-op option, a part-time evening degree program, a series of certificate programs in areas such as Training and Development, Telecommunications Management, Information Systems Management and Business Information Systems). Students have access to relevant minors in professionally related streams of courses (e.g. marketing, accounting, business and technical communications), to an articulation agreement with Syracuse University for a Masters of Science in Telecommunications and Network Management, and to a joint Masters program with York University, Toronto. in Communication and Culture

The new program will also provide courses in information technology to other Ryerson programs including the School of Business Management, the School of Hospitality and Tourism Management, the School of Retail Management, Public Administration, and others.

Curriculum redevelopment also provided an opportunity to assess teaching and learning strategies and ways in which to respond to emerging trends in technology enabled-learning (Cukier, 1997), mobile computing (Burg, 1998) and distance learning (AACSB, 1999). Further work in this area is under development. This includes extending the LINK program to all students.

The Ryerson LINK program, in its second year is open to a select group of students who pay for a ThinkPad laptop computer that they use in most classes. The project is based on the philosophy that students, like business executives, need effortless, on-demand access to the information tools of the trade which translates into having an Internet connection and a powerful computer at your fingertips regardless of where one chooses to do learning. Students take required courses in a networked classroom and information technology is built into their courses. Course materials and lecture notes are accessed through the Web, communication with professors and other students is through e-mail, some assignments are submitted electronically and some tests taken on-line.

Other teaching and learning strategies under development include providing a wider range of WEB-based courses, expanding lab facilities and incorporating specialized applications such as SAP.

7. CURRICULAR DESIGN

The program had to conform to the university tripartite structure, with a balance between core professional courses, professionally related courses and liberal studies courses. While there is no doubt that management courses are essential to the development of professionals who manage information systems and telecommunications, the committee decided that courses directly related to management of technology would be designated as Professional courses. Management courses although required, are considered as Professionally Related courses (See Table 3: Curriculum Structure).

The program was designed to provide a coherent and strong core of required courses in information systems consistent with the IS 97 model. The progression of courses begins with basic courses in information technology and programming, systems analysis and design, local area networks, wide area networks, database development, management of information systems and telecommunications, information systems strategy and applied project management. Each course spans 13 weeks and three hours of lecture or lab per week.

The final two-capstone courses require integration of business and information systems learning. In the first course student teams conduct a detailed analysis of an industry sector and examine a particular company and its strategic role of information technology as well as positioning and use of technology in that sector. In the second part of the course, the teams conduct a feasibility study of a system for the company they examined in the first term. Porter's analysis of competitiveness and the value chain provides a conceptual model. The course has some resemblance to the MBA core course proposed by Silver et al (1995) but at a more advanced level.

The three focus areas which students may consider include a range of electives (see Table 4). The applications development stream includes a range of courses related to systems development and programming. The telecommunications and network management stream includes advanced courses in telecommunications technology as well as its management and the industry. Finally, the digital media management stream includes courses in the development of multimedia systems. Further electives in this stream will include electronic commerce courses.

The program provides students with core business courses generally required for a typical Bachelor of Commerce degree, e.g. accounting, economics, finance and marketing, with particular emphasis on organizational behaviour and development. In this area, too, a broad electives range is provided for students to build some depth in a particular stream - such as marketing, finance, training, business and technical communications, public administration, etc.

The balance between required and core courses is intended to provide students with a solid grounding as well as wide options for specialization and further professional development. (For more detailed course descriptions, see www. ryerson.ca)

The software products used in the courses are to be reviewed each year and are subject to change depending on industry needs and new applications. The products that will be used for the first two years of the program include, Microsoft Excel, Word, Access, Visual basic 6.0, C++, CASE, Novell NetWare, HTML, CGI script, Java Script, Java applets, SQL, Powerbuilder and others.

Students may choose professionally related electives from a broad variety of courses including: accounting, communication, economics, finance French geography, history, law management, managing human resources and training, marketing, politics, public administration, Spanish, quantitative methods as well as other subjects.

In addition, students must complete a total of 6 liberal studies half courses during their four years of study.

8. CONCLUSION

The new Bachelor of Commerce in Information Technology Management is the largest undergraduate program in the discipline in Canada. The expected first year enrollment for 1999 is approximately 300 students. The program provides a solid grounding in both information technology and applications, as well as in management principles and their application in the IS environment. Given the rapid pace of development in the discipline and the evolution of learning technologies, the program is expected to continue to evolve over the next few years.

TABLE 3 CURRICULUM STRUCTURE

REQUIRED PROFESSIONAL COURSES	REQUIRED PROFESSIO-NALLY RELATED COURSES	ELECTIVES
Year One		
Business and IS	Foundations of Management	2 Liberal Studies
Personal Productivity	Introductory Financial Accounting	
Introduction to Application Development	Organizational Behaviour and Interpersonal Skills	
	Introduction to Marketing	
	Written Communication	
	Business Statistics	
Year Two		
Intermediate	Introduction to	1 Professional

Application Development	Finance	
Systems Analysis and Design	Business Law	1 Professional-ly Related
Telecom. Technology and Applications	Introduction to Management Accounting	1 Liberal Stud-ies
Intro to Network Technology		
Internet Software Applications Development		
Year Three		
Database Analysis and Design	Training Methods	1 Professional
Management of IS and Telecom	Introductory Microeconomics	1 Professional-ly Related
Data Communications	Introductory Macroeconomic	2Liberal Stud-ies
Year Four		
IT and Strategic Management	Managing Organizational Change	3 Professional
Applied Project Management		3 Professionally Related
		1 Liberal Stud-ies

TABLE 4: PROFESSIONAL ELECTIVES

Systems Development Focus

- Database Applications
- Business Process Re-Engineering
- Information Systems Security & Control
- Software Evaluation Methods
- Object-Oriented Analysis & Design
- Application Reverse Engineering
- Advanced Application Development
- Internet Applications Development
- Client Server Applications Development
- Database Administration
- Advanced Project Management

Telecommunications and Network Management Focus

- Introduction to Network Management
- Canadian Telecommunications Market
- Voice Systems & Services
- Telecommunications Applications
- Designing & Managing Integrated Networks
- Current Issues in Telecommunications
- Special Topics in Telecommunications (Ecommerce)

Multimedia Management Focus

- Multimedia in Business
- Internet Applications Development
- Interaction in Multimedia
- Managing Multimedia Projects

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Robotics and Intelligent Agents as a Theme in Artificial Intelligence Education

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Abstract

This paper introduces an implementation of the theme-based approach to curriculum development in the area of Artificial Intelligence education. In addition, it addresses the need of using real life projects, as test-beds for the applicability of various Artificial Intelligence techniques, instead of simulated environments. The use of Mobile Robots and Intelligent Agents is proposed as such an appropriate theme. The hardware platforms used, as well as examples of implemented projects are introduced.

Keywords: Artificial intelligence, intelligent agents, mobile robots

1. INTRODUCTION

The concept of theme based curriculum development in Computer Science and Information Systems is an appealing concept (Fendrich and Nikolopoulos, 1999, Meeden, 1996). Courses built around themes can enhance the students' motivation and learning. The approach can also support breadth-first teaching in introductory courses in computer science and information systems, (Meeden, 1996). In a subject such as computer science and artificial intelligence, which is an aggregation of concepts or pieces, there is a challenge of finding a unifying theme to obtain a vision of the subject. Among possible themes of knowledge representation, search, logic, vision, natural language, or across the board applications (e.g. aviation, flight control, flight simulation), the theme of intelligent agents/mobile robots was presented as a viable implementation. The robotics theme supports the agent perspective for artificial intelligence as describing and building intelligent agents that search for and receive environmental and perceptive input and then output appropriate actions. Another motivation was that the theme approach could support the inherent inter-disciplinarity of artificial intelligence. It can connect artificial intelligence to other parts of computer science (systems engineering or systems science or systems analysis and design, embedded and real time systems, software engineering) and other disciplines (mechanical engineering, electrical engineering, manufacturing and industrial engineering, biology and psychology among others).

The intelligent, agents-centered approach to learning/teaching artificial intelligence can be summarized as designing and building agents that receive perceptions as input, and then perform appropriate actions based on them. Artificial intelligence can be viewed as centering around how best to implement this mapping from perceptions to actions. The viewpoint of the agent-centered approach can be appropriately implemented using Robotics.

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The field of Artificial Intelligence has reached a level of maturity with a number of techniques which have proven themselves in real life problems, as primarily exemplified by the areas of neural networks, expert systems and genetic algorithms, (Nikolopoulos, 1997).

An AI system does not necessarily have to be a stand-alone system to be accepted as useful or intelligent. An AI system can interact with a human, complementing and increasing each other's capabilities, or it can be embedded in a traditional software system, making the total system more effective. Integrated systems and solutions, where AI is one of the system components, is today the norm.

AI has come to the forefront and is the best hope for solving many important and current problems, which defy solutions by traditional techniques. For example, with the advent of the web and the instant availability of huge amounts of on-line text based and multimedia information, the use of traditional indexing and database management tools is inadequate for effective information retrieval. In addition to the need for semantic information retrieval as opposed to syntactically based, other complex forms of multimedia data, such as video, image and sound files, also need to be indexed and accessed. AI is the main player promising the solution for the problem of converting the available, vast amounts of information into knowledge, and effectively solving the information retrieval and knowledge retrieval problems. Use of AI in engineering is proliferating in manufacturing systems such as product design, process planning, manufacturing plant layout, process control, etc. AI techniques can reduce the time required to engineer, design, produce and distribute products. In addition, AI seems to be the most promising approach in solving software development and maintenance problems, which are extremely hard to solve with traditional software engineering approaches.

Traditionally, AI has used the top-down design for building intelligent systems. Under this approach, large, complex systems are created to solve a particular aspect of intelligent behavior. For example, understand natural language, play chess, or predict the interest rate trend.

In the new emerging bottom-up approach of artificial life, intelligent creatures are created, capable of exhibiting multifaceted intelligent behavior in a complex environment. A complex environment is dynamic and exhibits the presence of more than one stimuli, creature behavior independent of others' actions but also influenced by them (culture, etc.), many simultaneous and maybe contradictory goals to be satisfied. These creatures are initially simple, but integrated systems, incorporating sensory input. Their sensory input dictates adaptation of their behavior and activation of various control modules. The goal of each animat is to satisfy its needs, goals and desires by achieving all the tasks that need to be completed towards that end. At the same time, each animat is supposed to learn from each environment, and improve its performance and chances of survivability.

Both the top down and the bottom up approaches to AI need to be studied in any AI curriculum. In addition, we believe that using the real world, as a test-bed for the various AI machine learning algorithms and other techniques, is preferable to using computer simulated environments. To that effect, we propose the use of a real life theme, or combination of themes, throughout the curriculum to demonstrate the usage and applicability of the various AI techniques. As an example of an appropriate theme, we propose the use of mobile robots as a test-bed of fundamental AI techniques, such as search algorithms, but also of all major approaches to AI as described above, including the evolutionary approach (Genetic Algorithms), the cognitive approach (Neural Networks), and the symbolic approach (Logic Programming and Expert Systems).

2. THE ROBOTICS PLATFORM

The project, of building a robotics based theme across a variety of AI classes, was housed in an interdisciplinary artificial intelligence laboratory with computer science, mechanical, manufacturing and industrial engineering. This laboratory provided the needed support for the project.

The primary technology used with this project was the Handy Board micro-controller developed by groups with Massachusetts Institute of Technology affiliations. It is the primary technology used to enable an autonomous, mobile robot at the initial stages of this project. One of the reasons for choosing this initial platform is the low start up cost. Handy Board controlled robots can be built for the cost of around $400 per unit, including the controller, motors, sensors and building blocks material. So the cost of a start up lab is not prohibitive. One disadvantage of the Handy Board technology is its limited memory capacity and number of ports, which reduces its ability to accommodate more sensory systems and support computationally intensive algorithms such as neural networks for example. For more advanced projects, the use of robotic platforms such as the Pioneer class or Khepera robots is recommended (this will involve a cost of around $3,000 per robot).

The Handy Board was developed during the period 1991-1997, by Fred G. Martin of the Media Laboratory at the Massachusetts Institute of Technology. The Handy Board is a hand-held, battery-operated, inexpensive micro-controller board well suitable for personal and educational robotics projects. Based on the Motorola 68HC11 microprocessor, the Handy Board includes 32K of battery-backed static RAM, outputs for four DC motors, inputs for a variety of sensors, and a 16X2 character LCD screen. The Handy Board runs Interactive C, a cross-platform, multi-tasking version of the C programming language.

3. ROBOTICS PROJECTS

A number of possible approaches to robotics can be investigated by assigning projects involving the robots. Firstly, the traditional symbolic AI approach which involves knowledge representation of the world environment. Based on sensor input, the robot constructs a model of the world. Various AI techniques can then be employed, such as search algorithms, logic programming etc., to help it explore its model of the world and plan its actions. These type of projects can also be given as early as the first/second programming course. For example, maze traversal algorithms may be given as programming projects. The physical maze map can be given as input to the robot, represented as a two-dimensional array, and a depth first search type of algorithm can be implemented to find a path out of the maze for the robot. The robot is then guided by the controller to follow this path.

Secondly, the behavior-based approach to robotics, Minsky's multi-agent intelligent systems approach and Brooks' subsumption based methodology can be investigated by applying them in a variety of robotics tasks, such as obstacle avoidance problems, (Brooks, 1986, Jones and Flynn, 1993). In this type of problems, the robot needs to avoid fixed or movable obstacles, while tracing the route in order to reach its goal. Several techniques including neural networks, can be employed for real-time determination of the robot's traveling route and speed.

In what follows, we describe some projects undertaken by student teams in order to give an idea of the possibilities. We believe these projects to be transferable to other institutions. Presently, the robots in the lab are mounted with the following types of sensors: touch sensors, infrared sensors, light sensors and Polaroid sonar sensors. In order to enable the robot to exhibit a more complex and sophisticated set of intelligent behaviors, additional sensors may need to be acquired, such as vision, weight/pressure, gyroscopes, etc.

Over the Fall of 1998 offering of CS 521, Introduction to Artificial Intelligence class, several teams of students, both undergraduate and graduate, engaged in the design, and building of micro-controller controlled mobile robots and implemented a number of the above mentioned algorithms on them.

For example, an undergraduate student team, consisting of Thomas Guenther, Korey Atterberry, Chris Delaney and Eric Wackerfuss, designed, constructed and programmed a Handy Board controlled mobile robot to detect and trace a contour. In the process, the robot learned about its world, so that each successive tracing of the contour was smoother and more accurate than its predecessor. In addition, if the contour was taken away or if portions of it were missing, the robot was still able to retrace the same path. The functionality of the robot is being extended by the team, including the ability to parallel park through the use of sonar sensors, and to perform specific actions depending on the color of color-coded areas over which the robot would drive.

The team met some difficulties in the original design and build phase, including such problems as accommodating the drive train, mounting the servo-motor and aligning the steering column and pinion gear with the rack. Eventually this part of the project met with success and a single motor, rear wheel drive robot was built with rack-and-pinion steering. It was found of great benefit and contributed to the success of the project to have team members with varied backgrounds including computer science, electrical and mechanical engineering backgrounds. The completed system models the performance of a modern automobile. Using this design, the lessons and methods learned for making such a vehicle follow a contour could have many applications. For example, industrial robots could be programmed to transport materials around the factory. Based on hardware limitations, it was found that if a high speed gear configuration was used, there would not be adequate power left to drive the robot. As a result, gearing was chosen to slow the robot, providing enough torque to facilitate mobility. Further development could involve increased speed or variable speed, with speed adjustment based on the curve angle of the contour to ensure safe navigation of the curves, without loosing the contour by going off at a tangent or having the vehicle tip over.

In a second project, the student team of Sanjeev Malik, Madhu Gaddamidi, Rebecca Walker and Alberto Leone implemented an obstacle avoidance algorithm and built a fire-fighter robot. The design of this robot was different, in that it used three servomotors. Two of the motors controlled the rear left and right wheels of the robot, and the third motor controlled a fan, that was used to blow out the fire. The robot was able to turn by rotating the left and right rear wheels at different speeds and directions. The robot was able to navigate around three-dimensional obstacles, as necessary to locate a fire, which it would then extinguish by rotating its fan. Its sensory inputs were obtained by four light sensors, two infrared sensors and two touch sensors.

Due to the limited number of robots available, but also for comparison purposes in order to determine the effectiveness of using the mobile robots platform in the student learning environment, a third team was assigned to build a fuzzy expert controller to solve the contour following problem in a simulated environment. The team successfully completed the project using a matrix of 0's as the terrain with the contour marked by 1's, and the robot's position by *'s. This work, of using fuzzy logic to help navigate a mobile robot, will be reported in a forthcoming paper. We observed a remarkable difference on the motivation and excitement of the teams that worked on the real robot platform, as opposed to teams that worked on simulated environments. Said plainly, the students who used the real platform had more fun. And since they did something they enjoyed, they tended to put more hours of work into it. At the end, they were very proud of their creations, which they exhibited to the class. Based on our experiences, the theme based approach to teaching AI works. It can really motivate and excite students. This is a desirable secondary benefit of the robotics approach. The ultimate goal of learning the material, engaging in real time system control and development (getting away from the "spread-sheet" type of development students typically engage on), providing cohesion among various curriculum units, and providing opportunities for interdisciplinary curriculum initiatives is thus enhanced.

Many students who already had taken the AI class in previous semesters, upon learning what some of their classmates were doing, came forward requesting to do independent study projects on the robotics platform. In one such project, Ian Hornicki, a senior in Computer Science is investigating the application of neural networks to mobile robot navigation. A feed-forward neural network trained with back propagation is used to implement a contour following and obstacle avoidance algorithm. The goal of the algorithm will be to determine the mobile robot's speed and angle to turn in order to avoid obstacles/follow a contour smoothly. Three ultrasonic sensors are used for measuring distances. One of the sensors is mounted on the robot front and three on the left side. The inputs to the neural net consist of a three dimensional vector (f,s_1,s_2) of continuous real coordinates, corresponding to the front and two side distances from the robot to the closest wall/contour. Based on these inputs, the robot's speed is adjusted, so that it doesn't crash into the obstacle, and the turning angle is determined, so that it smoothly turns in a direction parallel to the contour.

4. CONCLUSIONS, FUTURE PLANS

The proposed approach is being used to form the basis for a plan to incorporate mobile, autonomous robots in a series of courses, and to initiate an interdisciplinary concentration in artificial intelligence with mobile, autonomous robots education and research as a cornerstone. The preliminary ideas along this line are reported in Fendrich and Nikolopoulos, 1998. Our experience over last summer and this semester of incorporating robotics based projects in AI classes indicates that it has been an instructional success. The students get excited and motivated. The robotics theme provides a strong incentive towards learning because students want to see their inventions succeed.

Further projects, currently being undertaken by student teams, are:

Implementing a positioning system. Transmitters will be placed on the four corners of the robot's environment which transmit a constant signal. Based on the transmission intensity the robot can determine its own position.

A community of robots, Artificial Life. Wireless communication will enable robots to talk to each other and also talk to the main computer hosting the IC compiler without the use of cables. This opens up the possibility of many real life implementations of Artificial Life. Through first hand experience we have observed that simulations are not as motivating to students as having real animats move around. An immediate extension of the fire fighter robot planned is to have the robots and the host computer (the queen bee) communicate dispatching the robot closest to the fire to extinguish it without colliding with all the other robots roaming around.

A mobile robots platform provides endless possibilities for designing interesting student projects at both the undergraduate and graduate level. Almost every AI algorithm, from searches to machine learning, to scheduling or planning can be demonstrated or implemented in a mobile robotics platform. The Handy Board based platform provided a start. For more sophisticated applications, going to the next available level using Pioneer or Khepera robots may be necessary.

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INFORMATION SYSTEMS GRADUATES AND THE JOB MARKET: LOOKING BEYOND TECHNICAL SKILLS

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Abstract

This paper presents the results and findings from a study of hiring managers to see what skills and knowledge, other than technical, are considered most important in college graduates. Forty-five recruiters and managers who hire Information Systems (IS) graduates rated a list of twenty general skills and knowledge areas. The results showed which general skills and knowledge were highly valued by the recruiters and managers that hire IS graduates. The results indicate that recruiters and hiring managers believe interpersonal and ethical skills and knowledge are very important in today's business world, even for IS graduates. The four highest valued skills and knowledge areas by the recruiters and employers were (1) teamwork, (2) reliability, (3) persistence and (4) honesty, while global and cultural issues were rated at the bottom of the list.

Keywords: Job market skills, IS recruiting

1. INTRODUCTION

There is always some debate in colleges and universities, especially among the IS faculty, about the general skills and knowledge of newly graduating students and which ones are more desired by recruiters. Information systems (IS) students spend their time learning technical and general business skills that relate to a technical job market. The reality of the IS job market is that most students have acquired the technical skills they need to enter the IS job market. But, to get that first job, they have the become more than just "techies." Employers recruit entry-level IS graduates to fill a need. More often than not, it is the "soft" skills that actually land a job for an IS graduate. Recruiters and employing managers constantly evaluate prospective new hires to envision how they will fit in and perform in the organizational culture. The IS graduate's personality and general skills and knowledge become very important in the job selection process. If the student has the technical and general skills desired by the organization and the "cultural fit," then he/she is considered for the position. If the student does not have the skills and knowledge, either technical or general, needed for the job, then he/she usually is not usually hired for the position.

Colleges and universities are continually revising their curricula to keep up with what they believe are the needs of potential employers. This happens in two areas. First, the IS technical content must be relevant and up-to-date. More often than not, recruiters and employing managers are familiar with the IS curriculum, courses, and, many times, professors of the schools at which they recruit. Most of the time, they come to a college or university because they believe the graduates have the technical skills needed to perform on the job. Many times the technical skills are a given, since most IS graduates have taken most of the same courses. The only differentiation among students may be a class or two and the grade pint averages. Second, colleges and universities are adding general skill requirements to their curriculum. Specifically, oral communications, written communications, problem solving, and multi-cultural skills have been decried for years. Many colleges and universities are mandating a specific number of courses in these areas. Does the variety and range of curricula that students are experiencing effectively prepare them for the job market or are graduates' technical IS skills enough for the job market?

This paper is an initial effort to look at the job market from the employers' viewpoint and try to determine what soft or non-major skills employers are seeking in the candidates for entry-level IS positions in their company. It is believed that this study will provide a different look at the job market for IS graduates and can provide college and university business faculty with some insight into qualities that they should nurture in their students.

2. METHODOLOGY

The basic methodology for this study was to administer a questionnaire about non-technical skills needed by graduates to managers from company that recruited IS graduates from Appalachian State University. The questionnaire solicited the relative importance of a series of non-technical skills, abilities, or competencies. Managers were asked to rate the importance of each skill to their organization using a four point scale - Not Important; Somewhat Important; Important; and Very Important.

The questionnaire was administered in two ways. First, each person that came to campus to interview IS graduates in the Spring 1998 was asked to complete the survey. Second, a mail survey of people that visited campus in past semesters, but did not recruit on campus during the Spring 1998 semester, was also used. This methodology did allow more than one person from a company to complete the survey. However, since individuals that recruit IS graduates have different opinions on the skills and knowledge areas they look for, then individual answers were acceptable. In many cases, IS managers and human resource personnel were both part of the recruiting team and both completed a survey. Every effort was made to ensure that no more than three individuals from any company completed the survey. In all, 129 usable surveys were collected.

The skills and knowledge areas were taken from a focus group that contained members of the College of Business Advisory Council. They were meant to be skills and knowledge areas that were required in the workplace by any business graduate. Technical skills and competencies required by any employer were not listed or examined. The skills and knowledge areas examined in this study are shown in Exhibit 1.

It was recognized that there would be some limitations to using data from on-campus recruiters. First, the sample is not random. Because the sample included a wide variety of organizations and industries recruiting IS students, it was believed that this sample would be somewhat representative of the industry's needs for IS graduates. Second, the sample does not necessarily reflect the job market in any one discipline, time, or section of the country. They do represent overall desires of recruiters and employers that hire Appalachian State University IS graduates. Each educational institution must be aware of the skills and educational needs of their graduates and of the needs of the recruiters that recruit their graduates.

3. RESULTS

The results of the survey show some interesting preferences by recruiters and employers of recent IS graduates. Three distinctive tiers appeared when looking at the number of responses that listed a skill or knowledge area as "Very Important." Skills and knowledge areas that fell in the first tier (the number of "Very Important" responses are listed in parentheses) included: teamwork (127), reliability (125), persistence (125), and honesty (124). They were all closely bunched at the top. The second tier of skills or knowledge areas included listening (112), oral communication (111), decision making (103) and problem analysis (102). The third tier included leadership (78), written communications (69), applied computer skills (64), presentation (60), and understanding technology (59). When looking at the average scores, the same tiers appeared, but the order in the first tier was somewhat different. The number of responses that listed a skill or knowledge area as "Very Important" and the average and standard deviation (StdDev) for each of the 20 skills and knowledge areas measured is presented in Exhibit 1.

4. CONCLUSIONS

Several conclusions can be made from the results of this study regarding the non-technical skills and knowledge areas that are desired by employers for college graduates. First, managers believe interpersonal and ethical traits are very important in today's business world. Whether this would be stronger for IS graduates than other college of business graduates is not known. Teamwork, persistence, honesty and reliability were the four highest rated skills and knowledge areas, based on both the number of times rated "Very Important" and the average response. Recruiters and managers of IS graduates seem to be emphasizing interpersonal and ethical traits highest. The placement of teamwork as the trait with the most "Very Important" responses seems to emphasize the trends toward team systems development and the need for workers to interact and function in a team setting. Businesses and managers are placing a premium on traditional values - honesty, reliability and persistence - in the business workplace. This might suggest that recruiters and managers believe IS graduates still need to emphasize these personal traits and their placement in the highest tier is their way of telling colleges and universities to emphasize them more.

The next tier of responses consisted of listening, oral communications, problem analysis and decision making. These skills and knowledge areas seem to center around verbal communications and problem solving, two critical skills in today's business world. The emphasis on verbal communications and problem solving again seem to relate to the work that IS employees perform. IS employees must communicate with users, managers, non-technical employees and other IS employees to solve the business problems of the organization. As a result, the high emphasis of these skills for IS graduates should not be a surprise.

Surprisingly, the bottom tier contained (from the lowest) knowledge about global cultural differences, global business awareness, multimedia presentation, and technical writing. It is known that many of the business that responded have global operations. For that reason, it is surprising that global awareness was the bottom two from an average standpoint. This suggests that companies may not expect recent IS graduates to participate in global IS operations or be aware of global/cultural differences and needs. Maybe recruiters look for other majors for their global operations or maybe this is a possible problem with the sample.

What is the possible impact on the college educational system? First, interpersonal and ethical knowledge and skills must be emphasized in courses in the Information Systems degree. Courses should have team assignments, both short assignments and semester projects. Emphasis should be placed on teamwork, responsibility and persistence in completing team assignments. It should be pointed out to students that there is no "I" in "team." Second, verbal skills and problem solving continue to be important to companies hiring new college graduates and should be a vital part of the curriculum.

What can individual professors and students learn from the study? Professors must take the initiative and design courses with teamwork components. They must also insist on effective verbal communications. Students must emphasize the desired skills and knowledge areas in their resumes. Resumes should reflect that the student has worked in teams. Resumes should also reflect that the student has completed projects on time and at a high quality level.

We (IS faculty) can learn a lot from listening (number 5 on the list of skills and knowledge areas) to employers in what they are looking for in an IS graduate. If business schools are to effectively prepare their students for the job market then they must listen to the feedback from employers and be prepared to make the necessary adjustments to improve the IS programs. This study represents one attempt to find out what non-technical skills and knowledge areas employers want in IS graduates.

Exhibit 1

Non-Technical Skills and Knowledge Area For IS Graduates

	Very Important	Average	StdDev
Analytical Skills			
1. Problem analysis skill	102	3.67	57
2. Statistical analysis skills	30	2.65	95
Communication Skills			
3. Oral communications skills	111	3.73	.53
4. Diversity, or multi-cultural appreciation	42	2.99	.82
5. Written communication skills	69	3.33	.76
6. Listening skills	112	3.76	.48
7. Presentation skills	60	3.16	.86
8. Multimedia presentation skills	13	2.36	.91
9. Technical report writing	21	2.39	.99
Interpersonal Skills			
10. Teamwork (ability to work with others)	127	3.86	.48
11. Persistence to accomplish tasks	125	3.84	.44
Knowledge About Business Practice			
12. Leadership skills	78	3.48	.65
13. Decision-making skills	103	3.72	.51
14. Planning management	72	2.50	.53
Knowledge About the Global Economy			
15. Global business awareness	14	2.34	.87
16. Global cultural differences and diversity	12	2.25	.90
Knowledge About Ethical Responsibilities			
17. Honesty and integrity	124	3.87	.41
18. Reliability (taking responsibility)	125	3.88	.40

Information Technology			
19. Applied computer skills	64	3.28	.80
20. Understanding of information technology	59	3.19	.84

Information Technology Connections Lectures: Connecting IT Theory with Industry Best Practices

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Abstract

As part of a recent state-wide opportunity for curriculum revision, the IS major's capstone experience was revised and enhanced to increase the students' exposure to industry perspectives and to strengthen the industry-academia connection. The IT Connections Lectures is a one semester-hour course that brings together industry practitioners and senior IS majors to discuss how an organization utilizes IT to accomplish its mission. Each week, a lecturer presents an overview of how their organization applies IS technologies in support of strategic and operational goals. The lecture is followed by a question-and-answer period, enabling the students to explore how their curriculum is preparing them for the workplace application of the technology. An accompanying on-line discussion forum offers the students additional opportunities for interaction and reflection.

Keywords: IS curriculum, capstone course, industry

1. INTRODUCTION

James Burke's revolutionary book, *Connections* (Burke, 1995) illustrates the importance of understanding the connectivity among the common, and not-so-common, objects in our lives. These sometimes invisible connections give the reader illumination into the evolutionary relationship among technological objects. As our Information Systems students conclude their program of study, they too are looking to connect the theory of their curriculum to industry best practices. How does the theoretical knowledge of TCP/IP evolve into a career as a network administrator? How does knowledge of data structures "connect" with a career as a database administrator? In order to maintain credibility with students and employers alike, IS curriculum design must address the bridging of classroom theory into industry practices (Williams, 1997).

2. BACKGROUND

In the spring of 1996, the Computer Science and Information Systems department at Kennesaw State University was given the opportunity for wholesale curriculum redesign. As a part of a statewide initiative to convert from quarters to semesters, each university was expected to evaluate their existing programs, particularly in regard to outcome assessment. Programs that efficiently and effectively produced graduates with high market demand would receive "redirected" resources from within the institution. Several significant changes were made to the Information Systems curriculum, but perhaps the most significant was changing the capstone experience.

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Every IS program should have a capstone experience to help the students integrate the various dimensions of knowledge gained. In current curriculum models, there is little explicitly mentioned regarding capstone courses (Davis et al., 1997; Longenecker et al., 1994; Mulder and Lidtke, 1999).
However, a capstone experience can serve many of the learning objectives identified for an overall IS curriculum. Many programs use a projects course to enable the student to bring together the various skills learned while completing the curriculum. IS97.10, "Project Management and Practice," describes a model of a senior project-type class (Davis et al., 1997).

At KSU, students have the opportunity to pursue major systems projects in several other courses. The capstone experience had previously consisted of a single course in Information Resource Management that stressed the conventional topics: Planning, budgeting, operations, security, management of systems development, etc. What was missing was a piece that would connect these topics to the workplace in which the students would soon find themselves competing.

3. CSIS 4841 INFORMATION TECHNOLOGY CONNECTION LECTURES

In the revised curriculum (effective Fall, 1998) the capstone course was split into two separate courses, Information Resource Management and Policy (CSIS 4840) and a new course, Information Technology Connection Lectures (CSIS 4841). The IT Connections Lectures is a one semester-hour course that brings together industry practitioners and senior IS majors in a classroom setting to discuss how an organization utilizes IT to accomplish its mission. Each week, a lecturer presents a 45-minute overview of how his/her organization applies IS technologies in support of strategic and operational goals. The lecture is followed by a question-and-answer period, enabling the students to explore how their curriculum is preparing them for the workplace application of the technology. Dick and Jones (1995) discuss a similar incorporation of industry colloquia as part of a Business Information Technology curriculum.

4. LECTURER'S ROLE AND RESPONSIBILITIES

Each lecturer is asked to prepare a presentation that represents his or her firm's best practices in a technology that is relevant to the IS curriculum. The presentation must be more than a commercial for the firm; it must address how the company maps the application of the technology to a strategic or operational goal. Examples of presentations include:

Presenter Roles and Topics:

- CIO "The Role of the CIO in Strategic Planning"
- Software Development Manager "Transitioning From Structured to O-O Methods"
- Consulting Group Manager "Preventing Consultant Burnout"
- Technical Marketing Specialist "Merging ATM and TCP/IP Solutions"
- Decision Support Manager "Data Warehousing Practices and Customer Profiling"
- Support Center Manager "Managing Multi-lingual and Multi-cultural Support Centers"
- IT Mediator "Using Mediation to Resolve Software Copyright Disputes"
- Documentation Manager "The Role of Documentation in the SDLC"
- Consultant "Outsourcing Strategic IT Planning"

An additional benefit to the lecturer is the opportunity to present his or her firm in the best possible light before an audience of 30-35 graduating IS majors. Presenters are encouraged to bring employment-related information to the classroom and stay after to talk with students who are interested in their company. This creates a unique recruiting opportunity for the lecturer.

At the conclusion of each lecture, the instructor for the course posts three or four discussion questions from the lecturer's presentation at a discussion forum on the course's web site. This enables the lecturer to follow up on points missed or misunderstood, and to see how the students responded to his/her presentation.

Lecturers are recruited from a variety of sources. The KSU CSIS Industry Advisory Board provides many of our lecturers. Alumni who have gone on to achieve success in the IS world are an excellent source for lecturers. These practitioners are uniquely qualified to connect with our current students. They can also answer the all-important question, "How well did your KSU education prepare you for the job market?" Co-operative Education employers, and firms interested in recruiting on campus, are other excellent sources for lecturers.

5. STUDENT'S ROLES AND RESPONSIBILITIES

Enrollment in CSIS 4841 averages 33 students per semester. Students are required to attend all lectures (unless excused for cause). At the conclusion of each lecture the student is required to go to the course web site and participate in a follow-up discussion forum related to the lecture. This enables the students to share their different viewpoints and to benefit from each other's insights and experiences with the topic. It also lets them follow up any unasked or unresolved question with the lecturer.

The students are also required to write a one-page summary of the presentation and to research (using the web) at least one additional source of information related to the topic presented. This increases the student's awareness of the pervasiveness of the topic, creating one more opportunity for them to "connect" the topic to a wider scope of application. An additional benefit is the opportunity to practice their written communication skills. Grades are based upon: 1) class participation, 2) forum participation, and 3) summaries.

6. EVALUATION

Industry Response.

Industry response has been strong and positive to the initial offerings of this course. In addition to fulfilling their need to stand at the front of a classroom and be listened to, the lecturers value their association with the university. The most commented on feature of the course is the online discussion forum, which allows the lecturer to see if the students got the message, and clarify any lingering questions or misunderstood comments.

Student Response.

Students have shown strong support for this class and praise its inclusion in the curriculum. Typical student comments focus on the benefits of hearing "real world" discussions of academic topics. The opportunity to ask an industry practitioner for guidance in job seeking, resume writing, interviewing techniques, and other first-job related questions, is also valued by the students.

7. CONCLUSIONS

In programs that already fulfill the project requirement in other courses, a capstone experience that brings industry practitioners into the classroom to describe their organization's best IT practices can significantly enhance the students' understanding and appreciation of the overall curriculum. It can reinforce the integrated nature of information systems, motivate an expanded job search, and expand the student's knowledge of critical success factors in the IS industry. Additionally, this industry-integrated approach formalizes the relationship between the institution and industry in a way that honors and recognizes the significance of the contribution. Instead of an ad-hoc collection of guest lecturers, the practitioners have a structured, formal role to play in contributing to the IS curriculum. This strengthens the institution's partnerships with industry, as well as providing the students with richer, perhaps more realistic perspectives on the business world that they are about to enter. The IT Connections course provides a model example of the kind of industry/academic collaboration described in numerous curriculum initiatives (Dick and Jones, 1995, p. 5; Mulder and Lidtke, 1999, p. 61).

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9. APPENDIX A - COURSE SYLLABUS

CSIS 4841
Information Technology Connections Lectures Series

Kennesaw State University
Computer Science and Information Systems
Syllabus

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Objective: IS majors must understand how to apply IT theory to support the strategic and tactical missions of the business organization. Students must be able to connect the theory presented in the IS curriculum with industry best practices.

Description: CSIS 4841 Information Technology Connections Lecture Series is a unique course designed to provide IS majors an opportunity to experience industry best practices as related by lecturers who are also industry practitioners. Each week a new lecturer presents a different topic describing how their organization utilizes information technology to accomplish its mission.

Text: No text is used in this course.

Grading:

Class and discussion forum participation 50%
At the conclusion of each lecture, students will participate in an online discussion forum that expands upon and reinforces the lecturer's presentation.

Summaries 50%
Students will prepare a one-page summary of each presenter's lecture and include a reference to an additional source of information on the Web that relates to the presenter's topic. Summaries will be due the week following the presentation. Late summaries will not be accepted.

Teaching a "Y2K" Intensive Training Program Within a Corporate Environment

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Abstract

Illinois State University's Applied Computer Science (ACS) Department has been teaching information technology for the past two decades. As a professor at ISU teaching within the ACS Department, I was granted academic leave to focus on training entry-level personnel from various companies throughout the United States in Y2K compliance. The main topics covered during these training sessions were MVS/JCL, COBOL, CICS, DB2, IMS, and Y2K compliance. The central point of the training program was to prepare the entry-level person to handle "Y2K" compliance applications within a mainframe environment. The training session was a concentrated, 6-8 week program covering the basics: (1) MVS, (2) JCL, and (3) COBOL. Additional topics included a week for CICS, a week for DB2, and a week for IMS. Upon graduation from the training program, the trainees were assigned information system projects directed at Y2K compliance.

Key words: COBOL, Y2K, training, programming, MVS, JCL

1. INTRODUCTION

Illinois State University's Applied Computer Science (ACS) Department has been teaching information system technology for the past two decades. As a professor within the ACS Department, I have been involved in the evolution of our curriculum to meet the challenges of the information technology field. As a result of the "Y2K" computer bug, I requested an annual academic leave from ISU. The purpose of my academic leave was to help institute and teach a training program for entry level personnel within a corporate environment.

The training program was generally divided into several areas: (1) MVS mainframe operating system, (2) Job Control Language (JCL), (3) COBOL computer language, (4) CICS, (5) DB2, and (6) IMS. The focus of the training program was to prepare the trainee to handle "Y2K" applications. Once the trainee graduated, he/she generally joined a Y2K, project team with more experience personnel that would establish a mentor relationship until they gain the experience and confidence to handle "Y2K" applications.

2. MVS/JCL

Accepting trainees from a wide variety of backgrounds--which often times doesn't include computing or information technology, it is important to provide the trainee with a good overall view of the MVS operating system and the Job Control Language (JCL) that interacts with the system. Compressing a lot of information technology knowledge into a relatively short period time requires the instructor to be aware of the short cuts that can facilitate the learning process. Representing the overall view of the operating system and the relationships to the JCL and COBOL language can provide the trainee with an added insight that can often times overcome lack of technological skills. Figure 1 illustrates a simple overall approach to the MVS/JCL relationship that reflects this approach.

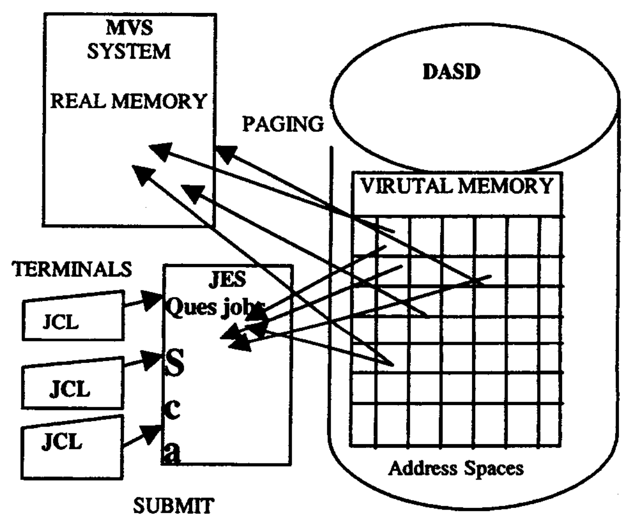

Figure 1. MVS/JCL Relationship

The key components of Figure 1 that the trainee should appreciate is the relationship between the programmers who are using terminals (PCs for MicroFocus COBOL emulation software package) to communicate with the mainframe and the MVS operating system. As indicated by Figure 1, a working knowledge of Job Control Language (JCL) is another important component of the communication process as well as the Job Entry System (JES). Figure 2 illustrates the type of JES log message and condition codes (or return codes-RC0000) generated from MicroFocus COBOL. The trainee will become familiar testing these codes by using either the "IF" statement or the "COND" parameter.

```
EXECUTION SUMMARY ****
19:20:46 STEP010        - STEP STARTED
$SYSCATLG\14800100.001
&&TEMP.SY010002.480
C:\ADMVS32\CATALOG\S5704803.DAT
19:20:49 STEP010- STEP WAS EXECUTED RC(0000)
19:20:49 STEP020        - STEP STARTED
DAVE.Y2K.THISPP
C:\DAVE\Y2K\THISPP.DAT
&&TEMP.THISPP.480
C:\ADMVS32\CATALOG\S5704804.DAT
$SYSCATLG\14800200.003
&&TEMP.SY020004.480
C:\ADMVS32\CATALOG\S5704806.DAT
19:20:51 STEP020- STEP WAS EXECUTED RC(0000)
19:20:51 STEP030        - STEP STARTED
DAVE.Y2K.EMPL
C:\DAVE\Y2K\EMPL.DAT
&&TEMP.THISPP.480
:\ADMVS32\CATALOG\S5704804.DAT
DAVE.Y2K.CALC
C:\ADMVS32\CATALOG\S5704807.DAT
$SYSCATLG\14800300.005
19:20:52 STEP030- STEP WAS EXECUTED RC(0000)
19:20:52 STEP040        - STEP STARTED
$SYSCATLG\14800000.000
DAVE.Y2K.CALC
```

Figure 2. JES Log messages Emulation

Constructing JCL jobsteams can be accomplished by using established templates that reflect a basic understanding of the execution steps and the files (DD statements) needed to execute the programs. Over a short period of time, the trainee can expand this basic knowledge into more complicated, comprehensive jobstreams that can contain procedures, IBM utilities, and program execution. Figure 3 represent a basic template for a jobstream that was expanded using multiple steps.

The trainee becomes aware of the fact that jobstreams generally represent more than just one program; but, a series of programs working together to accomplish certain objectives like payroll (see Figure 3), accounts receivables, or any other application. Thus, the concept of an information system is applied on a practical basis and reinforced at the end of the training session with a realistic system project.

Understanding the overall MVS system and the basic programming process is the two major aspects of the training program. The trainee is taught to structure a solution to an application program using tools that forces them to apply the structured concepts presented during training. These tools include: (1) a structure charts, (2) a structured flowcharts, and (3) input/output specification diagrams.

```
//TSO-ID JOB (XXXXXXXXXX),'DAVE',
// CLASS=B,
// PRY=9,
// MSGCLASS=X,
// NOTIFY=TSO-ID
//*******************************************
//** PROGRAM THAT CALCULATES GROSS PAY  **
//*******************************************
//STEP010 EXEC PGM=PRCALC,PARM='010998'
//*******************************************
//**DD STATEMENT (FILE) IDENTIFIE     **
//*******************************************
//STEPLIB  DD DSN=TSO.LOADLIB,DISP=SHR
//*******************************************
//**DD STATEMENTS (FILES) USED BY PROGRAM **
//*******************************************
//EMPL   DD DSN=TSO.TRAINING.EMPL,DISP=SHR
//THISPP DD DSN=TSO.TRAINING.THSPP,DISP=SHR
//HISTORY DD DSN=TSO-ID.TRAINING.CALC,
//      DISP=(NEW,CATLG,DELETE),
//      UNIT=SYSDA,SPACE=(TRK,(1,1),RLSE),
//      DCB=(RECFM=FB,LRECL=18,BLKSIZE=0)
//*******************************************
//**DD STATEMENT(FILE) USED BY ANY DISPLAY
//*******************************************
```

Figure 3. JCL Program Format

Figure 4 represents a sample COBOL program generated within the TSO/ ISPF feature of MicroFocus COBOL. MicroFocus COBOL (MFC) is a computer software program for the personal computer (PC) that emulates the MVS/JCL environment by supporting COBOL programming, and database applications like IMS and DB2. The hierarchical menu system common to TSO/ISPF is very similar with modifications to correlate the PC file naming conventions and the MVS file naming conventions.

```
PROCEDURE DIVISION USING PARM-DATA.
0000-MAINLINE.
    PERFORM 1000-BOJ.
    PERFORM 2000-PROCESS-FILE
      UNTIL EMPL-EOF OR THISPP-EOF.
    PERFORM 3000-EOJ.
    GOBACK.
1000-BOJ.
    OPEN INPUT EMPLOYEE-FILE THISPP-FILE
    OUTPUT HISTORY-FILE.
    PERFORM 1100-READ-EMPLOYEE.
    PERFORM 1200-READ-THISPP.
1100-READ-EMPLOYEE.
    READ EMPLOYEE-FILE INTO EMPL-INPUT-RECORD
       AT END SET EMPL-EOF TO TRUE
       NOT AT END ADD 1 TO EMPL-IN-CT.
1200-READ-THISPP.
    READ THISPP-FILE INTO THISPP-INPUT-RECORD
       AT END SET THISPP-EOF TO TRUE
       NOT AT END ADD 1 TO THISPP-IN-CT.
2000-PROCESS-FILE.
   EVALUATE TRUE
```

Figure 4. COBOL sample program

The trainee can look at their output through the SDS option within MicroFocus COBOL. Figure 5 illustrates the output generated through the JCL submission. By selecting the first output for JOB 1465, the condition codes and completion codes can be examined for any possible exception or error conditions. The trainee can look at their output through the SDS option within the TSO/ISPF environment.

The TSO/ISPF is the Time Sharing Option within the mainframe environment that allows the novice programmer to interactively create files (both program and data files), execute programs, and view resulting output. Figure 5 illustrates the output generated through the JCL submission. By selecting the first output for JOB 1465, the condition codes and completion codes can be examined for any possible exception or error conditions.

```
COMMAND ===>                                 SCROLL===> HALF

( D = DELETE  E = EDIT  B = BROWSE  P = PRINT )

  JOBNAME   JOBN  C  STEP     PSTEP  DDNAME
  -------   ----  -  -------  ------ --------
_ DAVE      1465  X
_ DAVE      1465  X  STEP010         SYSPRINT
_ DAVE      1465  X  STEP020         SYSOUT
_ DAVE      1465  X  STEP030         SYSOUT
_ DAVE      1465  X  STEP040         SYSPRINT
_ DAVE      1465  X  STEP050         SYSOUT
S DAVE      1465  X  STEP060         REPORT
_ DAVE      1465  X  STEP060         SYSOUT

REPORT

             SMALL TOWN PAYROLL  PAGE   1

     PAYROLL HISTORY FOR 12/26/97 THRU 01/09/98

NUM     EMPLOYEE NAME        PPED     HOURS GROSS
--- -------------------- -------- ----- ------
111  BRIAN       DAYLEY    12/26/97 30.00 165.00
                           01/02/98 30.00 180.00
                           01/09/98 25.00 150.00
```

Figure 5. SDS sample output

The trainee also has the capability to use animation to step through the logic of the program and query variables as it executes each statement. Animation is a valuable learning tool within a training environment. Using the 'ANIM' compiler option or parameter, the resulting intermediate code can be used to animate or step-through the logic the program. The animation capabilities of MicroFocus COBOL or the expeditor on the mainframe reinforces the structure constructs within a COBOL program. By stepping through the logic of the program, the novice programmer can visualize more readily the building block concepts implemented within their program as well as the example programs presented during the training session. For example, control break logic can be traced through the minor break routine through the major break routine reinforcing the basic principles relating to control break logic. Additional concepts can be implemented into the structure of the program by tracing through critical paths outlined in the animation process. The novice programmer gains a solid comprehension of the structured program process within a relatively short period of time.

3. CICS

MicroFocus COBOL (MFC) supports the emulation of the mainframe interactive environment--CICS. The administration nightmare associated with establishing an instructional environment or regions that programmers can use to create interactive files, maps, and programs can be easily implemented with MicroFocus COBOL workbench. Figure 6 illustrates a sample CICS program developed within the MFC environment. Notice the use of the attention keys (PFs keys) within the main paragraph of the COBOL program reflecting the pseudo conversation technique.

MFC also supports animation within this environment by offering an animation region that the programmer can use to trace the logic of their program and reinforce the concepts of the pseudo conversation. For novice programmer the pseudo-conversation technique is a difficult topic to teach because it is very different from the batch environment that they understand from the first few programs. The animation feature clearly shows the flow of logic through the program as the program carries on a conversation with an imaginary user.

```
PROCEDURE DIVISION.
MAIN-LOGIC.
 EVALUATE TRUE
       WHEN EIBCALEN = ZERO
          PERFORM 1000-FIRST-TIME-HERE
       WHEN EIBAID = DFHCLEAR
          PERFORM 1000-FIRST-TIME-HERE
       WHEN EIBAID = DFHPA1 OR DFHPA2 OR DFHPA3
          CONTINUE
       WHEN EIBAID = DFHPF3
          IF MODE-IS-EDIT
             EXEC CICS XCTL
                PROGRAM(MENU-PROGRAM)
             END-EXEC
          ELSE
             MOVE LOW-VALUES TO RECORD
             SET MODE-IS-EDIT  TO TRUE
             MOVE ADD-CANCELLED  TO  MESSAGEO
             SET  SEND-ERASE   TO  TRUE
             PERFORM 8200-SEND-MAP
          END-IF
       WHEN EIBAID = DFHPF9 AND MODE-IS-CONFIRM
          PERFORM 3000-CONFIRM
       WHEN EIBAID = DFHENTER AND MODE-IS-EDIT
          PERFORM 2000-VALIDATE
       WHEN OTHER
          MOVE LOW-VALUE TO SCAQMPO
          MOVE 'INVALID KEY PRESSED.' TO
          SET SEND-DATAONLY-ALARM TO TRUE
          PERFORM 8200-SEND-MAP
 END-EVALUATE.
```

Figure 6. COBOL CICS Program

The CICS option support from the TSO/ISPF main menu allows the user to easily generate both physical and symbolic maps used with CICS applications. This option also allows the novice programmer the opportunity to work with tables necessary to support the interactive CICS environment--FCT (File Control Table), PCT (Program Control Table), and PPT (Program Processing Table). The ease, the convenience, the animation capability, and the cost effectiveness are the main advantages of using MFC to teach CICS in a training environment.

4. DATABASE SUPPORT

The training program supports two important databases: (1) IMS, and (2) DB2. IMS is your traditional hierarchical database and DB2 is the relational database. If using MFC, MFC supports the IMS interface program—DFSRRC00—with PROXIMS that is the standard support, the mainframe. Along with the program support, MFC allows the programmer to create their IMS database definitions: (1) DBD, and (2) PSB with a menu driven system. Figure 7 represents the menu system used by MFC workbench to generate the physical description of the database (DBD), and the logical description of the database (PSB).

```
------------------- IMS UTILITIES MENU
OPTION ===>

1  DBD UTILITIES - DBDGEN or ZEROLOAD
2  PSBGEN
3  MFSGEN
4  INDEPENDENT IMS DB/DC WITH ANIMATION
5  INDEPENDENT IMS DB/DC
6  IMSGEN - STAGE 1 DEFINITION
7  DBDMAP
9  IMSPRINT
D  IMS DATA BASE UTILITY
P  Start IMS DB/DC Region PL/I Debugger
S  3270-A7 (3270) ANIMATION INDEPENDEN
T  3270-A7 (3270) INDEPENDENT REGION
X  EXIT

Default IMS Command:

Enter END command terminate IMS UTILITIES
```

Figure 7. IMS Support for DBDs and PSBs

Again a setup manual to facilitate the definition and the creation of the IMS database and the associated DBD and PSBs can be very beneficial. The DBD, database definition, physically describes the hierarchy of the IMS database. The PSB, program specification block, logically describes different views of the IMS database that the user can access. The PSBs provide security by limiting the user access to only a specific portion of the database. The manual also helps the trainee to visualize the hierarchical structure of an IMS database and the critical concatenation of keys to locate individual records. Once the database is created, application programs can be applied against the database to demonstrate both the random and sequential access capabilities. Figure 8 illustrates an IMS COBOL program that accesses an IMS database.

Notice the use of copy statements in the code in Figure 8. To facilitate the learning process and the time constraints, program segments are discussed in terms of blocks of code that accomplish certain task. For example the function codes are discussed in relationship to both sequential and random access of an IMS database. A copy library is established to expedite the implementation of these codes into an application program. Search arguments are also discussed in relationship to accessing an IMS database and is included as members of a copy library to expedite its implementation. The Program Communication Block is handle in a similar fashion. The copy statements allow the programmer to progress at a much quicker pace without sacrificing the learning process.

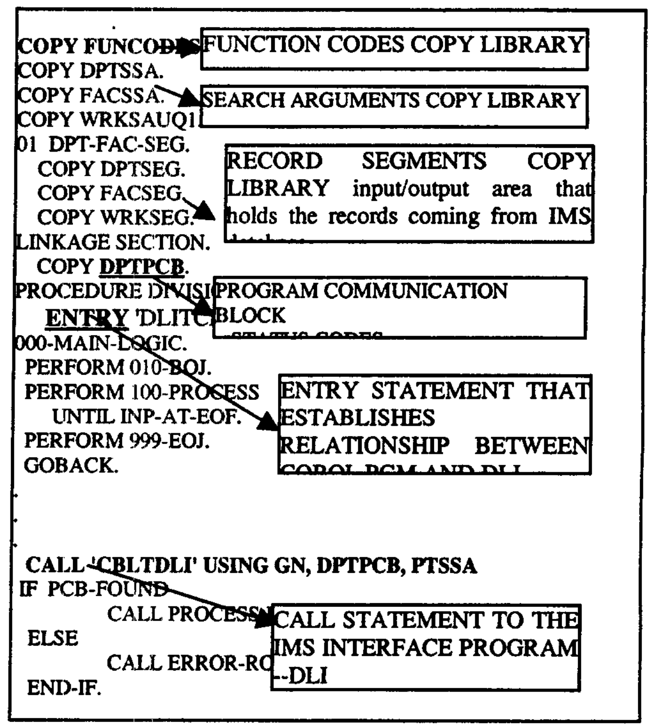

Figure 8. IMS COBOL program components

DB2 is an especially difficult training topic because of the administrative overhead necessary to setup a database with tablespaces that trainees can use to create and update their own tables. The security issues also have to be addressed so that the instructor has the authority to assign tablespaces and grant privileges on those tablespaces. Using XDB (DB2 clone) within MFC simplifies the training environment and reduces the training costs significantly without negatively affecting the quality of the learning process. Therefore, the trainee can be expeditiously and effectively introduced to the operational components of a DB2 database. MFC also has the ability to use CICS as a "front-end" component of a DB2 COBOL program. Thus, trainee can be exposed to a more comprehensive curriculum reflecting "real world" applications.

Using the XDB SQL Wizard, the trainee can setup and create the sample databases required during the training session. Once the databases are created, then the trainee can be taught the SQL commands from the wizard before beginning to embed this command within a COBOL program. Figure 9 illustrates a sample SQL command within the SQL wizard.

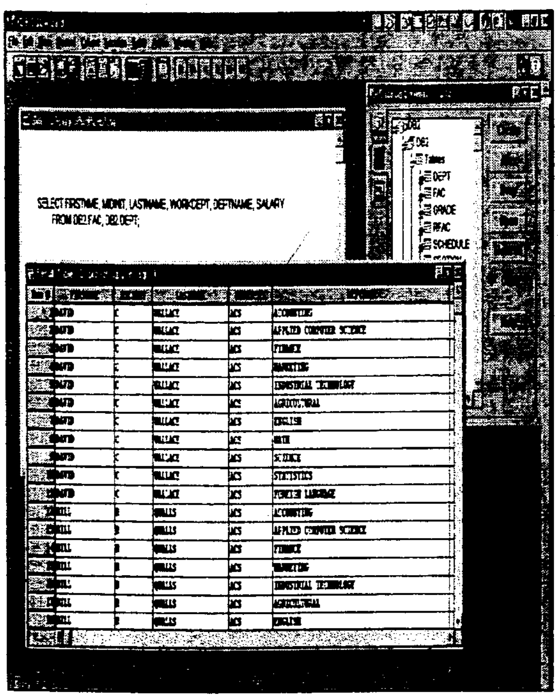

Figure 9. Sample SQL command

Once the trainee has become familiar with the various SQL commands, they are ready to embed these commands within a COBOL program. The complete implementation of a COBOL program with imbedded SQL commands is (1) precompile - interprets the SQL command and generates a Database Request Module which provides the administration of the database from the COBOL program, (2) compile - interprets the COBOL statements, (3) linking - creates an executable load module, and (4) binding - establishes a binding plan between the executable program and the database. The relatively short nature of the training program requires the instructor to introduce these topics and reinforce them with a practical application as soon as each topic is presented.

5. Y2K COMPLIANCE

"Y2K" compliance was approach from two different directions: (1) patch fix, and (2) comprehensive fix. The patch fix included approaches to compress the date with the century component and the "subtract-50" method. The compression of the date required the trainee to understand the difference between zone decimal and packed-decimal representation. For example, the standard date format of "19990325" represents eight bytes of storage in zone decimal format; but, you can take the same date format and pack the numbers into 5 bytes of storage in packed-decimal format. Thus, you would not have to increase the size of a file with the compress date format. Yet, you would have to change the programs that access this date and unpack the fields to print them out. Figure 10 illustrates the basic code.

COBOL Source Code

```
01 DATE-STRUCTURED.
   05   CHARACTER-DATE   PIC X(8).
   05   ZONED-DECIMAL-DATE REDEFINES
                 CHARACTER-DATE                PIC 9(8).
   05   DATE-TIMES-TEN      PIC S9(9) PACKED-DECIMAL.
   05   FILLER REDEFINES DATE-TIMES-TEN.
        10   PACKED-NO-SIGN-DATE  PIC X(4).
        10   PACKED-ZERO   PIC S9(1) PACKED-DECIMAL.

   MOVE '19980325' TO CHARACTER-DATE.
   MULTIPLY ZONED-DECIMAL-DATE BY 10
        GIVING DATE-TIMES-TEN.
   MOVE PACKED-NO-SIGN-DATE TO FILE-DATE.
```

FILE-DATE WILL HOLD THE CURRENT DATE IN PACKED DECIMAL FORMAT - 5 bytes

Figure 10. Date Compression Method

The second patch date is the "subtract-50" method. The subtract-50 method simply subtracts 50 from the year portion of the standard 2-digit year format. For example "990325" and "010325" would have to have the year portion of their date manipulated to obtain the correct difference between the years. So if you subtract 50 from the first year "99", the result would be "49". If you subtract 50 from "01" (you would have to adjust the calculation in order to get a positive number by adding "100" to "01") , the result would be "51" (101 - 50 = 51). Thus, the difference between 49 and 51 is 2, which is the difference between 1999 and 2001. Figure 11 illustrates the COBOL code that could handle this calculation.

COBOL Source Code

```
             01   DATE-STRUCTURE.
   05  YEAR-PLUS-100              PIC 9(3).
   05  FILLER REDEFINES YEAR-PLUS-100.
       10   ONE-HUNDRED           PIC X.
       10   SUB-50-DATE           PIC X(2).


       MOVE '01' TO SUB-50-DATE.
       MOVE '1' TO ONE-HUNDRED.
       SUBTRACT 50 FROM YEAR-PLUS-100.
```

Figure 11. Subtract-50 Method

The last fix is the comprehensive fix, which involves two stages: (1) file expansion, and (2) COBOL code changes. File expansion was accomplished using the sort utility available on the mainframe computer. The Sort Utility allows a programmer to copy a file with a slightly different format. Figure 12 demonstrates the use of the sort utility to expand a file for the century component of date. All of the COBOL programs that uses this file will have to be modify in order to account for the extra two digits for the date. Consequently, this method is the most comprehensive approach; however, this method is the very time consuming and costly.

One of the earlier payroll programs was used to incorporate each of these techniques. After completing the assignment, the trainees were required to outline the advantages and disadvantages of each technique.

```
//STEP010 EXEC PGM=SORT
//SYSOUT DD SYSOUT=*
//SORTIN DD DSN=OLD-FILE,DISP=SHR
//SORTOUT DD DSN=NEW-FILE,DISP=MOD
//SYSIN DD *
 SORT FIELDS=COPY
 OUTREC=(1:1,24,
        25:C'19',
        27:25,2)
```

NOTICE HOW THE CENTURY IS INSERTED BEFORE THE YY TO GIVE 1998.

The COBOL programs that uses this file will have to be modify to account for the extra 2 bytes in the file!!!

Old program:

```
01 DATE-STRUCTURE.
05 YEAR       PIC XX.
05 MONTH      PIC XX.
05 DAY        PIC XX.
```

New program:

```
01 DATE-STRUCTURE.
05 CENTURY    PIC XX.
05 YEAR       PIC XX.
05 MONTH      PIC XX.
05 DAY        PIC XX.
```

Figure 12. Expansion File Technique

Finally, Y2K procedures were adapted to handle IMS and DB2 databases. IMS databases were difficult because the trainee had to understand the three levels of date modifications. The first level is to change any date field described within in the physical view of the IMS database or DBD. Figure 13 shows the changes made at the DBD level.

```
DBD NAME=WCDDEPT,ACCESS=(HIDAM,OSAM)
DSGROUP0 DATASET DD1=WDEPT,DEVICE=3380,BLOCK=4096
 SEGM NAME=FACDATA,PARENT=DPTDATA,BYTES=33
 SEGM NAME=WRKDATA,PARENT=FACDATA,BYTES=31
 FIELD
NAME=(WRKDATE,SEQ,U),BYTES=6,START=1,TYPE=C
 FIELD NAME=WRKORG,BYTES=15,START=7,TYPE=C
 FIELD NAME=WRKSKIL,BYTES=10,START=22,TYPE=C

WRKDATE - CHANGED TO 8 BYTES. & OVERALL LEN
```

Figure 13. Physical Date Changes for IMS

PSB - Definition

```
PCB TYPE=DB,DBDNAME=WDEPT,KEYLEN=32,PROCOPT=AP
    SENSEG NAME=DPTDATA,PARENT=0
    SENSEG NAME=CRSDATA,PARENT=DPTDATA
    SENSEG NAME=SECDATA,PARENT=CRSDATA
    SENSEG NAME=STDDATA,PARENT=SECDATA
    SENSEG NAME=FACDATA,PARENT=DPTDATA
    SENSEG NAME=WRKDATA,PARENT=FACDATA
    SENSEG NAME=DPNDATA,PARENT=FACDATA
    SENSEG NAME=INSDATA,PARENT=FACDATA
    PSBGEN LANG=COBOL,PSBNAME=DEPPSBU1
    END
```

The concatenated key length for this specific view has to be changed to 34 because **WRKDATE** is part of the path--- KEYLEN= 34. Within the **WRKDATA** segment, there is a field called **WRKDATE**. This field is a key field and is included in the path that allows the user to access records at this level.. Thus, when you increase the size of the **WRKDATE** field to 8 bytes, this increases the overall size of all the keys in this path by 2 bytes. KEYLEN will have to be increase from 32 to 34 bytes. This can

Figure 14. Logical Date Change for IMS

The next level is the logical level or the PSB level, which describes the access for IMS users. Any path that has a date field within it has to be increased by 2 bytes. Figure 14 illustrates the type of change necessary for a PSB.

Figure 15. Date Change for DB2

```
*******************************************************
* DCLGEN TABLE(usrid.EMP)
* ... IS THE DCLGEN COMMAND
*******************************************************
     EXEC SQL DECLARE usrid.EMP TABLE
     ( EMPNO              CHAR(6) NOT NULL,
       FIRSTNME           VARCHAR(12) NOT NULL,
       MIDINIT            CHAR(1) NOT NULL,
       LASTNAME           VARCHAR(15) NOT NULL,
       WORKDEPT           CHAR(3),
       HIREDATE           CHAR(6),
       SALARY             DECIMAL(9, 2)
          ) END-EXEC.
*******************************************************
* COBOL DECLARATION FOR TABLE usrid.EMP
*******************************************************
 01  DCLEMP.
     10 EMPNO              PIC X(6).
     10 FIRSTNME.
        49 FIRSTNME-LEN    PIC S9(4) USAGE COMP.
        49 FIRSTNME-TEXT   PIC X(12).
     10 MIDINIT            PIC X(1).
     10 LASTNAME.
        49 LASTNAME-LEN    PIC S9(4) USAGE COMP.
        49 LASTNAME-TEXT          PIC X(15).
     10 WORKDEPT           PIC X(3).
     10 HIREDATE           PIC X(6).
     10 SALARY             PIC S9(7)V9(2) COMP-3.

The HIREDATE will have to be changed within DB2 definition to
8 bytes for the complete date: "19950815" with the century.

        HIREDATE           CHAR(8)

        10 HIREDATE        PIC X(8)
```

Finally, date changes has to be made within the COBOL program to account for: (1) search arguments that have the date within it, (2) input/output areas describing any date return from the database. The last date changes were made to the DB2 database. Again, the trainee had to realize that the date change occurs at the definition of the database level and the COBOL program level. At the database level sample DB2 tables were readily changed using the XDB Wizard tool. Each date field was increased or "ALTER" by 2 bytes using this tool. The DB2 generator was used to create a new structured with the expanded date field. This structured is copied into the DB2 COBOL program. Figure 15 demonstrates a brief example of this process.

6. SUMMARY

The challenges of the "Y2K" computer bug often force companies to seek accelerated training programs for their entry-level computer programming personnel. Universities, colleges, and other traditional sources of computer educated personnel have not been able to supply the demand for graduates with this type of knowledge. This is especially true in the mainframe, MVS/JCL, COBOL, CICS, DB2, and IMS areas. Consequently, comprehensive, intensive-training programs described in these paper serves an important function in providing organization with entry-level personnel that can handle the challenges of "Y2K".

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A Pilot Course in Information Systems Consulting

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Abstract

This paper examines a pilot course in Information Systems Consulting developed for a business information systems program. Professional consultants currently working in the industry, coordinated by a faculty member, developed the course objectives, created the course projects, served as mentors for student teams, and conducted most of the classes. This unique partnership between consulting firms and the university delivered a course that students found to be challenging, exciting and relevant, and that the instructors evaluated as worthwhile and rewarding.

Keywords: Information systems, consulting, curriculum

1. BACKGROUND

A study of positions accepted by graduates from our program over the past several years revealed that approximately 50 to 60 percent of our graduates accepted their first positions with consulting firms (Young, 1998). Studies also indicate that the consulting industry is expected to experience a high growth rate at least until 2006 (Bureau of Labor Statistics, 1998). There is a body of knowledge and a set of skills that are especially important to the consulting industry. There was no place in the current curriculum where this body of knowledge would fit or could be covered in a coherent manner.

With some encouragement from consulting firms, we decided that a consulting course should be developed. A review of college curriculums using the Internet revealed no business colleges with a course that specifically addressed the consulting industry. As we had little expertise in the industry we decided to ask the advice of several of the consulting firms that recruit on the campus.

All the firms we spoke with were very excited about the idea. They agreed to help in the development of the course and offered any other type of assistance they could provide. Nine firms were recruited to participate in the course.

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2. COURSE DEVELOPMENT

In the spring and summer of 1998 several meetings were held with representatives from the participating firms to develop the course objectives and a course outline. Since many of the consulting firms have formal training programs in place, the original concept was to model the course around these programs. The result of these meetings produced a course model that had elements of several of these training programs. The model also included many topics not covered in formal training programs yet deemed important by the consultants from the participating firms. After several rounds of revisions, a set of objectives were set for the course.

3. COURSE OBJECTIVES

1. To develop professionalism in the student.
2. To understand the structure and organization of project teams and to develop good teamwork habits.
3. To develop good interpersonal skills.
4. To develop presentation skills and skills in organizing meetings.

5. To understand the consulting life cycle.
6. To be able to develop a response to a request for proposal (RFP).
7. To be able to develop a project plan.
8. To be able to perform a detailed requirements analysis and create a requirements journal for a project.
9. To be able to create a system design.
10. Given a specific problem, the student will be able to create a prototype for a system to solve the problem.
11. To be able to develop a test plan for a system implementation.
12. To be able to present a project proposal, project plan, and project design to a prospective client.
13. To be able to interpret a statement of work and determine what activities are covered and what activities are not covered in a statement of work.
14. To understand different professional cultures and to be able to work within a given culture.

Many of these objectives can be found in information systems curricula (Davis, et al., 1997; Misic, 1996; Ng Tye, 1995; Srinivasan, et al., 1999). Many of these skills are associated with traditional IS job skills (Todd, McKeen & Gallupe, 1995). There is also some overlap with a traditional systems analysis and design course. The consultants felt, however, that there were many differences between the approaches used for in-house systems development, which is typically the focus of a university systems analysis and design course, and that used by consulting firms.

4. COURSE ADMISSION

During this initial pilot of the course, entrance to the class was restricted. Each prospective student was required to make an application for admission. The application consisted of a resume, transcript, a statement of career objectives, and references. Students were selected using a mix of grade point average, courses completed, skill sets, career objectives, and references. Efforts were made to provide a diverse mix of students that could be used to form teams that would have the proper skill set. Students were accepted from various degree programs and majors, as long as their studies had a focus on information technology. Some of these programs included accounting information systems, computer science, and computer information systems. All the students in the class were in the final year of a four-year computer information systems curriculum.

5. COURSE STRUCTURE

All students in the class were assigned to three-person teams. The teams were created based upon skill sets. The goal was to insure that each team had as many skills as possible. All course work was project oriented and all projects were completed and submitted by the team. There were nine teams in all, and 27 students in the class.

Each team was assigned to a mentor firm. The mentor firm provided one or two primary contact mentors who were current consultants working with the firm. The job of the primary mentor was to help guide the team through certain projects and otherwise provide help with specific types of materials that were required on projects. The mentors worked closely with their student teams to assure that the teams stayed on track. The mentors helped remove roadblocks when they occurred.

Each team was required to submit status reports to their mentor firms on a regular basis. The individual team mentors determined the frequency and format of the status reports.

Teams were expected to complete several focused projects as the semester progressed. They were also given a large "consulting project" to be completed by the end of the semester. This final project was assigned at approximately mid-term. The project included a written presentation and an oral presentation of the project to the other teams and the mentor firms.

Individual team members were required to perform two written performance appraisals of their colleagues on the team.

6. INSTRUCTIONAL FACULTY

The instructional faculty were provided by the mentor firms. Each firm was responsible for covering specific topic areas. For most firms, this included at least two days of classroom instruction. Many firms covered more than two days. The university compensated none of the mentors.

In most cases, the instructional faculty consisted of consultants with the rank of project manager or higher. In some cases, the instructional faculty was a trainer from within the firm. In many cases, the topic was a condensed version of a course developed for the firm's executives or a course developed for their own training program. The instructional faculty provided lecture outlines for the students. Most classes included exercises that were completed by the end of the class period.

Both the consultants and a university faculty member evaluated students. Grades on projects were assigned by the faculty member based on comments by the consultants and on the faculty member's evaluation of the project deliverables. The faculty member compiled the evaluations that each student received during the class from all the sources of evaluation, including student peer evaluations, consultants evaluations, and classroom observation by the faculty member. Student outcomes related to the course objectives were assessed through observation and through the team peer evaluations.

7. MENTOR FIRMS

Mentor firms that participated in the course were:

Andersen Consulting
American Management Systems
Booz-Allen & Hamilton
Ernst & Young
Broughton Systems
Computer Sciences Corporation.
Business Impact Systems
PricewaterhouseCoopers
Electronic Data Systems

8. COURSE HIGHLIGHTS

Although all parts of the course went well, certain aspects of the course stood out.

One of the most successful projects completed by the teams was a response to an RFP. The original RFP had been won by one of the participating firms. Most of the teams were required to visit their mentor firms site to browse through resumes in order to select the key personnel for the RFP. They were also required to produce cost estimates that included software, hardware, and personnel as well as burdening for the personnel. In some cases, the teams decided to partner with other firms because their mentor firm lacked expertise in a specific area. Members from several of the participating firms evaluated the proposals. One class period was devoted to critiquing each team's proposal and awarding the engagement.

The final project was also a highlight of the course. The project required that the student teams develop a solution for an engagement. Most teams decided to use a packaged solution. This forced students to work with their mentor firms to review several package solutions, perform a gap analysis on each package, and select a package for implementation. A few teams decided to design their own solution. This required the students to develop a prototype for their solution.

Presentations were made on a Saturday. Each mentor firm sent one or more representatives to evaluate presentations. The mentor firms acted as the client. Teams were required to develop an agenda, present their solution, and field questions from the mentor firms.

Many of the firms hosted receptions for the students after class or provided beverages, snacks, pizzas or sandwiches during class breaks. All of these refreshments were provided at the expense of the participating firms.

9. COURSE CHALLENGES

Several challenges were encountered during the pilot of the course. The first challenge was coordination of the mentor firms. Each topic was assigned to a mentor firm and an initial schedule was developed. As the semester progressed, some of the schedules needed to be changed. This created a ripple effect that required several changes to the schedule.

An additional challenge was encountered with several projects involving proprietary information. Since each firm received a copy of all RFP responses, mentor firms were reluctant to release employee resumes. This challenge was resolved by altering the names of the employees and modifying other elements of the resumes so that the employees were unrecognizable.

Most mentor firms also use boilerplate material and templates for their RFP responses. They were initially reluctant to allow the student teams to use this material. After several conferences the firms agreed to allow the teams to use a modified version of their templates. Teams were allowed to use most of the cost estimating templates from their mentor firms; however they could only include final estimates in their proposal.

Since development methodology was also required for the final project, firms were also reluctant to release their methodology.

Students also needed to wrestle with an additional challenge. Since they worked closely with their mentor firms, many students felt pressure to accept positions with their mentor firms. In some cases, this pressure was imaginary, but in other cases it was real.

10. COURSE CHANGES TO BE IMPLEMENTED

Several changes will be made to the course in the upcoming semester. These are based upon student comments, mentor comments, and our own observations. These changes include:

1. Each mentor firm will provide at least two consultants to be assigned to their team. A backup is needed in case the mentoring consultant gets too busy or leaves the firm.
2. The final project will be to implement the proposal used in the RFP response. This suggestion came from several of the students. In the pilot semester, the RFP and the final project involved different problems. If possible, students will be required to visit the firm involved in the project.
3. A pool of resumes will be provided to all teams. All teams will pull key employees from this pool when they prepare the RFP response.

This change will be made because of the desire of the mentor firms to protect their personnel.

4. Several RFP templates will be provided to all teams. This will provide all teams with the same starting point. Mentor firms will provide additional boilerplate information.

5. All students will be required to sign a confidentially agreement with their mentor firms at the beginning of the semester.

6. Firms will be discouraged from placing pressure on students to sign contracts with the mentoring firm. The firm is not discouraged from making offers, only from applying pressure for an early acceptance.

11. STUDENT'S EVALUATIONS

Student evaluations were performed through student critiques and exit interviews. In general, student evaluations were positive. A few of the more common comments are listed below.

- The class was excellent. I liked the variety of topics and that professionals currently working in the industry prepared and taught the course.
- I now have a totally different image of the consulting world. I feel that I have a better understanding of what consultants do and how they do it.
- The response to the RFP was an excellent learning experience.
- I learned more from the final project then I have on any project I have completed in my four years of college.
- I have used much of the material covered in this class during job interviews this semester. When the consulting recruiters talk about certain areas, I am able to respond with the experiences from this class.
- We had an excellent mentor firm. They always responded to questions promptly and provided our team with excellent material.
- I enjoyed they way the class was organized. The selection of the topics was excellent. I liked the open atmosphere of the class and enjoyed talking with a lot of the consultants after class.
- Some of the assignments and projects were not well suited to they type of work performed by our mentor firm. The mentor firm helped as much as possible but in some cases we were left on our own.
- Transitions from one class to another were difficult at times. Firms would use different terminology and techniques from those used in previous classes and we were not always aware that they meant the same thing.
- Would like to have faster feedback and more feedback on graded assignments.
- Would like to have more small assignments to prepare us for the final project.
- I liked the idea of seeing many different firms. I feel that I am in a better position to evaluate job offers from these firms and match my own objectives to the culture of a firm.
- I appreciated the mentors staying after a presentation to talk one-on-one with students. I learned more about the firm and consulting in general through these conversations.

12. MENTOR FIRM EVALUATIONS

In general, the mentor firms were pleased with the outcome of the class. Most firms feel the class has accomplished at least one of their objectives. This objective was to get exposure to as many students as possible. This exposure has helped their recruiting efforts.

The mentor firms feel that it is too early to give an evaluation as to how well the course prepared students for the consulting world. They would like to monitor the progress of students who have completed the class and make an evaluation after the students have worked for about one year.

All of the firms expressed eagerness to participate in the class again in the next academic year. Since the initial pilot course was offered, several additional firms have offered their services to the course. We will be selecting the firms for participation in the next class offering based on the kinds of experiences they can provide for the student teams and the firms' ability to participate in the entire semester-long course. We will limit participation to no more than ten firms and thirty students.

13. CONCLUSION

In the future, the consulting industry will provide many opportunities for new college graduates. These opportunities will require additional skill sets beyond those usually taught in the information systems curriculum. When they are taught, they are often not being taught in relation to how they are used in a consulting environment. By offering a course that focuses on consulting, higher education would be better preparing graduates for the work world.

The approach used in this pilot course has fostered a partnership with the consulting industry. No mentor firms in his pilot course know of any college or university that has offered a course similar to this one. By using the consulting firms as mentors, students in the course have had an experience that few students get.

The consulting firms involved in the pilot course have also gained insight to higher education and the educational process. They have gained a better understanding of both the freedoms that higher education has to offer and the restrictions under which higher education must work (c.f. Stone, 1991).

Higher education also gains from this approach. In times of limited resources, higher education can draw on the expertise of consulting professionals and bring this expertise into the classroom. Close alliances and partnerships can be established between institutions and the firms that hire their students. Consulting firms stress long term partnerships with their clients. This approach allows institutions of higher learning to establish long term partnerships with their clients, the consulting firms. This class represents a successful example of industry and academia working together to address the changing needs of the information systems profession (Lee, Trauth & Farwell, 1995).

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An Improved Teaching and Student Learning Methodology

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Abstract

The Purdue University - Anderson site students primarily are considered 'non-traditional' since their average age is thirty-one and almost ninety-five percent are employed[1]. These individuals, also referred to as 'adult learners,' have special needs that must be recognized and addressed if their learning and retention is to be maximized. . During the Spring 1999 semester, three courses at Purdue University - Anderson, Leadership for Team Development, Data Communication Development, and Electronic System Fabrication used a learning contract methodology to satisfy both the students' and the university's needs. This andragogy educational adult learner method was followed where the students became the focal point of the course as self-directed learners rather than the normal emphasis on the instructor as being the key provider of information. In the initial weeks of the courses, the instructors developed (1) key collaborative relationships with the students, (2) the foundation of knowledge and general course expectations, and (3) an understanding of learning contracts. The students then developed their learning contracts and in dialogue with the instructor reached mutually agreed upon course learning objectives relative to each student. All three courses had been offered to similar groups of student during the prior semester. Since the courses' instructors, content and texts were the same, these classes were used as control groups and the documented results from these classes were used for comparisons. The conclusions showed all students successfully accomplished their learning objectives and they met all course expectations. Their test scores on the average were one-half grade higher than the scores from the control classes. The amount of time individually working on their learning contract objectives in the labs increased substantially based on the lab-time records. Their lab work and projects were all completed in a timely manner and were much more thorough and complete. The students' evaluations of the courses and the instructors increased by .48 on a five-point scale compared to the control classes' results.

Keywords: Teaching student-learning, andragogy, contracts, success

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1. INTRODUCTION

The term 'andragogy' originated in the United States by Dr. Malcolm Knowles (Zemke 1998) who is considered by many as the 'Father' of andragogy (Pratt 1988): the study and application methods of adult learning using the primary premise that virtually all learning is self-directed through one's life-based experiences and interactions. The andragogy method is infinitely superior when a more modern definition of college or adult education is used especially in this electronic computer-based age. The learner must become the educational focus of the definition which is 'the preparation for and acquisition of knowledge, skills and understanding to become an adaptable human being' (Brookfield 1986).

Andragogy, according to Malcolm Knowles (Knowles 1984) is "a continuum of assumptions" about how adults learn. Five main foundational premises of andragogy (Brookfield 1986; Pratt 1988; Zemke 1998) are

(1) virtually all learning is self-directed

(2) students' experiences and interactions should be maximized as a prime learning source.

(3) readiness to learn increases and is dependent upon each individual's life, work and/or social roles.

(4) material and information should be relevant and task or problem centered.

(5) adults primarily use a near-term time perspective and want an immediacy of application.

Allen Tough's (Brookfield 1986) [research] and findings greatly support these premises. Tough has extensively measured the means adults primarily use when learning and has found that only seven percent (7%) is through an instructor. He, too, finds that the great majority of adult learning is self-directed particularly now with the tremendous usage of computers and the Internet. Patricia Cross's (Brookfield 1986) [research] adds to the above list identifying intrinsic motivation as being pivotal in the adult's learning. The learner also must perceive the material as being well organized, meaningful and relevant. If the learning occurs in a classroom, a facilitative environment providing positive reinforcement is needed especially in laboratory sessions. These proponents of andragogy all encourage the use of learning contracts with adult learners through which they can identify:

What they want to learn and **Why**?

How they plan to learn the identified knowledge and/or skill?

Where and **How** they will apply the knowledge/ skill attained in their work/life/ social roles?

How they will measure their interim progress and ultimate achievement?

Since the majority of the Purdue University - Anderson site classes consist of approximately eight to fifteen students with ninety-five percent (95%) classified as 'non-traditional' adult students (University 1998), three courses during the Spring 1999 semester used the andragogy, learning contract method. The courses were Leadership for Team Development in the Organizational Leadership Department, Data Communications Development in the Computer Technology Department, and Electronic System Fabrication in the Electrical Engineering Technology Department. These courses were selected since they all included laboratory sessions and they were all offered during the Fall semester with the same instructor, course expectations, texts and similar adult-learner students. These Fall classes became the comparison control groups. The Organizational Leadership course included what was termed 'experiential laboratory of team development'.

During the first four weeks of each course the students were thoroughly introduced to the course expectations and overall objectives. A foundation of course content also was established during this period. The students were introduced to learning contracts and how they directly related to the accomplishment of the course objectives. But, more importantly, each student identified his/her own learning plan so the ultimate outcome of the course would be his or her meaningful attainment and understanding of the material. They understood that they must learn both the theory and application aspects of each course's material.

The learning contracts were submitted to the instructor, who, subsequently, conducted one-on-one discussions with each student. Once mutual understanding and agreement of the **What, When, Where, Why and How?** was reached, a final contract was written. The instructor's role changed from being a content provider, laboratory guide to a facilitator of the students' learning process. Yes, each lecture session included a content portion but the mode of presentation became more of a discussion, question-answer session on relevant applications of the information. The laboratory sessions were more directly related to the attainment of their learning contracts but sufficient benchmark measures were included to assure that the students were learning to apply the course content.

2. THE LEARNING CONTRACTS

In the Electronic System Fabrication course and the Leadership for Team Development course the same basic learning contract form was used. Figure 1 is the specific form used by the team development students while the electrical engineering technology students used a slightly modified version. In the Data Communications Development course the instructor provided more detailed guidelines for the more narrative learning contracts. Figure 2 is a sample of one student's finalized contract.

I, _______________, specifically want to learn and become skilled in the following team development areas:

Because:

I plan to maximize my learning in these areas by:

I, and you, will be able to measure my competence (knowledge and skill) using these

Interim measures:

Final measures:

In the following ways your help will be needed to accomplish this learning contract:

Figure 1. Learning Contract for Team Development

Part 1 Objectives:

To learn about small LAN systems; how the systems and servers work and how to maximize the number of PCs having access to the Internet via one telephone line

How to enable PCs to access Internet via a server using one telephone line

Part 1 Measures:

Written or oral report on how a Proxy Server works, what it looks like and costs. How many and what types of lines can be hooked up (POTS, ISDN, etc.). Does the Proxy Server provide e-mail to each station or will multiple e-mail accounts have to be contracted with an Internet Service Provider? Also, a report how the LAN system was hooked up at church X.

Part 2 Objectives:

Learn how large LAN systems work, how they access the Internet and associated costs compared to small systems.

Part 2 Measures:

Written or oral report on Anderson University's LAN system including what equipment (routes, etc.) is used to support Internet access; what kind of line do they use and from whom do they lease it? What steps have they taken to assure adequate bandwidth? Also, a tour may be scheduled showing both a large LAN system and a smaller LAN system.

Figure 2. Learning Contract for Data Communications Development

3. CONCLUSION

The learning contracts were all successfully accomplished in the three courses. The enthusiasm, indicative of intrinsic motivation, was extremely high especially since the content in each course was highly relevant to each student's identified learning objectives. Using the three Fall control-group classes for comparison, it was documented by the lab records that these students used many more 'extra' hours in the laboratories. An anticipated but uncertain change from using the andragogy method of learning contracts was the role change for the instructors. All of them had almost twice the number of individual and team conferences to assist the students with their research and laboratory work compared to the prior semester. Each instructor indicated a more involved learning relationship with the students and teams even though more time was required than simply offering a lecture or monitoring a laboratory. Not only were the students learning more on a self-directed basis but also the instructors were better able to specifically help each student to accomplish the course and contract objectives. At the end of the semester the students' results were all better: test scores were one-half grade higher than in the prior semester offerings of these courses, completeness and the degree of depth in the laboratory assignments was significantly higher and overall morale of the students seemed much more positive. All the students indicated they preferred the learning contract method to other methods. And, the instructors all liked the results since their entire course and student evaluations were on the average .48 points higher on a five-point scale.

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Improving Student Satisfaction in Large-sized Classes Through a Computer Mediated Communications System

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Abstract

Large size classes provide unique challenges to instructors. In classrooms of seventy-five or more students, these challenges include maintaining effective student contact and providing the student with a feeling of 'personalized' instruction. This paper details several of the unique problems found in teaching classes with large enrollments, and implements the use of a Computer Mediated Communications (CMC) system to meet these challenges. It ends with a student satisfaction survey where it was demonstrated that a CMC system improves student satisfaction in this environment

Keywords: Computer mediated communications (CMC), instructional technology, large size classes, student satisfaction class management

INTRODUCTION

Many faculty members are faced with the dilemma of teaching large scaled classes, which we define as classes with enrollments of over seventy-five learners. An overriding educational concern is providing 'personalized' contact with individual students. Prior studies have shown that students generally learn best in an environment of one-on-one instruction or in small groups [Hannafin & Peck, 1988]. In large classes it is impossible to provide this 'personalized' contact due to the sheer number of students.

Other concerns to a faculty member include providing timely feedback, personalized student assistance, keeping the learners informed of changes to the syllabus or changes to the due dates for the requirements in the course. On the administrative side grading of tests and assignments can become a burden, in addition to just posting the grades.

This paper discusses several of the concerns and problems that surface in large-scale classes and potential solutions. It also discusses the implementation and outcomes of using a computer to facilitate enhanced communications or a computer mediated systems (CMC). Hiltz and Wellman [1997] defined using a computer to enhance communications as ***computer-mediated communications***. The paper concludes with a survey that was completed to gauge the level of student satisfaction in utilizing a CMC

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system in large sized classes to assist in the learning process.

At a large university (over 20,000 students) a computerized student / faculty communication system has been instituted in over 10 different classes, with subjects ranging from statistics to computer principles to management concepts. The primary goal of the system was to provide increased communication channels between faculty and students as well as peer to peer. Another goal was to reduce the administrative load for instructors.

A survey was completed which queried learners in four different sections, (taught by four different instructors) to measure the learner's satisfaction level with the information flow and feedback for these courses. All of the class enrollments were larger then seventy-five students (average size 179).

PROBLEM STATEMENTS

The fact that a student who is one out of 75 or one out of 200 participants in a class, may lead the student to a feeling of isolation and place a artificial barrier between themselves and the instructor. This barrier may lead to the student not asking questions when they don't understand a concept or a feeling that they are not getting the personalized feedback they need when they complete an exam or homework project.

It is assumed that most instructors want to provide as effective learning environment as possible. However large classes present many of the following challenges to the faculty member:

- Quickly getting course information and changes to the curricula to the students.
- Is the class on track and grasping the new material? As the semester progresses it can be difficult for the instructor to get an understanding if the members of the class are following and comprehending the material presented.
- Developing exams that can be graded efficiently. Provide tests that are challenging and become a learning tool. Can 'ScanTron' bubble sheet exams provide the learning experience necessary?
- Personalized contact with students, especially since time is precious and administrative tasks consume valuable time. Students often have questions of an administrative nature.
- Attendance tracking.
- Administrative headaches, which comprise significant time that, could be used to develop more improved lesson plans.
- Implementing meaningful homework assignments which impact the learning of the student, while they are easy to grade. The other option is to provide a sea of graduate students to grade assignments, which results in feedback of mixed quality.

Correspondingly from the student perspective, a student in a larger scale class faces these concerns:

- Feeling of isolation (lost in a large sea of students).
- Fear of asking questions in large-scale classes; they don't want to be embarrassed even if others in the class also do not understand the same information.
- Getting individual help on assignments or projects or concepts when needed.
- Getting to the instructor's office hours, maybe they work, or the professor has a line out the office door.
- Personalized feedback on homework and projects.
- Finding peers to offer assistance.

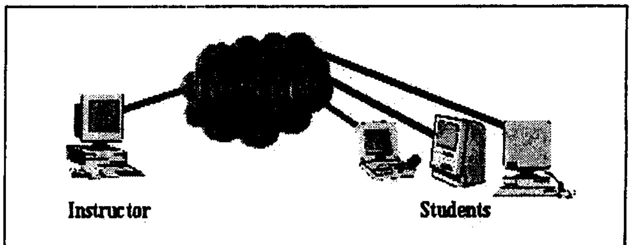

Figure 1
The Internet may increase student / faculty interaction in large classes

A research question is does a computer-mediated communication (CMC) system provide increased personalized contact with each student while reducing this 'contact' time burden for the instructor. Thus leaving time for the instructor to prepare lesson plans and other meaningful related activities.

LITERATURE OVERVIEW

A University of California at Santa Barbara [1995] study details problems found in large and small classes. They are: a) cheating - over 90% of students report that they will cheat at least once in their college career; b) easy grading standards; c) not using tests as learning experiences and d) misusing collaborative learning. Given these issues, this UCSB study does offer several recommendations for large classes:

1. personalize, personalize, personalize
2. ask students for feedback
3. give feedback to students early and often.

Studies have shown that large-scale classes can be just as effective as smaller classes when the instructional goals involve learning and comprehending *factual* goals. Smaller classes have been found more effective when the goals involve higher cognitive skills including application, analysis and synthesis. Smaller classes provide for greater contact between students and faculty, which appears to be needed for students with low motivation, or when the conceptual material is difficult, [McKeachie, 1994]. Therefore the same research question surfaces: does a computer system provide that missing personal contact, or at least reduce the distance between student and faculty?

Perrin and Rueter [1996] report that the Portland State University is facing the same dilemma, as their new lecture hall (300 seating) will accommodate 2100 to 2400 students per quarter in various classes. They are turning to technology in the forms of multimedia presentations, the Internet, electronic study guides and computer-based tutorials, simulation, email and threaded on-line discussion groups. This project is currently in its third year and is awaiting the results of significant data they have collected.

The University of Georgia at Athens [1997] offers some guidelines to improve the handling of large sized classes. These include not distributing materials during the class, instead distribute these materials via electronic means, using technology to present material in and out of class, and establishing an electronic gradebook.

Finally, at James Cook University, Dyreson.[1997] gives several keys to improving class performance. Included are using a combination of lectures with on-line learning materials, electronic quizzes, self-assessment quizzes (pre-tests) and student access to grades. They tracked student usage of the features of the system and found student usage highest of the grading system, followed by self-assessment test. The lowest usage was the on-line learning materials.

The literature can be summarized with the following student needs:

- Provide personalized feedback
- Provide timely feedback
- Provide exams that are learning tools
- Provide an environment where a student may easily ask a question
- Provide an environment that can communicate what is expected of the student and provide a means to update this expectation.

DEVELOPMENT OF THE COMPUTER MEDIATED COMMUNICATIONS SYSTEM (ORION)

In the fall of 1995, a computerized system named ORION was created with multiple goals. These were to: a) increase the communications and information flow to students, b) provide more effective learning and feedback, and c) decrease the administrative load for instructors. This paper will primarily focus on the communication and feedback arenas.

The literature USCB [1995], Dyreson [1997], Hannafin & Peck [1988] indicates that efforts should be undertaken to provide timely information as well as a personalized feeling of feedback for the student. The ORION system was designed to provide increased communications and information flow. A review of the ***main student menu*** choices demon-strates the key communication features of the system

Status	Quizzes	Assignments	Communication
Status Report	Quiz List	Assignment List	FAQ
Syllabus	Study Guide	Submit Assignments	Class Powerpoints
	Practice Quizzes		Message Board Chat Center
			Professor Janicki's homepage email

Figure 2
Student Menu Choices

After a student enters a personalized ID and password, they may access a wealth of information about the class in general. These include course requirements, homework assignments, due dates, handouts, frequently asked questions, and even a class on-line bulletin board. Personal information concerning the student's current grades in class, and customized feedback on individual projects and individual exams is also available.

All of the information is web-based, and is available to the student 24 hours a day from any IP (Internet Protocol) address. This ubiquitous of the web makes it invaluable as a communications backbone. It renders geography irrelevant and allows students and instructors to participate and communicate from locations of convenience.

Goal One: Keep student informed of expectations

A look at one of the hyperlinks under the ***Status*** heading, takes a student to an on-line ***syllabus***. As a course is set-up by an instructor a syllabus is built (the instructors are prompted by the ORION system for the typical syllabus items). These include asking the instructor for class objectives, textbooks and other materials required, projects and assignments, tests, and the weight factor for each item. This is built without the instructor having to know HTML (the language of the web pages), but merely answering questions presented in the web browser. As the instructor builds this course syllabus a list of due dates is also built by the system which is communicated to the student in various locations by the CMC system.

Homework 1 (due 2/3/1999)	Homework 2 (due 2/3/1999)
Homework 3 (due 2/15/1999)	Homework 4 (due 3/1/1999)
Homework 5 (due 3/1/1999)	Homework 6 (due 3/15/1999)
Homework 7 (due 4/12/1999)	Homework 8 (due 4/12/1999)
Homework 9 (due 5/3/1999)	Homework 10 (due 5/3/1999)
ExtraCredit 1 (due 2/28/1999)	ExtraCredit 2 (due 3/31/1999)
ExtraCredit 3 (due 3/31/1999)	ExtraCredit 4 (due 4/30/1999)
ExtraCredit 5 (due 4/30/1999)	Back

Figure 3
Assignment list with due dates

Figure 3 demonstrates a screen under the ***Assignment List*** link. Here students are provided a list of all the projects and assignments due for the class.

For each assignment, clicking on the 'GO' button will display an additional web page which details the requirements for that project and the grading criteria. To make the homework process easier the student may also submit their homework

Item	Course Points	Your Score	% of Course	Points Earned	Comment
Quiz 1	9	95	9	8.55	View Quiz 1 Results
Quiz 2	13	92	13	11.96	View Quiz 2 Results
Quiz 3	13		13		Due 2/26/1999.
Quiz 4	13		13		Due 3/12/1999.
Quiz 5	13		13		Due 3/26/1999.
Quiz 6	13		13		Due 4/16/1999.
Quiz 7	13		13		Due 4/30/1999.
Quiz 8	13		13		Due 5/11/1999.
Homework 1	P/F	Passed	P/F		
Homework 2	P/F	Passed	P/F		
Homework 3	P/F	Passed	P/F		You were correct on 15 out of 20 questions for a score of 75.0%. 70% was required to pass.

Figure 4
A portion of the student status report

via the web for grading. Notice that some of the links are 'lights' and not 'GO' buttons. These represent on-line homework assignments. The student may receive a test, problem set, or other evaluative item, that they complete over the web (from any location) and submit for automatic homework grading.

Goal Two: Provide the student with timely data on their individual progress.

The ***status report*** (a portion shown at the left) link provides significant information to keep the learner up to date on their progress. It displays the due dates for all projects and exams (this is provided many times to the student), as well as the weight factor for each component of their final average (figure 4).

At the bottom of the student status report (not shown), the student's grade average is calculated using the weight factors for each item, as well as a list of items not yet completed in the class. This is displayed as an average (i.e. 85%) in addition to an actual estimated grade (i.e. B) for that point in the semester. A student has the option to insert their email addresses as well as homepage URL (the web address for their page) on this page to foster additional communication. Clicking on the 'GO' button beside a completed exam is discussed in goal 3.

Goal Three: Provide personalized feedback on projects and exams

The student receives personalized feedback on all homework assignments via the status report. The ORION system has the capability to grade homeworks prepared using software products from the Microsoft Office Suite as well as other popular file formats (HTML, Image, Text). It then provides detailed feedback for improvement. Figure 5 demonstrates feedback for a particular Excel homework assignment.

Notice on the homework example in Figure 5 (which was a pass/fail assignment), that the student 'Passed.' It also details the student score (95 out of 100), but provides additional feedback by telling the
student they have the incorrect function in cell D2 of Sheet 3 for this particular spreadsheet. This feedback can be as long or short as the instructor desires. Most importantly, the assignment was submitted electronically (not on disk) and graded automatically by the CMC (ORION) system.

The instructor was only involved in created the assignment and defining the solution, not in the grading. Thus an instructor can increase the number and variety of assignments required of the students without increasing his/her grading effort. As an example at this large university, one course which has an enrollment of over 450 students, currently has ten homework assignments per student per semester now that the system is in operation, versus three in the old manner (teaching assistants manually grading computer diskettes).

Exams may be taken on-line (take-home or in a lab proctor environment). Once the exam period is complete the student receives a detailed analysis of their answers both correct and incorrect by clicking on the 'GO View Quiz Results' button shown in Figure 4.

Homework 4	P/F	Passed	P/F		You earned 95 of 100 possible points for a score of 95.%. The minimum for passing is 75.% so you passed, Good Job!! Did not use the TODAY function in D2 in Sheet 3

Figure 5
Personalized feedback on homework assignments.

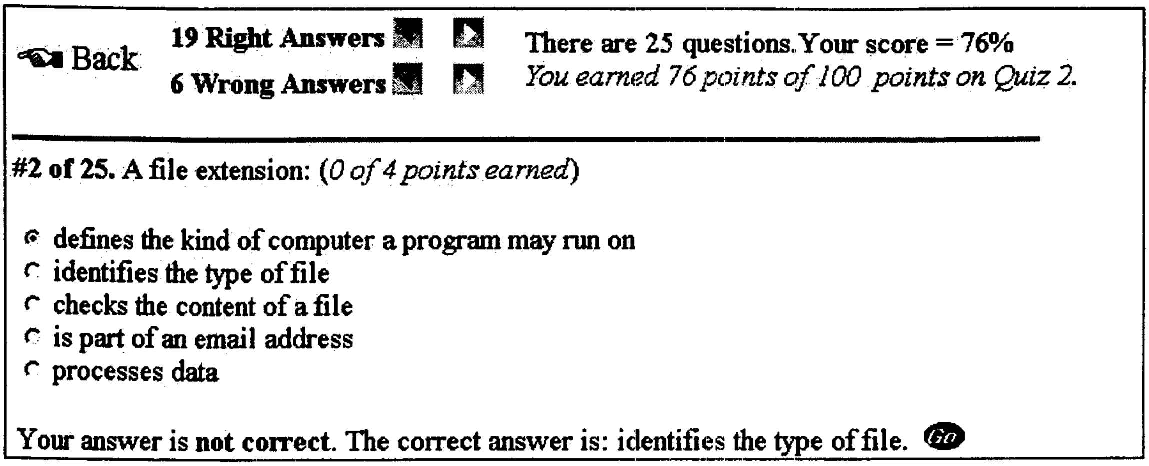

Figure 6
Detailed analysis of one quiz question

Once the 'GO' button is clicked, the learner is provided the screen shown in Figure 6. The student may scroll through all of their correct answers as well as incorrect answers to provide a learning experience from the exams, not just a checkpoint of their progress. Exam questions may be true/false, multiple choice, short answer, matching and longer essay response. The essay responses are not graded by the CMC system, but saved for future on-line grading by instructor. For difficult questions, the instructor may provide additional feedback and reference links back to course material in the feedback area.

Goal Four: Provide on-line learning assistance

Under the ***Quizzes*** option as shown in Figure 2, students may retrieve a study guide for each exam as well as take a practice quiz. This practice quiz may be a combination of short answers, multiple choice, matching and true/false questions. The student may take the practice quiz and then is given immediate feedback on the their score as well as detailed analysis pertaining to the questions missed as shown in Figure 7.

Another resource is that course handouts, PowerPoint Slides, and other documents demonstrated in class can be added to the student's
menu options via the web as shown under the ***Communication*** Option. These resources may be downloaded or linked to on-line documents.

Goal Five: - Provide increased communications between instructors and students and student to student.

Various options are available under the Communication option. The first is a FAQ (Frequently Asked Questions) area. Here instructors or proctors may post hints or answers to questions in which the students are having difficulty. It can be an exchange of tools and suggestions to solve an issue.

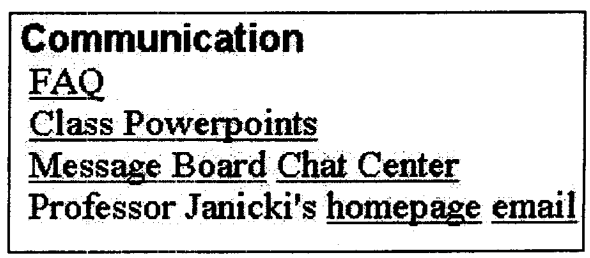

Figure 7
Communication Options

The Message Board can be used for faculty to communicate general course information, or to communicate from one student to student. Figure 8 details the top layer of the message board. Students may reply to previous topics (threads) or add a new discussion point (thread). The faculty member has the ability to delete any inappropriate comments on the message board.

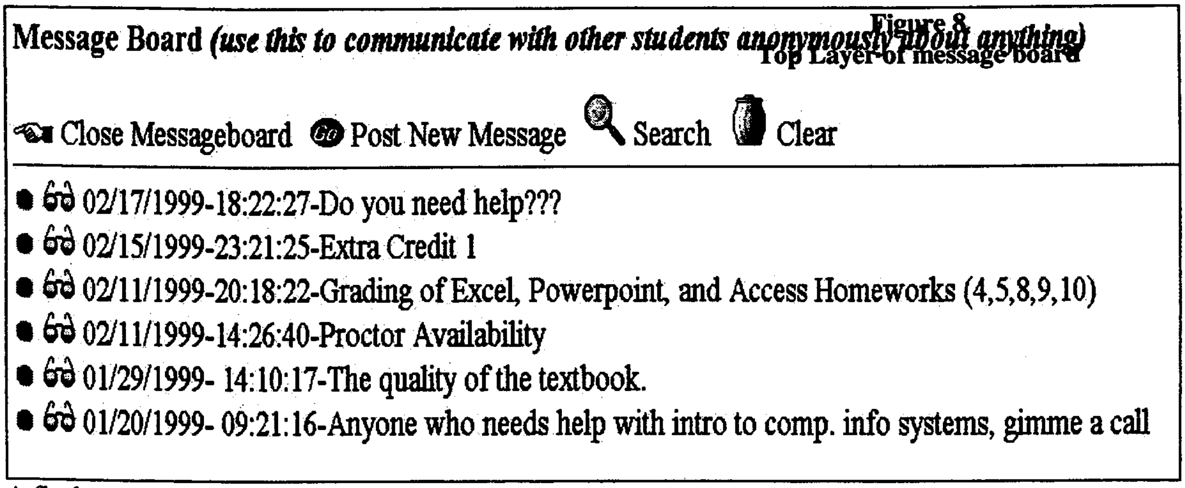

Figure 8
Top Layer of message board

A final communication option is a on-line chat center, in which student can communicate with each other in real time or the instructor can schedule 'help sessions' on-line at certain times of the week.

STUDENT SATISFACTION STUDY

The overall question we desired to answer is: does this CMC system decrease the feeling of isolation in large classes and increase student satisfaction and learning? During the spring semester of 1999, a survey is underway (in four different large sized classes) to determine student satisfaction with this CMC system. Survey questions included:

- Basic demographic information on the student (year, major, minor)
- How many computer courses they completed
- How many courses they have had with 75 or more students
- Are homework assignments more or less clear to understand
- Changes to the syllabus communicated clearly?
- On-line test taking (good or bad)
- Feedback on answers to tests
- Electronic grading of homeworks
- Feedback on homeworks
- Communication features as bulletin board, FAQ's and live chat
- Overall satisfaction rating of the system

The results are shown in relationship to the goals stated earlier. **The total number of respondents was 768.** The percentages below reflect Strong or High Agreement with the question that follows.

Goal One: Keep the student informed of expectations.

68.0% Web-based materials have enhanced my learning in this class:

81.2% The fact that homework assignments were posted saved me time and effort (figure 3)

Goal Two: Provide the student with timely data on their individual progress

91.9% The status report has increased my satisfaction with this course (figure 4)

Goal Three: Provide personalized feedback on projects and exams

81.3% I like the on-line testing feature of this course

90.0% Feedback on exams is beneficial to my learning of the subject matter (figure 6)

95.2% Feedback on homework is beneficial (figure 5)

Goal Four: Provide on-line learning assistance

76.8% The on-line study guides assisted me to improve my scores

67.7% The on-line practice quizzes increased my test scores

Goal Five: Provide increased communication between instructors and students as well as student to student.

Communication Bulleting Board
Improved 37.6%
Never used 45.0%

FAQ (Frequently Asked Questions)
Improved 46.0%

Never Used 47.3%

DISCUSSION AND CONCLUSIONS

In summary, the CMS system incorporated the following electronic techniques to improve the satisfaction of students and reduce the feeling of isolation. These techniques are:

1) Personalized feedback on exams
2) Practice exams
3) Study guides
4) On line due dates and assignments
5) Communication bulletin boards
6) FAQ area for instructors/proctors to keep students up to date
7) Mass e-mail capabilities for rapid change
8) Individual status report for each student showing their progress to date

The first round of surveys (over 750 respondents) found that adding course information such as syllabi, homework assignment, and an updated status report of their grades and progress in the course to be beneficial. Over 90% of the students reported that knowing their grades as all times enhanced the communications and their level of understanding their progress.

More interesting was that the students reported the best feature to impact learning was the enhanced feedback on individual test questions and homework assignments that the ORION system provides. Without a computerized approach this would not have been feasible in large-scale classes. Learning theory states that feedback must be personalized, and must follow the question quickly. Questions related to feedback all achieved over a 90% strong or very high agreement level. The impact of on-line study guides and practice quizzes were in the 60 to 70% range.

Finally the students took least advantage of the communications features of the system with over 40% stating they were unaware of the features (even though it was a hyperlink on their main menu screen). The FAQ's and bulletin board earned a 40% importance level.

Future research will involve contrasting the test results for the different subject matters. Is there a difference in student satisfaction between the statistics and computer principles courses?

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PANEL: EXPANDING ROLE MODEL RESOURCES FOR THE RETENTION OF WOMEN IN TECHNOLOGY

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Abstract

Despite expanding opportunities and substantial financial incentives, women are significantly underrepresented at both the collegiate and professional levels of the information sciences. Furthermore, there is significant evidence that women experience a cumulative disadvantage, in computer terms, that begins in the grade school and continues through the college experience, where it too often leads to disillusion and drop-out. [Frenkel, 1991] The panel focuses on the ongoing strategies employed for the integration and retention of women in the computer and information sciences (CIS) discipline with an outlook toward the corporate computing environment.

Strategies For Retention Of Women With A View To The Computing Environment

The survey of 46 corporations in the Pittsburgh metropolitan area has attempted to determine the corporate response to the recruitment, retention and promotion of women in the Information Sciences. Specifically, the following questions have been posed:

1. Have corporations and institutions followed the promising initiatives of the collegiate community in recognizing the full potential of women in the Information Technology field?

2. Have the barriers to full integration of women into the corporate Information community been identified and removed?

3. What specific strategies are employed by corporations to capitalize on the resources provided by women in Information Technology?

4. Has the "Glass Ceiling" been shattered at the middle and upper levels of the corporate technology world?

5. What specific issues, according to high-level Information Technology managers, might account for the absence of women in the highest sectors of Information Technology?

Most corporate managers of information technology, both male and female, have suggested various reasons for unequal treatment of male and female technology workers. Few believe that a "glass ceiling"

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exists. Those that grudgingly admit to that possibility claim that it is a quite surmountable obstacle, not an immovable object. The majority of managers did agree, however, that the relatively smaller numbers of women computing graduates in the pipeline, the family planning issue, and the difficulty in getting included in the corporate hierarchical network presented real roadblocks to equality. Male corporate information managers frequently implied that women were not vocal or assertive enough, could not handle pressure or stress well, and did not exercise power as adroitly as their male co-workers.[Frenkel, 1990]

The cumulative disadvantages that often handicap the young female computing hopeful at the college level is somewhat easier to define and more widely-accepted than the corporate rationale. It is, however, still controversial and arguable. By surveying male and female college freshman and college seniors concerning their attitudes towards computing activities, certain consistent issues arose. These issues are discussed.

The strategies developed to enroll, retain and integrate women into the CIS program at Robert Morris College originated as an open-ended and ongoing plan to enroll and retain all students (not specifically females) in the CIS major. However, it was quickly recognized that the components of the plan might prove more beneficial to women students than to men students. Many of the strategies are currently in place, while others are awaiting integration into the system.

Partnering with Industry: A Role Model Resource

A 1990 study sponsored by the American Association of University Women suggests that a major problem in attracting and keeping women and minorities in the computer sciences is the lack of role models at all levels. [Pfleeger 1995]. One way to adapt the culture of science to include more women is to "provide role models for girls to emulate and to stimulate their motivations, models of young women scientists who have survived college or are 'living the life of the mind.'"

Appropriate role models can increase the retention rate of females. Role model effectiveness is largely dependent on whether the model presents an image to which the target student would aspire to imitate. Increasing the number of role models would increase the probability that female students would identify with one or more; and therefore continue pursuit of the technical degree.

Retention of women in the technological sciences is an objective of our program. Analogies to the other, once dominated white, male professions, as doctors and lawyers that currently have equal representation of women are frequently made in discussions of the problem. The term, *critical mass*, is applied to the magic number of role models needed to demonstrate the profession universally as an achievable one for women. The proposed plan is based on the hypothesis that strategic placement of female role models during the first two years of the program increases the retention rate of female students.

The University of South Alabama entered a partnership agreement with a local technology-based company in 1995 to support an intern program. The purpose of the intern program is to provide educational opportunities for students in the technical disciplines to apply classroom theory to practical problems. Lessons learned from industry benefit all students through intern contributions to classroom discussion and group projects.

In an effort to provide additional role models for the Women in the Technological Sciences support program (WITS), an agreement to expand the internship program to allow freshmen women to enter the program was reached in the Spring of 1998.

Over the program's three-year history, 140 students have participated in the program, 112 males and 28 females. Currently 49 students are in the program, 37 males, 12 females. Five of the twelve females entered through the WITS program.

The long-term plan is to create positions for the WITS participants on campus as lab assistants and tutors in the freshman and sophomore programming classes after completion of two years in the intern program. Additional women in these high visibility roles on campus, plus the continuation of the WITS intern program will provide critical role models for our future students. The goal is to significantly increase the size of our pipeline of women in technology to make real strides toward attaining that "critical mass" enigma for the representation of women in computer science.

Accessible Role Models

Consistent with national trends, the female computer science students at University of Wisconsin-Parkside (UWP) typically comprise 20% of the lower level classes but only 12% of the upper-level classes. Like the idea of the "appropriate role model" discussed earlier, the Computer Science Department at UWP is providing accessible role models for female students [Haller 1998]. An "accessible role model" is one that students interact with on a regular basis, and one that they can realistically see themselves becoming in the near future. To provide accessible role models, the computer science laboratory is staffed by as many women as men to ensure that woman are visibly in control of the computing workplace. The systems administrator is a woman, and women are hired whenever possible for student help positions in the lab.

The laboratory facility is designed to be gender neutral. There are no basketball hoops, neither are there dried flower wreaths. The design is inviting and professional. The lab is carpeted, and workstations are placed in islands instead of rows with ample space between them. There are large windows to the outside filled with large potted, hanging plants. On one side of the lab, a large conference area with table and chairs is a popular workplace and meeting place for CS students. Students have card access to the lab all hours that the building is open. Women have indicated that they have a very positive response to the lab. It is well used by all of the CS students, and it has created a strong sense of community among them.

Another strategy believed to help to attract and retain women is being put into place this fall. Two area corporations - Harley-Davidson and Allegiance Health Care - are creating virtual internships on the campus. In a virtual internship arrangement, the companies put equipment on campus so that students can work for the company at UWP. Students make regular visits to the company and project managers are assigned to the students and visit them at campus. We feel that these on-campus internships will be particularly appealing to our female students since they will help to transition them from the academic computing environment to the workplace. Students gain experience working for a company while still having the supportive environment of the Computer Science Department at UWP.

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Panel:
Ethics and Computing: Sources and Resources

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PANEL: Ethics and Computing: Sources and Resources

There is a need for the incorporation of ethics and other social impact topics into the computing curricula for all majors--CS/CE/IS. The panelists will provide information regarding the topics that should be included in the curricula, whether taught in a single course or incorporated throughout, and will provide resources available to all. Two of the panelists have extensive classroom experience in teaching such materials.

Dr. C. Dianne Martin, Professor of Electrical Engineering and Computer Science at George Washington University, is currently Program Director of Computer Science, Division of Undergraduate Education for the National Science Foundation. Martin has served as Chair of the Special Interest Group on Computers and Society for ACM from 1993 through 1997 and has been actively involved in research in the historical, social, and ethical issues of computing (ImpactCS: http://www.seas.gwu.edu/impactcs/index.html). Recipient of numerous teaching awards, Dr. Martin is highly sought as a speaker on this topic.

Dr. Kevin W. Bowyer, Professor of Computer Science and Engineering at University of South Florida, is the director for the NSF-sponsored workshops in 1998 and 1999 on teaching "Ethics and Computing". Dr. Bowyer, also a recipient of numerous teaching awards, has developed and taught a course on ethics and computing, and has published a book on the subject by IEEE Computer Society Press.

Dr. Cindy Meyer Hanchey, Associate Professor of Computer Science at Oklahoma Baptist University, will serve as moderator for the panel. Hanchey teaches both computer science and computer information systems majors. A participant at the 1999 NSF Workshop (described above), Dr. Hanchey will provide a list of resources for members of the audience to take with them.

Panel:
Proposed Accreditation Criteria for Bachelor's Programs in Information Systems*

Gayle Yaverbaum[1], Pennsylvania State University, Harrisburg
and
David Feinstein[2], University of South Alabama
and
John Gorgone[3], Bentley College,

The Computing Sciences Accreditation Board (CSAB) has accredited bachelor Programs in Computer Science since 1986. There has been growing interest in similar accreditation for programs in Information Systems. A task force funded by the National Science foundation and representing the major professional societies in computing, Association for Computing Machinery (ACM), IEEE Computer Society (IEEE-CS), Association for Information Systems (AIS), Association for Information Technology Professionals (AITP) and CSAB has been established. A proposed set of criteria for accreditation standards partially based on IS'97 have been developed. This session will present the draft criteria. Audience participation is strongly encouraged. Feedback from the community is solicited.

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Enrollment Management in an Era of Student Abundance: The CIS Department of the Future

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Abstract

Recent years have seen a sharp increase in industry demand for skilled information systems professionals. This demand has in turn generated attractive starting salaries for computer information systems graduates and, not surprisingly, unprecedented interest in information systems courses. Although interest in a subject does not necessarily translate into serious inquiry, it does pose an opportunity for those who manage it wisely. This paper explores this matter while considering the challenges and pitfalls of managing a successful CIS program in an era of overly abundant student demand.

Keywords: Enrollment management, growth, rightsizing, curriculum

1. THE CIS PROGRAM

Our CIS Department is housed within the College of Business Administration. Other departments within the College include Accounting, Finance, International Business & Marketing, Management & Human Resources, and Technology & Operations Management. The program immerses the students in the object-oriented paradigm while allowing them to choose an option in application software development, business systems analysis, interactive web design, and telecommunications. Our school is on the quarter system and awards students successfully completing the CIS program with the degree of Bachelor of Science in Business Administration with a major in Computer Information Systems.

All CIS students must take a core set of classes emphasizing a minimum of one course from each of the four tracks plus a careers in CIS course before being allowed to declare an option. The first course students take is object-oriented programming using the Java language. Subsequent courses emphasize systems development using the Unified Modeling Language, Visual Basic, C++, and telecommunication networks. The capstone course requires students to organize as teams for the development of a software project, often for a real business or other organization.

2. EXPLOSION IN GROWTH

Beginning in 1994, the program underwent a shift away from a traditional structured programming model to embrace object-oriented design and development. We believe that this shift, coupled with the rise in business use of microcomputers and of the Internet is largely responsible for the soaring demand to become a CIS major (Institutional Research and Planning 1999). Enrollment figures for the period 1994 through 1998 are shown in Figure 1.

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As can be seen in the accompanying figure, the number of students enrolling in CIS as a major began a sharp increase starting in 1995. For the five-year period ending in fall 1998, the total number of students majoring in CIS rose each year from an initial level of

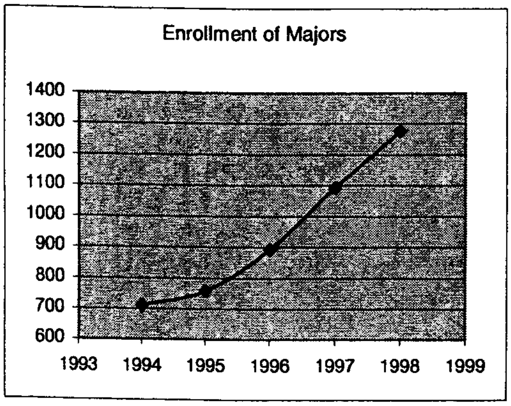

Figure 1: CIS Enrollment

710 majors to a total of 1276 majors – an increase of eighty-one percent.

Moreover, after five years, the trend in increasing demand for majors shows no sign of abating. In fact, excluding an initial acceleration between 1994 and 1996, the trend has shown a steady increase during the last three years of this period.

3. A STRATEGY TO AVOID

Our principal means of dealing with increasing enrollment from 1994 to 1997 was to volunteer to teach larger class sizes and to hire more faculty. Both approaches have inherent limitations. Teaching larger class sizes offers a temporary salve at the expense of both the faculty and students in the class. Matters such as faculty availability during office hours, time required for grading, and related resource constraints are not satisfactorily resolved by this approach. Hiring increasing numbers of faculty presents its own challenges, not the least of which is competing with industry for candidates. With respect to adjunct or part-time faculty, the challenge has been to find qualified individuals who are willing to teach and are available at the times required by students. Many individuals who have expressed interest in teaching part-time are only available during evenings and weekends – neither of which satisfies the great majority of our day students. Increasing the part-time faculty pool also has a built-in constraint – AACSB restricts the proportion of course sections that can be taught by part-time faculty. Currently we strive to restrict this amount to twenty percent of total weighted teaching units or equivalent sections taught by the College.

While appearing as a common sense approach to the problem of increasing demand, this strategy proved to be ill formed and was disappointing from the standpoint of both faculty and students. While initially serving to placate demand, our effort fell short of satisfying what we came to realize was a much larger backlog than we had envisioned. Additionally, as a result of the increased gap between student enrollment and available classes, students who had previously limited their complaints to not being able to enroll in our first course were now much more vocal in their complaints about not being allowed to enroll in subsequent courses.

In spite of our best efforts, by 1997 it had become clear that our strategy was not working. While generating an increase in overall full-time equivalent students (FTE) taught, we had failed to close the gap between FTE taught and FTE requested.

4. RIGHTSIZING

Beginning in 1997, the CIS Department began earnest discussions on the issue of enrollment management and rightsizing our department. With two years of hard experience as our guide, these new discussions moved us away from simply placating demand to what we believe will be a cornerstone in the successful future of many CIS programs – enrollment management. Up until this time, we had simply followed the standard university guideline for students wishing to select CIS as a major. In brief, this guideline allows newly admitted students their choice of major. Students who wish to change majors must be in good standing– defined as a GPA of 2.0 or higher in both their current major and overall university GPA – before a change of major is permitted. This is a guideline, not a rule, and we were to learn that departments have a great deal more flexibility in dealing with situations of unsatisfied demand than we had previously understood. In our situation, the key to crafting a successful enrollment management plan was to have a unified faculty, a credible vision of our future, and a supportive dean.

Our first step toward a new future was to clarify the term "satisfactory progress" as defined in the university catalog (California State Polytechnic University, Pomona 1997). The term is used as a requirement of students in order to stay enrolled in a major. Our effort took two forms. We began by specifying the minimum acceptable standard for satisfactory progress as a grade of C or better in CIS courses required of all majors. It should be noted that our school permits the use of plus and minus grades – and that for purposes of this definition, a grade of C- or below is not acceptable. We also set an upper limit on the number of times a course could be retaken in order for this standard to be achieved. Whereas previously, we had no limit on the number of times a student could retake a course, we created what quickly became known among students as the "three-strikes" rule; that is, a grade of C or better must be achieved within a maximum of three attempts. It should also be noted that the majority of our required courses are encountered at the onset of the program so that the effect of our policy was to remove the less qualified students sooner, rather than later.

The effect of this change was to form a policy whereby we could continue to retain the best students, but also work to quickly remove those less serious students who were simply interested in using computers as well as those that lacked the requisite aptitude for CIS. Classroom space had become a precious commodity and we wanted our policy to reflect this fact. Our hope was that by raising the standard of performance at the beginning stages of our program, we would cause students to become more committed before choosing CIS as a major and enrolling in our courses – as opposed to simply failing a larger number of them.

While two effects of our policy were immediate – an increase in the rate of repeated courses and a modest increase in student quality – little was accomplished with respect to our still growing demand for majors. In fact, with more students required to repeat the initial course sequence, we realized a shift in demand in toward these courses. This shift required a corresponding change in the allocation of resources, which we undertook.

By fall 1998, we had lived under our new, "three-strikes" rule for one year, and had realized an *increase* in the number of majors to 1276 – an unprecedented level for our department – and conveying upon us the distinction of being the largest department on campus.

During this period, another round of discussions ensued as we considered our future. We began by seeking out other departments and colleges that had dealt with similar demand patterns and we endeavored to learn from their experiences. We did not have to look very far. We discovered that both our Department of Accounting and College of Engineering have a rich history of dealing with excess demand. Accounting has long had a ready market for its graduates with national CPA firms; the College of Engineering has always had close ties with the aerospace and defense industry in Southern California – an industry known for its cyclical behavior.

5. AN EVOLUTION IN THOUGHT

While our three-strikes policy was moving us toward improving student quality, it was doing little to solve our backlog problem. Using our accounting department as a role model, we have chosen to further restrict the number of attempts to pass a required course to just two tries. Our intent is to separate the merely interested students from those who are genuinely committed to academic inquiry. While not presently active, our new "two-strikes" rule goes into effect fall 1999. As before, the minimum acceptable level for passing is a grade of C or better.

While our discussions with Accounting helped shed light on one way to manage our current students, the College of Engineering provided us with guidance in the area of admissions policy – as a result of which, we have now restricted the window of opportunity allowed for admission of new majors. As noted previously, our University requires only that existing students are in good standing to petition for a change of major, with new students provided their choice of major upon entry. We have further restricted this policy so that we now accept new majors only once per year – regardless of admission status. Changes of majors are required to attend an annual information session in the winter and to pass our first CIS course (or an approved equivalent) before becoming a major. Applications from new students are accepted only during the month of November for admission in September of the following year.

A normal reaction by students to the foregoing limitation on majors has been to express their intention to continue to take our courses until such time as they are permitted to become CIS majors. Our response to this possibility has been to limit enrollment in all but our first course to CIS majors. Allowing non-majors into our first course was seen as a desirable means of attracting top quality students from other areas.

We have also added prerequisites to our first course so that students must have completed all remedial math and English requirements as established by the University before being allowed to enroll. While the math is more relevant for our programming and telecommunications courses, we believe the English requirement to be especially important for studying systems analysis.

Finally, recent years have brought excess demand by students seeking to enroll in our capstone course. Many of these students have job offers pending and suffer the possibility of a delayed graduation should they not receive this course. To prioritize enrollment in this course, we have taken the unusual step of permitting enrollment to occur only after the first day of class. Students wishing to enroll in the course are told to attend the first day of class with proof of their intent to graduate. Delaying enrollment until the beginning of class allows the Department to verify the number of units pending until graduation and provide each instructor with a prioritized list of candidates to be added. This list is returned to the instructor within twenty-four hours, with enrollment of successful candidates occurring on the second day of class.

6. THE FUTURE

As an academic department, we are faced with many challenges. For purposes of this article, our principal challenge is that of managing our own success. Strictly speaking, we are closed to new majors – at least until fall 2000. Currently under consideration is our next step – impaction. As noted previously, academic departments within our university are normally required to accept new majors when the candidate student is in good standing. When granted impacted status, the relevant department is allowed to request a higher level of admission standard for itself.

While seemingly a logical next step, we have been advised that impaction often carries with it one unintended consequence: the appearance of having such a high standard for admission that many students – even the very good ones – simply won't apply. This has given us pause. Impaction is a powerful tool. We believe that to pursue this strategy, we must first work closely with our supporting institutions, principally local two-year colleges and high schools, if we are to realize the intended effect.

7. CONCLUSION

We believe that the best approach to rightsizing our department is to continue to evolve our current policy of enrollment management. This approach not only works to improve the quality of our graduates, but provides a much fairer mechanism for allocating scarce faculty and classroom resources than a more open admission policy. By restricting admission of majors to those best qualified, we believe that we are on the correct path to maintaining an acceptable backlog of demand while simultaneously improving the quality of the collegiate experience for all those concerned.

8. ACKNOWLEDGEMENTS

We wish to thank Dr. Eduardo Ochoa, Dean, College of Business Administration for his ongoing support of our enrollment management effort. We also wish to thank Dr. Carl Rathmann, Associate Dean, College of Engineering and Dr. Donald Putnam, Chair, Department of Accounting, for sharing their insights and experiences with us.

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Changing Computer Proficiency of "Introduction to Computer" Students

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Abstract

This study compares survey data on computer proficiency. The surveys occurred during 1991-1992 and spring 1999. The motivation for the study was to determine whether the course was covering material the students already know. The analysis indicates that current introductory computer students have a greater level of proficiency in the use of computers than students of a seven years ago did. This increase appears to be mostly in general computer knowledge and word processing skill. Spreadsheets and database proficiency showed a significant statistical increase but did not move them out of a "none to limited" range of proficiency. The gain in computer proficiency appears to be from use of the computer at home and not from formal computer instruction in elementary and secondary education systems. Further increases in computer proficiency may not be possible without requiring teacher education programs at colleges and universities to require technology training for new teachers.

Keywords: Introduction to computers, computer proficiency, IS curriculum, prior computer experience, computer instruction

1. INTRODUCTION

Are students entering the introductory course in computer information systems more proficient in the use of computers than students were a decade ago? Do students already possess word-processing skills? Are they proficient in the use of mouse, menus, and toolbars? These questions motivated our study.

Purpose

A desire to change the strategy underlying our Introduction to Computer Information Systems (CIS) course prompted these questions. We would like to emphasize more problem-solving skills (analyzing, synthesizing, and evaluating) in the course. However, problem solving relies on the students already having knowledge of computer information systems and the ability to use the systems. The current strategy, formulated nearly a decade ago when students entering the course had limited or no computer skills, emphasizes knowledge and how-to-use applications.

Over the years, we have made some changes to instruction in our lab component. These changes were to accommodate changes in software, such as switching from DOS to Windows products and decreasing word processing instruction to include instruction about the Web. We have not changed the course to directly reflect any changes in the students' computer proficiencies. It is our hope that we will be able to go directly to data analysis and creating reports for management use instead of

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teaching what a spreadsheet is and how to use menus and tool-buttons.

Problem

Before making such a fundamental change to the course, we needed to know if our entering students had become more proficient in the use of computers.

At the beginning of each semester, we survey our Introduction to CIS students. One of the areas on the survey is their computer background prior to taking our course. This survey is used to assist us in the selection of students for our internship program. In our internship program we select and interview those students with high levels of computer experience and have them complete alternative activities in place of attending the normal lecture and lab for the course requirements. Interns are assigned positions as lab aids, setting up hardware and software, data communications, academic and administrative computer support.

Since a similar survey was used seven years ago to determine the current approach to the course, we decided to compare the results. By comparing the two surveys, we hoped to ascertain whether or not the gains (if any) in computer proficiency are substantial enough to make the desired course redesign possible.

2. PREVIOUS STUDY

In 1991-1992, we examined the students' self-reported prior computer experience with performance in the course as measured by an average of exam scores. No significant relationship was found between the two. We did find significant relationships with prior work experience, repeating of the course, class rank, and math level. In recent years, the survey was made anonymous and we are not able to tie reported prior computer experience with course performance. However, we are able to examine the change in the reported level of prior computer experience between 1991-1992 and spring 1999.

The current study examines the differences between the self-reported computer background and proficiency of introduction to computer information systems between 1991-1992 and spring 1999. The questions common to both studies concern computer ownership, working knowledge of computers, and proficiency in word processing, spreadsheet, and database.

3. METHOD OF INVESTIGATION

To determine whether there has been a change in students' preparedness for the introductory course in computer information systems, the pre-surveys for the two groups of students were compared. The first group took the course during the academic year 1991-92. This first group was designated group-zero. The second group took the course during the spring semester of 1999. The more recent group is group-one. Group-zero contained 1113 students. Group-one consisted of 415 students.

Over the past seven years, the questions on the survey have changed, so only seven questions considered equivalent were used. For example, "I have my own computer" and "Do you own a computer for use at school" were considered equivalent questions. Four questions were skill questions, such as "What is you level of proficiency with word processing?" The skill questions required re-coding to have the order of skill level proceeding in the same direction. The proficiency levels for computer skills were listed from "No knowledge" to "Expert" on the survey for group-zero. For group-one the skill levels were listed from "Advanced knowledge" to "No knowledge." The four skill questions were for word-processing, spreadsheets, database, and general proficiency. The remaining two common questions were demographic: major and university classification (freshman, sophomore, junior, senior, or grad).

4. ANALYSIS PROCEDURE

To compare the preparedness reported on the 1991-92 survey with that reported on the spring 1999 surveys, t-tests were used. We were not interested in comparisons between questions, just in the differences between groups for the same question. Therefore, we used the following set of hypotheses.

$$H_0: m_{i, Group\,0} = m_{i, Group\,1} \quad (1)$$

$$H_A: m_{i, Group\,0} \bullet \; m_{i, Group\,1} \quad (2)$$

When "*i*" is one of the seven questions in the surveys.

Systat was used to perform the computations. No preset level of significance is required by Systat. Systat performs two-tailed t-tests and reports the probability of a greater absolute value of t.

5. RESULTS

Only the demographic questions resulted in failure to reject the null hypothesis. All of the proficiency questions and the computer ownership question had a probability of a greater absolute value of t (p) equal to 0.000. Therefore, all of the skill questions indicate that for any conventional level of significance (0.1, 0.05, 0.01, or 0.001) the groups would be significantly different, and the null hypothesis would be rejected. The demographics do not have probability that would allow rejecting the null at any of traditional levels of significance. We failed to detect any significant difference between the two groups composition for class rank (p=0.318) or by major (p=0.312).

Demographic Data of Students

We have two demographic measures of the students taking the course. These two measures are class level and college major. Our analysis showed no significant change in the class level of the students. Students taking the course are mostly freshman or sophomores. Our introduction to computer information systems course is a required course for all business majors and can be used by non-business majors for liberal (general) studies. No significant difference was found in the number of reported business versus non-business majors.

Analysis of Data

The first question asked if the student owned a computer. A significant difference was found between 1991-1992 and spring 1999. On average, more of the spring 1999 group reported owning a computer.

In both surveys, students rated their working knowledge of computers. The responses were coded so that 1 was strong knowledge and 4 was no knowledge. The mean on this question was 2.269 for spring 1999 and 3.020 for 1991-1992. This difference was significant with the spring 1999 rating being in the range of little-to-basic working knowledge and 1991-1992 rating being in the range of none-to-basic working knowledge.

The software proficiencies (word processing, spreadsheets, and database) were measured on a four-point scale that used 1 for advanced, 2 for moderate, 3 for limited and 4 for none. In word processing, spreadsheet, and database the students rated themselves as more proficient in spring 1999 as compared to 1991-1992. The greatest difference in the means was in the word processing rating (1991-92 mean = 2.2, 1999 mean = 3.2). The word processing rating went from a mean rating in the none-to-limited proficiency range to the limited-to-moderate range. Although the students in spring 1999 perceived their skills to be higher than students from 1991-1992 did for spreadsheet and database, the mean ratings were still considered to be at a none-to-limited range of proficiency, as shown in Table 1.

Table 1: Mean Proficiencies

Proficiency	Group	Mean
Spreadsheet	Spring 1999	3.0
	1991-92	3.7
Database	Spring 1999	3.4
	1991-92	3.7

Based on these self-reported measures the current students appear to have a greater level of computer proficiency than the students in 1991-92 did.

6. DISCUSSION

The question that comes to mind is "Where are these students acquiring this increased computer proficiency?" From the survey results on question one with increased ownership of computers, we can assume that at least some of this increase is from using a computer at home without formal instruction.

What impact has computer instruction in the elementary and secondary school systems had? A report released by the CEO Forum on Education and Technology on February 23, 1999, would indicate that only a minor impact in increased computer proficiency is from our elementary and secondary education systems. The CEO Forum created a self-assessment for schools to gauge their current use of technology and to measure progress towards integration of technology in education. *The School Technology and Readiness Report* (STaR Chart) for the state that our university is located in shows that greater than 50 percent of the schools are in the low tech area and only with about 14 percent in the high tech area. Low tech has a student to computer ratio of 8-20 students and high tech has a 4-8 student ratio. The chart also assesses multimedia use of computers and connection to the Internet.

The CEO Forum assessment would indicate that a majority of the increase in computer proficiency is from self, family, or friend instruction at home and not from formal computer instruction in a school setting. The CEO Forum concluded that the teachers were not prepared to teach the latest technology. They have found that one-third of teacher education programs do not have facilities for technology instruction and that only two states require technology training for new teachers.

7. CONCLUSIONS

Based on the comparison of computer proficiency between 1991-1992 and spring 1999, we conclude that introductory computer students have a greater level of proficiency in the use of computers. However, this use appears to be most purposeful in general computer knowledge and word processing. Although knowledge of spreadsheets and database software showed a significant statistical result, the increase did not move them out of a none-to-limited range of proficiency.

Students appear to be gaining most of this increase in computer proficiency from use of the computer at home and not from formal computer instruction in elementary and secondary education systems. Further increases in computer proficiency may not be possible without changes in the teacher education programs to require technology training for new teachers so that they can successfully teach the technology in the elementary and secondary school systems.

Proficiency in computer use has not progressed to moderate-to-advanced range. We do not foresee an immediate change in technology instruction at the elementary and secondary school level. Therefore, we will have to continue teaching applications rather than problem solving in the introductory course for awhile longer.

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Adult Learners and Technology: New Challenges for Instructors

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Abstract

University instructors are seeing an increasing number of adults entering classrooms. In order to instruct and train adult learners effectively, instructors will need to retool and learn new ways of facilitating adult learning. This is especially true for instructors who will be dealing with adults learning technology in any field. Adult learning theory stresses mutual helping in a participative, collaborative learning environment. Instructors are *facilitators* of learning and must employ a wide range of teaching methods when teaching technology to adults. Some of these include group discussion, peer-to-peer teaching, collaboration, and team projects. There are also many techniques unique to adult learning including teamwork, demonstration, students' on-going evaluation of course content, and a climate of mutual respect. As the field of adult learning grows, it is important for adult educators to continue exploring new ways of improving the teaching and training of adult learners in technology.

Keywords: Adult learners, technology, adult learning theory, andragogy, facilitator

1. WHO IS THE ADULT LEARNER

Many university instructors are seeing an increase in adults entering classrooms. Today there are approximately seven million adults *24 years of age or older* (our definition of an adult learner) who are enrolled in college credit-bearing programs. Recent studies show that the typical adult learner is a "33 year-old white female who works full time" (The Demographics of Continuing Education, 1997, p. 5); nearly 50 percent of today's college students are over the age of 24 and 65 percent of these are women. Most adult students work full time, have family responsibilities, and other personal commitments.

2. WHY ARE ADULTS IN SCHOOL?

Many adult learners site accreditation or certification (especially technological certification) as reasons for returning to the classroom. Others want to increase their skill set; some are making career changes and many return for the "sheer joy of learning" (The Demographics of Continuing Education, 1995, p. 5). At Pace University, adult learners represent more than 50 percent of the undergraduate population and 90 percent of the graduate population (Clutter, 1997). In order to instruct and train adult learners effectively, instructors will need to retool

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and learn new ways of facilitating adult learning. This is especially true for instructors will who be dealing with adults learning technology in any field.

3. HOW LONG HAS THIS BEEN GOING ON?

Since World War II (and the G.I. Bill) there has been an upswing in adult enrollment as returning service personnel came back to the classroom for educational and professional enhancement. Those adult learners were more homogeneous than today's adult learners. They were usually men, frequently middle class. This pattern continued through the Korean War and the Vietnam War, paving the way for *all* adults to consider the idea of returning to school for professional and/or personal growth. With older adults in such great numbers in universities, it is necessary for instructors to consider how teaching them differs from teaching children and young people.

4. THE TWO LEARNING THEORIES

Pedagogy, traditional learning theory, refers to the art and science of *directing* children through the learning process. "The pedagogic system, which began in the Middle Ages by monks for teaching small numbers of elite [male] children ... presumes that the teacher knows almost everything and the learner almost nothing" (Ricks, 1988, p. 604).

Andragogy, adult learning theory, refers to the art and science of *facilitating* adults through the learning process. AThe educator functions as a facilitator and provocateur rather than as an authority on subject matter" (Mezirow, 1997, p. 11). The science of andragogy, which began in Europe in the 1920s, was introduced in the United States by Malcolm Knowles in the 60s/70s (Knowles, 1984, pp. 49-51). Other pioneers include Stephen Brookfield, Rosemary Caffarella, Patricia Cranton, Sharan Merriam, and Jack Mezirow. Andragogy fosters self-direction and critical thinking as students work in a participative, collaborative learning environment as compared to pedagogy which emphasizes controlling or directing by the teacher. Adult learning theory postulates that because adults bring a wealth of experiences to the classroom, learning must be relevant and applicable so that outcomes can be put to use immediately in concrete, practical, and self-benefiting terms.

5. SOME COMPARISONS

Adults are responsible for their own lives. Because "experience is the adult learner's living textbook," (Lindeman, 1926, p. 10) they tend to be independent and self-managing. As a result, adults "resent being talked down to, having decisions imposed on...[them], being controlled, directed, and otherwise treated like children" (Knowles, 1984, p. 175). Adults are task oriented in their learning and learn best when they learn in the context of their needs. They want to be actively engaged in their own learning. "In active learning, the teacher is a 'guide on the side' rather than a 'sage on the stage' (Dirkx and Prenger, 1997, p. 22) B one resource in "the spirit of mutual inquiry" (Knowles, 1984, p. 84). Moreover, "the facilitator works herself out of the job of authority figure to become a colearner by progressively transferring leadership to the group as it becomes more self-directive" (Mezirow, 1997, p. 11).

Adults	Children
Reservoir of learning experiences	Just forming and growing
Self-directed; increasingly independent	Dependent
Task or problem centered	Subject centered
Pragmatic; focused with high level of concentration	Easily distracted
Cautious risk takers	Impetuous, spontaneous
Motivated by internal incentives	Motivated by external incentives
Classroom environment	**Classroom environment**
Relaxed and informal	Formal
Flattened; group shares authority	Hierarchical; teacher *is* authority
Collaborative	Competitive
Active participants	Passive recipients
Instructor	**Teacher**
Is one resource	Is the major resource
Shares life experiences	Avoids personal anecdotes
Over time "fades" away	Stays in control

Sources: Knowles, M. (19840, p. 116; O'Connor, B.N., Bronner, M., and Delaney, C. (1996), p. 115; and authors' personal experiences.

6. THE POSITIVES AND CHALLENGES

The positives

Adults bring a wealth of life experiences to the classroom. Because they are reservoirs of information for others to draw upon, each student improves and enriches the entire class. They are interested in their classmates' experiences; they believe they have a right to some ownership in their own learning process; and they take learning seriously. They learn by doing. They are more focused, more pragmatic, and they want to do it "right" the first time. Adult students take a "consumer's attitude," for the want their money's worth as education is a "big ticket item;" they take a "business attitude," for they want to find solutions to problems.

The Challenges

Because adults are juggling complex lives, they have little discretionary time. Therefore, learning must be timely and relevant. Homework and independent projects should relate to real business problems leading to sound solutions that can be immediately applicable. Adult learners have delicate egos; they fear failing; or losing face with younger colleagues (Meskill and Melendez, 1997, p. 88). Many senior executives fear appearing foolish when learning computers (Boone, 1991, p. 236). Adults are cautious risk takers and can be more apprehensive about learning technology than younger learners. Adults are less interested in theory for theory's sake and if they must have theory, they want to apply it immediately to what is relative in their lives--to help solve some of life's dilemmas. In fact, Aadults...will not participate in formal or nonformal [sic] learning activities that are not responsive to their needs" (Merriam and Caffarella, 1991, p. 270). Because of high expectations, they are tough on themselves and are tough on instructors. They are motivated to work hard, they expect to be challenged, and they strive for good grades--a C will never suffice.

7. QUALITIES OF ADULT EDUCATORS

Adult educators who have studied andragogical learning principles exhibit unique qualities in their teaching. They try to cultivate a physical and psychological climate conducive to learning. Like coaches, they make it a point to know the players—taking time to learn students' experiences, strengths, skill levels, and expectations. They involve the learners in mutual planning and course management. They encourage learners to identify their own resources for problem solving. Adult educators are also co-learners along the educational path—discovering new knowledge with their students; they are flexible as well as self-reflecting—searching for better ways to improve adult learning, critical and independent thinking, and empowerment. These educators bridge teaching and research by bringing back to their classrooms recently acquired information so that everyone can collaboratively analyze and disseminate. Adult educators frequently return to the role of the learner--revisiting what it feels like to learn something new, especially something challenging. Reflecting on the experience of learning has some very powerful implications for teaching (Brookfield, 1990, p. 196). Finally, adult educators employ a wide range of teaching methods and techniques.

8. TEACHING METHODS AND TECHNIQUES

Teaching Methods

The foremost adult teaching methods is the use of **group discussion** in creating a community of learners. Group discussion moves away from individual, solitary learning toward connected learning through "shared ownership that honors all members equally and sees the work as significant for its own sake" (Drennon and Foucar-Szocki, 1997, p. 77). In order to promote sharing and interaction, students need to be able to see and talk to each other easily (Dirkz and Prenger, 1997, p. 84). When a seating arrangement is configured in a U shape or around a conference table with recessed microcomputers, group discussion is naturally promoted--and learning is increased.

> Chairs in rows and a lectern in front is probably the least conducive method of learning that the fertile human brain can invent. It announces to anyone entering the room that the name of the game here is one-way transmission; that the proper role of the student is to sit and listen to transmission from the lectern (Knowles & Associates, 1984, p. 15).

Peer to peer teaching reinforces the notion that *to teach is to learn twice.* People tend to feel committed to an activity in direct proportion to the degree in which they have participated (Knowles, 1984, p. 123). When one student teaches another, this is active participation, and self-confidence grows on the part of the student-teacher. Since the student-learner is being taught by a peer, there is no loss of self-esteem. A good example of informal peer teaching occurs in a computer classroom when students serendipitously discover solutions and share and/or demonstrate this newly acquired information to classmates.

Another effective method is the use of **teams and the collaborative effort.** In most cases adults returning to school have had extensive experience in working cooperatively in the business world, and have the necessary interpersonal skills to make this kind of teaching productive. However, real cooperation takes place best when the instructor structures the task so that interdependence is necessary. This can be done by having the group agree on a "group goal" for a project, a structure that requires coordination for an agreed-upon goal to be reached. Another possibility is for the instructor to create a situation in which students must become dependent on one another for information and help. "The emphasis is on creating an environment in which learners become increasingly adept at learning from each other and at helping each other learn in problem-solving groups" (Mezirow, 1997, p. 11).

Guest experts often foster student participation and self-directed learning as guests bring fresh ideas and new perspectives to the classroom. This gives students a chance to hear, evaluate, and possibly challenge ideas that may be different from what they already know or have recently learned in class.

Finally, **case studies** provide pragmatic ways to relate theory to practice and **independent projects** encourage students to explore on their own and share findings with classmates. *Short* dynamic **lectures** can trigger lively group discussion. "Say a lot about a little. Use a lot of examples. Keep moving. Capitalize on variety" (Farrah, 1991, p. 182.)

Teaching Techniques

Adult learning facilitators strive to keep their hands off students' computers. "You're invading the person's personal space...you're [also] conveying impatience with how fast they're learning" (Blumfield, 1997, p. 49). Adults learn best when doing their own hands-on work in order to answer their own questions (Meskell and Melendez, 1997, p. 88). Adult students learn from their own mistakes, which can be quite instructive (Regan and O'Connor, 1994, p. 562). For example, when students misspell a word in a database query or write an incorrect spreadsheet formula and there are no results or the result is an error message, let the students try to find the mistake. This becomes an unforgettable lesson.

Adults assume they will have their own computer to work on in class. Since many adults leave their workplace with a personal computer on each desk, that same standard is expected in the classroom. Some instructors have attempted to teach skills with paired students on a single computer. However, those students who are fast in learning new concepts or on the keyboard lose patience with slower partners, and slower partners—sensing the difference—become easily embarrassed or resentful.

One of the simplest ways to create a relaxed climate of mutual respect is to establish social equality. Ranks and titles can be eliminated—*adult* students and *adult* facilitators maintain the same status. If instructors call students by their first names, then students should be able to address instructors similarly. If individual instructors feel uncomfortable being addressed by their first names, that same courtesy should be extended to the students. This modest technique not only creates a more relaxed classroom, but increases student participation. By creating a comfortable, *respectful* [italics added], and supportive environment (Knowles, 1984, p. 83), the facilitator creates an exemplary place to learn.

Students should always sit at their computers while the instructor explains and demonstrates from his or her workstation. Students need to *see* what you are doing, *hear* what you are doing, and *do* what you are doing. Demonstrate using current technology—a powerful LCD panel, overheads, videos, etc. We agree with Shneiderman (1995), who said that *responsible* instructors (using LCD panels hooked to the instructor's workstation projecting to a large public screen for clear viewing) demonstrate with the students. Since learning occurs through various senses and styles, demonstration reinforces assorted kinds of learning.

Keep "techie talk" to a minimum, especially in introductory or survey computer courses. "People neither understand nor appreciate 'expert talk'" (Wadsworth, 1997, p. 752). Computer vocabulary should be explained in simple, clear language and equated with something students already know. For example, Megahertz (MHz) is like horsepower; the more the MHz the faster the processing speed. Or, Megabytes (Mb) are like Megabucks—a million dollars. So Megabytes means a million bytes.

Many times, instructors don't know the answer to a question for the particular problem has never come up before. Show students that even though the instructor is stumped, *together* in a collaborative effort the answer can be found whether it is through Help menus, wizards and coaches, guidebooks, other texts, hot-line numbers, or trial and error. When the students leave the classroom for their workplace, they will be confident for they know that there are many resources available to help them find solutions to problems.

Let students choose their own teams. Some instructors trained in pedagogical principles have been taught to build heterogeneous teams. While, in theory, this may work with children, it can create a learning obstacle for adults. If adults have chosen their own teams and issues of productivity or personality occur, they will have learned the importance of selecting appropriate team members and taking responsibility for their actions. If poor selections are made, teams still have the responsibility of completing group projects. Just as in the workplace, there are all kinds of teams—those that work and those that don't.

9. SUGGESTIONS FOR TEACHING A TECHNOLOGY COURSE

- Understand your students. Learn their backgrounds: academic, experiential, and skill level. Find out how familiar they are with the subject matter and how much detail they will need. If necessary, perform a quick needs analysis to set realistic objectives and possibly revise class goals.

- Be flexible in managing the time allotment for each class meeting. Individuals come with a wide variety of technological skill levels and aptitudes. Some topics may take more time than planned, while others may move quickly. The original course outline may undergo considerable "tweaking" as the term evolves.

- Set clear, measurable performance objectives. State them in the course syllabus. Students need to know what is expected of them—from the start. Ask them what their purpose is in taking the course and what *they* hope to learn. Again, be prepared to amend the course outline.

- Be organized. Well-organized material is easier to teach from and easier to learn from. It can also help adults form mental constructs that will serve as a frame of reference for future learning (Bezdek, 1985, p. 125). Because adults have high expectations (for themselves as well as others), they assume instructors will be well prepared for class.

- Follow a logical sequence. The first point should serve as a foundation for later points—like building blocks. For example, before introducing complex queries with multiple criteria from linked tables, students should be comfortable creating simple queries from single tables.

- Use illustrations, analogies, and examples (Bezdek, 1985, p. 125) so students can relate new information to what they already know. For example, equate the set-up of directories and sub-directories to a tree with branches or a subject filing system that they may be familiar with in the workplace.

- Model your comfort and enthusiasm about technology. Let students know what a valuable tool technology is. "When teachers display their own enthusiasm...students tend to follow the model that is put forth..." (Lewis, 1991, p. 320).

- Let students evaluate the course content and the instructor at various points in the term. Empowering students in their own learning process improves participation. Students commit to the course and to each other when they know the instructor is listening. Mid-term evaluations enable instructors to reflect "on the instructional process and the content both during the session and after it is over" (Caffarella, 1994, p. 194) and to make necessary changes.

- The actual learning is up to the students. Rogers' student-centered approach to education postulates that "we cannot teach another person directly; we can only facilitate his learning" (1951, p. 390). While instructors are responsible for providing the best learning environment and materials possible, adult students are responsible for their own learning (Jones, 1990, p. 3).

10. CONCLUDING REMARKS

In conclusion, participation increases and learning happens when adult educators become facilitators easing their students through the learning process in a collaborative learning environment—a place where self-directed learning and critical thinking is advocated and nurtured. Adult learning principles and methods are constantly evolving, and it is essential that those of us who are adult educators add our own teaching, training, research, and personal experiences to the growing body of knowledge. We need to continue improving our own teaching and training methods to meet *adult* needs, especially those adults learning technology. The following quote, written in 1926, still rings true.

> Authoritative teaching...rigid pedagogical formula...have no place in adult education...Small groups of aspiring adults who desire to keep their minds fresh and vigorous; who begin to learn [how to confront] pertinent situations; who dig down into their reservoirs of experiences...who are led in the discussions of teachers who are also searchers after wisdom and not oracles; this constitutes the setting for adult education, the modern quest for life's meaning (Lindeman, 1926, pp. 10-11).

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A Second Course in Systems Analysis and Design: A Rationale and a Proposed Course Outline

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ABSTRACT

A second course in Systems Analysis and Design is needed to help satisfy the IS '97 Curriculum and to provide the competencies and skills needed by the entry-level systems development specialist. Universities who offer a second systems analysis and design course is certainly on the right track because information systems university recruiters admit that grads are hard to find who have sufficient training in systems analysis and design. To align with the IS '97 model a third systems development course should compliment the course the author proposes. Curriculums with one systems analysis course is severely limited in its abilities to teach multiple methodologies such as information engineering, prototyping, RAD, and OOA. Universities with limited course offerings must make critical decisions on course inclusion and exclusion issues. Today, the information systems specialist must also know how to work with automated tools that augment the systems analysis process. These tools may include model-based software products that allow full-life cycle development from planning through construction. Students who grasp model-based techniques that include central encyclopedias (or repositories) are often way ahead of the game. They are able to work within a group, with precision and toward common development objects. A second course objectives is proposed with some sample assignments and solutions using the Sterling Cool Gen product. The product is used solely to enforce laboratory assignments related to information engineering and prototyping.

Keywords: Information engineering, prototyping, rapid application design, model-based approach, model-based development

1. INTRODUCTION

Most information systems curriculums include a systems analysis and design course and is generally taught from a business perspective. This course is normally taught within the college of business, and faculty who have taught a systems analysis course would agree that there are many content issues and differences in philosophy surrounding the theoretical frame of reference one takes in teaching the class. Today, this is especially true as manifested by the various paradigms such as Object Oriented Analysis (OOA), Object Modeling Technique (OMT), Unified Modeling Language (UML), Prototyping and Information Engineering. The most noteworthy is Object Oriented Analysis that makes use of OMT or UML. As a faculty, do we follow an OOA approach or do we follow a more traditional methodology such as Information Engineering (IE), Prototyping, RAD or Structured Analysis?

Most texts on the subject state that the purpose of the first course in systems analysis and design is to provide the student with a wide range of knowledge about different modeling techniques that survey both the OOA arena and the Information Engineering/Structured Analysis/RAD arenas as well (Whitten, 1997). In this traditional first course in systems analysis (S/A), students must learn many principles related to each of these techniques and methods. The teacher is faced with reducing the amount of coverage time for each topic or method. For some teachers this "watering down" approach is necessary to provide some coverage for each method. This watering down of subject matter is not taken well by industry since they are seeking grads with strong skills within this domain of knowledge. Our college graduates' reduced knowledge level of process and data modeling comes as a shock to many corporate analysts who firmly believe that this discipline should receive increased attention by information systems departments (Simpson, 1998). In conversations with corporate leaders from USAA, Lockheed Martin, J C Penney and others, they often express concern that their new hires simply do not have the essential knowledge to become a functioning member of a systems development team mainly because of their lack of project implementation savvy and vocabulary. The newly hired college grads are often placed into "fast track" programs to get them up to speed in systems analysis and systems design. Corporate leaders often comment that the typical grad has fairly strong programming skills, but they simply do not have an adequate terminology base in systems analysis to adequately function within a systems development team environment. These opinions are made manifest now more than ever when the demand for systems design skills are at an all time high.

2. MULTIPLE METHODOLOGIES CANNOT BE TAUGHT IN ONE SEMESTER: TWO COURSES ARE A MUST: THREE COURSES IS PREFERRED BY INDUSTRY

This purpose of this paper is to propose a second course in systems analysis that follows a data and process modeling approach with strong emphasis in the use of model based, shared repository design. This involves windows and web-based user interface design. To achieve this goal, an outline is presented of three essential courses that should be taught pertaining to systems analysis and design. It is the second course within the series that is highlighted and discussed in detail. The narrative that follows briefly describes the three courses. The first course is titled "Systems Analysis and Design I." The second course is titled "Systems Analysis and Design II. The second course emphasizes a model based approach to the planning, analysis, design, dynamic construction and implementation of a new system. The third course is titled "Systems Analysis and Design III" and will emphasize both client server and web-enabled designed systems. This course will also explore Object-Oriented Analysis and Design as well as provide extended knowledge of relational technology.

Systems Analysis and Design I (The First Course)

This course will continue to provide the student with the broad array of topics within the arena of systems analysis and design. Normally the course will provide equal coverage of both data and process modeling worlds in addition to the upcoming object oriented environment. Students will learn a gamut of modeling techniques which will include Information Engineering, RAD, Joint Application Design (JAD), Prototyping, Object Oriented Analysis and Object Modeling Technique. The learning outcomes of this course will ensure that the student will have a basic grasp of the terminology for all techniques.

Systems Analysis and Design II (The Second Course)

Nothing less than a comprehensive coverage of both data and process modeling will suffice. Educators and corporate professionals tend to agree that students must have a comprehensive understanding of both methodological approaches to systems analysis and design. The learning outcomes of the proposed second course in systems analysis are essential to new grads if they are to be successful. Moreover, to develop an understanding of the object oriented concepts students need to have a firm understanding of both process and data modeling. Many assignments are often necessary to insure the success of the student. Two or three data models are not sufficient. Students must drill through at least a dozen entity relationship diagrams before they begin to develop any level of strong comprehension. The author has taught this class for ten years and has tried various assignment scenarios. In the case of data modeling the author believes that more is better. Of course drilling students through a plurality of data modeling examples will take time. It also requires energy on the part of the teacher to work through these assignments in class on the board. There is no short cut here. These assignments cannot simply be thrown at the students without feedback.

Once students have grasped the essential modeling skills they must work within a team environment on a controlled business problem that requires both data and process modeling talent. This problem should have a controlled scope and not be too unwieldy, but should have a touch of realism also. After all, students are not professional developers yet. Having a strong knowledge of IE, Structured Analysis, RAD and Prototyping provides the future student of Object Oriented Analysis the advantage of being able to see the affinity between the various methods as well as their differences. Students need to understand these differences and similarities since some projects may involve multiple methodologies. Finally, the student, with a strong proficiency in using a model-based approach such as Sterling Cool: Gen or ORACLE Developer 2000 will have a tremendous edge as they enter the profession.

Advanced Systems Design and Development III (A Third Course)

New hires within the I/S development area are expected to have a reasonable grasp of both the process and data modeling world and the Object Modeling Technique and Unified Modeling Language. A "real world" but scoped business problem that fits the time allowed should be used. The OOA concepts must be reviewed and students will be required to apply this knowledge to a case study. Approximately thirty (30) percent of the course will be devoted to OOA. Thirty percent will include client/server and how to web enable a client server system. The remainder of the class will be spent working within groups to solve a real world problem. This time will involve interviewing, proposals and final presentations. Lecture time will include interviewing techniques, structured interviewing, proposal writing, payback analysis, client server and web enabling concepts and tools. As the reader knows the demand for graduates with web enabling and client server skills are at an all time high in the job market. The teacher of the third course can be creative as to which object-oriented avenue to take. The teacher should focus on allowing students to analyze, design and implement a complete business system using either an object-oriented approach or a process/data approach.

It is recognized that AACSB schools may have a course selection issue in trying to offer multiple systems analysis and design courses. Faculty will often say, "...we just do not have the space within the curriculum to offer a second course in systems analysis and design. The author strongly believes that this type of thinking requires review and analysis. The purpose of this article is to bring attention to the issue and stress the importance of its inclusion in some manner. It is recommended to carefully review existing course requirements and find a place for at least a second experience in systems analysis even if it means a curriculum modification. Traditional curriculums were likely created when the importance of systems analysis may have had a secondary role to programming. This is just not the case any longer. Some university faculties could teach the second and third courses as IS electives or "topics" courses while it buys time to integrate the course(s) officially into the curriculum.

3. COLLEGE GRADS ARE IN GREAT DEMAND WITH DATA AND PROCESS MODELING TALENTS.

New college graduates with web-enabled and client server skills, who also possess a strong understanding of both data and process modeling, are at the pinnacle of demand within the information systems field. Conference proceedings often reveal that students are expected to understand traditional process and data modeling once they get to the job. The following reasons support the teaching of an advanced course, which emphasizes process and data modeling using Model Based (Full Life Cycle) Development.

- There is a growing number of companies who are showing use of object-oriented analysis and design; however, the statistics indicate that still over eighty (80) percent of American companies continue to follow more traditional methods such as Prototyping, JAD, RAD, and Information Engineering rather than Object-Oriented Analysis. The reason is mainly because of the myriad of data and process business models currently within use today (Sterling, 1997). The author believes that there is a strong movement in the direction of OOA and object oriented tools, but at the present time we should not swiftly abandon the more traditional analysis and design methods.

- Corporate executives and representatives continue to recruit college information systems graduates that have relational modeling skills and who can effectively use and manipulate relational databases (Simpson, 1998). The need for new graduates that possess these relational database skills is still on the climb (Baumgart, 1998).

4. CORPORATE OPINION: MULTIPLE SKILL SETS ARE THE ANSWER

Students Lack Specific Skills in Data and Processing Modeling

The typical college graduate today has a poor grasp of the systems development process regardless of the methodology employed according to corporate information systems specialists. Often industry will evaluate the students as quite competent in various programming languages, data structures, operating systems, network and database management systems; however, when these new college grads are confronted with rudimentary tasks related to process and data modeling, they often perplexed and unable to perform adequately. Students who have basic knowledge of Object-Oriented Analysis and Design are certainly praised for their knowledge, but often have great difficulty functioning within the typical development environment which continues to use relational databases, COBOL, C, DBMS, SQL, and integrated CASE products (Abshire, 1998).

New information systems graduates who possess data and process modeling skills are often made team leaders prior to other peers, as well as their superiors in some cases. New graduates who understand IE and Structured Analysis are able to grasp OOA concepts quickly.

On the other hand we are remise if we do not offer an adequate coverage of OOA. A growing percentage of companies are gradually turning resources in the direction of Object Oriented Analysis and Design. Few existing developers have skills in this area. Companies will rely heavily on new, entry-level new hires who are recent college grads.

Students Need Team Skills

Corporate representatives often give universities the lowest marks in providing college grads an adequate opportunity to work within teams. Few courses within our curriculums require students to work on a complete application from analysis, through systems design and complete implementation. Many students have worked together as a team on the analysis phase of a project, but they have not performed significant design and implementation in a full life-cycle development environment. The typical beginning analysis and design course simply is too over loaded with theories, concepts and methods to allow students much time to immerse themselves into real-life industry experiences. The limited time available also prohibits students from becoming proficient with the use of a model-based Integrated Computer-Aided Systems Engineering (I-CASE) product. Proficiency with Model Based CASE is becoming a must in systems analysis and development today. This is especially true when team participants build non-trivial and intricate models that usually require each person to work with precision.

Students Need More Model Based (Integrated) I-CASE Skills

The rising use of integrated, model-based development tools points to the need to teach these technologies within the classroom. The author believes it is essential that senior level information systems students gain a strong degree of proficiency at using both prototyping tools and full life cycle design and development tools, i.e. I-CASE. This environment is essential for students to work as a team and complete specific project deliverables on time and within budgetary constraints. This belief may go in the face of those who believe that we should not teach specific technology but instead should teach only theories and concepts. The author's philosophy of teaching attempts to integrate theories and concepts and the application of both by the student. The author believes that theories and concepts must be brought alive with actual applications for the students to work on with analysis and design software products. Students should especially gain proficiency in the use of these tools that promote skills in client/server development and the web enabling of system applications. Besides, students with these specific software skills are in great demand in industry and provide an additional job outlet for your new graduates (Matile, 1998).

5. A SINGLE COURSE IN SYSTEMS ANALYSIS LACKS DEPTH IN KEY AREAS

The first course exposes students as to what the role a systems analyst plays in the problem solving process. Business trends and their associated implications are often introduced to the student. Students will likely review a number of information systems fundamentals related to transaction processing, interactive processing, MIS, decision support systems, expert systems, data warehousing and Integrated Computer-Aided Systems Engineering.

The first systems analysis course often will include knowledge about the different methodologies that are usually followed in the analysis and design process. These methodologies typically include the following: Structured Analysis, Information Engineering (IE), Joint Application Design (JAD), Prototyping, Business Process Redesign (BPR), Object-Oriented Analysis (OOA) and others (Whitten, 1997). Students will often learn the basic differences of some of these methods, but time constraints prohibit students from delving deeply into this material.

It is common for teachers to skip several of the chapters in the typical systems analysis text simply because of time limitations for each section of material. Time is a prohibitive factor in allowing complete coverage of chapters on data modeling techniques, process modeling techniques and various user interface styles.

With a limited amount of time available a teacher will often provide a quick coverage of the use of CASE. This type of coverage is often worse than no coverage at all. In some cases students become frustrated and feel defeated when there is not enough time to become proficient. Some of the better texts (author's opinion) on the subject of Systems Analysis and Design typically provide some exposure to the use of CASE. For example, Systems Analysis and Design Methods by Whitten and Bentley (McGraw Hill) uses a product called *Systems Architect* by Popkin Software (Whitten, 1997). A text by Course Technologies titled Systems Analysis and Design, Third Edition, by Shelly, Cashman and Rosenblatt uses a CASE product called *Visible Analyst* (Shelly, 1997). The *Visible Analyst* tool can be bundled with the textbook to allow the student a personal copy. These are typical scenarios with the various textbooks. Students will often create a few data models and process models with these CASE products; hence some student learning will obviously take place. The problem is that students rarely get far enough to cause much advanced (industrial grade) learning to take place. When questioned toward the end of this course students will often admit that the material was a "blur", and there was simply no time to drill back through the material or was there time to delve into examples that might challenge the motivated students.

6. THE SECOND COURSE: SYSTEMS ANALYSIS AND DESIGN II

A model capstone course that addresses the deficiencies of a first course will include the learning outcomes listed below. The components are built around the Information Engineering, Prototyping and Structured Analysis paradigms. The course will focus on business area analysis where the students will learn how to draw entity relationship diagrams (ERD) through proper normalization processes.

First Normal Form (1NF), Second Normal Form (2NF) and Third Normal Form (3NF) will be discussed in great detail. Students will design many ERDs from scratch. Many examples of the inappropriate design of entity relationship diagrams will also be described for student evaluation. Students will learn to examine these poorly designed entity relationship diagrams and determine what new entity types need inclusion to remove repeating fields (1NF), remove partial dependencies (2NF), and to remove transitive dependencies (3NF).

Objectives: The following learning objectives are listed in the order that they are addressed in the classroom (Russell, 99).

Upon completion of this course students will be able to:

1. Compare and contrast IE, Structured Analysis, JAD, RAD and OOA.

2. Identify key terms used in relational database design (i.e., data model, ERD, relationship, relationship membership, cardinality, optionality, referential integrity and data integrity).

3. Draw entity relationship diagrams using model based software. Students will draw fourteen (14) diagrams. Two of the diagrams will build on the previous one. This insures that students understand normalization. The teacher asks students to improve the existing diagram by finding 1NF, 2NF and 3NF violations, and then redraw the diagram using the Cool: Gen software.

4. Define terms such as functions, processes and elementary processes (or primitive processes).

5. Draw activity hierarchy diagrams that show the hierarchical relationships between the functions and processes. This diagram will require the decomposition of processes to their lowest levels that continue to leave the business in a consistent state.

6. Draw activity dependency diagrams that will show how one process depends on the successful execution of another.

7. Analyze the various processes within the activity hierarchy and determine which of these processes should be included within a specific business system

8. Design the navigation path or dialog path between various procedures within the system. A procedure represents the user interface (window or screen) and its associated procedure action diagram (high level statements that can later be constructed into C++, COBOL, ADA, JAVA etc.) Understand different window styles and techniques of GUI window design.

9. Build window and dialog boxes. Students will learn how to build useful main menus as a primary window. They will learn how to design primary windows that contain "pull downs", list boxes, check boxes, radio buttons, vertical scroll and horizontal scroll and bit maps.

10. Build dialog boxes that are invoked from a primary window. The dialog box is often invoked as a result of an event such as clicking a menu item on the primary window. Build the associated Procedure Action Diagrams (PrADs) and Process Action Diagrams (PADs) for the various windows designs. The Procedure Action Diagrams represent the user interface statements behind the window and dialog box actions. The Process Action Diagrams (PADs) represent the high level SQL statements behind the elementary processes.

11. Establish the technical environment for the business system.

12. Package the various procedures into an appropriate load module or separate load modules.

13. Generate the business model into C++, COBOL, JAVA or ADA.

14. Install (or Compile) the source language code into machine language for testing.

15. Test the load module(s) for proper functionality and accuracy.

16. Complete the *Tutorial Series for Cool Gen* by Jack Russell. This is a comprehensive but simple to use tutorial that carries the student in a click by click fashion through analysis, design and construction of a simple customer maintenance and sales representative maintenance model.

17. Work in a small group to solve a business problem related to a specific business area within the organization. This is a small-contrived business case that students can normally solve in 12 to 15 clock hours.

Materials:

1. *Systems Analysis and Design Methods,* Whitten Bentley and Barlow, McGraw *Hill*
2. *Sterling Guidelines for Success, Developer's Series: Analysis,* Second Edition, Sterling Part Number 2616285-0003
3. *Sterling Guidelines for Success, Developer's Series: Design,* Second Edition, Sterling Part Number 2616286-003
4. *A Tutorial Series for Cool Gen 4.11* by Jack Russell
5. *Student Tool Kit for Cool Gen* (optional)
6. Teacher handout packet (by Jack Russell)

Suggested Laboratory Requirements

A separate teaching laboratory can offer several advantages if it can be provided. It is essential to have a computer available for the teacher in the front of the room with a quality presentation projection system. To provide structured hands-on sessions during the semester it is an advantage to have a separate facility. For large lecture demonstrations it is essential to have a teaching classroom with a high end microcomputer loaded with Cool Gen, an acceptable database package (Oracle, SQL Server, DB2, DB2, Sybase). The system should have Visual C++ on the hard drive as well. To perform web enabled applications one can either use the COM PROXY (Sterling Software) method or the JAVA PROXY (Sterling Software) method accomplish this.

Teacher Training Needed:

To enable the teacher adequate training in the use of Cool Gen, Sterling Corporation will provide workshop exposure for various faculties who are members of the Sterling University Program. Sterling provides some training opportunities for faculty who attends the Sterling User Conference held in Dallas each year. The author has been attending these sessions for the last six years and has found them very helpful in being able to successfully teach the course. Faculty may contact Sterling through their web site at www.sterling.com. Look for the University Program information.

Teaching Tips:

The author has developed a Laboratory Kit (Russell, 98) for this class. Excerpts of the Laboratory Kit appear in the Appendix section of the original paper, but due to space considerations it is not found here in the "Proceedings" version. The complete paper is being made available to each participant at ISECON. The six page paper limit prohibits the inclusion of the complete section on Teaching Tips.

7. CONCLUSION

A second systems analysis course that builds on the first is a must! Your department is on the right track if it is offering multiple learning experiences in systems analysis and design. If your department or division does not then the author encourages your department to expand this vital area of the curriculum. The author suggests that the IS faculty weigh the value of having future graduates who are very strong in systems analysis. Companies will be quick to hire highly skilled graduates especially in systems analysis. All we have to do is compare the starting salary for new hires in the area of systems analysis and design with starting salaries in the area of programming. In some cases there is a five to ten thousand dollar salary advantage for the entry-level systems analyst over the entry-level programmer. The author realizes that there are always exceptions to this, but when looking at the national salary surveys in general the analyst is listed at the top. CNN News reported in February 1999 that the Business Systems Analyst was rated as the number one occupation in the nation. The survey came from the U.S. Labor Department. Consequently, it makes sense to provide significantly more training in this area than is possible in a single systems analysis class. Departments of Information Systems should provide both teaching and financial resources for an advanced course(s) in systems analysis and design. The creation of a teaching laboratory that is equipped with high-end personal computers with one or more of the integrated CASE products such as Sterling's Cool: Gen is essential to the success of teaching the second course in systems analysis. To enable this lab to double up for teaching the third course in client server development plus some object-oriented analysis and design tools.

This highly dynamic field is moving target. Either the method, or the technique, or the software is changing every eleven months according to recent figures. If the methods and software are changing approximately every year then it makes sense to reevaluate what we are teaching and how we are teaching it. Faculty should be alert to these changes and be willing to attend training workshops frequently if they plan to stay abreast of the changing paradigms and software. Faculty should be prepared to meet this challenge if we are to prepare the information systems graduates for the jobs of the twenty first century.

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Migrating A Distance Education Programming Course From Web-Based To Real Networks Video For The Internet

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Abstract

Are you currently teaching a distance education course that is primarily web and text based? Have you ever thought it would be advantageous to having your distance education student be able to see what is happening in the on campus classroom? If you answered "yes" to these questions, then this paper will assist you in the development of a migration path from web and text based distance education courses to providing full audio and video options for your distance students.

Keywords: Internet course delivery, video on the Internet

INTRODUCTION

"A picture is worth 1,000 words." If this is true, then what must the notion of adding an audio and video option to a web based distance education course be worth? At Dakota State University University this has been done for two semesters and has been well received by both the students and the faculty member teaching the course. This paper outlines what is necessary for the implementation of adding audio and video to a web site for a programming course taught to students at a distance.

COURSE OVERVIEW

The CSC 150 Principles of Programming course is one of two courses that meets a University specific general education requirement for a computer programming requirement. The course is a three-semester hour course that not only meets general education, but also is the prerequisite course for all Information Systems, Business Administration and Computer Science majors. The CSC 150 Principles of Programming course teaches programming methodologies and procedures. It uses Microsoft Visual C++ version 5.0. The current textbook is An Introduction to Programming with C++ written by Diane Zak and published by Course Technology.

Historically the course has had multiple sections that are taught on campus and since the fall of 1996, the course has been taught for distance delivery using a World Wide Web site as the primary method of instructional delivery. During the fall semester of 1998, the distance delivery method changed dramatically with the addition of video of the on campus lectures being made available from the web site. The home page for the course is www.triton.dsu.edu/csc150.

THE IDEA EMERGES

The approach of recording the lectures and placing them on the Internet came from one of the students enrolled in the distance course during the spring of 1998. In addition to taking the course the student works for South Dakota Public Broadcasting for their on-line services department. The concept was developed of recording lectures and making them available to students via the Internet and using Real Networks video streaming technology. South Dakota Public Broadcasting was already working with the Real Networks concept for several of their broadcast programming endeavors including several video broadcasts from the state legislature. They had the equipment to capture the lectures from video tapes and encode them so they could be stored on the South Dakota Public Broadcasting servers and later accessed from the CSC 150 Principles of Programming course web site. They were able to archive all of the lectures for the entire semester.

The use of web access to lectures allows students to receive more information than was made available by exclusively using web based text distribution. Web access to lectures provides distance students with the question and answer interaction that so often occurs in the more traditional face to face classroom discussions. It also provided for more in depth material on key programming concepts.

IMPLEMENTATION FALL 1998

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The decision was made in late August that the CSC 150 Principles of Programming course would be taught using the Real Networks streaming video concept. A meeting was held between representatives from South Dakota Public Broadcasting, representatives of the Dakota State University administration, the Director of Distance Education program, Computing Services staff as well as the professor for the course.

The professor of the course was scheduled to teach three sections of CSC 150 Principles of Programming on the campus as well as the Internet section of CSC 150 Principles of Programming. A decision was made that the first section of the day would be the class that would be taught in the studio and recorded on VHS videotape. It was this videotape that was encoded and streamed for use by the Internet students. The first section was chosen for several reasons, but the most important consideration was that if there was a problem with the recording of the lecture it could be recorded again with one of the later sections. Using a later section was utilized a few times in the early going, as there was either equipment failure or professor error.

By using the same studio as is used for broadcasting courses on a closed circuit television network on a statewide basis, the equipment was available. The computer that was used for presentation of class notes using PowerPoint presentations as well as to demonstrate code and programming techniques uses an ELMO projector which projects computer information as well as hand written information. There are two cameras within the studio. One of the cameras is used to project the instructor and the other camera is used to project the students in the classroom area. Microphones are used at the teacher station as well as microphones at the student stations. The studio is equipped with two VCRs. One of the VCR's is used for recording and the other is used as a playback machine. The studio has seating for approximately 36 students.

The use of the second camera and the microphones provides the opportunity for the catching class interaction. The most valuable interaction comes from questions about assignments and concepts that are being presented in the lecture. It also provides the opportunity for the distance student to get a flavor of what is happening on the campus.

The decision was made that the lectures would be taped and sent via a courier service to the public broadcasting studio located approximately 90 miles away where the encoding and uploading to the server would be done. This would cause approximately a 48-hour delay in posting the lectures to the web site. Once the lectures were stored on the server, a RAM file was created on the course web site that pointed to the lecture on the South Dakota Public Broadcasting server. At the same time a link was created from the course web site to this RAM file which was stored on the web site for the course. It was the RAM file that opens the encoded file and allows the client's Real Networks RealPlayer software to access the streamed video file.

FILE SPECIFICATIONS AND USES

When working with the Real Networks video system, there are two major files that you must work with. The encoded video file which has an extension of rm and a ram file which is used to link between the Web page and the rm file.

The rm file

The rm file is actually the video-encoded file that resides on a server, which may or may not be the same server as the remainder of the Web information, is stored. An average 50 minute lecture encoded consumes about 6,000 K of storage which provides tremendous compression of the video as compared to the storage requirements of video that is not streamed.

Currently the rm file is accessed as link through the ram file and can be viewed via the Real Player software or a link has been provided for the opportunity of downloading the entire file.

The ram file

The ram file is one line of code that provides the link between the streamed file and the Web page that has the link. It needs to reside on the Web server where the link is to be made. To create the ram file a text editor is used and the information is then saved using a ram extension, which makes it a ram file.

The following is an example of a ram file:

pnm://138.247.68.39/media/csc150-sp/1-13-99.rm

The pnm portion of the ram file is the command portion of the file. The colon and double front slash points to the ip address where the rm file is stored. The /media/csc150-sp is the folder on the server where the rm file is stored. The 1-13-99.rm is the actual streamed rm file of the day's lecture.

Another sample ram file:

pnm://164.154.218.9/dsu/101498.rm

As you compare the two ram files you will note that the ip address portion of the file has changed as has the folder structure and file name.

STUDIO ALTERNATIVES

For campuses that do not have access to a studio, any classroom setting will work as long the class activities can be captured on VHS videotape. The studio allows for the ease of capturing information from multiple resources including the computer, the board and student questions.

MODIFICATIONS FOR SPRING 1999

For spring semester of 1999 the procedure for encoding the tapes was modified. The tapes are still recorded during the first class of multiple sections and then they are taken to the distance education office on the campus where the encoding process is completed. This allows lectures to be available to distance education students the same day as they are recorded. The 48-hour time delay was one of the few negative comments that students reported from the first semester.

SERVER HARDWARE

During the fall semester, South Dakota Public Broadcasting used a Gateway Pentium Pro 200 with a 10 gig hard drive and 128 Megs of RAM as a server machine. They used Microsoft Windows NT 4.0 as an operating system. The encoding machine that was used was a Gateway dual Pentium II 450 Xeon with 256 Megs of ram and 45 gig hard drive. This is an extremely powerful encoding machine because South Dakota Public broadcasting does live streaming of video.

During the spring semester, the encoded lectures were stored on a similar Pentium server machine. This same server machine also houses numerous other class sites. This caused some problems with network congestion and at times the streamed lectures were slow to be accessed partially due to the congestion on the network, but also because the lectures were stored on the web site instead of using Real Server. The long-term solution is to have a dedicated server for the Real Networks server software and files to reside on. However, a temporary solution has been to have a link from the CSC 150 Principles of Programming web site that allows students to download an entire lecture. On a 56K modem it takes less than 30 minutes to download the file. A 50 minute lecture is just over 6,000 KB. Providing the option of being able to stream directly from the server or to download the entire encoded file has been well received by students.

THE ENCODING PROCESS

The Instructional Technologist from the Office of Distance Education at Dakota State University has taken the lead in providing the on campus technical support of the Real Networks video project. The video capture card that is being used is manufactured by IOMEGA and is the Buz Multimedia Producer for the PC. The retail cost of the card is less than $200.00.

The actual process of encoding is accomplished by connecting the Buz card to a VCR and the computer. The tape is then played in the VCR and saved as a rm file on the hard drive of the computer that is connected to the Buz card. The process takes as long as many minutes as the tape is long.

SERVER SOFTWARE

Dakota State University uses Real Networks Real Producer Product. The cost of the RealProducer Plus is $149.95. This software allows for live broadcasts, creates scalable SureStream files, creates backward compatible files for RealPlayer 5.0, creates content capable of streaming severless or from RealServers, allows for easy publishing to personal pages, Web servers or RealServers. Some advantages of using Real Networks Real Producer are that it allows for encoded lectures to be stored on the college web sever and it does not require server software access. The RealProducer has provided a good short term inexpensive solution to providing video over the Internet.

South Dakota Public Broadcasting uses the server software from Real Networks that is version 5.0 and is licensed to handle 100 streams. This would provide for the ultimate campus environment for providing video lectures either in real time or as streams of video.

CLIENT (STUDENT) HARDWARE

With Dakota State University using the RealProducer Plus G2 we have made the expectation that students will utilize the Real Networks RealPlayer G2. The RealPlayer G2 is available two ways from the www.real.com web site. One option is to download the free RealPlayer G2 software with some limitations on features and no support. The other option is to purchase the RealPlayer Plus G2 software complete with both support and enhanced options.

The hardware requirements on the student side are minimal by today's standards.

90 MHz Intel Pentium processor or equivalent
16 MB of RAM
14.4 Kbps modem (audio only) 28.8 Kpbs modem (video)
16 bit sound card and speakers
65,000-color video display card (video)
Windows 95 Operating System
Internet connection and web browser

If a student's computer hardware does not meet these standards they could still view the lectures by using RealPlayer version 5.0. The author has used a 486 - 66 MHz computer with 8 MB of RAM and a 28.8 modem to access video lectures using the RealPlayer version 5.0.

STUDENT REACTIONS

Students were very complimentary to being able to receive lectures via the Internet. They did express concern over the large delay in getting lectures during the Fall of 1998, but have been pleased with the turn around time that has been accomplished during the Spring of 1999. Most of the students reported watching many of the lectures and gaining valuable information from the lectures. Some of the students even indicated in the comments section of the evaluation form that they would not be interested in taking a distance education class that did not utilize the lectures being available on the Internet.

FACULTY REACTION

The author feels that the use of video lecture provides a more positive experience for students. The Real Video lectures provide considerably more information than strictly the web based distance course cannot provide. The video does require an additional level of work for professor, but the effort is well worth the benefits received by students.

Where Do We Go From Here

For the immediate future the lectures will be archived from the server and burned on to a CD. The lectures will continue to be available from the Internet and will also be made available to students on the CD. Improvements in server hardware and server software made on our host side will continue to enhance the quality of education for the distance education students.

An ultimate long-term goal is to provide for link between the Real Networks video and the PowerPoint slides. This link would allow for students to be able to click on a hyperlink in the PowerPoint outline and then bring up the video on that concept.

CONCLUSIONS

Academic year 1998 –1999 provided quantum leaps in terms of providing distance education students with an additional learning tool. This learning tool was the use of Real Networks streaming video technology, which has proven to be affordable and accomplishable at both the student end and also at Dakota State.

The students who have used the technology have reported that they really benefited from the lectures and have even stated that they would prefer to take only distance courses that provide that advantage.

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INCORPORATING INTERNET DISTANCE LEARNING COMPONENTS IN A MANAGEMENT INFORMATION SYSTEMS COURSE

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Abstract

Many US undergraduate business curricula include a required course on Management Information Systems. This course provides instructors with an ideal opportunity to introduce students to Internet concepts and applications by blending them into an existing traditional course structure. In this transitional approach between traditional classroom and pure Internet-based distance learning, some course activities occur in "same time, same place" traditional classrooms and others take place in cyber-space. This paper discusses current issues and developments in Internet applications to learning, one experience with incorporating Internet distance learning concepts and applications into a traditional Management Information Systems course, and the related resource requirements.

Keywords: Internet, distance learning, management information systems, technology-enhanced learning, web-enabled learning

Introduction

Many US undergraduate business curricula include a required course on Management Information Systems (MIS). This course is often used to introduce students to emerging information technology (IT) that is important for management. In the early 1980s, the technologies included PC operating systems, word processing, electronic spreadsheets and databases. Recent applications include presentation managers, Internet browsers, E-mail and other communication-oriented applications. As each technology moves into the mainstream, it is typically incorporated into other courses that students take earlier in the curriculum, and becomes a prerequisite for the MIS course.

The MIS course currently provides instructors with an ideal opportunity to introduce students to Internet concepts and applications by incorporating them in an existing traditional MIS class. This approach gives students hands-on experience using Internet tools for learning. It also provides an excellent springboard for discussing a topic that this course typically covers--the Internet's effect on individual work practices and on entire industries. The students' intimate familiarity, as customers, with the higher education and publishing industries brings a level of knowledge and motivation to the discussion that applies to few other industries. As with other types of IT, Internet technologies are likely to migrate to entry level courses in the future, but, for now, the MIS course is an excellent place to introduce them.

This paper discusses current issues and developments in Internet tools for learning, and one experience with incorporating Internet concepts and applications into a traditional MIS course. Topics covered include the effects on pedagogy and course structure, the costs and benefits, student reactions to the various Internet

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activities, and the resources needed to implement them.

The Internet in higher education

It has finally become clear that information technology (IT) and the Internet are radically transforming the way we live and work. Consumer computer sales are finally taking off, thanks to a combination of price decreases, design improvements, and heavy consumer advertising. Computers have made their way into the family room, and truly "personal" computers for each family member seem likely to become at least as common as personal televisions are now.

Higher education has had a somewhat ambivalent, or schizophrenic, relationship with the Internet. Some universities have embraced IT fully, providing pure distance learning courses and even programs online. Several web sites (e.g., www.gnacademy.org) list thousands of classes that can be registered for, paid for, and taken totally via Internet. Yet, in many a hallowed hall, both faculty and administrators can be heard saying that distance learning really isn't either a threat or an opportunity for them. They claim that students attend their programs for the live interpersonal interaction with faculty and other students. On the other hand, applying Internet technology to traditional classes seems to have a wider appeal to administrators, at least in concept. Some faculty members still think the Internet and other IT is totally irrelevant to their courses, but many others are experimenting with it at some level. This paper discusses one such effort.

Distance Learning

Distance learning, like information systems, has existed in some form for centuries, but came into the public eye only in the past few decades. Emerging technologies that now offer nearly infinite options are forcing educators, and learners, to think much more carefully about the learning process. (Morrison, 1999b)

Distance learning takes place when the student and teacher are physically at different locations. The classic traditional form of pure distance learning is correspondence courses, where course materials and assignments are snail-mailed (hard-copy via the postal service) back and forth by the instructor and student. Some Internet distance learning courses use the same design, except that the course materials are posted on a web site and students E-mail the assignments to the instructor. The ability to quickly correspond by E-mail also allows the electronic equivalent of office hours in a distance learning environment. Phone conferences, which were also increasingly used in traditional correspondence courses, are another option for student-instructor interaction.

Video and teleconferencing were the predominant technology-based approaches to distance learning in the 1980s and early 1990s. They are now being rapidly overtaken and surpassed by Internet-based distance learning (CyberAtlas, 1999).

Although seldom discussed as such, the widespread availability and adoption of text books introduced distance learning activities into traditional classes. In early education on conceptual subjects, the students heard the words of wisdom direct from the professor's mouth and discussed ideas in person with the professor and other students. More skill-oriented learning took place via apprenticeships, in which the apprentice watched and assisted the master craftsman, and undertook progressively more difficult tasks under the master's watchful eye.

In this century, it has become quite common for students to learn by reading a textbook. If an instructor follows the assigned textbook closely in both lectures and testing, a good student may have little need to attend class unless other types of activities are conducted there. In fact, there is great disparity in how much instructors rely on and adhere to text books. The ability to self-determine course content and structure is one of the most cherished in the academic culture, and one that is rarely challenged by administrators or other faculty.

Pedagogy

Many currently popular pedagogical theories advocate abandoning the "sage on the stage" method of teaching in favor of a "facilitator model". The teacher is no longer the one who "knows it all" and stands at the front of the class lecturing. Instead, the teacher facilitates students learning experientially on their own and from each other. Some instructors embrace this change, others resist it.

Truly great lecturers seem likely to survive quite well in cyber-space, both live and in full-motion video. Those who lecture may not be the same ones who lead discussions, as has long been common in very large sections of introductory courses at many state universities. Ironically, text

books let less knowledgeable teachers be successful because student performance was not as dependent on the lecture quality.
But mediocre lecturers who add no other value to the class are likely to find themselves with a dwindling market share.

Students

The student population, like the general population, is also becoming more diverse. A growing proportion of the population attains some form of post-secondary education, and the entry-level knowledge, skills and abilities of students is now extremely varied. Some undergraduates have built PCs from scratch, done extensive programming and been web-masters for years by the time they enter college. Others may have barely ever touched a PC, and aren't sure what they did with it when they did use it. This diversity of IT backgrounds poses a serious challenge.

Today's students have been called the "Sesame Street" generation. University instructors have been heard to plaintively ask how they can compete with Big Bird--especially on an instructor's salary, a tight university budget, and under the pressure to publish or perish that has infiltrated even "teaching schools". Most college-age students today have learned more of what they know from television than from reading books. They expect learning, like life, to be multi-media. "Chalk and talk" comes off pretty weak by comparison.

The only thing more appealing to students, of all ages, than a great multi-media performance (whether live or recorded) is a great multi-media performance that they participate in rather than just watch! They want to create, act, and interact in the show itself. Virtually all students will enter into and participate in this type of learning environment with enthusiasm. The challenge for instructors is to create that environment. It is not a trivial challenge.

Internet and Other IT Learning Tools

Just as the Internet and other IT is transforming how we live and work, it will transform how we teach and learn. Part of the task of higher education today is to prepare students to live and work in a technology enabled society and workplace, and to turn them into life-long learners. This argues for using the Internet and other IT to teach and to help students learn not only the subject matter of our courses (whether MIS or biology) but how to use technology to work and learn.

Traditionally, lectures and discussions take place in the classroom, at the class time and location scheduled by the administration. Students read textbooks, and develop, practice and refine their grasp of skills and concepts by doing homework and research outside the classroom, at the time and location they prefer. Many instructors go over the correct solutions to homework problems in class, while others put solution manuals on reserve in the library or a tutoring center for students to use. Most instructors also use class time to answer questions and clarify concepts that students find difficult. Class time is also devoted to group activities and student presentations.

"Blended" courses, conducted partly in physical classrooms and partly in cyber-space, are becoming increasingly common. Other terms used to describe such courses are "technology-enhanced learning" (Bocchi, et al, 1999) and "web-enabled learning" (Staunch 1999)

Technology offers us what Pogo would have surely called an "insurmountable opportunity" to change how we teach and our students learn. Educators are still collectively and individually figuring out what technologies work for what types of learning, or what parts of the learning process.

Search Engines: The most common first application of the Internet in higher education was for students to use search engines to do research for class projects. Many university libraries subscribe to online journal databases that students can access from other locations, allowing them to complete both Internet and journal research for class projects from home, work, or anywhere else they have Internet access. This educational use of the Internet spread rapidly, perhaps because it doesn't significantly change pedagogy. It changes only where and how students do research for projects and the types of material they are likely to be able to get access to.

E-mail: E-mail use has primarily been on an optional basis to date. Professors who use E-mail themselves will typically accept and respond to E-mail from students, in much the same way as they do telephone calls.

Some instructors have required students to communicate by E-mail on class projects and send the instructor copies. With the exception of very small classes, most instructors quickly abandoned this practice as their inboxes became constantly clogged with copies of student correspondence.

Listservers: A growing use of E-mail is a mailing list, or listserv. In some cases it is used primarily by the instructor to send messages to all the students between class meetings. Lists are an excellent way to communicate unexpected class cancellations, assignment changes or clarifications, and similar communications that were previously nearly impossible to do anywhere other than in the physical classroom.

A listserv can also be used as an alternative to a discussion forum to conduct class discussions. If participants use the subject line correctly and carefully, listserv conversations become threaded. "Threaded" means that entries (questions, answers, and comments) that pertain to the same thread, or topic, of discussion can be identified, and allows participants to easily follow the part(s) of the online conversation.

Chat rooms: Chat rooms are synchronous (same time) facilities where anyone who has access to the chat room can say (type) whatever they want to. Most chat rooms do not archive (record and save) comments, so, like an unrecorded verbal conversation, if you aren't there when it takes place, you've missed it forever.

The difficulty, when there are more than two or three people in a chat room at the same time, is that responses may be separated from their related comment or question by several other comments that may not be related in any way to what others are saying. It is common for participants to "meet" in a general chat room and then move to a private chat room to continue a more focused discussion.

Although chat rooms are primarily known for their use as social meeting places, they can be used effectively for synchronous discussions by small groups if all participants stay on the topic. In an MIS course, at least one chat room assignment, usually conducted during the scheduled class time, helps students compare this technology with others.

Discussion Forums: Discussion forums are closely related to the bulletin board systems (BBS) that have existed since pre-internet days. Also known as news groups, clubs, discussion groups, and probably by other names as well, these applications are asynchronous and support "threaded" discussions. Entries that pertain to the same thread of discussion are entered in a single area, following a logical sequence of question, answer, clarification, comment, etc. "Asynchronous" means "not at the same time", so comments participants enter at one time remain available for others who visit the forum later to read them and respond. Many interest groups use forums to conduct online discussions.

Forums may be open (anyone who finds them can participate) or closed (access by permission only). They may also be moderated (someone screens each entry before it is actually posted to the forum) or unmoderated (every entry is posted directly by the author). If the response times are fast enough, an unmoderated discussion forum can be used synchronously, giving the immediate response benefit of a chat room, plus the recording and threading benefits of the forum.

Educators and the Education Industry

Educators are no longer who they used to be. For the entire history of this country, from K through post-doc, educators have worked in the government and nonprofit educational institutions that constituted the education industry. Proprietary (for-profit) organizations didn't participate directly in this sector because, frankly, they saw no profit to be made in it. The first exception was textbook publishers, who in many ways parallel the pharmaceutical companies in the health care sector. Like prescription drugs, textbook "prescriptions" are dictated by professors, and if students (patients) want to be educated (cured) they will buy the textbook (medicine).

As soon as education, especially post-secondary education, was recognized to be potentially profitable, business jumped in with both feet. There are several successful for-profit education providers, such as DeVry and Phoenix University. Alliances between traditional higher education institutions and businesses are proliferating (McGeehan, 1999). Several large corporations, from McDonalds to Motorola, have created their own in-house "universities" to teach their employees what they want them to know. These developments, and the concept of "just-in-time learning", are having a profound effect on the education industry and those who work in it. (Kull, 1999)

The entry of significant for-profit players in post-secondary education will change it forever. Existing higher education institutions can adapt or be put out of business.

One approach to Internet integration

There are an infinite number of possible ways to enhance traditional courses by integrating Internet use. Each instructor must consider the university resources and reward system, student capabilities and technology access, the course objectives, and their own abilities and constraints. This section discusses one approach that the author has created and used successfully. Although it could be adopted in toto by others, it is intended primarily to spark thinking and suggest possibilities.

Traditional Course Structure

The traditional course (pre-1995) allocated about half the course time and grade to learning concepts and definitions. PowerPoint supported lectures and discussions of the concepts and definitions occurred in class. Outside of class time, students were expected to read and study the assigned MIS text book. Objective (multiple choice) mid-term and final examinations were used to evaluate students' mastery of concepts and definitions.

The other half of the course time and grade was allocated to a research project that required each student to individually investigate and document the feasibility of applying a selected emerging IT in a specific industry or function. This project developed and demonstrated students' abilities to identify an emerging IT, to conduct research to determine the expected costs and benefits of implementing the IT, and to report the results of that research to peers and superiors. This is a task business school graduates are likely to be engaged in for the rest of their careers. Each student also gains deeper knowledge of one type of emerging IT.

Students were taught and required to search library-based electronic journal databases to conduct the research for this project. They communicated their project results by making in-class verbal presentations using PowerPoint slides they created, as well as by turning in written papers.

Internet-enhanced Course Structure

In 1995, students were taught and required to use Internet search engines to conduct their research, and the electronic journal databases they used also became available by Internet.

In 1997-98, students were required to use E-mail and the HyperNews discussion forum to communicate with the instructor and classmates. The required E-mail use was limited to being able to log on to E-mail and send and receive messages. The HyperNews forum was used to discuss a few end-of-chapter questions from the text, and issues related to the research project. Most of the students used HyperNews only in the manner and degree required by the course.

In 1997-98, the instructor also created a web-site that contained most of the course materials. These included the course welcome, syllabus, lecture notes, instructions for the research project, instructions for other course activities, and a sample stand-alone research project presentation.

The research project work product delivery requirements were also changed. Students now had to create stand-alone PowerPoint presentations, and post them on their own web-sites, instead of making in-class verbal presentations. Although most of the students had used PowerPoint to support verbal in-class presentations in other courses, few had designed, developed and implemented a stand-alone, web-based presentation. Students were also required to critique the presentations of three classmates, and E-mail the critiques to both the presentation author and the instructor.

Thus, in the 1997-98 academic year, both the instructor and students used the Internet to present information to the entire class. The discussion forum and E-mail were required to be used only in a rather limited fashion. Class time was still used for PowerPoint supported lectures and discussions of the textbook material, and to present and discuss the research project requirements and progress. All assignments were required to be submitted electronically. Objective tests were administered in the traditional manner, manually, in the classroom.

In 1998-99 the instructor created and introduced an Internet activity to simulate a real world, group problem-solving activity involving a community policing program. The objective of this project was to engage the students in more meaningful use of the discussion forum. Student teams were assigned to investigate specific types of crime problems and design approaches to reduce them. Teams were required to communicate using the discussion forum, and to present their recommended solutions in a word document delivered to the instructor as an attachment to an E-mail message. The grade for this "Team Problem Solving Project" is based on both the HyperNews participation (quality and quantity) and the final report quality.

In the spring quarter of 1999, all the course materials were delivered on the course web site. All the work for the course, except for reading the text and taking the examinations, could be done and submitted online. Class time was devoted to discussing concepts that the students had difficulty with in the texts, discussing applications and to face-to-face interactions among students related to the projects.

Student Feedback

Student feedback has been obtained from two formal sources, in addition to informal ad-hoc student comments. In HyperNews discussions, students were asked to address the pros and cons of specific course activities. These comments were made during the course and were identifiable by author. In addition, all classes fill out anonymous course evaluation questionnaires that include written comments. Responses on these questionnaires that related to the Internet activities were also considered.

Course Web Site and E-mail Use: Virtually all students like having course materials available on the Internet, although a few said they would also like to have copies handed out in class. A readable, clear, navigable web site design is crucial, as is posting needed information immediately when it becomes available. If you say something will be posted by 5pm Monday, it had better be there, no excuses. While not all students can be counted on to visit the course site daily, some do and they are quick to give feedback.

There is presently a wide range of student behaviors with respect to E-mail and web site use. Some check their E-mail more often than they check voice-mail, and access their favorite sites at least once a day. Others do not have Internet access at home or work, and have to come to campus to use either. They tend to concentrate Internet and E-mail use into the small time slots they have available before and after class once a week. When working on a specific class activity that requires Internet access, they will typically have to make a special trip to campus to work on it.

Teaching methods, instructor expectations, and course activity design must take this diversity into account. Schools with many commuter students who attend class only once or twice a week in the evening after work, cannot yet expect all students to have and use daily Internet access. Daily Internet access would have to be clearly listed as a course requirement in the bulletin and course syllabus, and be supported by the administration, before it could be successfully implemented.

Online Project Presentations: Most students were amazed and very pleased that they were actually able to conduct research, create a stand-alone PowerPoint presentation, and post it on their own web site for the world to view. The "Wow! I did that?!!" reaction was very gratifying.

On the other hand, several basic "housekeeping" tasks were tremendously frustrating and time consuming for both students and instructor. Getting students to access their accounts on the UNIX machine that hosts them, create a public_html web space, and change permission to allow others to view the site wasted far more time, energy, and probably brain cells than it should have. A few student accounts had been set up incorrectly, and required extended discussions with and prodding of IT support personnel to get them to investigate, locate, admit and finally fix the problems. Finally, a few students created files too big to fit on the space allocated for their web sites and had to cut them down to fit. Needless to say, they were not happy about this.

Discussion Forum: Use of the discussion forum remains the least satisfactory Internet activity in the course. Some of the problems stem from the nature of HyperNews itself, and others from the design and implementation of the activities to motivate students to use it.

HyperNews forums rapidly become very cluttered when discussions are being conducted. Comments are not easy for either the author or administrator to move or delete. The interface is not especially intuitive and discussions are hard to follow. Some students have great difficulty getting their entries posted in the right location. The author is investigating other platforms (see below) to host this activity.

Students have not used the discussion forum except when and as it has been required. The instructor has always designated space for students to discuss the projects and other course content and issues. It has never been used. In addition, even in the areas where students are required to participate, the entries tend to be mostly individual comments and rarely real discussions. On reflection, this is similar to the types of comments common in class discussions, where most students are concerned with saying what they think and only rarely respond to others' ideas. This may be yet another manifestation of the traditional focus on individual work rather than team work that has dominated the US educational system. This activity is currently being redesigned to try to overcome these problems. (Suggestions welcome!)

Development Is an Iterative Process

All of the Internet activities required (or will require) several iterations of adjustment and revision to reach a final form that worked well. No matter how much energy was put in up front, revisions and adjustments were always needed. Several other professors who also use Internet activities in their courses have said they experienced the same thing, whether they self-developed or adopted the activities. The need for customization just seems to be an inevitable part of the process, not unique to Internet activities, but applicable to any new course activity.

Resource Requirements

Many different types of resources are needed to integrate Internet and other IT into traditional courses.

Faculty Time and Effort

These activities and materials were developed and implemented incrementally over several academic years. The instructor had to undertake significant research, conceptualization, learning and other preparation prior to actually developing and implementing these Internet activities. The instructor had to learn to use several IT tools, learn how to teach students to use those tools, and to design and develop activities using those tools to support learning consistent with the course objectives.

Faculty time and effort was a major resource requirement for this project, partly because it involved creating new materials and also because it was still bleeding edge technology at the time. Availability of improved tools and training, along with Internet activities that can be adopted instead of created, should substantially decrease the time and effort required of faculty in the future.

While intrinsically rewarding, Internet activities place heavy time demands on the instructor for participation and evaluation. Past the initial setup time, instructor time demands tend to increase linearly with the number of students. Students also seem to expect faculty to be available and to respond to their E-mails around the clock and through weekends. University administrators, on the other hand, seem to believe that the Internet will somehow enable an instructor to teach more students at the same cost. This may apply to fully automated Internet computer based training (CBT), but not to participative, interactive activities such as those described above. However, the tight market for academic faculty positions may still force matters in this direction.

Culture and Expectations

These activities required students to have and use computer access between class meetings. Some students claimed that this posed an unusual hardship, because they do not have access to computers at home or work, and have to make extra trips to the campus to use the Internet. The university must be willing to either require students to have their own computers and Internet access, or provide adequate PC lab and Internet access facilities to meet student demand. PC and Internet literacy must also be enforceable course pre-requisites.

Accreditation and Contact Hour Issues

Although many universities pay lip service to the importance of IT, the role of the Internet and other IT in their curricula is still unclear. Often, instructors are free to add Internet activities and requirements to their courses, but are still expected to physically meet in the assigned classroom with the students at the scheduled times. Accrediting agencies are usually blamed for the inability to change this requirement. For faculty who want to use Internet and other IT tools, the easiest alternative has been to continue to meet physically in the classroom or a PC lab at scheduled class times, and to add IT-based activities.

The attitudes and policies of both individual educational institutions and accrediting agencies can significantly affect both the difficulty and results that a faculty member will incur by incorporating IT in a traditional course. This is especially true when one moves toward a blended delivery structure in which all classes do not meet in the assigned classroom, but some meet virtually, in cyberspace. It seems that educational institutions and accrediting agencies will have to deal with both blended and pure distance learning courses in the near future. To date, both seem to be lagging far behind the innovations of individual faculty and institutions.

Tools: PCs, E-mail, Internet Access, and HyperNews

The author's university provides both faculty and students with E-mail and web site space. The university also provides Internet access to students and faculty for a very reasonable annual or quarterly fee. It provides PC labs for student use on each campus. It acquired and supported the HyperNews Internet discussion forum software, and provides some faculty training and assistance in using Internet tools for education.

The pace and timing of developing and implementing the Internet activities discussed in this paper was based on the university providing support for the necessary tools. All the tools discussed above and used to date are generic Internet applications that are not designed specifically to support teaching and learning. Faculty today have a growing number of alternatives to depending strictly on their own university's support and facilities.

IT Alternatives: Online Learning Platforms

Complete, integrated online learning platforms are now becoming widely available. Most of the major business textbook publishers have selected a platform to deliver materials related to their textbooks, and have some form of partnering arrangement with the platform vendor. Most publishers also seem to be developing their content to be portable to other platforms, in case their vendor of choice fails, or if a university uses a different platform and refuses to support another.

Many universities are in the process of selecting and implementing a distance learning platform on their own university networks. Top Class, Blackboard, Web Course in a Box, Lotus Learning Space and WebCT are among those frequently mentioned and reviewed. (Gray, 1998) Each seems to have its disciples and detractors, its pros and cons. The distance learning platform market is currently quite young and volatile, and some universities are either waiting to see who emerges as the winner, or still believe their own collection of tools is superior to commercially available platforms.

IT Alternatives: Externally-hosted DL Platforms

When this project began, tool selection was constrained to those available within and supported by the university. Today, however, most of these types of tools are available on the open market, either free or for a very reasonable price. If your institution lacks tools you want to use, an instructor can use some platforms by making arrangements independently with the vendor.

CyberClass: Course Technology, Inc., has adopted the CyberClass platform, which allows individual faculty to set up classes on its web site for free. Students then pay CyberClass, usually by buying a "class-key" from the bookstore, to access the course web site. CyberClass is a complete, sophisticated course management system, which lets faculty enter their own content or use content provided by the publisher, in virtually any combination the instructor desires.

Yahoo: The Internet Search engine or portal, Yahoo, lets any user set up free "clubs". These don't provide complete course management capabilities, but do provide discussion forum capabilities if that's all you need.

Milken Virtual Education Network (MVEN): MVEN requires a formal proposal process in order to be able to create a course on its site. It seems to be designed for more experimental efforts, but might prove useful for other types of specialized classes.

Moving Toward Distance Learning

The logical next step in the evolution of the efforts discussed here is to explicitly designate two class periods as synchronous and two others as asynchronous distance learning class periods. The class would not meet in the usual classroom for these four classes, but specific "cyber-class" interactive activities would be conducted. The synchronous activities would require all students to be online and participate simultaneously, at the regularly scheduled class time. The asynchronous activities would be assigned to be completed between the physical class meetings, using a discussion forum. Part of each traditional class period immediately following each cyber-class would be devoted to discussing the cyber-class experiences, and to comparing the synchronous and asynchronous tools after both have been used. Actual implementation of these plans is contingent on administrative approval for not meeting in the designated classroom in the specified periods.

The following suggestions are for those who are not yet using any Internet tools. They are based on the author's experience.

Getting Started

The first logical step for any faculty member is to put the basic course materials on a course web site. In fact, many universities are now providing resources to put all syllabi on the Internet, because other (competitor) institutions have done so. However, if you have developed unique, proprietary materials, consider putting them on a non-university site to avoid potential claims of the university on the intellectual property it hosts.

Most publishers now have a web site that contains Internet-based materials related to each textbook they publish. Some have general sites by topic area, especially if they publish more than one textbook on that topic. Many of these sites, or at least parts of them, are accessible to the public. These can be excellent sources of knowledge about available materials, and in some cases may drive your text selection.

The growing body of Internet activities and tools each emphasize different skills and knowledge. Instructors must choose those that best meet their course objectives. While evaluation and selection are time consuming, they require much less time than developing original materials. Reviews of the different tools are useful for background and comparison purposes, but there is no substitute for experimenting with the tool itself. Discussing, either in online lists or at academic conferences, alternative tools with other professors who have used them can be very useful.

Conclusions

While many still view distance learning with skepticism, technology-enhanced learning is more widely accepted. Faculty and institutions will have to make the transition sooner or later, to remain competitive. This article is intended to make the education lane of the information highway a bit less bumpy for the coming drivers.

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Electronic Office Hours: A Distance Learning Component using Computer-based Communication

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Abstract

This paper describes techniques to blend distance learning with traditional educational methods using Electronic Office Hours. Electronic Office Hours can connect the teacher and students outside the classroom by using existing computer mediated communication tools and techniques. The teacher and students have a choice as to the times and locations of the meetings. Short descriptions are presented along with advantages and disadvantages of each technique. The descriptions are based on the authors' experiences over a period of 15 years of use in the classroom.

Keywords: Distance education, office hours, computer-based human communication

1. INTRODUCTION

1.1 Concepts of Electronic Office Hours

Office hours are a central and critical part of the educational process and a teacher's interaction with students (Wankat and Oreovicz, 1999). Traditional tools used during office hours are limited by space and time; the teacher and the student are required to be in the same place and/or available at the same time. Small group meetings are dependent on available physical space and require special time arrangements. Telephone conversations allow the teacher and student to be in different places but still require that they "meet" at the same time. Voice mail allows a modicum of time independence but is generally limited to a one-on-one interaction. Maintaining a record of these meetings is difficult and in some cases not possible. A record of these meetings is important if teachers find they are having discussions on the same topic with multiple students. If the teacher is in an environment with a large nontraditional student component, these constraints may have an increasingly detrimental effect on the educational process.

The general concept of Electronic Office Hours is not new (Turner, 1984) but recent changes in technology have made Electronic Office Hours more feasible. This paper outlines a set of readily available computer tools designed to make Electronic Office Hours feasible and realistic. Computer-based Electronic Office Hours provide an alternative to traditional office hours by introducing a distance learning component. Electronic Office Hours provide the capability for time-independent as well as same-time communication from remote locations. The remote locations may be connected to the teacher's computer via the Internet or a Local Area Network (LAN). It should be noted that the Electronic Office Hours concept is not intended to be a replacement for traditional office hours but instead can be considered as an extension of them. The distance learning component of Electronic Office Hours may be used with traditional classes but can also be used with classes that are totally remote.

Electronic Office Hours techniques consist of six computer-based communication tools; 1) E-mail, 2) newsgroups, 3) text-based computer conferences, 4) video-based computer conferences, 5) computer-based voice communication (computer telephony), and 6) shared applications. While each of these tools is useful on its own, these tools can provide the greatest benefit when used together.

The primary advantage of Electronic Office Hours over traditional office hours is an increased opportunity for the students to directly communicate with the teacher or with other students. Students in higher education institutions often do not have the opportunity to be on campus at specific times due to work, family commitments, or travel constraints. This often precludes the students from directly interacting with the teacher or other students in a face-to-face fashion. Electronic Office Hours give these students a chance to communicate by using a personal computer with inexpensive or free software and a connection to the Internet. Another key to Electronic Office Hours is that the techniques described below are not dependent on a specific computer platform. The software is available for computers running Microsoft Windows, Apple MacOS, IBM OS/2, Linux, BeOS, and other operating systems. As long as the software adheres to established standards, the different computer systems will be able to work together.

The primary personal downside of Electronic Office Hours is an increased need for time management, which can be perceived by some teachers as an increased demand on a teacher's limited time. By increasing the number of ways that students can communicate with a teacher, the teacher has to decide when they are "in" for Electronic Office Hours. With Electronic Office Hours, the students can communicate with a teacher at night, on the weekends, during holidays, and between semesters. While this is good for the educational process, it may be seen as an intrusion by some educators. The teachers and students should have realistic expectations about the timeliness of responses, particularly when using E-mail or newsgroups. A secondary personal downside to Electronic Office Hours may be a feeling of isolation (Tannehill, 1995).

The primary technical disadvantage of Electronic Office Hours is the increased dependence on computer support staff. The staff will need to install and manage the server software as well as provide technical support for the client software users. Another technical downside may be the increased traffic on the network (whether it is a LAN or the Internet) which could affect how the teachers access their other network resources. The computer hardware needed for Electronic Office Hours is modest with the possible exception of video conferencing hardware.

1.2 Types of Communication

The different Electronic Office Hours communication techniques will be discussed in terms of interaction time (immediate or delayed) and the number of people involved in the discussion (one-to-one, one-to-many, or many-to-many) (Ellis, Gibbs, and Rein, 1991). For example, E-mail is a delayed communication between two people (one-to-one) or from one person to a group of people (one-to-many) while text-based conferencing is an immediate communication between two people (one-to-one), from one person to a group of people (one-to-many), or a group discussion (many-to-many). Table 1 provides an overview of two dimensions of the computer-based communication used in Electronic Office Hours. The number correspond to the different computer-based techniques discussed in this paper (1=E-mail, 2=newsgroups, 3=text-based conferences, 4=video-based conferences, 5=computer-based voice conferences, and 6=shared applications).

Interaction time may be immediate or delayed. Immediate interactions are electronic conversations with characteristics that are similar to verbal conversations in that the participants do not have time to think through their statements, organize their syntax, or check their spelling.

	1 to 1	1 to Many	Many to Many
Delayed	1	1	1,2
Immediate	3,4,5,6	3,4,5,6	3,4,6

Table 1. Two Dimensions of Communication

Delayed interactions are similar to more formal communications, such as memos or written correspondence, with the opportunity to think about the concepts to be communicated, the form of the communication, and the accuracy of the spelling and grammar of the communication. Telephone conversations are an example of immediate communication and E-mail is an example of delayed communication.

The number of people involved in the communication has a profound impact on the effectiveness of the communication. One-to-one communication allows students to "talk" directly with the teacher (potentially a rare occurrence in large college classes using traditional office hour techniques) or another student. One-to-many communication allows a teacher to pass along information to the class or a small group of students without taking up valuable lecture time. Many-to-many communication allows the teacher to "talk" with the group about special topics or allows the students to form special interest groups.

Electronic communication allows a type of interaction that has very different characteristics than those found in a typical classroom. There is some evidence that people who would be reluctant to speak out in a classroom setting feel more confident in an electronic environment (Warren, 1996). However, there is also evidence that Electronic Office Hour techniques are not appropriate for other students (Jegede and Kirkwood, 1994); therefore, Electronic Office Hours should not totally replace traditional office hours without additional research about effective distance education practices.

1.3 Electronic Office Hours Techniques Overview

This paper describes a basic set of computer tools needed to establish Electronic Office Hours. Some of the tools have been used by the authors for more than 15 years. The tools have two separate components: clients and servers. The client software packages are used by the students and teachers to communicate. The servers are software packages to support the clients. One example is a client that runs on a student's home computer and connects to a server running on the school's Unix or Microsoft Windows NT computer through the Internet. In this case, the student All of the computer techniques discussed below use software tools that are readily and, in many cases, freely available on the Internet. To maintain class security, discussion focus, and an academic level of discourse, the tools will be described as resources that are isolated from the casual and social aspects of the Internet. To accomplish this, none of the communications servers discussed below should be connected to other servers on the Internet. This ensures that the students do not accidentally "surf" into a non-academic Internet site or that people who are not in the class do not choose to "visit" the academic site.

The World Wide Web (the Web) is often used with classes to provide class information, such as syllabi, class notes, and additional class resources (for example, see Ryan, 1997; Saunders, 1997; Sloane, 1997). However, the use of the Web for Electronic Office Hours is only tangentially associated with interactive office hours and won't be discussed in this document.

1.4 Costs and Practical Concerns of Electronic Office Hours

The most obvious cost to the teacher is the potential need to learn new software. However, a more fundamental cost to the teachers is the time needed to learn potentially new communication techniques to integrate Electronic Office Hours into their curriculum. A practical cost to teachers is additional time management to make sure that the Electronic Office Hours are a benefit to the educational process and not just an added burden.

Teachers can meet these costs in several ways. The easiest way to learn the software tools is to use them. If the teacher sets up the Electronic Office Hours for a trial semester with optional student participation, many of the technical and educational concerns may be resolved. A trial semester will also allow the teacher to get an idea of the type of time management needed to establish realistic expectations, particularly for message response times. A trial semester will give the technical support staff a chance to configure and test the Electronic Office Hours servers under actual conditions.

2. CLIENT RESOURCES FOR ELECTRONIC OFFICE HOURS

2.1 E-mail

E-mail is a form of interactive discussion that allows time and place independence. E-mail also provides a one-to-one or one-to-many communication. E-mail has been used for teacher-student communication for many years (see Atamian and DeMonville, 1998).

need only know how to use the client software and might not even know what type of computer the school's server was using.

E-mail reader software, known as an E-mail client, is available for virtually all types of popular computer systems. Modern E-mail clients are able to send and receive attachments so that the teacher and the students can exchange nontext information, such as word processing documents, pictures, or sound files. These attachments may be used by the teacher to accept student homework assignments or projects electronically and avoid having to manage mounds of paper. Most E-mail clients automatically maintain a record of the E-mail received and the E-mail sent.

Modern E-mail clients have the capability to maintain an alias list - a list of E-mail addresses that can be grouped together under one name. For example, student E-mail addresses for a class can be placed in a class alias for the teacher so that all students in a particular class can receive the same E-mail message. Small groups of students (for example, study groups) can create their own mail aliases for discussions that do not concern the entire class.

Teachers can use an E-mail feature called folders to separate E-mail messages by class and within each class by assignment and topic. The use of E-mail folders is a key component to managing large volumes of E-mail. If the teacher subdivides the folders by semester and course, a record of the semester's E-mail exchanges may be easily archived. Folders also serve to manage communications from students enrolled in directed study or independent research courses.

Automated electronic mail lists have been used in some instances to automatically forward an E-mail message to all students and to allow students to forward E-mail to the class as a whole. Most mail list servers send a separate E-mail document to each student thus creating multiple copies of the message and presenting the increased possibility of E-mail delivery failure due to lost passwords, changed E-mail addresses, or an E-mail server hard disk that is full. The functionality of mail lists is better served through newsgroups, described below.

The technical disadvantage to E-mail is the amount of hard disk drive space that E-mail can consume. Many people seem to be hesitant to delete E-mail messages.

There are two personal disadvantages to E-mail for Electronic Office Hours. One is that E-mail is rarely limited to academic pursuits. "Spam" - unwanted E-mail - has become a way of life. Modern E-mail clients have the capability to "filter" unwanted E-mail. Teachers can reduce the amount of class generated spam by educating the students about the proper use of academic E-mail. For example, E-mail about Web sites that sell textbooks at a The second potential disadvantage of E-mail is the perception that E-mail intrudes on a teacher's personal time. Some teachers have expressed concern that class E-mail may place new demands on their time. Because E-mail allows communication to occur after normal working hours and on weekends or holidays, some teachers feel that their "job" is no longer confined to normal working hours and that they are now "on-call" during off-hours. Other teachers see E-mail as an opportunity to interact with students in a more timely fashion. The entire reason for Electronic Office Hours is to allow a choice. Teachers should be able to choose the interaction method that best suits their educational style. E-mail allows teachers to respond at a time of their choosing. Teachers can explicitly set realistic expectations for E-mail response time in class or in the course syllabus.

2.2 Usenet Newsgroups

The Usenet is a collection of specific topic discussion groups called newsgroups that contain articles from individuals about that specific topic. Articles can be viewed by anyone who accesses the Usenet news server with Usenet client software called newsreaders. News readers are available as standalone software packages like PMINews and Agent or as part of a larger Web browser software package such as those from NetScape or Microsoft. The newsgroups are time and place independent meaning that the students and the teacher do not have to be online at the same time or in the same physical space. Newsgroups have been advocated for use in the educational process (Bull, Bull, and Sigmon, 1997; Partee, 1996; Wilson, 1993) but may also serve a function in Electronic Office Hours.

Usenet newsgroups can be formed that contain messages that are specific to a given class. They also allow a group of people to participate in discussions on topics that might not be appropriate during lecture periods, such as professional issues, tangential questions, breaking news in the discipline, or in-depth discussions of problem solving approaches.

Newsgroups can get non-time-critical information to a large group of people in a more efficient way than an automated mail list. Only one copy of the message is stored on the newsgroup server. Additionally, newsgroup readers have the ability to group messages according to the subject of the message (called threading). This organization makes it much easier for the student (and the teacher) to follow one conversational thread. Students may respond to the entire group through the newsgroup or use E-mail to send a message of interest to a smaller group. Records of the newsgroup interactions are automatically saved and maintained by the newsgroup server.

There are no major technical disadvantages in using newsgroups for educational purposes other than the disk space used by the messages. The primary concerns can be avoided

reduced rate may be of interest to all students but E-mail about available free kittens may not.

if the computer support staff installs the newsgroup server so that it does NOT connect to other Internet newsgroups servers. The concern about spam mentioned in the above section on E-mail would also apply here.

The primary personal disadvantage to using newsgroups is that students may treat newsgroups as a cross between E-mail and text-based computer conferences. The student responses can remain available for long periods of time (usually the entire semester) but the "atmosphere" of a newsgroup is akin to the immediacy of a text-based conference. Students occasionally may respond impulsively without full consideration of the effect of their message. The teacher can forestall this problem by explaining the different functions of E-mail and newsgroups to the class.

2.3 Text-based Conferencing

The nature of some office hour topics requires real-time, interactive discussions. These discussions are place-independent (the participants do not have to be in the same room) but not time-independent as the people have to be online at the same time. In terms of the number of people involved, text-based real-time discussions can be one-to-one, one-to-many, or many-to-many.

One-to-one text-based computer conferences, often called "talk," can be accomplished without a server where the teacher and the student directly connect to each other's computer. This requires the teacher and the student to reconfigure their client software but is more private than using a server. One-to-one communication can also be accomplished using a server where one of the participants creates a "private" chat channel and invites the other person to join them.

Text-based one-to-many conferencing allows the teacher or special guest to "broadcast" information to a group of students in real time. This is useful for moderated communication on a special topic and is considered a more traditional approach to distance learning (Duin and Archee, 1996; McCollum, 1997). The moderator, usually the teacher, can control the topics so communication is more structured than the verbal free-for-all of a group discussion. Also, guest speakers can present material to the class and respond to selected questions provided via E-mail before the session.

The most effective use of text-based conferencing may be in many-to-many mode. This allows a true discussion, as opposed to a lecture, among all of the people who choose to participate. Each participant has an equal opportunity to express an opinion or ask a question. However, as the number of participants grows, the potential for communication chaos may increase. From the authors' experience, the optimum number of naive or novice participants seems to be between eight and fifteen per channel.

Text-based communication can be achieved through Internet Relay Chat (irc) software. Systems such as irc allow a group of people to interactively write to the group and see what others have written. Each class may have its own discussion space (irc channel) and students may dynamically create new There are no major technical disadvantages to using text-based computer conferences. The irc server, for example, uses few computer resources other than the network connection. If the online discussion is saved, disk space may be an issue. The primary technical issue is that the computer support staff set up the text-based conference server so that it does NOT connect to other Internet servers. The network speed needed for irc is not great but may need to be considered.

The primary personal disadvantage to text-based computer conferences is coordinating times to meet. Connecting to a text-based computer conference when no one else is there can be frustrating (much like waiting outside a teacher's closed door). There are software packages, such as ICQ by Mirablis, that can tell whether a person is online or not. Usually, a short E-mail reminder is all that is needed to remind participants of the conference.

Another potential personal disadvantage is related to a misplaced sense of anonymity. Some students may feel that they can use another name and no one can trace their true identity. This is generally untrue. The computer support staff can configure the server to log each student and their network address. While this isn't foolproof, it seems to work reasonably well in the authors' experiences. Also, some students may pick up bad communication habits using Internet social irc (such as an overuse of acronyms or a brusk manner that is common on many social irc servers) and have a hard time changing to an academic environment. The teacher may need to explain expected irc conduct for Electronic Office Hours.

2.4 Computer Video Communication

In the authors' experience, additional information (broad nonverbal cues, participant identification, and nonelectronic communication tools) may be conveyed by using a video component. Even slow or poor video seems to provide additional information when compared to text-based communication. Video communication can be delayed or immediate but may be most effective for Electronic Office Hours when it is immediate. Video conference software packages will allow a one-to-one, a one-to-many, or a many-to-many interaction.

Video communication does not require students to have a computer camera to participate. Most of the video communication clients will allow a participant to receive video, text, and sound from others but do not require that the participant produce video. Recording these meetings is often possible but tends to take up large amounts of disk space.

special topic channels as the need arises. Most irc clients have the capability to automatically record the sessions in log files for later review and can divide the records into separate log files by channel. If more privacy is needed, the irc server can be configured to require a password to enter the text-based conference server or a specific chat space.

The most common way to use video communication is as a "talking head" where the students can see the speaker's facial expressions but little else. With video communication, it is possible, although difficult, to include additional nonverbal tools such as a physical whiteboard where the speaker can draw images or a physical prop to demonstrate specific points. The danger is that the students may not be able to see the physical tools due to the size of the image on the students' screens. A better alternative is to use electronic whiteboards where the speaker draws images on a computer pad and the images are displayed on the students' computer screens.

Delayed one-to-many computer video information may be provided to students in two forms: full download and streaming. Full download video requires the students to download the entire video file (most video display clients will do this automatically) before the image appears on the students' screens. Because video files are so large, this may take a prohibitive amount of time to download and/or space on the student's hard disk drive. Streaming video information starts to display while the data is being transferred and is usually not saved on the student's hard disk drive. Streaming video depends upon a fast network connection to prevent skips or temporary halts in the video display. Delayed video information display is a one-to-many form of communication.

Immediate one-to-one video conferencing may be accomplished without a server by having the two participants directly connect to each other's computer. This provides a greater degree of privacy and may provide better video performance than using a server.

Immediate one-to-many video communication has many of the same characteristics as one-to-many text-based communication. The primary benefit of video conferencing over text-based conferencing is the nonverbal information provided when the students can see the speaker. This is the approach that many schools use for distance education (see Sankar, Ford, and Terase, 1997; Schutte, 1998).

Immediate many-to-many video provides a more traditional video conference setting. The participants who are producing video will be visible to the other participants but all participants may join in the conversation either through text or voice.

Video conferences require a fast network connection, good video equipment, and a high-end computer for full motion. Cameras that attach to the computer's parallel port are inexpensive and well supported but cannot deliver high quality motion. Video recorder cameras attached to video capture computer cards give much better results than parallel port cameras at only a slightly higher cost. The settings in the client software can also adversely affect the quality of the video communication.

The number of video-producing participants directly affects the quality of the video communication. The appropriate maximum number of participants for effective video communication depends upon the video server, the network connection, the video client software, and the power of the video client computer. Based on the authors' experiences, the most effective number of naive and novice video participants is between six and ten.

The most popular video conference client is CU-SeeMe and compatible packages originally developed at Cornell University which still provides a free version of the software for MS-Windows and the Apple Macintosh. Several other video conference clients (for example, Microsoft's NetMeeting and Mirablis' ICQ) come with the capability for text conferencing and shared applications as well as video-based conferencing.

The major technical disadvantage of computer video conferences is that the quality of the video motion may not be good, particularly if voice is also used. Powerful computers and fast networks are required for full motion video.

One personal disadvantage to computer video conferences deals with perceived anonymity. The participants may forget that others can see them and engage in inappropriate behavior such as not looking at the camera, leaving, or engaging in personal hygiene activities.

2.5 Computer Voice Communication

Computer-mediated voice communication has not reached the quality or practical convenience of the telephone (Custer, 1994; DeMillo, 1998). Voice meetings can be digitally recorded but they may take up large amounts of disk space. Free software is available for voice communication over a computer network and the hardware needed is a simple sound card with a small microphone. Headphones may be needed in a lab setting to keep from bothering others and vice versa. Pilot work has shown that students should provide their own microphones and headphones for health and comfort issues. Another concern with voice communication is the amount of bandwidth that voice demands. Voice often takes more network capacity than video communication without voice. Computer-based voice communication has been included in this paper but the authors' experiences have not shown any advantages over text-based computer conferences.

Using the voice component of computer video conferencing provides a richer experience but also requires more resources. Many student computers may not be capable of using voice in a conference with several other participants. The network requirements are also higher when using voice with video conferencing. An alternative is to use the text-based conference capability included with most computer video software.

2.6 Shared Applications

One advantage of the traditional office meeting is the ability to use nontext techniques (for example, drawing pictures or graphs) to illustrate a point. This can be accomplished in electronic communication through the use of a shared application (Dolhon, 1997). The most common shared applications are shared text editors and shared graphics packages. A shared text editor allows several people in distributed locations to change a text document at the same time. A shared graphics package allows several people to "draw" on an electronic pad at the same time. The available shared application packages prevent one person from changing an area that is currently being changed by someone else.

The primary technical disadvantage to using shared applications is the amount of resources required. Slow network connections can cause a delay in updating the application for all participants which may lead to confusion and frustration.

The primary personal disadvantage to using shared applications is the need for participant training and practice because there is no direct analogy in traditional office hour techniques. The cost-benefit of using shared applications may suggest that the technique is only useful for long-term projects.

3. CONCLUSIONS AND RECOMMENDATIONS

In summary, Electronic Office Hours can provide a distance learning component to traditional courses while increasing the interaction between students and teachers as well as between students and other students. Some students may find Electronic Office Hours useful while others may be intimidated and prefer to use traditional office hours techniques. Electronic Office Hours also provide an additional way to evaluate classroom teaching techniques by noting the topics that students want to discuss. The monetary cost of Electronic Office Hours is minimal since the techniques rely on existing Internet tools.

The following recommendations are based on the authors' experiences and pilot research. The recommendations are listed from the potentially most useful with the least amount of effort to the potentially least useful with the most amount of effort. Naturally, your mileage may vary.

E-mail has been used for educational communication for many years. It has become increasingly rare to find a school where students do not have access to E-mail. The authors have noted that students are less hesitant to use E-mail than the teachers. However, when the teachers have learned to control the expectations for immediate response times, E-mail becomes a permanent part of their teaching toolbox. Creating mailboxes for each class each semester helps manage the volume and focus of the E-mail messages particularly if the teacher is using E-mail to accept student projects.

In the authors' experience, newsgroups tend to be very good for students to exchange information with other students. effective. The authors require some students to make presentations during office hours and allow students to combine text-based conferences with Web pages for their presentations.

The performance of video-based conferences is not currently adequate for full motion videoconferences. However, students have commented that they like the verification that a "real" person is involved with the conference.

Computer telephony does not currently provide the quality of a telephone. However, students have mentioned that they like the ability to make a "free" call to the teacher no matter where they are. The authors and their students have used computer telephony as a replacement for cellular phones.

In the authors' experience, shared applications work best when combined with text-based conferences. Shared graphic applications allow the teacher and the student to cooperatively draw system diagrams, logic charts, and notate program code.

In the authors' experience, E-mail, newsgroups, and text-based conferences provide tremendous educational value for a small amount of effort. Shared applications provide good educational value for Electronic Office Hours but at a greater effort on the teacher's part.

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Since the teacher is a part of the communication, any mistakes in the exchanged information can be easily corrected. Students still have "lab gab" sessions but use newsgroups for systems analysis material such as clarifying project specifications.

Text-based conferences are very good for office hours at unusual times such as late at night or on the weekend. The authors have noted that students who complain about the response time for E-mail find text-based conferences more

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Design and Implementation of Multimedia Web-based On-line Courses

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Abstract

Multimedia Web-based on-line courses are now a major support for advances in distance education. They are going to be a major component in the development of information systems education. This paper discusses the design and implementation of multimedia Web-based on-line courses.

Keywords: on-line course, multi-media, audio, video, graphics, animation

1. INTRODUCTION

Web-based on-line courses came into existence in the mid 90's (Greenlaw and Hepp 1999). With the rapid development in computer hardware and software, Web-based on-line courses have become one of the most rapidly developing services on the World Wide Web. Many features have been added to Web-based on-line courses recently (Beise 1996, Carswell 1997, Marshall and Hurley 1996, Owen 1996, Thomas, Carswell, Emms, Petre, Poniatowska, and Price 1996, Vetter 1997). One of the most significant features is multimedia (Lowe and Hall 1999). In this paper, we present a set of guidelines for the design and implementation of multimedia Web-based on-line courses.

2. DESIGN CONSIDERATIONS OF MULTIMEDIA WEB-BASED ON-LINE COURSES

A multimedia Web-based on-line course supports distance education in a virtual classroom (Wong 1997) in which the students in a class are in different physical locations. It should be designed to provide communication systems that facilitate interaction in such a distributed environment. The communication systems include live course content, on-demand course content, and additional communication facilities.

Live Course Content
Live course content is the live broadcast of an on-line course on the Web. Interactive live course content allows students and the instructor to talk to and see each other on the Web. A typical setting requires that cameras and microphones be mounted in the virtual classroom and at each student's personal computer.

Live course content has to be carefully planned and monitored to avoid poor use of lecture time. Procedures should be set up to control the interactions between students and the teacher. Video switching has to be precisely controlled.

On-demand Course Content
On-demand course content is a pre-recorded lecture. It is a one-way asynchronous interaction system (Cristian 1996). Students view pre-recorded video, study on-line lecture notes and perform interactive activities during the lecture. Due to the asynchronous nature of the lecture, students can take the lecture at their convenience, and they can go back and forth as they view the presentation. Because the lecture is pre-recorded, special effects can be added to the lecture to help students focus on certain parts of the course content.

Additional Communication Facilities
E-mail, chat room, bulletin board, course calendar, and homework uploading systems can provide additional interaction to on-line multimedia Web-based on-line courses (Dawson-Howe 1996, Wong 1997).

E-mail (electronic mail) is an asynchronous communication system. Students and the instructor may send and read e-mails at their convenience. To take advantage of e-mail, the on-line course may provide an e-mail assistant that has the ability to automatically send e-mails to all students when an event occurs. The e-mail assistant may also provide a comprehensive directory service to look up e-mail addresses of the students, the instructor, and related persons or organizations. The system may also employ voice mail to increase effectiveness.

A chat room is a synchronous communication system. Participants have to be available at the time of communication. With a chat room, each student participates in a live on-line conversation with the instructor and the other students. Questions can be answered immediately, and the instructor needs to answer a question only once. A chat room can be viewed as a virtual classroom in which students and the instructor can have a real-time discussion. Chat rooms that support live video and audio conversation can add effectiveness to the virtual classroom.

A bulletin board is an asynchronous communication system. A student posts a question and later the instructor or another student posts an answer to the question. Both questions and answers can be posted in multimedia format to improve effectiveness.

A course calendar provides a structure through which the students and the instructor may schedule events such as on-line discussions and examinations. The calendar may also contain an outline of the course to guide students in tracking their progress in the course. Announcements recorded in multimedia format can be very effective.

A homework uploading system provides a structure for students to turn in their homework. Students' homework will be stored at designated file space on the server for the instructor to pick up later. The system should allow students to submit homework in multimedia format when desired.

The most important factors of any successful multimedia communication facilities are video, graphics and animation, and audio support. Proper use of these facilities are important design issues for a successful multimedia Web-based on-line course (Miller 1996).

Video effect of the instructor gives students a link between a real classroom and a virtual classroom. Video switching helps students focus on the part of the course content being discussed. When using video switching, we must be careful to select the right moment for switching between cameras.

Because of the current frame rate problem, a video (particularly a live video) can be choppy if we switch between cameras while a fast movement is being recorded. In general, we want to select a simple background for a video production (an empty wall, or a classroom with very little furniture) with the instructor staying relatively still and switch the cameras when the instructor is not in fast motion. Use as many cameras as needed and make sure the camera shootings are well coordinated. For example, we may put one camera on the instructor, one on the live audience (students) and one on the course material. We may also use pre-recorded video such as news clips and animations to improve course content. We may use hot spots and flip frames to improve effectiveness. A hot spot is an area in the video that, when clicked, expands to become a frame sitting next to the video. Hot spots can be used to bring focus on the details of certain parts of the video while the video is running. Flip frames sit next to a video and can be used to show pre-recorded lecture notes related to the video.

Graphics and animation can be very effective in the presentation of the course material. Special effects can be produced when they are combined with audio output. The most sophisticated graphics support is virtual reality (Greenlaw and Hepp 1999). Virtual reality involves a three-dimensional simulation of an environment. It can be used to present course material very effectively. The underlying mechanism in virtual reality is the language VRML (Virtual Reality Markup Language). A VRML file contains information that describes cameras, colors, event handlers, lighting, three-dimensional objects, and textures. VRML software is becoming increasingly available, but Virtual Reality is still in an early stage of development. Proper use of the technology is important if it is to be effective in a Web-based on-line course.

Audio output should be clear because audio output is the actual course content. Use as many microphones as needed and make sure their uses are well coordinated. For example, we may put a microphone on the instructor, one in the room where the recording is made, and one on the live audience (students).

3. IMPLEMENTATION ISSUES FOR MULTIMEDIA WEB-BASED ON-LINE COURSES

Implementation of a multimedia Web-based on-line course involves many issues (England, Elaine, and Finney 1999). The most essential considerations include course platform, bandwidth, browsers to be used, user interface, course administration utilities, and multimedia production tools.

Course platform

We should choose reliable and efficient system architecture to house a multimedia Web-based on-line course. Determine whether you need architecture that supports live course content or on-demand course content. Find out whether your students have access to the Internet or a local area network. You may implement your on-line course on an external system provided by a third party organization. Many publishers are now providing systems and facilities so that you can implement an on-line course on their Web sites. For example, McGraw-Hill has a system called PageOut in which you build on-line courses on their Web site. McGraw-Hill provides 24 hours a day, 7 days a week continuous system support service for PageOut. The system is user friendly and course production and administration services are provided. Test banks and other course material for certain types of courses are also available. The cost of using a system from a publisher is low except that you may be required to use textbooks from the publisher. Some commercial software organizations (*e.g.*, Collegis) also provide similar services and the cost of using their systems varies from company to company. You may implement an on-line course on your local Web site. Many systems are available for this purpose (*e.g.*, Web Course in a Box(WCB) and McGraw-Hill Learning Architecture

(MHLA)). These systems are user friendly and performance is good. Because these systems reside on your local Web server, you have to provide your own system administration and maintenance services. You may also build your own on-line course system from scratch. There are many tools and languages available; these include HyperText Markup Language(HTML), JavaScript, Java, and CGI scripts (Avila 1998, Raggett, Lam, Alexander, and Kmiec 1998). Building your on-line course on your own Web site provides you the most freedom. You need to have a development team because the amount of work is non-trivial. Some team members should have a good working knowledge of Web development tools and languages.

Bandwidth

High bandwidth Internet access is becoming more widely available. However, there are still many places where the communication links between students and the school are relatively slow. Use multimedia content wisely. Choose a multimedia type that uses the smallest amount of storage, if possible, to avoid unnecessary delay in transferring frames through the slow links. Two major course content techniques are unicasting and multicasting. In unicasting, course content is sent to the client sites one site at a time. Unicasting is not very efficient in terms of bandwidth utilization, but it works on a wide variety of network topologies. In multicasting, the system broadcasts course content to all client sites simultaneously. Multicasting is more efficient for bandwidth utilization, but it will not work on certain types of network topologies such as token-rings.

Browsers

Netscape and Microsoft Internet Explorer are the two most commonly used browsers. The course content and activities should be constructed in such a way that students can access them through either of these browsers.

User interface

The user interface is extremely important. The course should provide each student a uniform interface to all the components in the course. Careful use of audio and visual effects will help students to follow the progress of the course.

Course administration utilities

Administration utilities include setting up user names, accessing structures such as passwords and e-mail entries, allocating disk space for uploading students' assignments, creation and maintenance of video and audio class notes, examinations, assignments, and other course material, setting up times for timed-tests, and scheduling events such as discussions and examinations.

Multimedia production tools

Many software tools are available for the production of multimedia courses (Sanders and Hartman 1999). According to Sanders and Hartman, these tools can be classified as video software tools (*e.g.*, Adobe Premiere, AVI Constructor, ClearVideo, iFilmEdit, Infini-D, MainActor, MyFlix, Person AVI Editor, RBCap, Real Video, TrueMotion, TZ-Video master, Ulead, V-Active, VideoStudio, WebFlix, WebMedia, and WebVideo), authoring software tools (*e.g.*, EasyMM, Formula Graphics, ISIS, Macromedia Director, and Multimedia Toolbook), capture software tools (*e.g.*, GutmannSoft's Screen Shot, HperCam, and Total Recorder), graphics/animation software tools (*e.g.*, Adobe Photoshop, AniMagic, Animation Shop, Gear, GIF Construction Set, m2GIF, GIF Movie, MorphInk, MorphMan, and Paint Shop), and audio software tools (*e.g.*, Acid WAV, AudioPoint, CAKEwalk, Cool Edit, DDClip, Internet Audio Publisher, JAMMER, MetaSound, MetaVoice, Mixman Studio, Musical Wizard, NoteWorthy Composer, n-Track Studio, Quack, SSEYO Koan, Sweet Sixteen MIDI Sequencer, and Ultimate Encoder). Some software tools are sophisticated and expensive, but basic systems are available for a moderate cost. Some low cost tools actually work well in certain environments. Select tools that suit your budget and environment.

Cost and time requirements

Web site maintenance cost and the course content production cost are two major costs associated with a multimedia Web-based on-line course.

Web site maintenance cost is minimal if the course is run on a Web site provided by a textbook publisher. If the course is run on a commercial Web site provider, the cost will vary from provider to provider. If we want to install an on-line course system software on the school's Web site to run the course, the cost includes the software and the hiring of a system administrator to maintain the system. If we want to build our own on-line course system, the cost depends on the system development team and the system development tools needed.

The course content production cost includes cost of hardware/software tools and supporting staffs. The time involved in running a multimedia Web-based online course is non-trivial. The most time consuming part is the production of multimedia course content. However, with the rapid development in hardware and software, effective tools that facilitate the process are becoming widely available.

In additional to the time and effort to produce and run a multimedia Web-based on-line course, we also have to be concerned with the coordination with other organizations. For example, if a supervised examination is desired in the course, a student may have to take the examination at the campus of another school or at a public location such a city library where an off site proctor is available.

4. CONCLUSIONS

Information technology has matured to the point that multimedia Web-based on-line courses are now reality. As we move into the 21st century, multimedia Web-based on-line courses will play a major role in the delivery of computer information systems education. At the moment, development of models, tools, techniques, and standards for multimedia Web-based on-line courses has become an immediate goal for educators and system developers. We have developed a set of guidelines for the design and implementation of multimedia Web-based on-line courses. We want to share our results with educators, students, software developers, and the community to promote better use of multimedia Web-based on-line courses.

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A Method for Grading Computer Programming Laboratory Exercises

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Abstract

This paper describes a methodology that can be used by faculty, instructors or graduate assistants for grading computer programming laboratory exercises that is flexible, enforces consistency and provides feedback to the student in the criteria that, as a whole, make up a well-written computer program.

Keywords: Computer program grading, grading consistency, grading policy, computer program criteria, programming standards

1. INTRODUCTION

Grading programming assignments can be a time-consuming, subjective process. Some (mostly students) believe that anything producing correct output should receive a grade of A, regardless of how the results were obtained.

Attempts to evaluate the program source code for an entire class of students can result in an inconsistent application of criteria. Looking through a source listing to determine how the programming problem was solved is a time-consuming task. Some courses can have 25 or more students. Spending 10 minutes studying each program would take 250 minutes, or over 4 hours. Trying to be consistent, keeping the same criteria in mind for 4 hours is difficult. This can lead to situations where students ask why points were taken off their work, but not from a classmate's, who's program uses similar techniques. Other students argue that their output was correct, so no points should be taken off at all.

A grading technique is needed that is rigorous, applies the same criteria to each student's assignment and provides constructive feedback to the student. This paper describes a method for grading programming assignments that focuses on 5 important criteria of a well-written program.

Most mature program development organizations have a set of standards that must be followed for every program that is written for production purposes. Standards are important for reasons such as program efficiency, ease of modification, and code reuse. Students should be exposed to, and get used to using programming standards as early in their academic careers as possible. It is difficult to break poor habits once they are established. These criteria can serve as a beginning set of standards.

The 5 criteria are style, documentation, resource use, correctness of the solution and human/computer interaction. The criteria can be distributed to students at the beginning of each term so they know what is expected of them, and how the programming assignments will be graded. A grading sheet can be developed listing the important aspects of each area, ensuring fair and consistent application of criteria during the grading process and providing feedback to the student. The next sections explore each of the 5 areas in more detail.

2. STYLE

Style as used in this document refers to the rules and policies for program identification and source code structure. Every programming instructor will have his or her own preference for what constitutes good style. A minimal set of three style criteria is described here. They are program identification, programmer-supplied names and source code structure.

Each program should have a section that contains identifying information. Program identification should be located at the beginning of the program source listing and

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include such items as program name, author, course, instructor name, assignment name or number, the date written and the purpose or description of program. The program description should be succinct and short; no more that one small paragraph.

Programmer-supplied names are the labels chosen by the student to identify items such as functions or subroutines, constants and data items. It should be recognized that in certain situations the data names are fixed and cannot be changed. An example is a purchased package of library routines used to provide services such as linked list management, or scientific and engineering routines.

Function or subroutine names should be indicative of the activity performed. An example of an acceptable name for a function or subroutine that reads a master file record might be master_file_read.

Data item names should also be indicative of the purpose or use. A well-formed data name can consist of a concatenation of a unique identifier and a standard suffix indicating the use of the data item. Table 1 lists examples of some standard suffixes.

TABLE 1

Suffix	**Purpose or Use**
file	indicates a data file
rec	indicates a record
row	indicates a database row
ctr	indicates a counter field
accum	indicates an accumulator field
switch	indicates a switch field
code	indicates a code field

Examples of data names are master_file, master_rec, master_rec_ctr, master_rec_amt_accum, and master_eof_switch. In the case of records or database rows, each data item within the record or row can be prefaced with the record or table name. For example, master_rec_amt would indicate an amount field within the master record.

Source code structure refers to the physical layout of the program source statements in the source file. Of course, some languages allow more freedom than others do when manipulating the source code layout. Of those that do allow more flexibility, an important concern is proper indentation that plainly shows the relationships of related items. Proper indentation highlights the relationship among data items, with subdivisions of a compound data item indented beneath higher level divisions. Indentation can also be used within the structure of the program logic, such as if-then-else constructs, improving readability.

Another concern of source code structure is the placement of matching punctuation. Items such as parentheses and braces should be aligned to reflect matching pairs. Opening and closing parentheses or braces should be indented the same amount to help indicate which pairs match. Nested pairs should be indented further to indicate the various levels of nesting.

Each of the three areas, program identification, programmer-supplied names and source code structure, should be considered when assigning credit for style.

3. DOCUMENTATION

The second criterion that should be graded is documentation. The four general types of documentation for which the programmer is either responsible, or is a contributor are described in Table 2 (Shelly 1998).

TABLE 2

Type of Documentation	**Description**
Program	Describes the program and surrounding requirements, relationships, and effects
System	Describes system functions
Operations	Describes the purpose of the program, run/setup requirements, error handling instructions
User	describes program concepts, contains examples of and instructions for use, and help facilities

In most programming courses, only program documentation is relevant and so is addressed here. Program documentation records facts and specifications about the program. It should be relevant and descriptive. The program documentation can be divided into two types: internal and external.

The program's external documentation consists of report layouts, screen layouts, record or table layouts, the program logic design, a program narrative and a current source code listing. The individual instructor can determine which of these items the student should submit.

Internal documentation consists of descriptive information embedded in the program source code. This descriptive information, often times called comments, should be strategically located within the program to describe the purpose of data items, and describe the purpose and function of sections of code.

Arguments have been made that the code is self-explanatory, so no commenting is needed. This is the case in some instances, such as very short subroutines or functions. However, a strategically placed comment goes a long way in assisting the person reading the source code in their understanding of what the program is doing.

Both internal and external documentation should be considered when assigning credit for documentation.

4. EFFICIENT USE OF RESOURCES

The third criterion is consumption of computer resources by a program. The two main resources are CPU time and memory space. The algorithm chosen by the student affects both the amount of time the program takes to run, and the amount of memory consumed.

The program should be developed using some program design technique such as structured or object-oriented design. It is acceptable to sacrifice some efficiency in return for the benefits of using this program design technique. Standards rules such as one entrance/one exit for functions or subroutines, and using a certain program skeleton or template can be enforced.

Interactive development environments (IDEs) and event-driven programs, which have a different structure that traditional procedural programs may leave little room for customizing the program structure and would need special consideration.

A description of the logic plan used to design the program should be provided. The plan should show the relationship between the functions or subroutines of the program, and the logic within. A balance should exist in the overall program structure. Designs such as too little or too many functions or subroutines, or too many hierarchical levels, or a skewed hierarchy are to be avoided.

Students have a tendency to take the program specifications, sit down at a computer station and start coding a solution. They then take the resulting program and write the logic plan that is submitted for grading. Requiring the logic plan to be submitted for approval beforehand forces the student to at least give some thought to the design of the program before coding.

During grading, the source listing should be studied to find inefficiencies such as unnecessary or unused instructions, or not using the best, shortest technique for accomplishing a task. It is here that the lack of a logic plan becomes evident. Most of the problems will be simple, such as an extra, unnecessary call to a heading routine, or using unnecessary data items to hold partial results of calculations in progress.

The source listing should also be studied for how data structures are used. The program should use the proper data structure for the job. The chosen algorithm may dictate some data structures. Unused or unnecessary data items should not be in the program. There will be situations where the student tries several different solutions, each requiring a few data items unique to that particular attempted solution. The student then removes the instructions for all the failed attempts, but forgets to remove all the accompanying data declarations, resulting in data items that were never used in the final version of the program.

There are other consumable resources to consider, such as network usage, and the use of disk space - the number, structure and size of both temporary and permanent files. The importance of these consumables depends largely on whether or not they are required by the program assignment.

At a minimum, the use of memory and the algorithms chosen should be considered when assigning credit for resource usage. Other resources used in the program can be included in the grade calculation based on the program requirements.

5. CORRECTNESS OF THE SOLUTION

The fourth criterion is the correctness of the solution. Students should adhere to the program specifications and adequately test the program to reduce the change of errors or bugs.

Program specifications enforce consistency on the work that is turned in by students. Make sure the specifications cover all the important aspects of the exercise. Leaving out one or two important points can make for radically different programs. A student once turned in a linked list solution to a programming exercise in array handling. When told they had to adhere to the specifications, the student complained, arguing their solution was better that the solution using an array, even though it could be proved that their program used more CPU time and memory that an array-based solution.

Program specifications should, if possible, show input and output requirements. The student is expected to adhere to those specifications.

It has been my experience that students will perform only those program tests specifically asked for. If none are specified, they do no testing at all, other than those tests necessary to determine why the program does not generate the desired output. As soon as the output looks correct, testing stops.

Entire sections of the program, such as error routines, go untested. The student should understand that the purpose of testing is not to demonstrate that the program works. It should be obvious that no amount of testing can prove that. A program is only as good as it's last test. Tests can only show the program doesn't work (Beizer, 1990).

Testing should be a discipline that attempts to reduce the risk that a program does not work. Each program should be run through a series of tests that attempts to exercise the major logic paths or sections of code in the program. Developing a thorough test suite requires imagination. The major logic paths have to be identified and a proper test devised for them. Valid as well as invalid data should be sent through the paths. Several levels of tests should be used. Table 3 lists some of the tests that should be employed (Beizer 1990).

TABLE 3

Type of test	**Description**
Unit	tests program as a whole
Component	tests individual function or subroutine
Component integration	tests interaction between functions or subroutines
System	tests interaction between programs

Testing is the process of creating models in which the behavior of the program is predicted and verified. The results of the test either confirm or refute the prediction. The student can turn in a log describing the types of tests performed and the results of those tests.

Adherence to the program specifications and a description of testing techniques should be considered when determining credit for the correctness of the solution.

6. HUMAN/COMPUTER INTERACTION

The last criterion is human/computer interaction. This refers to the input/output methods used by the program. The usefulness and consistency of any input prompts should be considered, as well as the usefulness and consistency of any output. Screen and report layouts should be checked against the actual screens and reports generated by the program.

Help facilities should be available in case the user gets stuck. Proper error or exception handled should be included in the program. The student should anticipate the types of problems that could occur and either prevent them, or provide appropriate error messages describing what happened, and optionally, what can be done about it. Table 4 lists some of the goals of human/computer interaction (Shneiderman 1992).

TABLE 4

Goal	**Description**
Consistency	Format/layout of screens, reports, messages Similar terminology and sequences of actions Exceptions are limited Judicious use of color and other formatting (bold/blink/underline)
Feedback	Tell user what is happening
error handling	Design system to prevent errors Strive to do no harm Leave system unchanged if possible

The student can take steps in the design of the data entry activity to minimize action by the user. Any action in a computerized system performed by a human is error-prone. The program should use techniques such as a single keystroke to choose from among several possible choices. This reduces the chance of error. The amount of hand movement between the keyboard and mouse should be minimized. The mouse is supposed to be a laborsaving device, not a time-consuming one. The order of items entered on a screen should be the same as the input document structure. The program should get as much data as it can from sources that already exist in the computer. The student's choice of input/output dialogs, help facilities and error handling should be considered when assigning credit for human/computer interaction.

7. CONCLUSIONS

Grading programs using the 5 criteria discussed above would require multiple passes, focusing on a different criterion each time. The scores for each criterion are recorded individually. The five scores are then merged to obtain the final grade for the program. Figure 1 shows a sample grading sheet containing the criteria discussed above. This sheet can be used to ensure consistency during grading and be given to the student and provide feedback in those areas on which they should be spending more effort. It can be individualized to include those areas that are important to each instructor and remove those areas of lesser importance.

This grading technique can be customized to place more or less emphasis on certain criteria, depending on such things as the type of problem, whether or not there is any human-readable input or output, or simply instructor preference. Some items should always be considered, however, such as proper style, documentation, efficient use of resources and correctness of solution.

Using style, documentation, resource use, correctness of the solution and human/computer interaction as grading criteria has several benefits. Students know what criteria will be used for grading. Students get useful feedback on several important aspects of well-written programs. Using the criteria results in consistent application of grading standards to all students' work. This technique results in a well-rounded approach to grading.

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A Predictor for Performance of Computer and Information Science Freshmen in a Problem Solving Course

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Abstract

This research investigates the development of a simple predictive tool which measures the likelihood that a college freshman majoring in computer and information sciences will successfully complete a gateway course in problem solving and programming concepts. The beta version of the tool consisted of a four-question test administered at the beginning of the course (n=145). The results of this test were correlated to ACT/SAT mathematics scores and the final course grade (n=92). Other variables included age, gender, ethnicity, country in which high school was attended, and specialization. Using a Pearson *r*, the following correlations were found to be significant ($p<.05$): ACT(Math) with predictor test score ($r = .3035$); ACT (Math) with final grade ($r = .5578$); and predictor score with final grade ($r = .3274$).

Keywords: Predictor tests; problem solving courses; student retention; computer science education

Introduction

The University of South Alabama is a state institution with an undergraduate enrollment of over 10,000 students. The School of Computer and Information Sciences (CIS) has over 500 undergraduates and offers a curriculum leading to bachelor of science degrees in Computer Science (CSC), Information Science (ISC) and Information Technology (ITE). The school also offers a joint program with the College of Engineering leading to a Bachelor of Science degree in Computer Engineering (CpE). All CIS majors are required to complete the two-semester course, •Problem Solving and Programming Concepts•. This •gateway• course must be passed in order to continue in the CIS program. A departmental heuristic states that a grade less than B in the gateway course is a good predictor for academic failure in computer and information sciences.

In the fall of 1998, the University converted from a quarter system to a semester system. The problem solving requirement was effected in two ways: 1) under the semester plan, material covered in three quarters is now covered in two semesters; 2) the programming tool was changed from C++ to Java. Historically, about 25% of the students received a grade of less than C in the first quarter course. These outcomes have given rise to an ongoing faculty discussion on possible causes of the relatively high failure rate. Because this introductory course is crucial to students who enter the freshman year with an early interest in computer science careers, it is essential that faculty understand the nature of this problem. Perhaps a predictive model, incorporated in a comprehensive retention program, can support timely intervention in the early stages of matriculation.

Background

The faculty observation is that many students have difficulty converting word problems to programmable formulas and algorithms. This observation led to the premise of this research: is there a simple predictor, based in transforming verbal problems to formulas, for undergraduate success in problem solving and programming concepts?

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The null hypothesis of this research is that a simple test in converting word problems to formulas is not a good predictor of success in a problem solving course.

Predictive tools have been widely employed in academia despite a continuing debate as to which factors, if any, accurately predict academic success. High school grade point average (HGPA) is considered to be the best predictor of success in college (Chase 1989; Wesley 1994) although issues of generalizability, institution types, and internal validity remain open for future study (Gutkowski 1998). While as many as fourteen independent variables have been employed in predictor studies (Turk 1998), there is interest in determining if a simple tool can be developed which meets the parochial needs of a CIS program.

Other factors related to predicting academic success at the college level have been studied including social support (Arce 1996; Petrie 1997), the utilization of first year seminars (Hyers 1998), participation in summer academic enrichment programs (Hesser 1998), levels of indecision and self-esteem (Arce 1996), classroom anxiety (Wilson 1997), teacher effectiveness , and teacher characteristics (Dinnan 1996).

Predictive tools for specific disciplines

Prior research directed to specific academic disciplines revealed the following:

> The attitudes and behaviors of nursing students, measured by the Myers-Briggs Type Indicator (MBTI) and the Learning Orientation/Grade Orientation Scale II (LOGO II), was used to profile affective tendencies which contributed or detracted from success in a nursing program. (Barr, 1998).

The College of Veterinary Medicine at the University of Illinois used various admission variables to predict subsequent success (Zachary 1994). This six year study concluded that academic success was positively correlated with: 1) grade point averages and standardized test scores; and 2) a regression equation developed by the school based on objective factors used during the admissions process. However, academic success was not correlated with subjective evaluations such as applicant interviews.

The University of Kentucky Law School relies heavily on an applicant•s undergraduate GPA and performance on the Law School Admission Test (LSAT). Other academic factors include trend of college grades (strong undergraduate finish), letters of recommendation, previous graduate study, time interval between college graduation and application to law school, outside activities, and close analysis of undergraduate records to determine difficulty of undergraduate curriculum. (See web page in References.)

Methodology

A four-question test was administered the first A four-question test was administered the first week of the semester to 146 students (see Appendix). Participation was optional; only one student chose not to be identified and was dropped from the data.

An additional one-page questionnaire captured student name, student number, ACT/SAT mathematics score, gender, age, country where high school was attended, first time a problem solving course is being taken (Yes/No), and specialization (CSC, ISC, ITE, CpE, or other). ACT/SAT scores were confirmed from the University•s student database and corrected as required.

Ethnicity was also determined and added as a variable. Two instructors, teaching two sections each, were involved in the study.

Results

The results are presented in three groups: descriptive statistics from the questionnaire, descriptive statistics from the four-question predictor test, and correlation statistics.

Descriptive Statistics (questionnaire)

ETHNICITY (N=145)	NUMBER
White, Non-Hispanic	93
Black, Non-Hispanic	17
Hispanic	3
Asian	8
American Indian	2
Non-Resident Alien	22

MAJOR (N=145)	NUMBER
Computer Science	55
Information Science	32
Information Technology	17
Computer Engineering	26
Other	15

Other majors: Mathematics(2); Undecided(2);

Chemistry(1);English(1); History(1); Geography(1);
Marketing(1); Finance(2); Engineering(1); Political Science(1); Biology(1); Speech Pathology(1); Physics(1).

HIGH SCHOOL COUNTRY(N=145)	NUMBER
Africa	1
Malaysia	1
Saudi Arabia	2
United States	140
Venezuela	1

ACT (MATH) (N=92)	NUMBER
14	1
15	1
16	4
17	6
18	9
19	13
20	9
21	7
22	8
23	2
24	6
25	8
26	7
27	2
28	2
29	0
30	3
31	3
32	0
33	0
34	0
35	0
36	1

Note: ACT MATH SCORES (n=92); Mean=21.8. These data include only students who entered a value for ACT/SAT Math or whose ACT/SAT Math score could be determined from the University database. The ACT/SAT Math from the student database was used where it did not agree with the ACT/SAT Math entered by the student. SAT scores were converted to ACT scores.

OTHER DATA (n=145):

Gender: Male = 101 Female = 44

Average age: Mean = 21.8 years.
Range = 17 to 63 years.

Previous programming course?: NO – 103 YES - 42

Descriptive Statistics (predictor test)

NUMBER TIMES EACH QUESTION WAS ANSWERED CORRECTLY (N=145)			
QUESTION	QUESTION	QUESTION	QUESTION
46	46	54	74

Number of Students Answering Questions Correctly (n=145)				
0 CORRECT	1 CORRECT	2 CORRECT	3 CORRECT	4 CORRECT
14	29	55	36	11

Average Number of Correct Answers = 2.01

Correlation Statistics

At the end of the course, the two instructors submitted 102 final grades. Ten students had not taken the predictor test and their grades were not included in the data. The mean value of the final grades was 64.5 percent with a range of 2 to 92 percent. A *t*-test revealed no significant difference between the means of the grades assigned by the two instructors. ($t = _{(.05)(-3.01)}$)

Pearson's *r* correlation results are presented below:

CORRELATION (N=92)	PEARSON r
ACT with predictor score	.3035
ACT with final grade	.5578
Predictor score with final grade	.3274

Level of Significance ($p < .05$)

Based on these results, the null hypothesis is rejected.

Discussion

The fact that the null hypothesis is rejected is not surprising given prior research. However, of great interest is the possibility that a simple mathematical reasoning test may be a good predictor of performance in a course critical to CIS majors.

The Value of the Predictor Tool

Why not just use the ACT scores? There are several reasons:

ACT scores were not recorded in the University's database for 35 students in the test group. Several Students overstated their ACT scores on the questionnaire.

The predictor test can give a better insight into the nature of a student's deficiencies and permit a more effective intervention.

The predictor tool can be expanded to include other factors related to academic success such as student goals, motivation and expectations.

The predictor tool can be administered periodically to determine student progress in acquiring desired skills.

A predictor can be useful by providing insight to the background of students entering the computer and information science profession.

Improving the Predictor Tool

This predictor tool will be used again in the fall of 1999 with the following changes:

The four questions will be given to a wide range of participants in order to review and improve them in terms of how the problems are stated.

Additional demographic data will be captured to explain some of the phenomena observed. For example, it was interesting to note that non-CIS majors performed better than CIS majors. The predictor test and final grade scores for each major is shown below.

MAJOR	PREDICTOR TEST AVERAGE	FINAL GRADE AVERAGE
Other	2.93	80.2
CpE	2.27	69.3
CS	2.11	63.3
IT	1.67	56.5
IS	1.75	53.6

While not confirmed, the performance of the "Other" group was attributed to the fact that they were probably well-motivated juniors or seniors with good study skills.

The questionnaire will be expanded to measure the goals, motivations, and expectations of students entering the CIS professions.

The Predictor Tool as an Impetus for Other Actions

The predictor tool may provide impetus for other actions:

Developing a seminar for incoming freshmen to discuss aspects of the computer and information science profession. Another option would be to present this material as part of the current curriculum, adding standard tests which determine the student attitudes and behavior.

Determining the feasibility an intervention plan offered early in the course if student performance on the predictor test is below an established threshold.

The Effect on Changing Academic Calendar Formats and Programming Languages

The effects of changing from quarter system to semester system have been reported by The College of DuPage in Glen Ellyn, Illinois, who completed an extensive study on changing academic calendar formats. Among their observations was a decrease in letter grades (including more D, F and W grades), and a negative impact on student progress during the first year of transition followed by an improvement during the second year [College of DuPage 1992]. The additional change from C++ to Java may have further effects on teacher performance related to new preparations. These factors will have less influence in the next phase of this study.

Further Work

The results of this research are encouraging. Outcomes measurement is another important aspect of an effective retention plan. Therefore, the predictor tool will be employed as part of a comprehensive study to better determine the nature of student motivations and expectations. To this end, the fall 1999 freshman group will be surveyed and tracked over their four-year period of matriculation to determine the final outcome of their academic efforts.

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Appendix: The Four-Question Predictor Test

1. The XYZ Fence Company builds rectangular fences with dimensions x and y, where x and y are in whole feet. Each fence is constructed from 6-inch wide wooden boards spaced 6 inches apart as shown below (Note: a figure is provided with this question). The fenced-in area can have one or more 3-foot gates which are added later; however, you must leave 3 feet of space for each gate. The formula which computes the number of 6-inch boards required for a fence with two gates is:

a. 2(x+y)/2 –3 b. 2(x/2 + y/2) – 6 c. 2(x+y) –6 d. (2x + 2y)/2 –6 e. no correct answer

2. The overtime pay rate at the Happy Toys Company is one and one-half times the regular pay rate. For example, if the regular pay rate is $10/hour, the overtime rate is $15/hour. For a weekly payroll, the overtime rate is applied to all hours worked in excess of 40 hours/week. If the hourly rate is P, what formula calculates total pay for h hours where h is greater that 40 hours?

a. 1.5P(h-40) b. [40 + (h-40)1.5]P c. (40-h)1.5P d. (40P + 1.5P)h e. no correct answer

3. Your credit card balance is $1000 and the monthly interest rate is 1%. If you do not pay off the full amount at the end of the month, 1% of the amount owed is added to your balance due, then any payment is subtracted. For example, if you owe $1000 and made a payment of $100, the new balance would be $910 calculated as follows: $1000 (balance) + $10 (interest) - $100 (payment) = $910. Starting with a balance of $1000, you make three consecutive monthly payments of $110, $209 and $300. Because you do not pay off the full amount owed, one percent of the balance owed is added to your account each month. After making the payments noted, what is the balance due on your next statement?

a. $400.76 b. $407 c. $409 d. $410 e. no correct answer

4. A utility company's electricity charges are based on the number of kilowatts (KW) used during a month, that is, the more a customer uses, the higher the rate. The rates are as follows:

KW used	rate per KW
Less than or equal to 1000KW	$0.05 (for the first 1000 KW)
1001KW to 2000KW	$0.07 (for the second 1000KW)
more than 2000 KW	$0.10 (for remaining KW over 2000)

For example, if a customer used 1100 KW during the month, the charge would be computed as follows:
1000KW x $0.05/KW + 100KW x $0.07/KW = $50 + $7 = $57

What would your bill be if your monthly usage was 2012 KW?

a. $121.23 b. $121.20 c. $121.10 d.$120.10 e. no correct answer

FIGURE 1

Grade Sheet

Student Name ______________________ **Assignment** ________________

Style
- Program Identification
  - program name ________
  - author ________
  - assignment number ________
  - purpose ________
- Programmer-supplied Names
  - functions/Subroutines ________
  - data Names ________
- Source Code Structure
  - indentation ________
  - matching punctuation ________

Style ________

Documentation
- External ________
- Internal ________

Documentation ________

Resource Use
- Algorithm ________
- Memory usage ________
- Other resources ________

Resource Use ________

Correctness
- Specifications
  - input ________
  - output ________
- Testing
  - major logic paths ________
  - error routines ________

Correctness ________

Human/Computer Interaction
- Input ________
  - reduce human actions ________
- Output ________
- Help facilities ________
- Error handling ________

H/C Interaction________

Program Score________

A Two-Track Approach to Integrating Structured and Object-Oriented Programming in an Undergraduate Information Systems Curriculum

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Abstract

This paper describes an approach to structuring an undergraduate curriculum in order to incorporate structured and object-oriented programming concepts in a progressive manner. The sequence of introductory programming classes required of all students in the first two years is presented, along with a synopsis of the material in, and the corresponding rationale for, each required programming course. The curriculum presented is in the first two years of a "2 plus 2" program, where students achieve an associate degree and then become more specialized as they continue towards the bachelor's degree. This has allowed for continuity between courses and the addition of new technologies, such as Java, when appropriate. This approach was designed to give students a strong foundation in basic concepts and a high degree of early employability, which is a goal of the associate degree program.

Keywords: Information Systems curriculum, curriculum design, structured programming, object-oriented programming

1. INTRODUCTION

The program presented here describes an undergraduate curriculum designed to integrate two paradigms of current programming practice, structured and object-oriented, in such a manner as to provide students with a strong foundation for continued educational work and with practical skills for transition into the information systems workforce. Currently, the curriculum is built around a "2 plus 2" framework, where students first pursue an associate degree, with subsequent work leading to the bachelor's degree. In the associate degree portion of the program, students generally take the same courses (there is some variation in required programming courses in the networking option, but the other options are the same. See figure 1 and figure 2). In the additional years pursuing the bachelor's degree, they can become more specialized in the area of their choice. The programming requirements in the initial two years are focused on providing practical skills that can result in employability, particularly within the regional workforce, prior to completing the undergraduate degree. By providing employable students, local industry has a ready source of less expensive skilled labor, and students may gain practical experience, providing them with a "running start" upon graduation, either with their current employer or with a new employment opportunity.

2. INTRODUCING STRUCTURED PROGRAMMING

In the evolution of the structure of this program, a point of concern was what to provide as introductory programming classes. While technology continues to change at a rapid pace, the paradigm of structured programming has been around for approximately thirty years. It was decided that for teaching students good business programming skills, structured concepts were necessary. We wanted to emphasize good design and the maintainability of computer programs. However, the educational issue was how to teach these concepts to beginning programming students without loosing them in the syntax of a complex programming language.

For a number of years, assembler was used as an introductory language. While this brought a certain rigor to the program, it was hardly ideal for teaching structured concepts. While keeping assembler in the curriculum, the move was made to introduce structure through PL/1 and, subsequently, the C programming language. However, the focus of the student was still often on learning the syntax, not the structured concepts. Emphasis on structured concepts was necessary for the reasons mentioned earlier, and also because these concepts would carry through to subsequent language courses, where a particular syntax would not. Finally, we settled on an older but improved and fairly simple language for the introductory course: BASIC. In the form currently used, it is QuickBasic with subprograms. This was chosen because of its support for structured programming constructs and its relatively simple syntax. Also, being available on a personal computer platform and quite affordable meant that students could have an individual copy of the software for doing lab work at home. In fact, since the initial use in the introductory course (CIS 215 - Introduction to Structured Programming using Basic), the textbook used has come with the student software supplied.

CIS 215 BASIC Rationale and Material Synopsis

This introductory programming course actually does not do any "hands on" programming for the first several weeks of the semester. The focus during this time is on developing logic skills and being able to express that logic with various tools such as flowcharts. Even after programming assignments are begun, this emphasis is continued by requiring logic flowcharts be submitted along with program code.

During this first course, students are exposed to such subjects as the program development life cycle, logic diagrams, debugging procedures, top-down design, top-down programming, and structured programming. Extensive written homework and computer laboratory (programming) exercises are assigned. During those first few weeks, students do assignments that require them to think through logical actions, such as giving movement instructions to a "mechanical man" and navigating a "mechanical mouse" through a maze. As the course progresses into coding assignments, students receive an introduction to the basics of personal computer hardware and stored program concepts. Concurrent with this course, they are typically taking CIS 210, which is a course on personal computer technology. Prior to beginning this sequence, they are required to have a level of knowledge regarding the use of a PC. This is obtained through an introductory computer literacy course (CIS 204) or its equivalent. By the time they actually begin writing code, they should be fairly comfortable around a personal computer and have a basic understanding of how to approach problem solving in a logical fashion.

As the students learn the pertinent aspects of the BASIC programming language, they initially learn how to do basic input and output. This is quickly followed by the introduction of top-down design and its application through the use of subprograms. As students begin doing calculations with data, they learn about different data types, such as integers and floating-point data, and issues such as range and precision of data. They learn how to declare data and the differences between numeric and string data. Although not exposed to the "bits and bytes" of data storage, they are being exposed to differences in data storage, in preparation for further data typing issues in subsequent language courses. Iteration and selection, as fundamental structured constructs, are presented. This is done through the DO and LOOP statements, with explanation of the structured Do-While and Do-Until constructs, and through the IF and SELECT CASE statements. Subsequent topics presented are menu-driven programs, file processing, control-break processing, FOR loops, and arrays.

As students exit this course, they should have a reasonable understanding of how to decompose a problem into component parts, how to formulate a logical solution to the problem, how to use logic tools to describe that solution, and how to implement that solution in a programming language. They also should have the basic structured programming constructs and rules well in place, and be able to apply them, regardless of the choice of implementation language. As this course is prerequisite to other programming courses, those students who do not successfully complete this course cannot proceed through the department curriculum. This gives academic advisors an opportunity to discuss options with the student, as to whether remedial work is necessary, or if a change in degree focus would be more appropriate. Students who successfully complete this course have the foundation for applying structured concepts in subsequent language courses.

3. INTRODUCING OBJECT-ORIENTED PROGRAMMING

As the object-oriented paradigm began to take hold, the issue facing the department was once again how to teach the concepts at an introductory level as a foundation for further work in the area. Also, as with structured programming, we desired to give practical exposure through a medium that would not overwhelm students, but would encourage them and help reinforce their comprehension of the concepts. In addition to object-oriented terminology, we also wanted to introduce the idea of event-driven programming. While this is a model that they have experienced as users of computer programs, it is significantly different from the approach they have previously experienced as computer programmers.

Actually, the approach taken for this paradigm is based on the approach used with the structured programming paradigm. This is understandable, since the goals are much the same, only the programming model is different. Again, we wanted to spend some time in the course initially exposing students to concepts and challenging them to think in terms of this new programming model, prior to learning a particular programming language in which to implement the model. Since we wanted a language without a high learning curve yet with a fairly strong capability to illustrate the concepts, Visual Basic was the language of choice. This led to the development of CIS 216 - Introduction to Object-oriented Programming, which uses Visual Basic as the vehicle for implementation.

Furthermore, this language also allows students to work at home on their personal computer, as well as on campus.

CIS 216 Visual Basic - Rationale and Material Synopsis

As with the first course in structured programming, this course begins with concepts critical to understanding the object-oriented paradigm, without involving students in the chore of producing working programs. As indicated earlier, the goal of these introductory courses is to lay a conceptual foundation that can be utilized in subsequent courses, regardless of implementation language. By focusing on concepts first, we strive to illustrate that the language chosen is variable, but the principles remain.

In the first several weeks of the course, students begin learning object-oriented terminology and how that applies to modeling real-world objects. Initially, students are reminded of the concepts of structured programming already learned. Then object-oriented concepts are introduced, along with terminology and tools. Students do exercises with generalization hierarchies, object structure diagrams, and event diagrams. They learn terminology such as message, properties, method, object, class, subclass, superclass, and instance. Concepts of encapsulation, inheritance, and polymorphism are introduced.

As we progress into coding, the students begin to get exposure to the difference between procedural programming and event-driven programming. This ability to clearly illustrate this is provided in the visual environment of the Visual Basic language. Due to their background with BASIC, the students adapt quickly to writing sections of procedural code for various objects. Familiarity with BASIC and the ability to illustrate object and event concepts through the visual nature of the environment are principal reasons for which Visual Basic was chosen as the implementation language. Furthermore, we emphasize the need to understand and apply structured concepts within each of the separate functions for object events, so what they have previously learned is immediately put into use, even within this different paradigm. Although there are some obvious differences even at the coding level, the students are sufficiently proficient with BASIC to do well at this point.

The structure of the course follows the text in as much as designing applications with a graphical user interface (GUI) is concerned. Students are instructed as to building the interface by selecting appropriate objects, setting their respective properties, and then writing code for individual events. All of this underscores the object-oriented and event-driven concepts presented earlier. Additionally, students are presented with instruction and exercises in building executable stand-alone programs, including building distribution diskettes for program installation, debugging applications, using multiple forms, or windows, building menus, producing reports, accessing databases, and building ActiveX controls.

In order to keep our pulse on the needs of the workplace, so that our students are prepared to make the transition from academia to industry, we have an advisory committee comprised of representatives from area organizations, many of which hire our graduates. As employers are requiring more skills in written and verbal communication, presentation and group collaboration, evidenced by feedback from the advisory committee, we have introduced a level of group projects and presentations in courses, even in such introductory programming courses. Students have opportunity to design projects and present the results before their peers. Furthermore, this course also requires use of the Internet to do research and produce a paper, on an individual student basis, on topics relevant to the course material.

Upon completion of this course, students have had a fairly significant exposure to object-oriented and event-driven concepts and skills, have integrated structured concepts within the object-oriented framework, have constructed fairly sophisticated Windows programs, including interaction with a relational database (Access), and have learned how to distribute those applications to end users.

4. BUILDING ON THE FOUNDATION

After these two introductory courses, one emphasizing structured concepts and the second building upon the first to emphasize object-oriented concepts, the next move in this progression is to more traditional languages with a wider base in industry usage. This has taken the shape of two programming languages that together cover a considerable span in the marketplace: COBOL (CIS 265) and C/C++ (CIS 262).

Both of these courses extend the structured track, building upon principles emphasized in the introductory course. As those principles are reiterated in these courses, they illustrate the applicability of the concepts across language boundaries. More recently, we have added an associate degree level course in Java to expand on the object-oriented track (CIS 263). It also builds on both structured and object-oriented concepts from the introductory courses.

CIS 262 The C Language - Rationale and Material Synopsis

As C has made a considerable impression on the marketplace, and has wide applicability to a variety of applications, it was decided that C should clearly be a part of the programming language curriculum. C had actually been used in some other courses giving an overview of several languages, but now it was to be a complete course in the language. Initially, this course was to build on the structured paradigm and as such begins with a brief review of those principles. As the language is presented, students are shown how the same structured constructs learned earlier are implemented in this language. The typing of data takes on a larger role than in previous classes and we also address issues of memory addressing, bit manipulation, and conversion between bases. The steps in the compilation process, the distinction between source and object code, and the concept of object libraries are all presented.

As the curriculum changes to incorporate new technologies and to accommodate university guidelines for general education, the number of courses in the major which can be offered is limited, so often something has to be eliminated. We decided to no longer offer assembler as a programming language and to incorporate certain concepts previously learned there into the C course. As this course has evolved, we have also incorporated some aspects of C++, but not the object-oriented portion. This is reserved for a later course in object-oriented programming in C++, offered at the bachelor's degree level. The focus of this class is to provide a good introduction to ANSII standard C and to good program design and programming style, as well as certain new concepts (e.g., pointers, memory addressing, etc.); to provide more depth in issues only briefly introduced previously, such as data typing; and to do all of this within a structured programming environment. While students have the ability to write and test programs locally on a home computer, they are required to do submit their labs from our local Alpha processor (AXP) from Digital Equipment Corporation. This can be accomplished from off-campus locations via a telnet link to the AXP. Due to the potential for damage to a PC, particularly when dealing with pointers, it was felt that the beginning course needed the protection afforded by a managed environment.

There is a continued emphasis on good business programming practices and on achieving a high degree of code readability and maintainability. Students are assigned labs that emphasize exhibiting learned aspects of the language while focusing on business applications.

Upon completion of this course, students will be prepared for the Topics in C course where they will build complete applications rather than only do lab assignments. They will also have sufficient grounding in the basics of the language that they can function in an entry-level position. Lastly, they will have continued experience with structured programming principles applied in a viable commercial language.

CIS 265 COBOL - Rationale and Material Synopsis

At the associate degree level, COBOL rounds out the offerings on the structured programming track. This language has been a staple of business programming for a very long time and will likely continue to be so for many years to come. As we have a large number of businesses, both locally and regionally, who continue to rely on programs written in this language, it was clear that we did need to continue with it. Furthermore, the English-like syntax, by design, helps to concentrate focus on the logic of the programmed solution rather than on esoteric language syntax. We find this to be a good reinforcement of student logic skills, from a pedagogical viewpoint.

Students get extensive lab work to further sharpen logical and programming skills. In addition to learning the structure and details of the language, students perform practical programming exercises dealing with topics like table handling, sorting, selection and file maintenance using sequential, indexed and direct files. This course lays a foundation in COBOL that is extended by later courses in advanced COBOL topics and online programming with CICS. Students can obtain compilers to do work at home as well as having lab access on campus.

CIS 263 Java - Rationale and Material Synopsis

As we work to expand the two-track offerings on the object-oriented side, we are looking at several options. One is advanced work in languages currently taught. While we do offer C++ in an object-oriented approach, it is an upper-division course and not introductory nor intermediate. Thought had been given to another course in Visual Basic or perhaps Smalltalk. There was a desire to add to the current Visual Basic course and the benefit of adding another separate course was unclear. Smalltalk offered a true object-oriented language, but the commercial viability seemed minimal. Concurrent with expanding object-oriented offerings arose a perceived need to address applications that are in some fashion web-based. It became clear that the language that would best fit with our current mix of offerings and with our desired pedagogical approach, and that would provide entry into web-based applications was Java.

Java is used to reinforce the object-oriented and event-driven concepts introduced in the initial Visual Basic course. It provides a more rigorous approach to object-oriented programming without the difficulties of C++, at least with respect to those it was designed to avoid, such as pointers and memory leaks. Furthermore, as a descendant of C, the similarities in syntax simplifies learning Java for the students, since the C course is a prerequisite in our curriculum sequence. This course (CIS 263) brings a convergence of what was previously presented in both the Visual Basic course and the C course into one language which can be used for traditional applications and also web-based programs. The course material does a quick coverage of the language structure and syntax, particularly with respect to familiar aspects. Students have opportunity to utilize a GUI development environment, but emphasis is placed on code compatible with the Java Development Toolkit (JDK) freely available from Sun's web site. An effort is made to supply students with home access to at least one GUI environment available on campus. Additionally, students may complete all assignments by using no more than the JDK. Students learn how to build Java applications and Java applets and how to use the JDK documentation to obtain necessary functionality from the Application Programming Interface (API). GUI components equivalent to those used in Visual Basic are presented along with multithreading, multimedia, Java networking (including an introduction to client/server applications) and the Java Database Connectivity API (JDBC). Students also are encouraged to exercise their written communications through a short paper on Java issues and to do research into Java issues and new Java functionality by using the Internet.

Upon completion of this course, students are more grounded in object-oriented terminology and have familiarity with a very flexible language that can do both traditional applications and web-based applets. They have additional knowledge of "cutting edge" developments related to the language and have an appreciation for more sophisticated levels of programming, such as client/server, web-enabled applications, embedded SQL calls, and network programming. Students have the ability to continue working with the language at home, to continue to keep up with new language developments via the web, and to explore additional aspects of the language on their own. They also are acquainted with a language that is seeing increasing demand in the business applications marketplace.

5. DATA COLLECTION AND EVALUATION

In an effort to determine whether these changes are having a positive effect, specifically whether students are being prepared for subsequent course work as well as entry into the workforce, we have looked and are continuing to look at data from two sources. The first source is a bi-annual survey of graduates, of both the associate degree and bachelor degree programs, at one and two years after graduation. Evaluation and Planning Services in the Assessment Office surveyed graduates from 1993 and 1994 in 1995, and graduates from 1995 and 1996 in 1997. This survey was begun as a means of program assessment by the school, and the department is continuing with this effort for our own assessment purposes in 1999. It was expected that this source might give some insight into student preparedness for the workforce.

The second source of data was our registration system where student progression through these courses and subsequent upper-division courses could be analyzed. It was hoped that this source would give some insight into whether students were prepared for upper-division course work.

Of the two initial courses, CIS 215 Basic and CIS 216 Visual Basic, the first was initially offered in its present form beginning with the 1992-1993 school year and the second not until the 1994-1995 school year. Therefore, the graduates in the first survey had little or no chance for exposure to these classes. Thus, the surveys would be sampling two groups, the first of which generally did not have these classes, and the second of which did. This is particularly true for those graduates at the associate degree level, although some at the bachelor degree level may have taken the CIS 216 course as a later elective.

Comparing the survey data from the earlier group (1993-1994) to the later group (1995-1996) showed that later students were at least as employable as their predecessors. Of those employed in their major, all were employed within approximately one year (11-13 months) in both groups, with the majority (50% or greater) employed within six months or less. Although the percentage employed dropped by five percent from 92.2% to 87.2%, those employed as fully as they wished actually increased 7.3%, from 60.8% to 68.1%, and those unemployed and looking for a job dropped from 5.9% to 4.3%. Furthermore, the later group appears to be more selective about accepting new employment as, among those looking for a new position, 50% of the '95-96 graduates are holding out for a specific position, compared to only 20% in the first group. Of those looking for a new job in the later group, 50% have been looking only two months or less, and 75% six months or less, while in the first group, 50% had been looking for 6 1/2 months or less and 75% for 10 1/4 months or less. It is assumed that the increase in selectivity and the decrease in job search time are likely due to existing market conditions in this field and not curricular issues. In order to determine whether the change in curriculum had any effect (e.g., holding out for a GUI, PC-based programming job versus a mainframe, legacy system) a new survey instrument would have to be designed.

Although job satisfaction rose from 83% to 87.5% and job security rose from 80.9% to 92.7%, this could again be reflective of market conditions. From the available data, there is no means to correlate this with specific job functions, and thus course preparation for those functions. It is significant that of those students employed full-time, the percentage making thirty thousand or more rose from 71.4% to 80.6%. Students are being offered higher beginning salaries and are more secure and satisfied in their work. The higher salaries may be due to increased demand as resources were directed to addressing "year 2000" issues. However, the trend may be due, as some suggest, to a "rising importance of [Information Technology] in our economy" (Mateyaschuk 1999). Whether this trend will continue to be evidenced in subsequent surveys, especially post-Y2K, will be of interest.

Unfortunately, the registration data available from our automated system was no earlier than the 1996-1997 school year. This prevented comparison of data for the alumni classes that were surveyed to date. The data as of yet shows no discernable trend that would indicate whether success in the earlier classes might predict success in subsequent classes.

6. CONCLUSIONS AND FUTURE DIRECTION

The above listed courses are not the full complement of programming languages offered. However, other language offerings, such as RPG, are elective and not required, particularly in the first two years. The courses presented here are those that were selected to implement the dual-track offering in structured and object-oriented methods and to meet the commercial demand in local and regional markets, as indicated principally by our industry advisory committee. Additionally, the indication with each language that students have the ability to do work at home or from home underscores the emphasis that we have placed upon distance learning, where we utilize the Internet in an asynchronous teaching mode. The department is working towards making the entire associate degree, at least from the aspect of our classes, obtainable in a distance learning format. This further recognizes the flexibility needed in course presentation to generate, engage, and maintain a student population that is often employed while attending school. We have found that as a general rule, students who have completed the associate degree are having no trouble in obtaining employment. So much so that it becomes difficult for us to find students available to work as tutors and lab assistants. This observation, student feedback, and direction from our advisory committee, do not contradict that the approach is giving students what is needed to make an early transition into the workplace, as well as preparing them for continued academic work. However, sufficient empirical data has not been obtained to make a definite correlation, much less to factor out external market influences. We believe they are getting the solid foundation necessary in both structured and object-oriented programming and are finding themselves prepared for future course work and for immediate employability. While the available data does not contradict this, neither is it yet sufficient to confirm this belief when one considers the current market demand.

We have noted, also through advisory committee response, that increasing the focus on databases, particularly using embedded SQL calls in the various languages, and further expansion of web-based programming is desirable. We have plans to increase offerings along these lines, with possible addition of another curriculum option to address web-based programming. This should continue to place our students in good stead for entering the market in this field.

7. FIGURES

Figure 1 – Associate Degree (non-networking)

First Semester

CIS 210	Personal Computer Technology
CIS 215	Structured Program Development
COM 115	Fundamentals of Public Speaking
ENGL 104	English Composition I
	Natural Science Laboratory Elective

Second Semester

CIS 216	Visual Programming
CIS 240	Introduction to Networks
CIS 286	Computer Operating Systems I
ENGL 220	Technical Report Writing
MA 153	Algebra and Trigonometry I

Third Semester

CIS 252	Systems Analysis and Design
CIS 253	Applied Database Techniques
CIS 262	C/C++ Programming
MA 214	Linear Algebra and Linear Programming
	Social Science Elective

Fourth Semester

CIS 263	JAVA Programming
CIS 265	COBOL Programming
MGMT 200	Introductory Accounting
MGMT 225	Fundamental Managerial Statistics
	Humanities Elective

Figure 2 – Associate Degree (networking)

First Semester

CIS 210	Personal Computer Technology
CIS 215	Structured Program Development
MA 153	Algebra and Trigonometry I
ENGL 104	English Composition I
	Elective

Second Semester

CIS 216	Visual Programming
CIS 240	Introduction to Networks
MA 154	Algebra and Trigonometry II
ENGL 220	Technical Report Writing
COM 115	Fundamentals of Public Speaking

Third Semester

PHYS 220	General Physics
CIS 286	Computer Operating Systems I
CIS 262	C/C++ Programming
MA 214	Linear Algebra and Linear Programming
	Social Science Elective

Fourth Semester

PHYS 221	General Physics
CIS 252	Systems Analysis and Design
CIS 253	Applied Database Techniques
MGMT 225	Fundamental Managerial Statistics
	Humanities Elective

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Figure 1 – Associate Degree (non-networking)

First Semester
CIS 210 Personal Computer Technology
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COM 115
ENGL 104
Natural Science Laboratory Elective

Second Semester
CIS 216 Visual Programming
CIS 240 Introduction to Networks
CIS 286 Computer Operating Systems I
ENGL 220
MA 153 Algebra and Trigonometry I

Figure 2 – Associate Degree (networking)

First Semester

CIS 210 Personal Computer Technology
CIS 215 Structured Program Development
MA 153 Algebra and Trigonometry I
ENGL 104 English Composition I

Elective

Second Semester
CIS 216 Visual Programming
CIS 240 Introduction to Networks
MA 154 Algebra and Trigonometry II
ENGL 220 Technical Report

Electronic Mail Communication Among Students and Their Professors

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Abstract

This paper reports on the results of a study designed to determine 1) how often students email their professors, 2) whether those messages represent additional contacts, or simply displace other means of communication, and 3) why students chose to use email other than communicating through some other means. Results indicate that most students send between one and five messages to a single professor during a term. Further, students report that these messages are simply replacements for other modes of communication. Finally, students use email primarily due to their perceptions of its convenience.

Keywords: Electronic-mail, communication, students, professors

1. INTRODUCTION

Is electronic mail (email) a great boon to communication among students and professors, or is it a huge black hole, sucking in great chunks of time spent replying to frivolous messages? One the one hand, email certainly provides a convenient means for students and professors to communicate. On the other, perhaps this convenience leads students to send messages that deal with questions that either could have waited or did not need to be asked at all. In order to gain insight into the nature of email communication among students and professors, a survey was administered to students in two universities. This paper reports on the results of that survey and attempts to draw some conclusions from those results. The report begins with a discussion of some of the literature concerned with email the in university environment. This is followed by an overview of the methodology and subjects used in the study. Then the results of the survey are provided followed by a discussion of the possible meaning of the results. Finally, some conclusions are drawn.

2. ELECTRONIC MAIL IN THE UNIVERSITY ENVIRONMENT

An article in the Tampa Tribune (Technology has ..., 1998) illustrates some of the issues surrounding students' use of email. While professors applaud the increased interaction afforded by email, they also note the increase in the number of questions from students and the expectations of quick response. As one professor noted, "I'm all for increased interaction with students. But this gets ridiculous." The professor goes on to

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observe that prior to the widespread use of email, students expected to be able to contact him two afternoons a week during office hours. Now students inundate him with emails at all hours of the day and night, and on weekends—and expect prompt replies.

There are at least three types of course-related email communication, 1) student to professor, 2) student to student, and 3) student to outside resources. In all three cases, one major advantage of email is that it can be employed to extend interaction beyond the walls of the classroom. Through email, students have a convenient opportunity to explore questions that did not occur to them during class or that they may have been too shy to ask in front of other students. Email communications can also facilitate interaction among students. Often, this is particularly useful when employing team-based assignments as part of a course. For example, email presents an efficient means of distributing documents among team members. One particularly interesting use of email is to enable students to access outside resources (Smith & Minnick, 1996). For example, one of the authors of this paper recently received correspondence from a team of Master's students from Sweden. The students inquired about an article the author had written on the diffusion of the Web. This led to the author providing additional information on electronic commerce to the students. A more structured example comes from the use of email in an industry mentoring program used as part of a telecommunications course. Students used email to communicate with industry professionals to gain information and insight into telecommunications-related aspects of information technology (Belanger, 1998).

Email may also lead to greater formality and accountability than face-to-face or telephone communication (Smith & Minnick, 1996). This aspect of email communication comes from the presence of a record. It is more difficult to deny something that is documented than it is to dispute the details of a conversation. This benefit of email impacts both communication among students and professors and that among students. In fact, this may represent a significant benefit to team coordination. If each student on a team has a "written" record of task assignments and deadlines, it may increase the level of commitment.

By fostering communication among students and professors, email may lead to students having better relations with their professors (Manning, 1996). For example, using email to ask career-oriented questions of a professor may cause students to feel more in touch with the faculty member and may lead to greater in-person interaction.

In addition, email can augment information dissemination (Manning, 1996). This is particularly true when class email lists are used. A professor can efficiently use email to inform students of interesting articles, upcoming course changes, or to follow up on points raised in class.

Email may also have a negative impact on student communication. The false sense of anonymity that some students associate with email communication may lead to abusive messages (Manning, 1996). Students may make remarks on email that they would be averse to making face-to-face.

Privacy issues should also be considered when using email (Manning, 1996). Some students may prefer that others in the class not have easy means of communicating. While unwanted attention via email may not be as invasive as phone calls, such potential still represents a potential roadblock to the use of course-related email. A related problem is that of tampered messages (Manning, 1996). More advanced students may have the ability to send emails that appear to emanate from the professor or other students. Those charged with securing academic computing facilities should take care to guard against such possibilities.

Professors should expect an increase in the amount of contact with students due to the use of email. This impact on the professor's workload can quickly escalate when employing email as an integral part of a course. For example, supporting small group discussions via email leads to a proliferation in the number of messages that must be read by the professor in order to monitor the group's discussion (Vician & Brown, 1996). If each member of a three person group sends five messages in the course of a discussion, the professor must read fifteen messages in order to stay current on the discussion.

To summarize, there are a number of benefits and some offsetting drawbacks to the course-related use of email. Table 1 provides a summary of these.

Benefits
Facilitates interaction outside the classroom (student-professor, student-student, student-outside resources)
Leads to higher level of accountability and formality
May improve student-professor relations
Augments information dissemination
Drawbacks
May increase professors' workloads
False sense of anonymity may encourage Abusive messages
May violate some students' sense of privacy
Tampered messages are possible

Table 1 – Benefits and Drawbacks of Email

In order to better understand the course-related use of email from the students' perspective, a study was performed that sought answers to three questions. These are sated as research questions below.

RQ1: How frequently do students email their professors in the course of a term?

RQ2: If email was not available, would students still contact their professors to ask certain types of questions?

RQ3: Why do students use email rather than some other form of communication?

The next section discusses the methodology used to investigate these questions.

3. METHODOLOGY

In order to gain insight into the research questions posed in the last section, a survey was conducted. The survey consisted of 30 items intended to provide descriptive information as to students' use and impressions of email communication with their professors. In addition, there were a number of demographic-oriented questions.

The subjects for this survey were 172 students from two universities who volunteered to complete the survey. One of the universities is a small, private university in the Southeast, while the other is a large, state-supported institution located in the Midwest. Seventy-one of the responses came from the smaller school, with the remaining one hundred-one coming from the larger.

Half (50%) of the subjects have at least two years of full-time work experience, and 66% have more than two years of part-time work experience. Most of the subjects are of traditional college age with only 23% of them being over 24 years of age. Females accounted for 41% of the subjects. The majority of the subjects were undergraduate students (76%), but 24% of them did report being graduate students. Business majors made up 44% of the subjects, 36% of the subjects were MIS majors. Most of the subjects had relatively high grade point averages, with 68% reporting that their GPA exceeded 3.0 on a 4 point scale.

Most of the students surveyed reported they are frequent users of email; 77% use email at least once a day, and over half (53%) use email several times each day. Only 5% report using email less than once a week. Note that both universities provide all students with free email accounts.

The subjects also are experienced computer users. Almost all (93%) indicate they have used a computer for more than two years. Only 3% have used a computer for less than one year. In addition, most of them (69%) have had access to a computer at home for more than two years.

The experience level extends to the use of the World Wide Web (Web). A heavy majority (89%) report using the Web for more than one year. In fact, 65% of the subjects have been using the Web for more than two years. They also appear to be fairly heavy users of the Web. Almost all of the students (90%) report that they access the Web for more than two hour per week, while 45% indicate that they spend more than four hours per week on the Web. Interestingly, more of the subjects report being asked to use the Web as part of a class (90%) than reported being required to use email as part of a class (85%).

4. RESULTS

This section presents the results of the survey. The presentation is broken down into results related to each research question.

Frequency of Use

From the results of this survey, it appears that most students do email their professors during the course of a term. Results indicate that 65% of the students surveyed sent their professors at least one email message during the current term. Note that the survey was conducted towards the end of a fall term. Most of the students (59%) indicate that they sent between one and five messages. Only 2% report that they sent more than ten messages to their professor.

On the surface these results seem to show that the use of email may not severely impact a professor's workload. However, some quick arithmetic reveals that even a relatively small number of messages per student can result in a significant number of messages overall. Taking a conservative figure of two messages per student from 100 students results in 200 messages that must be responded to.

In order to do a quick check of how reasonable this expectation is, one of the authors saved the messages from two sections of a course taught in a recent term. Together the two sections had sixty students enrolled. These sixty students generated 115 messages, which equates to approximately two per student. In addition to these 115 messages, there were also another 100 that were sent as part of assignments.

Having discussed the raw number of emails sent by students to professors, the next issue to address is whether or not these messages represent additional contact with the professor or if they simply displaced another means of communication.

Email vs. Other Communications

In order to determine whether email displaces other means of communications, a series of questions was included in the survey dealing with three types of questions and three means of communications. Subjects were asked how likely they would have been to ask three types of questions if email was not available. These types are 1) homework-related, 2) subject matter other than homework, and 3) administrative questions. Further, the subjects were asked whether they would use the following means of communication to ask the questions if email was not available, 1) in class, 2) telephone, and 3) in person in the professor's office. Results from these items are shown in Table 2.

	UL/VUL (%)	L/VL (%)
How likely to ask IN CLASS?		
Homework-related	18	66

Subject matter other than homework	23	50
Administrative	24	40
How likely to ask ON TELEPHONE?		
Homework-related	35	51
Subject matter other than homework	43	39
Administrative	41	38
How likely to ask IN PERSON IN OFFICE?		
Homework-related	13	72
Subject matter other than homework	18	65
Administrative	18	65

Table 2 - Email vs. Other Means of Communication

Note that UL/VUL refers to responses that were marked either "unlikely" or "very unlikely," while L/VL refers to responses marked "likely" or "very likely." Further note that the balance of 100% for each item is comprised of those who responded "Don't Know."

From the results of this survey it seems that email communication does, at least to some degree, replace other means of communication. This is particularly true for subject matter questions, both homework and non-homework related. In the case of in class and in office communication, the majority of the students indicate that they would be likely to still ask the question. In fact, it seems that when faced with subject-oriented questions students are particularly likely to approach the professor in class or in the office. They are less likely to pick up the phone and call the professor.

Even for administrative questions students in general feel that they would be likely to communicate with the professor via some means if email was not available. Most students appear to feel that it is better to ask administrative questions in person in the professor's office, rather than taking up class time or calling on the phone. Only in the case of telephone communications do students indicate that they are unlikely to ask administrative questions if email is not available.

The survey also asked students to indicate how likely they would be to not ask certain types of question at all if email was not available. Note that a response of "very unlikely" or "unlikely" to these items indicates that the subject feels that they would have asked the question, even if email was not available.

	UL/VUL (%)	L/VL (%)
How likely that you would not have asked the question at all?		
Homework-related	43	32
Subject matter other than homework	50	32
Administrative	44	31

Table 3 - Likelihood of Not Asking Question if Email Was Not Available

As can be seen from Table 3, more students reported that they would have been unlikely to avoid asking questions than reported that they would have been likely to not ask the question. In other words, of the students that made responses other than "don't know" the majority felt that they still would have asked all three types of questions.

From the responses to this survey, it appears that for most students email communications seem to displace other means of interacting with professors. This holds two implications. First, the findings appear to alleviate some of the fears that professors have regarding email leading to huge increases in their workload. However, additional research is necessary to definitively answer this question. Second, the results seem to show that email may not increase the amount of interaction between students and professors, which is counter to what some contend.

Why Students Use Email

The final research question addressed by this study is concerned with why students use email to communicate with their professors. To address this question subjects were asked to rate the importance of several reasons for using email rather than some other means to communicate with professors. Responses are summarized in Table 4. Note that NI/NVI refers to responses marked "of no importance" or "not very important," while I/VI refers to responses marked "important" or "very important." In each case, the balance of 100% is made up of responses marked "don't know."

	NI/NVI (%)	I/VI (%)
Have a record of the communication	27	56
More convenient	07	87
Quicker response	11	78
Better quality of response	15	58
Unable to contact in other ways, or professor did not respond to other ways	05	72

Table 4- Reasons for Using Email

Since students were not forced to choose among the different reasons or to rank the reasons (which, in retrospect may have been a good idea), it may be best to look at relative responses rather than discussing each reason individually.

Three of the reasons could be construed as being related to convenience. The "more convenient" response clearly falls into this category. In addition, the "quicker response," and "unable to contact/professor did not respond" items may also be seen as being related to convenience although further research is required to make this statement definitively. It seems clear that students find convenience-related reasons for using email more important than having a record of the communication or receiving a better quality response. All three of the convenience-related reasons were found to be important or very important by more than 70% of the subjects. In contrast, the two non-convenience related items were found to be important or very important by 56% and 58% respectively.

These findings seem to match the anecdotal evidence from the Tampa Tribune article noted earlier (Technology has ..., 1998). That article noted that professors feel that students want a fairly short turnaround time between sending a message and receiving a reply. In addition, it also seems clear that students find email more convenient than other means of communication. This is reflected in the "more convenient" reason having the highest portion of subjects finding it important (87%). Interestingly, professors also seem to appreciate the convenience of email (Nantz, & Wilkins, 1995).

The relative importance of being unable to contact the professor or the professor not responding to other means of communication should be taken with a rather large grain of salt. Most professors at one time or another have talked with students who complain that they are unable to contact professors. While this may be true in some cases, in many others the real truth may be that the professor is not available at a time convenient to the student. One almost sure-fire way to cut down on office hour visitors is to hold office hours at 8:00 AM. (Not that we advocate such behavior.) So, it may be that the relatively importance of the "unable to contact ..." reason may be more of a result of a mismatch between students' and professors' schedules than an indication that professors are unavailable.

In summary, it seems that students use email primarily because of the convenience offered by email communications. They appear to feel that not only is email convenient in general, but that they get quicker responses and are able to contact professors and get responses when they might not have been able to otherwise.

5. DISCUSSION

One major finding of this study is that student to professor email communication appears to replace other forms of communication, rather than representing additional contacts. Then why do some faculty members seem to feel that email increases their workload? The key to understanding this perception may come from an understanding of the nature of email communication.

Email is an asynchronous, half-duplex form of communication (Berghel, 1997). As a result, it is not necessary for both parties to engage in their end of the communication at the same time. This represents a major source of the perceived convenience of email (Berghel, 1997). It is possible that students also see this as a major convenience--they can send their professors messages whenever it is convenient. There is no need to wait for the professor to be in any particular location at any particular time.

However, this same characteristic may account for some professor's sense of increased workload. Answering questions in class or during office hours is basically a batch operation. Student questions are gathered together and posed to the professor during a given time period. For example, if a professor has office hours for 2:00 until 4:00, that time is set aside (at least to some degree) for talking to students. Email is more ubiquitous, however. It can reach us anytime, and anyplace we connect to our network. Even when working at home, many of us are in the habit of checking email several times a day. In the office, the connection to the network may be constant, as the "you've got mail" notification seems also to be. Thus email may present a considerable distraction similar to that of a ringing phone. Many heavy users of email are conditioned to check email as it is received, in much the same way some people automatically reach for the phone whenever it rings. This may make ten email messages seem more invasive than the same number of questions asked during office hours. The emails are interruptions, the office hour questions are a planned activity.

So, where does this leave us? Students find email convenient, and like to use it to communicate with their professors. In addition, students report that their email messages do not represent new contacts with professors, but rather are simply replacements for other modes of communication. But, anecdotal evidence leads us to believe that some professors find email intrusive and a drain on their productivity.

Perhaps the solution to the perceived efficiency drain can come from how we manage telephone calls. Over time, means have been devised to alleviate some of the interruptions from phone calls. Answering machines and voice mail allow us to let a ringing phone go unanswered without fear of missing an important message. Answering machines with call screening capabilities and caller ID help us avoid unwanted calls.

Most of us have been using telephones for the majority of our lives, while for many, email is a relatively new technology. We have learned how to manage telephone communications. Now we need to learn how to manage email communications.

Professors who find email message from students to be intrusive may find the following suggestions helpful.

1. Respond to student email questions in "batch" mode. Have a set time of day for answering email messages, much as office hours are set aside for helping students.
2. Inform students that you answer their emails at certain times. It is critical to set their expectations accurately. If students know that you answer emails at 4:00 on weekdays, they will not expect an immediate answer to a message sent at midnight.
3. Be consistent in the way you respond. Treat your "email response time" much as you treat office hours. Students do not (and should not) appreciate it when professors are unexpectedly absent during office hours. They may well be as disappointed when emails are not answered as expected.
4. Consider using technologies such as mailing lists (e.g. listserve), and discussion databases (e.g. Lotus Domino) to avoid answering the same question repeatedly.

6. CONCLUSIONS

The findings presented in this report indicate that students use email to communicate with professors primarily because they see it as being more convenient than other means of communication. In addition, according to most of the student subjects the messages they send to their professors do not seem to be additional contacts. They seem to be simply replacements for communications that would otherwise take place in class, on the phone, or in person.

We contend that the perception of some professors who see email as a time drain may be due to not managing email communication effectively. Following the suggestions offered in this paper may help professors better manage email and thus increase their efficiency.

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Panel: Report of the Joint ACM/AIS Committee on Graduate IS Curriculum

J. Gorgone, Bentley College[1], and P. Gray, Claremont Graduate University[2], (Committee Co-Chairs)

and

D. Feinstein, University of South Alabama; J. Luftman, Stevens Institute of Technology; E.A. Stohr,New York University, J. Valacich, Washington State University, R. Wigand, Syracuse University

This panel will discuss the *MS in IS Curriculum Guidelines for the 21st* Century. This curriculum is the work of a committee jointly sponsored by the Association for Information Systems (AIS) and the Association for Computing Machinery (ACM). The committee, chaired by John Gorgone and Paul Gray, conducted several virtual conferences and a series of meetings during 1998 and 1999. It also consulted extensively with the IS community through presentations at ten different national and international meetings.
In brief, the curriculum guidelines are suitable for

- both 1 year and 2 year MS programs;
- programs undertaken by beginners coming from outside IS and for programs for professionals upgrading their skills;
- students with different career objectives; and
- programs inside and outside schools of business.

The programs consists of five building blocks, two of which are prerequisite foundations in IT and in business, one is the IS core, a new block on integration, and a career track block to allow students to obtain a concentration in an area in which specific skills are required.

The program is a professional degree that integrates information and organizational cultures. In addition to providing specific IS skills it has the following themes running through it: ethics and professionalism, presentation skills, promoting ideas and negotiating, people skills, business skills, customer orientation and a real-world focus. Members of the panel will describe the program and its underlying philosophy. All members of the panel will then interact with the audience to answer questions and concerns.

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Panel:
Distance Learning as an Alternative Teaching Methodology

Panelists:
Nancy Thomson
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Maryville, Missouri

Stuart A. Varden
Professor of Information Systems
Pace University
Pleasantville, New York

David Zolzer
Director of the Electronic Commerce Program and
Associate Professor at Our Lady of the Lake University
San Antonio, Texas

Abstract

This panel will describe the options, delivery methods and instructional designs of interactive distance learning from both the faculty and student perspectives. A unique distance education project that involves business firms, universities and other educational entities will be described. The technologies and their advantages and disadvantages will be presented and summarized.

Key Words: Distance learning, online learning, teaching technologies, cooperative programs, pedagogy

Panel Overview:

- Dr. Thomson will serve as moderator and discuss delivery methods and instructional advantages and disadvantages from a faculty perspective.
- Dr. Varden will give an introduction and definitional overview of distance learning and describe a unique distance learning program and web example.
- Mr. Zolzer will discuss the important Implications for student learning from the student perspective as well as the hardware and software technologies for delivery.

Intended Audience:

- Educators interested in or in the beginning stages of building distance learning courses
- Educators experienced in distance education
- Industry trainers who are interested in cooperative programs with universities

Panel Goals:
The panel will provide a forum for discussion and clarification of distance education issues for courses ranging from interactive TV to web-based designs. Experiences will be shared with a focus on what works and what does not work in given circumstances. The audience is invited to participate in discussions after the panel's initial presentation.

Using JAD and RAD to Integrate Database Management and Systems Analysis and Design Courses

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Abstract

This paper describes our continued efforts to integrate our introductory database management and systems analysis and design courses. Our initial integration effort involved only one point of interconnection between the two classes. To better simulate real-world development activities, we have increased the integration points by adding common Joint Application Development and Rapid Application Development sessions. With a more integrated project, students better understand how their individual activities fit into the overall application development process.

Keywords: Systems analysis and design, database design, course integration, JAD, RAD

1. INTRODUCTION

This paper describes our continued efforts to integrate our introductory database management and systems analysis and design courses. The systems analysis and design (SAD) course is concerned with the development of an overall application system while the database management (DBM) course is concerned with the in-depth study of one portion of an application system – the database. Our previous integration efforts (Crepeau and Fernandez 1998) attempted to demonstrate the relationship between developing systems and designing databases by interleaving some of the processes from each course. Students in both classes worked on the same case study. Results of the information requirements identified by teams in the systems analysis and design class were handed off to teams in the database class. The students in the database management course used the information requirements to design the database structure for the case and prototype a solution using Microsoft Access 97. This prototype was returned to the SAD class for evaluation and inclusion in their final report. Figure 1 illustrates this integration effort.

Within this process, students in the SAD course realize considerable detail work is required in the database design phase while learning the breadth of the systems development cycle. Students in the DBM course learn how the design of a database occurs within the context of a larger systems development project.

However, this integration effort was not enough. Although students in both classes worked on the same case, the bulk of the work was still being done in disconnected phases with only one point of interconnection between the two classes. Realistically, waiting until the information requirements have been set to get database designers involved in the development process is not good practice. Nor is it good practice to have the database designers prototype the application without input from the analysts and end-users. Both the development experts and end-users need to be involved in the entire analysis and design process. To better simulate this involvement, we have replaced the report

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handoff with common Joint Application Development (JAD) and Rapid Application Development (RAD) sessions. In addition we have made our SAD and DBM courses corequisites.

2. THE COURSES

Database Management
The overall objectives of the database management course are to introduce students to basic database and data modeling concepts and provide them with an extensive exploration of data manipulation using a relational database management system (DBMS). Students complete database assignments using Query-By-Example (QBE) and Structured Query Language (SQL). In addition, students develop a database application using fourth generation database technology, currently Microsoft Access 97. They begin their development work with a logical data model, transform the model into a relational database design, implement the database in Access, and build an Access prototype using forms, reports, queries and macros.

In the past, we have taught the traditional Entity-Relationship data model. We are currently transitioning to object-oriented modeling techniques using the Object-Relationship model. We cover modeling object classes, attributes and relationships, and discuss transforming an Object-Relationship model into a logical relational database design.

Systems Analysis and Design
The overall objectives of the Systems Analysis and Design course are to introduce students to the processes and products of system analysis and design, and give them experience with process modeling tools. In the past, the course has emphasized the traditional systems development methodology utilizing organizational charts, program structure charts and logical and physical data flow diagrams. We have begun introducing alternatives to the traditional approach with a transition to object oriented analysis and design.

Other improvements in the SAD course include learning and applying Accelerated System Design (ASD) techniques and further integrating the data and process components of an application. In the area of accelerated techniques, JAD, RAD and prototyping techniques and benefits are taught. To reinforce the concepts, during the class students simulate all three approaches.

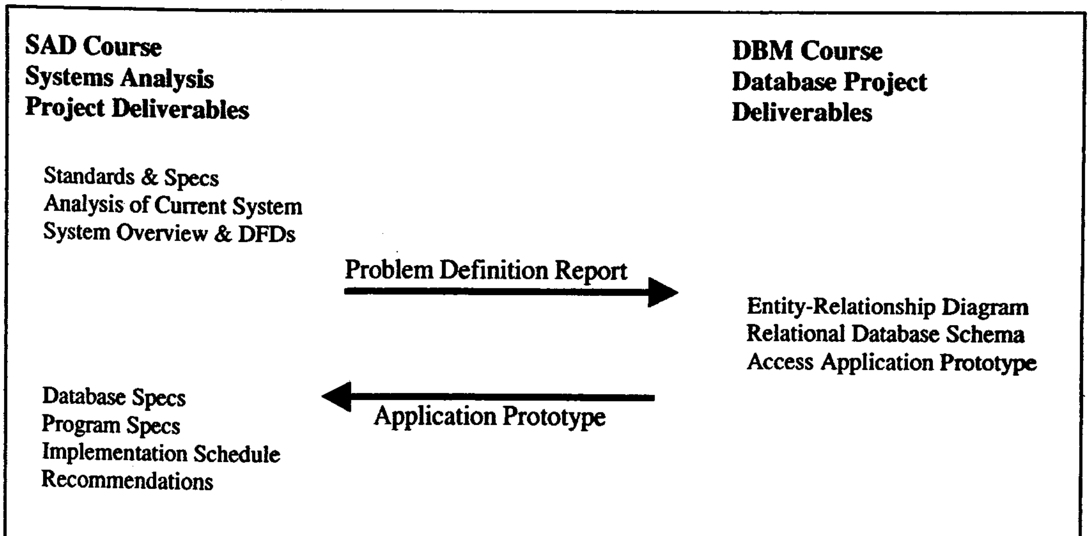

Figure 1 Previous Integration Effort

3. THE INTEGRATION

To implement the new SAD/DBM integration, the two courses were made corequisites for each other. In addition, we have replaced the single report handoff with joint ASD sessions using JAD and RAD. Students in both classes (now mostly the same students) are still assigned to work on the same case. In doing so, they still undertake the same process and database analysis and design activities discussed in the individual course descriptions above. Instruction and credit for each of these activities are distributed between the classes. However, these activities now include two major integration points, the joint JAD and RAD sessions. See Figure 2 for an outline of the integrated process.

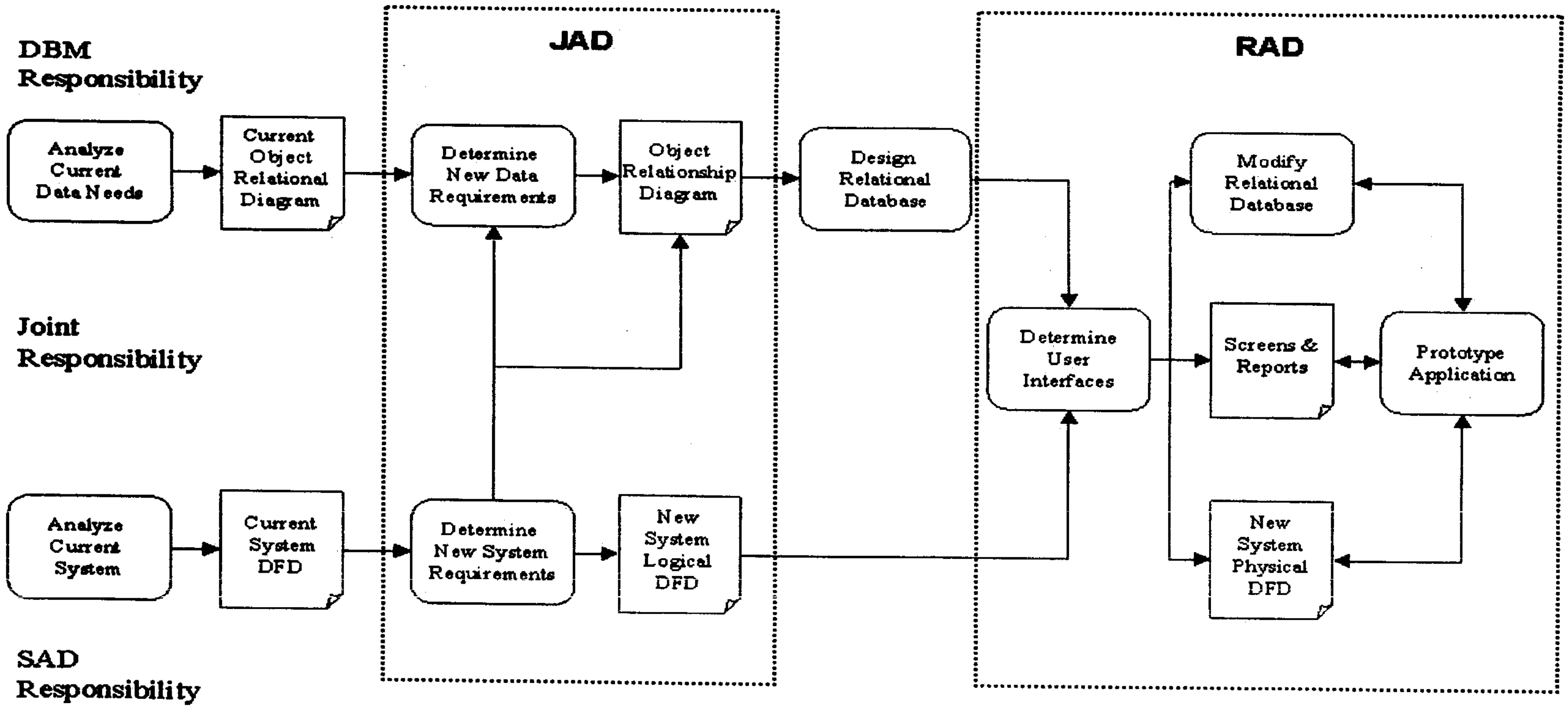

Figure 2 Integrated DBM and SAD Process

The first deliverable in the new integrated project for the SAD class is a model of the current physical system using a data flow diagramming tool. For the DBM class, the first deliverable is an object-relationship data model reflecting the data needed for the current application. These first deliverables were designed to prepare students for their participation in the first JAD session. An important note in this initial process is the early involvement by the data modelers. Early involvement by this group is necessary to fully exploit integration opportunities.

JAD: The First Major Integration Phase

The JAD process, which is frequently used by software developers to accelerate the development process, is also a major enabler of data and process integration. The JAD's primary claim to fame is its ability to bridge the end-user and developer perspectives in a relatively efficient manner. A secondary benefit allows data and process developers to concurrently model the application. During our simulated JAD, students acting as analysts extract information from the end-users (also role-played by students) that allow them to build a logical data flow diagram for the desired system. Students acting as database designers concurrently interview the end-users to build the data model needed to support the new application.

Outcomes of the JAD sessions include a logical data flow diagram of the new application, and an object-relationship model of the data for the new application. The data flow diagram is submitted for credit in the SAD class, while the object-relationship model is submitted to the DBM instructor.

RAD: The Second Major Integration Phase

Following the JAD, development teams from both courses refine their respective models. Depending on the size of the application, separate teams may be assigned to separate subsystems. During this time, the DBM students transform the object-relationship model into a logical database design. The next step is to reconvene the developers and end-users in a RAD session to identify the user interfaces needed for the application. The RAD methodology employs an iterative prototyping approach to subsystems of the application. Another important component of RAD is a time constraint (timeboxing) that enables an acceleration of the development phase. During the RAD session, the ingredients necessary for building the user prototypes are identified. This process also allows the data and process models to be further refined and solidified.

Teams reflecting a mix of data and process modelers are now ready to begin the construction process. During the RAD, students use Microsoft Access 97 to prototype screens and reports. In a real world scenario, the prototyping process would go through several iterations. In our classroom environment, students complete their construction efforts using the initial prototype developed in the RAD session.

4. LOGISTICS

In preparation for the JAD sessions, eight roles were identified: User Sponsor, JAD Facilitator, Scribe, Process Modeler, Data Modeler, Analyst, User/Client, and Observer. The DBM instructor acted as the User Sponsor while the SAD instructor took on the role of JAD Facilitator. Students selected the other roles. To increase the accuracy of the application deliverables, we used two Scribes, two Process Modelers and two Data Modelers. The remaining students were distributed among the other roles.

During the initial JAD session, the User/Clients set the pace of the discussion as the modelers attempted to gain a complete understanding of the business needs and opportunities. The User/Clients were given additional business-related information to help enhance their role as business experts and to add more realism to the sessions. As the business requirements started to solidify, the modelers took on more dominant roles, as they used their respective modeling tools to translate business requirements into technical specifications.

At the completion of the JAD sessions, students were able to partition the overall application into five major modules. A Process/Data Affinity Diagram was used to determine the number and nature of the application modules.

Teams of 4-5 students were then assigned to further analyze each application subsystem. For the RAD session, each team member chose one of the following roles: Process Developer, Database Developer and Subject Matter Expert. The goal of the RAD session was to produce a working model or prototype of the application using RAD techniques.

We found the interaction brought about by the different perspectives very stimulating and an integral part of the learning process. We also found (and encouraged) students to cross roles to spark discussion of potential problems and opportunities.

5. CONCLUSIONS

The interweaving of class assignments described in this paper represents our continuing efforts to integrate our database management course with our systems analysis and design course. The initial integration effort involved only one point of interconnection between the two classes. This was an important first step in providing the students with a more real-world simulation of industry practice.

We have now increased the integration points. With a more integrated project, students learn how their individual activities fit into the overall systems development process. Database modeling and design is taught within the context of application development and design instead of in isolation. Conversely, application development and design is taught with increased emphasis on the need for good database design. The current integration also increases the students' exposure to real-world development activities.

JAD and RAD sessions have been the key enablers for this integration. Students are taught the techniques for conducting these sessions and then given the opportunity to demonstrate their skills in a simulated real-world environment. The joint sessions also force students to cross-disciplinary boundaries. These skills are critical for increasing the effectiveness and the efficiency of the application development process.

Future opportunities for improving the application development process center around evolving the techniques required for object oriented analysis and design. The integration activities described in this paper should provide an excellent foundation for applying the techniques required for a fully functional object oriented development environment.

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Modeling in the Software Engineering Course: A Case for UML

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Abstract

The Unified Modeling Language (UML) has become the de facto *industry* standard for modeling object-oriented systems. In the traditional software engineering course, academicians introduce and highlight modeling techniques such as data modeling (Entity-Relationship Diagrams) and process modeling (Data Flow Diagrams). The advent of object-oriented analysis and design created new demands that spawned the need for new visual modeling techniques (Booch, Object Modeling Technique, Object-Oriented Software Engineering). The UML represents a convergence of these techniques and provides instructors with a rich, expressive modeling language that can represent entire systems. The UML is scalable from the classroom to industry and more importantly scalable from industry to the classroom.

Keywords: Unified modeling language, software engineering education, UML

1. INTRODUCTION

Traditionally, courses in the Software Engineering curricula provide the foundations and fundamentals in structured systems analysis and design (Mitchell 1999; Pressman 1997; Schach 1999). These techniques emphasize a top-down, functional decomposition approach and are accompanied by modeling notations to represent data (Entity-Relationship Diagrams), function (Data Flow Diagrams) and behavior (State Transition Diagrams)(Pressman 1997; Schach 1999). The advent of object-oriented programming languages and object-oriented analysis and design placed new demands on the modeling notations.

Object-oriented notations are used to document the structure and dynamic behavior of object systems. Over the last six to eight years a number of notations have been developed, usually in association with an analysis and design methodology (such as Booch, OOSE, and OMT). These techniques and notations use class diagrams, showing the classes in the system and their relationships, and various forms of interaction diagrams, showing how objects interact in order to perform a given task. The proliferation of methods and notations resulted in instructors either adopting one notation in exclusion of others, or in a survey approach introducing multiple techniques. On the industry front, the multiple notations create confusion and generated calls for standardization.

In response three leading practitioners joined forces to develop a standard notation for not only modeling object-oriented systems but with the goal of providing a unified modeling notation incorporating all aspects of the software development process from Business Systems Analysis to code generation and beyond. The three methodologists, Grady Booch, Ivan Jacobson and James Rumbaugh, had developed the most widely used first generation object-orientation methods. Starting in 1994, these practitioners joined forces at the Rational Software Corporation to define a single, unified method and notation based on their collective experience. They were motivated to join forces because (Rational 1999):

- Their methods were already evolving toward each other independently

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- By unifying the semantics and notation, they could bring some stability to the object-oriented marketplace.
- They expected that their collaboration would yield improvements in all three earlier methods helping them to capture lessons learned and to address problems that none of the methods previously handled well.

While working at Rational, the three developed the Unified Modeling Language (UML) and an associated analysis and design process called Objectory, now renamed the Unified Software Development Method (Rational 1999; Whitson 1998). Rational Software, with the support of industrial partners such as Microsoft, Hewlett-Packard and Oracle, presented the UML to the Object Management Group (OMG), an organization that coordinates the efforts of commercial object-oriented developers, for consideration as an international standard. The OMG quickly acted and adopted the UML, propelling it to a de-facto international standard for object-oriented modeling (Rational 1999; Whitson 1998).

2. AN OVERVIEW OF THE UML

The UML is a sophisticated notation (modeling language) for the visual description of object systems. It includes representations for a number of different views (class diagrams, interaction diagrams, etc.), and many other features. UML does not describe a process -- a way of doing analysis or design. Hence, many different processes can use UML for their notation (Amber 1998; Fowler 1998; Rational 1999; Rosenberg 1998; Schach 1999; Whitson 1998).

At this point in its evolution, the UML is recognized as a modeling language, not as a methodology or method. The difference is that a modeling language is more of a vocabulary or notation (in the case of UML, a mostly graphical notation) for expressing underlying object-oriented analysis and design concepts. A method or process consists of recommendations or advice on how to perform object-oriented analysis and design. The UML defines a number of diagrams and the meaning of those diagrams. A method goes further and describes the steps in which you develop the software, what diagrams are produced in what order, who does what tasks, and so on. The idea behind the UML is that it is method-independent (Amber 1998; Fowler 1998; Rational 1999; Rosenberg 1998; Whitson 1998)]. In the near future, various methods and processes will be proposed that use the UML notation. But you don't have to use a method or specific process to make use of the UML.

UML Diagrams

The UML is composed of several graphical diagrams. The following were adapted from (Fowler 1998; Whitson 1998). For brevity, figures are included for only the first three diagram types.

Use-case Diagrams: A use-case scenario is a description, typically written in structured English or point form, of a potential business situation that an application may or may not be able to handle. A use-case diagram describes a way in which a real-world actor-a person, organization, or external system-interacts with an organization or a system element. A simple use-case diagram is shown in Figure 1.

The combination of use-case scenarios and the corresponding use-case diagram is referred to as a use-case model. Use-case models are often accompanied by a glossary describing the terminology used within them.

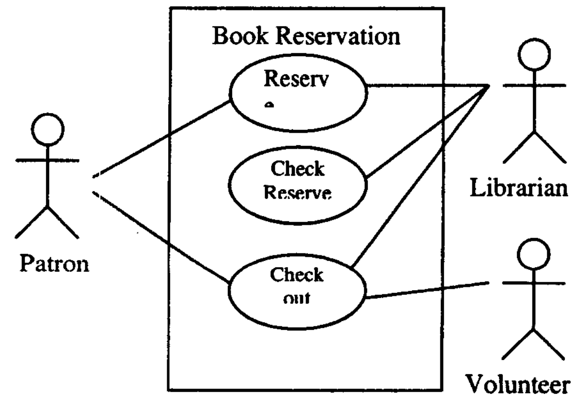

Figure 1. Use Case Diagram

Class Diagrams: Class diagrams provide a static structural model. They contain class names, attributes, and methods. Relationships such as inheritance, aggregation and association are graphically represented. Class diagrams provide the interfaces to classes and special notation is used to differentiate public, protected and private access methods. Class Diagrams are also used to represent specific instances. These specific instant diagrams are referred to as Object Diagrams. A simple class diagram is shown in Figure 2.

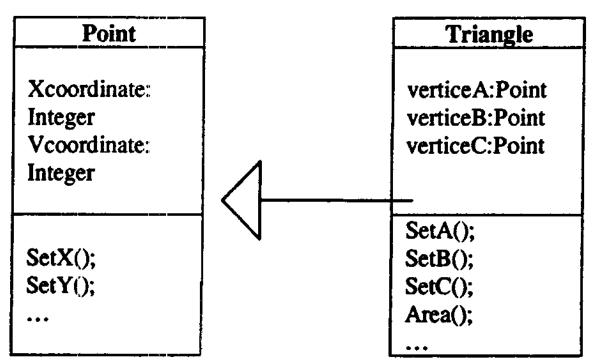

Figure 2. Simple Class Diagram

Sequence Diagrams: Sequence diagrams are used to show how system elements interact over time. They can be used to indicate interactions found in use-cases or they may be used to indicate interaction among objects. In a sequence diagram, objects are represented by rectangles, messages by directed arrows and a vertical line represents time. A sequence diagram is given in Figure 3.

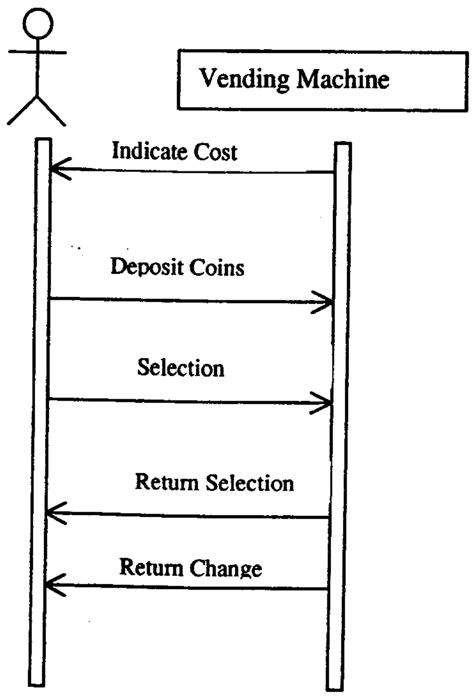

Figure 3. A Simple Sequence Diagram

State Diagrams: State diagrams are used to demonstrate state changes of individual objects in response to outside stimuli. State diagrams in UML are similar to the State Transition Diagrams (STD) of structured analysis.

Collaboration Diagrams: Collaboration diagrams demonstrate message flow from one object to another. Unlike sequence diagrams, collaboration diagrams do not include a time element. They are used to provide context in which behavior occurs and the messages that producing are produced by that behavior.

Component Diagrams: Component diagrams are used to represent system elements that have an existence that is separable and independent of the current system. These components may reside in DLL's, EXE's, or other accessible formats. In contemporary development, these external components may be specified in terms of DCOM objects, ActiveX, and CORBA objects.

Deployment Diagrams: Deployment diagrams are closely related to component diagrams. Deployment diagrams are utilized to show how the various computer systems may actually deploy a component in a distributed environment.

The UML provides a large and rich array of diagrams for analyzing and designing object-oriented systems. The diagrams mentioned above are only a sampling of the more popular ones.

3. UML IN THE SOFT. ENG. COURSE

The UML has several characteristics that make it an excellent choice for a modeling environment in the Software Engineering course. Some of the more positive characteristics are:

- Standardized notation
- Open notation
- Well accepted in industry
- Abundance of documentation on the Internet (see Amber 1998; Fowler 1998; Rational 1999; Rosenberg 1998 as an introduction)
- Models business processes, software processes and deployments
- Method and process independent

However, despite its widespread and growing support in industry, the UML does have several shortcomings in an academic environment. These include:

- Large and complex notation set
- Most suitable for Object-oriented projects
- Tool support could be expensive
- Lacks support for real-time systems

To investigate the application of the UML in an academic setting, the author utilized an Introductory Software Engineering course at the graduate level and a Software Engineering I course at the undergraduate level. This investigation and report is offered as anecdotal information and does not claim to be more than an experience report.

The graduate course was a new offering in our program and was composed of 10 students. The course was taught at an accelerated introductory level. Of the 10 students participating in the course, only 2 had an educational background in Computer Science. The other students had educational backgrounds in accounting, mathematics and business. The students were charged with developing a prototype for a computer-based system to be utilized by a local non-profit organization. The UML was utilized as an analysis and design modeling language. The Rapid Prototyping process was utilized to develop requirements and initiate design. As a mechanism for understanding the UML, the students were responsible for analyzing several tools that support developing UML diagrams.

The undergraduate course is a standing course in our program and is the first in a two-course sequence in Software Engineering. The course is required for students in our Information Systems track and our Software Engineering track. The course had 32 students with 20 being Information Systems students and 12 being Software Engineering students. This course emphasizes traditional structured decomposition methodologies and requires the students to produce a Requirements Specification document utilizing Data Flow Diagrams, a Data Dictionary and possibly Entity-Relationship Diagrams. Object-oriented (OO) concepts and notations are surveyed in this course although they are not utilized until the follow-up course. Note that this first course does not have an implementation component.

In this authors experience, the undergraduate students often struggle with defining scope and boundaries for the system they are modeling. For example, they may incorporate entities and processes into their Data Flow Diagrams that are completely external to the system under investigation. The students also have a difficult time transitioning from process to data or vise versa. The obvious cause of these problems is lack of experience and that is the purpose of the course. However, it is believed that if more contemporary models can aide the students in developing systems analysis experience, they should be explored.

This initial investigation revealed that the students in the graduate course easily grasped aspects of the UML. They especially made great strides in using use-case diagrams to understand the boundary and scope of their system. The diagrams were "user-friendly" and intuitive allowing the novice students to develop a fairly robust set of requirements. From these use-case diagrams, the students were able to develop class diagrams that accurately modeled the system under development. From the author's experience with the undergraduate course, the success of the graduate students in the initial use of UML was very encouraging. With a very limited software engineering background, the students produced a meaningful set of analysis and design documents accompanied by a working prototype of a real-world project.

This investigation offered the author at least anecdotal evidence that an introduction to the UML has a place in the software engineering course. This initial investigation has too many variables (student experience, requiring OO techniques in the undergraduate course, project size and type, etc) to be offered as a scientific study. It does suggest to the author that the UML may offer advantages to students. The author plans to incorporate the UML into the undergraduate course as a notation to understand object-oriented analysis and design concepts. The question of utilizing OO concepts or traditional methods in the project portion of the undergraduate course is still under investigation. At the time of writing this paper, we are planning to move OO concepts into and introduce the UML into the first undergraduate software engineering course in the fall of 1999.

4. CONCLUSION

The Unified Modeling Language marks a major advancement in the area of modeling language for object-oriented systems. It truly unifies the competing notations and provides a recognized and authorized international standard. The UML has received strong industrial support and is seen as a de facto standard.

With these great accolades, it is natural to investigate the application of UML in the software engineering course. This paper reports on a single investigation of teaching and applying the UML. Despite the obvious lack of rigor, this initial investigation has convinced this author to introduce the UML notation in conjunction with OO concepts. The UML contains a lot of notation. In an undergraduate course, the author recommends using a fairly minimal part of the notation, and not to use the advanced concepts unless they are really necessary.

One reason software is deceptively hard to develop is clear, accurate and concise communication between practitioners and users and amongst practitioners themselves (Pressman 1997). From an industry perspective, standardization is valuable because it enhances communication. It is difficult to communicate with people when they use and intermingle a variety of diagramming techniques. By having a single standard, analyst can communicate in a common language with users and amongst themselves. The UML aids communication and provides users and practitioners this standardized notation to clarify the problem at hand.

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Teaching the Database Course with Internet Examples: Blending Theory, Practice and Multiple Modes of Learning

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Abstract

This paper describes a novel approach to teaching the database course using Internet examples. The paper proceeds from seven premises—First, that students will be more highly motivated to solve and therefore will better grasp business problems that are within their realm of experience. Second, that MIS students tend to be visual learners. Third, that while visual diagrams are important, other modes of learning (words and programs) reinforce concepts. Fourth, that students better grasp theory when it is reinforced by practice. Fifth that students learn best by working complete examples from design through to implementation. Sixth, that problems which combine reverse engineering with functional prototyping draw on higher order educational skills. Seventh, that a course design that integrates concepts from the business and MIS core curricula helps build interest in the course and ultimately contributes to learning. The paper demonstrates rather than proves these premises by use of a complete example as it would be presented to students. The paper is organized in four parts. The first part provides background information. The second part explains the premises. The third part shows a complete sample design problem. The fourth part is a discussion of lessons learned.

Keywords: Database course, Internet examples, electronic commerce, reverse engineering, functional prototyping, learning styles

7. BACKGROUND

Many database courses prepare students to work in the business world by working through fictitious problems presented in database texts. There are several disadvantages to this approach. First, fictitious problems fail to inspire the intellectual curiosity and excitement that real problems inspire. Second, fictitious problems are often overly sanitized and thus fail to teach students how to separate essential from inessential elements in a problem. Third, fictitious problems are static. Students have no opportunity to interact with the problem—to test it under varying conditions.

Recognizing these limitations, some MIS professors have worked to expose their students to real world environments by having them visit corporations. These are enormously valuable experiences for students but they come at a price. First, they require a tremendous time commitment from professors, students and industry representatives. Second, limits on group size may necessitate that each student group has a different experience. While in some ways the diversity of experience may be beneficial, it does not allow for class discussion of a common experience. Finally, corporations may let students observe, but they tend to be hesitant to let students interact with the organization's production systems.

A third teaching model between real world experience and fictitious models is the use of case studies. Case studies have many of the advantages of the real world experience without the high costs. Nonetheless, cases are static—they do not let students interact with an organization's production systems.

The Internet has added new terrain to the educational landscape. For the first time, professors can easily expose students in a meaningful way to the front-end systems of real organizations. Students can visit the corporate Web sites of Amazon, RealNetworks, Delta Airlines, the Census Bureau, etc. Professors can challenge students to recreate the very systems with which they interact. Modeling an existing system requires reverse engineering the corporation's underlying database. The process of reverse

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engineering is enormously educational precisely because it is an educated guess which draws on many facets of the students' knowledge. Students need to study the business model of the corporation in order to design the database. In doing so they draw upon knowledge gained elsewhere in the MIS curriculum and business core. And as more organizations go online the landscape will get even richer. The online experience lies somewhere between a case study and the real world experience. It has many of the benefits of the real world experience without some of the costs. The professor has a greatly reduced time commitment since she does not have to coordinate with business representatives. Students do not have travel time to corporations. Groups of students can work on common problems—thus leading to uniform class discussion

The method described here was first used with great success in a course offered in the spring of 1999.

8. PREMISES

Students Better Grasp Problems in Their Realm of Experience

In an ideal classroom environment student motivation would come from intrinsic rewards rather than the extrinsic pressure of grades (Lowman 1990). Keeping the subject matter interesting and relevant helps to develop intrinsic motivation. The World Wide Web provides a unique opportunity to present students with tangible business problems within their realm of experience. The Internet is hot. Students tend to be avid Internet users. For this reason the examples in the course are drawn from the Internet—and especially the area of electronic commerce. Students tend to have more interest in Internet examples than they would have in the fictitious company examples often found in database textbooks. Analyzing the Web sites of RealNetworks, Delta Airlines or Amazon.com has more interest for students than the fictitious Walnut Valley Furniture Company. Fortunately, the same principles of database design apply irrespective of the subject matter. Thus students can both enjoy Internet examples and learn from them simultaneously.

MIS Students are Visual Learners

A great deal of educational research has focused on learning styles (Bostrom 1990; Gardiner 1998). An interesting result of this research is that students in different disciplines tend to have different learning style preferences. English majors learn best from the written word whereas MIS students learn best through pictures and diagrams. The diagrams help MIS students to assimilate concepts that would be much harder to grasp through only the written word. Most database texts have caught onto this and tend to be loaded with diagrams. However, what many of them lack is a visual image of the front-end—what the data display actually looks like for the end user. Fortunately the Internet again comes to the rescue. Since Web sites do represent the front-end display for e-commerce databases, students can be exposed to the front-end application.

Visual Learning is Supported by Other Modes of Learning

While visual diagrams are extremely important, other modes of learning such as verbal explanations and programs reinforce concepts. Here MIS professors can learn from research done by their colleagues in the mathematics department. A growing trend in mathematics education presents the student with multiple representations of the same problem in order to tap multiple modes of learning. The very same problem will be presented as a word problem, a pictorial representation, an algebraic formula and a graph of the algebraic formula. For example, to calculate the time that a ship travelling upstream against the current will arrive at its destination would first be described verbally. The word problem is supported by a pictorial representation of the problem showing a ship in the stream with the speed and direction of ship and stream labeled. The pictorial representation is supported by an algebraic formula to calculate the result. Finally, the algebraic formula is graphed on a Cartesian coordinate plane.

What is the equivalent tapping of multiple modes of learning in database education? Here is one example which follows the reverse engineering paradigm introduced earlier. First students are presented with a Web site (pictorial representation). They are challenged to develop from the Web site two verbal descriptions of the problem—a non-technical executive summary and a technical summary. The executive summary draws on their skills from the common business core since they need to tease out the business plan behind the development of the Web site. The technical summary presents a technical argument for the students' database designs. Next students must develop two diagrams—a logical model of the underlying database and a field list for each table in the database. The diagrams further reinforce visual learning and help students catch errors before they code. Next students need to construct the SQL statements to create the database—a programmatic representation of the problem similar to the algebraic formula in the mathematics example. Finally students construct queries against their database. Each query begins with a verbal description of the problem, followed by a query diagram, followed by the SQL query followed by the results. Thus, even the query portion of the exercise taps multiple modes of learning. The equivalencies between mathematics and database pedagogy are shown in the following table:

Mathematics	Database
word problem	word problem
pictorial representation	Web site
algebraic formula	SQL create and select statements
graph of algebraic formula	logical database design diagram and query diagram

The key concept is that if the very same problem is presented visually, verbally, and programmatically, then there is a greater chance of the concept being understood through one or more modes of learning.

Reinforce Theory with Practice

When combined, theory and practice reinforce one another. One way to get student buy in is to introduce theory in light of practice. This approach contrasts with more traditional modes of teaching. Many database texts introduce theory then follow it with examples. The approach advocated here introduces the example first and then explains the theory in light of the example. As the example is uncovered, theory is worked into the discussion. If the example is compelling, students will be very interested in understanding the theory behind the example. Internet examples tend to be very compelling for students. MIS students are attracted to the latest trends both out of curiosity and because they realize that their market value increases with their exposure to leading edge technologies.

Work Complete Examples

Students learn best by working through complete examples—from design through to implementation. Programming courses in languages such as Visual Basic, C, or Java almost universally require students to design, write and test their programs. Database texts, by contrast, often present the student with a completely designed and implemented database. The student's only role is to write queries against that database. Database design, if it is introduced, usually appears in a later chapter and even then tends to be a technical discussion of normalization rather than a focus on designing databases to solve business problems. This paper, by contrast, advocates integration of concepts, programming and design. Students work with business problems, design solutions, implement the solutions and then write queries against the solutions. Furthermore, they are given an organized framework in which to report their results—making it very easy for the professor to see where the students need help.

Problems that combine reverse engineering with functional prototyping draw on higher order educational skills

As all Web surfers know, sites constantly imitate the design and functionality of their competitors. To do so requires reverse engineering the competitor's site to understand how it was constructed. In the database course, the subject of interest is both the database behind the Web site and how the Web front-end ties in to the backend database. Reverse engineering is a very important skill that draws on higher order knowledge since the backend design is not always obvious. This is a classic example of problem based learning. What is interesting is that once students have mastered reverse engineering of one type of site—e.g. a retail storefront for Amazon.com—they become very adept at applying that knowledge to similar problems—e.g. a retail storefront for CDNow. Furthermore, by carefully choosing the sites to reverse engineer, the professor can lead the students through progressively complex database designs.

Integration of Concepts contributes to learning

It seems somewhat odd that the computer science and MIS departments sometimes use the very same database texts. Surely there are distinctive features which can and should be introduced in the MIS course. MIS students should be exposed to stories about real database companies, leading edge technical developments in the field (and how they work), and legal/ethical issues in database. The focus of the exposure should be on implications for business. Stories about real world companies could include the stellar rise of Oracle from a mini-computer to mainframe to Internet ready database product. Leading technical developments include the development of the Inktomi search engine used by Yahoo! as well as metasearch engines and graphics search engines. Legal and ethical issues include property, ethical codes (industry standards), SPAM, defamation (putting information in a false light), and data accuracy.

Introducing business topics helps position the MIS database course as a unique experience which is not duplicated in the computer science curriculum. It has the desirable effect of stimulating student interest in and knowledge of a field in which one day they will be professionals. Furthermore, weaving business topics into the database course reinforces other courses encountered in the business core.

Pedagogy

This paper does not try to prove the seven premises above—some of which are substantiated by ample bodies of research while others are based on the experience of the author. Rather the premises are assumed to be true and used to demonstrate a complete Internet example as it would be presented to students in the course.

The professor introduces students to a comprehensive reporting format. The report consists of 8 sections. The first 7 sections concern the design and creation of the database. These sections are all constructed in support of the 8th section, SQL queries. SQL queries are used to extract information necessary to solve business problems.

1) **Problem**—A statement of the problem.
2) **Executive Summary**—A non-technical overview which describes the problem in business terms. Prohibited words in this section include table, file, record, row, field, column, primary key and non-key field. A manager with no IS background should be able to read this section without any trouble.
3) **Technical Summary**—A technical discussion of the design requirements for the database. Included here are discussions of datatypes, tables, fields, etc.
4) **Logical Data Model**—A visual model which represents each table as a named rectangle.
5) **Field List**—Shows the fields for each table and identifies the primary key.
6) **SQL Create**—SQL statements to create the database
7) **SQL Insert**—SQL statements to populate the database
8) **SQL Queries**—SQL statements to extract information from the database in order to solve business problems.

This reporting format is an efficient way to present a database design. It helps professors and students identify and pinpoint errors in design.

9. SAMPLE DESIGN PROBLEM—AMAZON.COM

Amazon.com is an online retailer of books, CDs and videos. Students are asked to reverse engineer the underlying database behind the Amazon Web site. The online retailer must at a minimum maintain information about customers, products, and sales. The sales represent a many to many relationship between customers and products. Thus the design requires at least three tables. The three table design allows for the introduction of the concepts of intersection data, multi-table join statements and complex views. It also allows for the introduction of concepts of data security and data privacy.

Executive Summary

Amazon is one of the most fantastic success stories of the Internet. Jeff Bezos founded the company in 1995. He is now a billionaire. Part of the formula for Amazon's success is relationship marketing. Relationship marketing refers to developing a relationship with the individual customer. Amazon uses advanced technology to develop these relationships. In an old fashioned bookstore, the customer would expect to be greeted by name and to receive recommendations form the proprietor based on the customer's past purchase behavior. Amazon replicates these personal touches, using cookies stored on the user's computer to identify the customer and greet her by name and using collaborative filtering technologies to predict her preferences. Both of these technologies rely on databases. Indeed it is impossible to develop online relationships with customers without storing data about the customer.

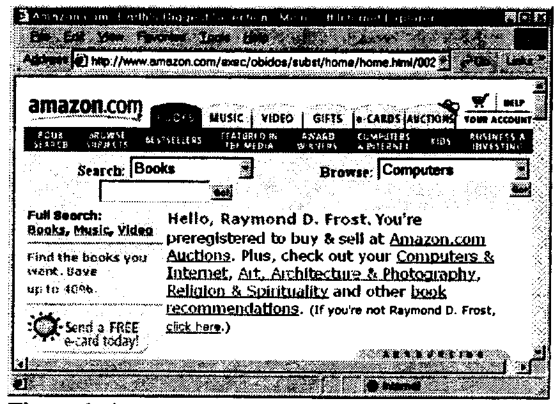

Figure 1 Amazon.com Welcome Screen
source: www.amazon.com

Amazon uses its Web sites to satisfy the following business goals:

1) To develop relationships with customers.
2) To serve as a medium for online transactions
3) To establish community through customer reviews, author interviews and reading group guides.
4) To promote its associates program which remunerates Web sites that drive sales to the Amazon site.

Note that nowhere on their Web site does Amazon list the business goals of the site. Rather students must infer the business goals from a study of the site.

Technical Summary

The welcome screen in Figure 1 immediately reveals two entities in the Amazon database—customers and books. One customer can buy many books and one book may be bought by many different customers. Clearly this forms the basis of a many to many relationship between customers and books. We might be tempted to develop a logical data model that looks like Figure 2.

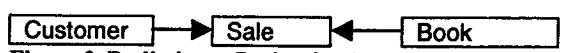

Figure 2 Preliminary Design for Amazon

This design would be fine if Amazon only allowed us to buy one book at a time. However, many Web sites, including Amazon, allow customers to fill up an electronic shopping basket and then check out all at once. The shopping basket is visible on the top right hand corner of the welcome screen in Figure 1. The design in Figure 2 does not allow for a shopping basket. Rather, the design requires that each sale be a separate transaction. We correct the design by including a new entity to represent the shopping basket. The customer fills the shopping basket with sales of books. The final design appears in Figure 3.

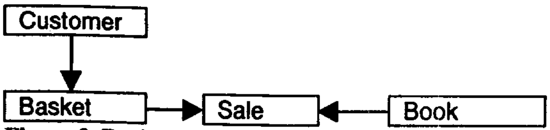

Figure 3 Revised Design for Amazon

Field List

The fields in Figure 4 can be observed or inferred from the Amazon Web site. In order to simplify the problem only attributes indicated by a ✓will be modeled in SQL.

Customer
- ✓ email*
- password
- ✓ last
- ✓ first
- phone
- street
- ✓ city
- ✓ state
- zip

Basket
- ✓ id*
- ✓ customer$email
- ✓ cardtype
- card#
- cardexpires
- dateofsale
- shippingmethod

Sale
- ✓ basket$id*
- ✓ book$isbn*
- ✓ saleprice
- ✓ quantity
- status

Book
- ✓ isbn*
- ✓ title
- ✓ authorlast
- ✓ authorfirst
- year
- currentprice

Figure 4 Amazon Field List

Simplifying the problem by limiting the attributes modeled serves two functions. First, it makes the problem tractable for a student project. Second, simplifying teaches students to separate essential from non-essential elements in a problem—a critical thinking skill.

SQL Create

The SQL create section provides for the tangible implementation of concepts such as datatypes, primary keys, foreign keys, and referential integrity. In evaluating student projects, this section together with the logical data model provide the best reference as to whether the students are on target.

```
create table customer
( email          char(20)   primary key,
  last           char(15),
  first          char(15),
  city           char(10),
  state          char(02) )

create table basket
( id             char(05)   primary key,
  customer$email char(20),
  cardtype       char(19),
  dateofsale     datetime )

create table book
( isbn           char(13)   primary key,
  title          char(30),
  authorlast     char(15),
  authorfirst    char(15) )

create table sale
( basket$id      char(05)   references basket(id),
  book$isbn      char(13)   references book(isbn),
  saleprice      decimal(6,2),
  quantity       integer,
  primary key (basket$id, book$isbn) )
```

SQL Insert

The value of having students include their insert statements is for debugging purposes. One of the most common errors that students commit is accidentally truncating character strings. These errors can be traced back to the insert statements.

SQL Queries

Query 1—Show the contents of the database. This is always the first query required since viewing the database contents is the only way to evaluate the correctness of all other queries.

```
select * from customer
select * from basket
select * from sale
select * from book
```

customer

email*	last	city	state
archere@gwu.edu	Archer	Washington	DC
jmason@stanford.edu	Mason	Palo Alto	CA
suarezm@miami.edu	Suarez	Miami	FL
taylorm@baylor.edu	Taylor	Waco	TX

basket

id*	customer$email	cardtype	dateofsale
10001	archere@gwu.edu	VISA	Sep 9 1999
10002	taylorm@baylor.edu	AMEX	Sep 22 1999
10003	suarezm@miami.edu	AMEX	Sep 25 1999
10004	archere@gwu.edu	AMEX	Oct 3 1999

sale

basket$id*	book$isbn*	saleprice	quantity
10001	0670882259	12.00	4
10002	0140265686	11.00	1
10002	0316601950	8.37	2
10002	0380712520	10.50	2
10003	0060256656	10.47	1
10004	0316601950	8.37	2

book

isbn*	title	authorlast	authorfirst
0060256656	The Giving Tree	Silverstein	Shel
0140265686	Out to Canaan	Karon	Jan
0316601950	The Pilot's Wife: A Novel	Shreve	Anita
0380712520	Don't Know Much About History	Davis	Kenneth
0670882259	At Home in Mitford	Karon	Jan

Query 2—Show the total sales figure for Washington, DC. Organizations often summarize regional sales figures in order to identify problems or market opportunities. This query seeks the regional sales figures for Washington, DC.

```
select  "Total DC Sales" = sum(sale.quantity)
from    customer, basket, sale, book
where   customer.email = basket.customer$email
and     basket.id = sale.basket$id
and     sale.book$isbn = book.isbn
and     customer.state = "DC"
```

Total DC Sales
6

Query 3—Show the total sales for each book listing the most popular books first. This query loosely corresponds to the Amazon sales rank which appears for each book. Such information is useful for customers interested in purchasing best sellers.

```
select  book.title, "number sold" = sum(sale.quantity)
from    basket, sale, book
where   basket.id = sale.basket$id
and     sale.book$isbn = book.isbn
group by book.title
order by "number sold" desc
```

title	number sold
At Home in Mitford	4
The Pilot's Wife: A Novel	4
Don't Know Much About History	2
Out to Canaan	1
The Giving Tree	1

Sequence of Projects

The Amazon project is actually the third project to which the students are introduced. The title of the Amazon section is many to many relationships. The section covers how to design and query many to many relationships. In addition the section also introduces normalization.

The course begins with one table databases using registration at RealNetworks as an example. The RealNetworks section covers proper design of a database table, naming conventions, primary keys, entity integrity, and basic SQL.

It then proceeds to one to many relationships using the Delta Airlines flight information database as an example. The Delta Airlines database requires a one to many relationship since there is both static and dynamic information about a given flight. Therefore the design requires two tables. The two table design allows for introduction of the concepts of foreign keys, referential integrity, two table join statements and views. Delta Airlines is followed by the Amazon project. After Amazon comes eBay, an online auction house which presents its own design challenges since the very same person can be both a buyer and a seller at the auction site.

Further in the course, students may be asked to construct a functional prototype of the front-end application. Ideally students would be able to reproduce exactly what they see on their Internet browsers—thus building their confidence that they can design and build databases for the information age.

4) CONCLUSIONS

So how successful is the pedagogical approach described above? The author has taught the database course for ten years. Never has he experienced such an enthusiastic reaction from the students. This alone might have made the experience worthwhile but there were also a number of other positive observed outcomes:

1) The professor was able to shift his pedagogical style from lecture to discovery learning. Most class sessions began with a short lecture followed by group work at workstations. The professor traveled from group to group assisting with questions. If a group discovered a particularly meaningful insight to the problem the professor would interrupt class to share their discovery with the other groups. For example, in the Amazon problem the entire class worked with the simple design of figure 2 until one group discovered that the design required each item to be purchased as a separate transaction. That group introduced the shopping basket as a separate table and the professor shared their discovery with the class.
2) The group dynamics were exceptionally positive. Since each group member had the opportunity to interact with the Web site being modeled, they each formed opinions about the problem solution and engaged in constructive debates.
3) The reporting format generated exceptionally high quality student work. Students worked very hard to imitate the reporting style and in the process they often uncovered their own design or implementation errors.
4) The professor was able to integrate more MIS and business concepts than ever before since these became essential to solve the problem at hand. For example, in the case of the Delta flight information database, it became essential to know how airlines schedule flights. How many cities can be linked by the same flight number? How often do flights fly? What is the domain of possible flight status values?
5) Students were able to generalize knowledge better than the professor had ever witnessed before. Once they had mastered one retail storefront, they were able to model other storefronts with relative ease.
6) Student performance on exams was improved as well. Concepts such as normalization and

referential integrity were no longer vague academic inventions, but rather practical design tools in the student's portfolio.

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Using the OSI Model to Teach Telecommunications

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Abstract

Teaching Telecommunications is made more difficult by the extremely broad topic area and the large number of devices, technologies and software used in the field. The problem is how to get a handle on this enormous body of information and reduce it to an organized, understandable body of knowledge. This paper is not a tutorial on telecommunications nor a defense of this model over any other model but a presentation on how the use of the Open System Interconnect Model (OSI), as an organizational tool, can benefit the student and the instructor. While other models could be used, none is as completely segmented and modularized at each layer. This concept is crucial to separating functionality, which is also taught religiously in all of our programming and systems classes. This is also not a complete Introductory or Advanced Course, with all the other coverages each would require. Rather, this is a focussed approach aimed at demonstrating the Telecommunications PROCESS. This approach could be used in either an Introductory Course or an Advanced Course. It is used in all courses I teach at both the undergraduate introductory, undergraduate advanced and the graduate levels. It varies the depth of coverage based upon the course objectives.

Keywords: OSI, open systems interconnect model, telecommunications.

1. BACKGROUND

The Open System Interconnect Model (OSI) is a great tool for this organization. While TCP/IP has become the protocol of choice, OSI has become the model for understanding and communicating telecommunications concepts. Most new technologies are constructed to be compliant with the OSI Model. In the future, OSI will embrace TCP/IP and the two will probably merge toward future protocol integration. But that is another paper. This one will focus on the use of OSI Model in communicating an understanding of telecommunications to the student.

One of the primary advantages of the OSI Model is that it covers all portions of the telecommunications process. It was designed to separate the functions of the telecommunications process into layers that could be designed and implemented independent of each other. This would allow different groups to develop products at each layer. The user can then select the products that best fit their individual needs. This demonstrates the modularity of telecommunications and reinforces the modularity of programming and systems development taught inmost modern CIS programs. Once we show the modularity, we can then demonstrate products at each layer to our students.

2. THE OPEN SYSTEMS INTERCONNECT MODEL

The OSI Model is divided into seven layers. Each layer can function independently from the other layers as long as they are designed to follow the standards. The lower numbered layers are closest to the physical medium of transfer, while the higher layers are more logical and become part of an operating system or a functional call from the operating system. The layers of the Model will be presented and then the remainder of this paper will deal with the use of these layers in teaching telecommunications. A brief description of the layers follows:

1. **Physical Layer** - responsible for placing bits on the medium and removing bits from the medium. Though actual medium is not part of this layer, each physical layer protocol is medium dependent.
2. **Data Link Layer** - responsible for the node-to-node error free delivery of messages. This includes error detection and error recovery.
3. **Network Layer** - routes the message through the system from entry to exit on the network. Only responsible for routing systems but uses a number of different techniques in the routing process.
4. **Transport Layer** - provides the end-to-end control for the telecommunication connection. It can guarantee the communications process and is responsible for insuring error free communications, if requested.
5. **Session Layer** - provides the management of the session between applications at each end of the communications process. It controls dialog, restart and recovery as defined by the user.
6. **Presentation Layer** - provides translation of coding and hardware between machines with

different architectures and "user selected" compression and encryption.

7. **Application Layer** - provides a user interface and sub-programs to help the user develop programs and systems. It provides an interface layer between its own sub-programs that functions similar to a mini-operating system. This allows the user to develop systems from functions that can call each other when needed.

This OSI Model presents, and modularizes, all aspects of the telecommunications process. It also gives us the organization needed to cover such a broad area. Without this organization, we end up with a shotgun approach, which most texts still use. Unfortunately, most authors confuse the ability of the model to explain with the fact that TCP/IP dominates the US market. We will now walk through the model showing how we can teach telecommunications at any level.

3. PHYSICAL LAYER

The Physical Layer starts us off with a discussion of how data is put on a medium. We discuss bits vs bytes and the framing of each. Asynchronous vs synchronous communications refers to the framing of characters vs the framing of messages. Directionality of a medium teaches the differences between simplex, half-duplex and full duplex communication. When talking about half and full duplex, we can also bring in the difference between line capability and software implementation.

Analog and digital communications systems can be discussed. Analog can be related to the student's modem. This is a good time to discuss some of the set up parameters of their modem. Digital systems can be discussed and related to the better quality of transmission and reception. A full discussion of analog modulation techniques and digital coding systems takes place here.

Next is a discussion of media. Broadband and baseband signaling are discussed and their application to each medium is discussed as we cover the medium. The order can change but we need to talk about twisted pair, coax, fiber and the various forms of wireless communications like microwave, satellite and infrared. Each medium should be related to their speeds, advantages and disadvantages. Frequency, time and statistical time division multiplexing is presented here to show how the various media can be used more efficiently and the trade-offs in the different techniques. The various services like ISDN and xDSL teach the student the extended capabilities a media can achieve. It is also a good time to discuss the capability and requirements of "channelizing" fiber.

We must discuss coding systems. How speed of transmission is affected by byte size and how their representation limitations and capabilities change in terms of their ability to carry information. An understanding of ASCII and EBCDIC is necessary here so architecture of machines can be explained when we get to the Presentation Layer.

4. DATA LINK LAYER

The Data Link Layer is divided into the Media Access Layer (MAC) and the Logical Link Control Layer (LLC). The closeness of the Data Link Layer to the Physical Layer is discussed. The student needs to understand that each Media Access Layer Protocol is tied to a physical medium.

The Media Access Layer is responsible for encoding and decoding the data on the specific medium and uses the addressing of that medium for communicating. Various protocols can be discussed including bit and byte oriented protocols. For coverage of most protocol methods, I use the BISYNC, DDCMP and HDLC protocols.

BISYNCH is an example of byte oriented protocols. It also shows the link control bytes available in standard coding systems and how their bit representations change. It also introduces the concept of transparency of data and how it is accomplished. ACK/NAK flow and error control is discussed and demonstrated.

Digital's DDCMP is used to demonstrate a byte count oriented protocol, which eliminates the need for transparency methods of other protocols. It introduces the concept of sliding window protocols. It also introduces high limits on flow of messages and introduces control and message format combinations. The high limits on the sliding window lend themselves to discussions on overcoming satellite propagation delay. Selective Reject and Go Back N methods are demonstrated and contrasted. Both buffer management and error control are discussed in terms of complexity of programming and memory needs.

HDLC is used to show bit-oriented protocols. HDLC adds control functions to control the link, which the others lack in the amount of control available. Bit stuffing for transparency is also demonstrated.

An important concept in using these protocols is the ability of protocols to allow multiple messages to be transmitted without acknowledgments. This is covered in the protocol error control methods of ACK/NAK, Go Back N, and Selective Retransmission. Error detection is covered with various forms of parity checking and the cyclical redundancy check. Frame Relay and Cell Relay error handling is contrasted at this time with the emphasis on where some of the speed gain is derived.

Though a Network Layer concept, network topologies is introduced here to facilitate the discussion of the OSI 8802 (IEEE 802) protocols. The student needs to understand the topologies of the Bus and Ring at a minimum. Star, Hierarchical and Mesh topologies are easily covered here to complete the topic.

The OSI 8802.x (IEEE 802.x) protocols are introduced and .3, .4 and .5 are covered in depth with their inherent incompatibilities discussed. 8802.6 is discussed in less detail as mentioned below. Students are encouraged to decide on how you could translate between them before bridges are introduced. Low level bridging to overcome these obstacles is discussed which leads us to the LLC and 8802.2 and 8802.1.

The Logical Link Control Layer (LLC) shows how message encapsulation works. This allows us to transfer data from systems with differing package, control and message limitations. We can use a transfer from 8802.3 to 8802.5 to demonstrate the bridging concepts in detail. 8802.6 lets us discuss Metropolitan Networks. While important in later courses, I find introductory students have difficulty differentiating between LANs, WANs and MANs due, I think, to the quantity of material covered at this level. In higher level courses, the students do not have the same problem.

5. NETWORK LAYER

The Network Layer demonstrates how messages move through a network. Networking concepts like Circuit Switching, Message Switching and Packet Switching are covered as is Connection-oriented and Connection-less systems. Network design concepts are presented including the requirements for both Static and Dynamic networks. Network control methods of centralized, de-centralized and independent control are covered.

The telephone company is used as an example of circuit switching and IP is used as an example of the packet switching. A crucial concept is demonstrating how packet switching, IP style, does not insure delivery of messages and the increased delay in determining lost messages while circuit switching insures order and quick detection of lost messages at the expense of a less robust system. The problem of downed nodes shows the student these differences.

The effect of the delay elements in setting up circuits (when not leased) vs packet switching demonstrates how throughput times for very large message blocks and very short message blocks may determine your networking strategy.

6. TRANSPORT LAYER

The Transport Layer, in the OSI Model, is based upon the type of underlying network in terms of lost messages and network stability. The OSI classification of networks is discussed and the Transport Protocol appropriate to each layer is reviewed. While OSI has five different transport layer protocols, the "TCP/IP" has only two which cover some of the OSI concerns. TCP and UDP are discussed and how they handle transmission errors is covered.

Some important concepts in this layer are the recovery of lost messages and the discovery of duplicated messages from lower layer problems. This layer is also responsible for insuring that the type of connection requested by the user appears to have been made. This means packet switched or data gram networks must be buffered and message streams sequenced to appear like circuit switched connections, if that is the requested form of connection. This layer is responsible for recovery of short-term network failures, which is why TP4 is so much more robust than TP0.

Though Quality of Service (QOS) is in place at all levels in OSI, it is introduced here and the exchange of information between the network and the transport layers is discussed. The students seem to understand the concept better when introduced here and then related through the different layers. The main QOS discussed in the lower classes deal with time delays and error reporting so the student can determine the robustness of the underlying network and see how each of the TP protocols can increase throughput dependent upon network status.

Relating Time Delays in the network to Time Outs, both in the network and at each end of the transmission, gives the student a better feel for the network traffic issues. Discussing Error Rates and Probabilities of not connecting or delivering messages help the student understand the issues of retries.

The Transport Layer is also responsible for multiplexing connections and the need for multiple buffers and management of these buffers is discussed. The problems of Crash Management of the connection and the increased buffer management problems are also covered here.

7. SESSION LAYER

The Session Layer, in the OSI Model, was the one unique contribution to the telecommunications knowledge at the time of its introduction. It must set up, manage and disconnect the "logical" connection between applications on each host machine. It is not the delivery management of the Transport layer but the interaction between the two, or more, host applications that must be managed while managing other application connections. It must also handle "graceful disconnects" where both ends are aware of the place of disconnect. It does this through the use of synchronization services, which maintain a rollback and restart resychronization point during the exchange of data.

The Session layer provides for control of flow and dialog through the use of tokens. The administration of the token system can increase or decrease a particular connection's speed and allow a multi-user system to regulate the speed of each connection based upon network resources and demand.

Quality of service is addressed here to show the need for inter-layer communications. The inter-layer communications can determine the TP protocol requested and the least acceptable level. How this is negotiated through the network between host systems is demonstrated.

8. PRESENTATION LAYER

The Presentation Layer is responsible for "form and format" of the data interchange. It can change coding systems, modify machine architecture data forms (through the use of ASN.1) and provide "user selected" encryption and compression.

Through code transformation, the student can see some of the differences in machine architecture (ASCII vs EBCDIC). Discussion of the various forms of floating point storage adds to this understanding. While ASN.1 is not covered in depth, it is presented to show the flexibility of the model.

It is important to show that data encryption and compression are "user selected" options at this layer. Hardware encryption and compression is independent of the model definition and occur at the physical layer. The user who needs to insure that their messages remain secure and/or compressed must select it at this layer because some network segments may not have encryption and compression as their standard. It also allows for further security independent of the network traversed.

9. APPLICATION LAYER

The Application Layer is one of the most misunderstood layers in the OSI Model. Many assume it is the application itself and, in fact in preliminary versions of the model, it was vague enough to lead to this conclusion. As the Model evolved, it became clearer that the layer was a "user environment" where pre-defined functions or services would be developed. There is even a "service" to control multiple services. This last concept is only for the OSI entrenched so it is only covered in higher level courses.

The primary services covered in all classes include the following:

1. Remote Transfer Service Element (RTSE), the guaranteed delivery service.
2. Remote Operation Serve Element (ROSE), invokes applications on remote systems
3. Commit, Concurrency and Recovery (CCR), which guarantees the complete updating of multiple databases or the roll back of transactions that do not successfully complete their updates.
4. Job Transfer and Manipulation (JTM), transfers an entire job stream to a remote system for execution on a faster or less loaded system.
5. File Transfer Access Management (FTM), provides movement of files and data across the network.
6. Virtual Terminal Services (VT), provides the means to insure data displayed at one end of the communications will be displayed the same at the other end.

The VT function was originally a major portion of the Presentation Layer but was moved after presentation functions became more standardized. This demonstrates that the model is not static but changes with changes in the environment, though very slowly.

The use of multiple service elements in combination is explained by using the RTSE to send a ROSE. ROSE is unacknowledged service so the use of RTSE would guarantee the delivery of the ROSE request. At this point, many systems can be discussed which could use these OSI functions.

10. ADDITIONAL COVERAGES

The OSI Model is presented as the vehicle to understand the telecommunications process. In addition to this coverage, we must also cover various telecommunications services and devices. It is beyond the scope of this paper to define the other coverages.

11. SUMMARY

This paper has presented an approach to teaching telecommunications. It is viable at all levels but is especially beneficial at the introductory level. This was not a tutorial and it could be expanded to cover an entire book. Many concepts are not detailed in their coverage in this paper but the reader should be able to understand where, in the OSI Model, they belong. The paper also does not include all the hardware, such as facsimile machines, and software, like management software, because it is not a complete course outline or coverage. Rather, it gives a structure to understand the communications transfer and allows the instructor the freedom to wrap their own unique approach and coverage of other aspects of telecommunications.

This approach can be used at the introductory level as presented or can be pushed to deeper levels dependent upon the course and level of student audience. For example, in a LAN course, the details of LANs are emphasized and the lower three layers would be tailored for LANs. Mesh networks, satellite and microwave transmission system systems would be de-emphasized. Network routing would be de-emphasized and bridging increased. For a WAN course, bus and ring systems would be de-emphasized and network routing emphasis would be increased at the expense of bridging. Satellite and microwave systems would get much more emphasis. The interplay between the Network and Transport Layers would gain importance and you would have a deeper discussion of the Quality of Service reporting and the negotiation of services process.

In conclusion, the OSI Model is rich enough to allow any course in telecommunications to be tailored around the levels most appropriate for the course. The reiteration of the model in each course emphasizes to the student the value of modular telecommunications development and the value of compatible protocols. As a teaching tool, the OSI Model is unsurpassed.

12. References

There are very few really good references for the OSI Model. Many authors are inaccurate in their descriptions but the best of the best is the one listed below. While it is an older book, it is still one of the most accurate. It is too much for a single course, except a course specifically on the OSI Model, but it is a very good source for any course.

Black, Uyless, 1991, OSI, A Model for Computer Communications Standards, Prentice Hall, New Jersey:.

ONE MODEL OF IS DEPARTMENT/INDUSTRY RELATIONS

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Abstract

The MIS Department at California State University, Sacramento has been following one model of relationships between the faculty of an IS Department and the business community for the past three years. This paper describes this model of relationships and provides a summary of three years using this model.

Keywords: Industry relations, information systems departments, models

1. INTRODUCTION

This paper presents a framework for creating stronger working relationships between the faculty of an IS Department and the business community. We call this the Annual Corporate Affiliate Program. In the next section, the goals of the Annual Corporate Affiliate Program are presented. This is followed by a description of the expectations made for both sides of the relationship. The fourth section presents a typical scenario for this relationship. The fifth section discusses the first three years of the Annual Corporate Affiliate Program. Finally, an overall assessment is made of the program.

2. GOALS OF CORPORATE AFFILIATE PROGRAM

We originally established four goals for this program. These are described below:

1) Provide recognition to corporate affiliates
   The placement of recognition plaques on faculty office doors and within the MIS Department office allows the MIS Department to display its recognition of key corporate affiliates. Further recognition would be in the form of public acknowledgment of the support given to the College of Business and the MIS Department by the corporate affiliates. Corporate affiliates would also be recognized at the annual College of Business Awards Banquet.
2) Provide corporate exposure to students
   The placement of recognition plaques on faculty office doors directly raises the visibility of the corporate affiliates to the MIS students, as well as other students. This name recognition, and the associated linkage to the MIS faculty member, raises the interest of the students concerning the faculty affiliates. This interest level directly affects the recruitment efforts of the corporate affiliates.
3) Raise discretionary funds for the MIS Department
   Discretionary funds are critical for the MIS Department. These funds allow the department to acquire key hardware and software technologies, hire student assistants, and support faculty professional development. This program would provide a recurring source of key discretionary funds for the MIS Department.
4) Raise faculty participation with local industry
   Faculty need opportunities to keep in touch with local industry, and this proposal provides additional incentive to become more involved. This involvement will directly influence activities and discussions that occur in the classroom.

Shortly after establishing the above four goals for this program, one of the original industry participants suggested an additional goal. This was brought before the other participants and it was adopted as the fifth formal goal of the program. This fifth goal is:

5) Raise scholarships for MIS students.
   Scholarships would help selected students focus more on their studies than on part time

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employment. This would help students, and provide even more name recognition for the corporate affiliates.

3. EXPECTATIONS

Each side of the IS Department/Industry relationship provides some benefit to the other side of the relationship. It was agreed that a clear understanding of what was expected from each side was critical to the potential success and long run viability of the program.

MIS Department
The expectations of the MIS Department (or what the MIS Department is to provide) are as follows:

1) Recognition plaque on faculty member's door.
   This is a simple plaque on each participating faculty member's door indicating their participation with a corporate affiliate. This supports the goals:
   - *Provide recognition to corporate affiliates.*
   - *Provide corporate exposure to students.*
2) Corporate name plate added to MIS Department sponsor plaque.
   The MIS Department Office maintains a plaque listing all corporate affiliates. This supports the goals:
   - *Provide recognition to corporate affiliates.*
   - *Provide corporate exposure to students.*
3) Single faculty member point of contact within the MIS department
   This is one side of the key characteristic of the program. Each side of the relationship must identify a single point of contact for the program. This greatly improves the channels of communication. This supports the goal:
   - *Raise faculty participation with local industry*
4) Named table at the Spring College of Business awards banquet
   Our College of Business has an annual awards banquet with an attendance of over 500 people representing students, faculty, scholarship sponsors, industry representatives, etc. A table named for the corporate affiliate at this event supports the goals:
   - *Provide recognition to corporate affiliates.*
   - *Provide corporate exposure to students.*
5) Space for a company representative at an undergraduate student advising seminar
   Our Department has an annual advising seminar for our majors that focuses on the student's ability to gain career and curricular advice from both industry representatives and faculty. A named table at this event supports the goals:
   - *Provide recognition to corporate affiliates.*
   - *Provide corporate exposure to students.*
6) Acknowledgment of support at events and in publications of the University, College of Business, and MIS Department.
   We provide recognition to our corporate affiliates in all official publications of our college and university. We also try to provide recognition to our corporate affiliates at any department or college event. This supports the goals:
   - *Provide recognition to corporate affiliates.*
   - *Provide corporate exposure to students.*
7) Access to students interested in cooperative education and internship opportunities
   While we can not restrict access to valid cooperative education or internship opportunities to certain organizations or certain students, we can be more active in promoting these experiences with our corporate affiliates. This supports the goals:
   - *Provide recognition to corporate affiliates.*
   - *Provide corporate exposure to students.*

Corporate Affiliate.
The expectations of the corporate affiliate (or what the corporate affiliate is to provide) are as follows:

1) Annual minimum donation of $5,000
   This contribution supports the goals:
   - *Raise discretionary funds for the MIS Department.*
   - *Raise scholarships for MIS students*
2) High level point of contact (VP, CIO, Director, IS Manager, etc.)
   This is the other side of the key characteristic of the program. Each side of the relationship must identify a single point of contact for the program. This greatly improves the channels of communication. This supports the goal:
   - *Raise faculty participation with local industry*
3) Annual attendance at advising seminars
   This helps add value to our annual advising seminar for our majors. A named table at this event supports the goals:
   - *Provide recognition to corporate affiliates.*
   - *Provide corporate exposure to students.*

4. SCENARIO OF A CORPORATE AFFILIATE

The following is a sample scenario for our Annual Corporate Affiliate program. Assume that one of our corporate affiliates is American Management Systems (AMS)[6]. AMS would provide a specific corporate point of contact (at the Regional Vice President level), Mr. X. The MIS Department would designate a faculty member to be the point of contact for AMS, Prof. Y.

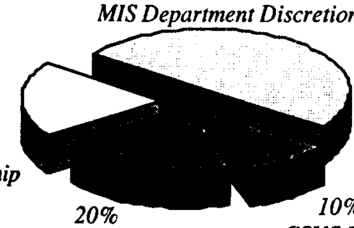

Figure 1. Allocation of Corporate Affiliate Funds.

AMS would also donate $5,000.00 to the MIS Department. These funds would be distributed as shown in Figure 1.

1) Scholarship Named for Corporate Affiliate. The Corporate Affiliate is responsible for setting the minimum qualifications for the scholarship to an MIS student. In this case it would be the American Management Systems Scholarship for $1,000.
2) $2,500 would be sent to the MIS Department Discretionary Fund for general support for the mission of the MIS Department.
3) $1,000 would be set aside for Prof. Y – the sponsored faculty member. While technically part of the MIS Department discretionary funds, the requests of the faculty member would have priority for the use of these particular funds
4) $500 would be sent to the University Fund. According to our university policy, 10% of all donated funds must be allocated to this fund, which is used to support the general mission of the university.

Prof. Y would advise Mr. X of MIS Department activities (e.g., student advising day schedules, student presentations of key projects, student group activities, etc.). Mr. X would advise Prof. Y of the opportunities and technical issues being faced by American Management Systems. Activities of AMS that might be of interest to MIS students could be announced through Prof. Y. Figure 2 shows a sample plaque for Prof. Y's office door (wording subject to change).

[6] American Management Systems has been a Corporate Affiliate for several years.

5. FIRST THREE YEARS

This model developed from earlier, loosely organized attempts to establish sustained relationships with major employers of our graduates. By establishing this model, we expected to build a strong framework and basis for strengthened relationships with these key firms. Two major contributors to this framework were Chief Information Officers for large organizations in our region.

1996 Participation.
The MIS Department had four Corporate Affiliates for 1996. These were AAA, BBB, CCC, and DDD. Each of these organizations contributed $5,000 to the MIS Department during Spring semester 1996. The $20,000 raised by the MIS Department through the Annual Corporate Affiliate Program enabled the department to invest in several areas that directly benefit MIS students. For 1996, the major investments were:

- Improving the classroom infrastructure for one classroom. This included the installation of a computer projection system.
- Purchasing portable hard disk drives to support students doing work with Powerbuilder and Oracle environments. By lending students these portable hard disk drives, they can use their own computers to meet the course requirements. This greatly reduced the demand on the limited resources that are housed in the MIS student labs, and allows more students access to advanced courses.
- Providing four $1,000 student scholarships.

1997 Participation.
The MIS Department had three Corporate Affiliates for 1997. These were AAA, BBB, and DDD. Each of these organizations again contributed $5,000 to the MIS Department during 1997. The $15,000 raised by the MIS Department through the Corporate Affiliate Program was combined with funds allocated by the State and invested in several areas that directly benefit MIS students. The major investments made by the MIS Department were:

- Improving the classroom infrastructure for two classrooms. This again involved the installation of computer projection systems.
- Providing three new computer systems for classrooms and one for use as a server for the MIS student lab.
- Providing three $1,000 student scholarships.

1998 Participation.
The MIS Department had only one Corporate Affiliate for 1998, BBB. BBB again contributed $5,000 to the MIS Department during 1998. This money was used for:

- Obtaining internal hard drives with mobile docking bays. These units are configured with software used in MIS courses and then checked out to MIS students. This provides greater student access to necessary software than is available through the university computer labs.

- Providing one $1,000 student scholarships.

6. ASSESSMENT

The original proposal for the Annual Corporate Affiliate Program, there were four goals identified. The fifth goal of raising scholarships for MIS students was quickly incorporated into the program based on the suggestion of one of the first Corporate Affiliates. These five goals are discussed below.

Provide recognition to corporate affiliates.

The recognition plaques placed on faculty office doors and within the MIS Department office, allow the Department to acknowledge corporate affiliates. Further recognition of Affiliate support was made in the form of public acknowledgment in the Business Futures magazine, the university Journal, and at the annual School of Business Awards Banquet.

Provide corporate exposure to students.

Corporate Affiliates were featured on our MIS department web page of recruiters (accessible through our home page at www.xxx.edu/mis). This exposure is further enhanced by the attendance of the Affiliates at the three main events of the year (Awards Banquet, Advising Seminar, and the MIS Convocation).

Raise discretionary funds for the MIS Department.

The funds that were raised by this program allowed the MIS Department to invest in critical areas that are necessary to the curricula. These areas would not otherwise have been supported if the department relied solely on budget allocations from the university and the College of Business Administration. Had these funds not have been available, either the investments listed above would not have been made or the resources would have to have been taken from other critical needs (such as faculty development or student assistants).

Raise faculty participation with local industry.

For the last two summers, MIS faculty have participated in an internship program with our corporate affiliates. All junior faculty in the department have experienced faculty internships through the corporate affiliates. This experience was positive for all involved, and continues to enhance classroom activities and discussions.

Raise scholarships for MIS students.

Over $8,000 in scholarship funds have been awarded to MIS students in the last three years. They are named after the sponsoring corporate affiliate and are publicly awarded at the annual Spring Awards Banquet.

7. SUMMARY

MIS Department Corporate Affiliates have included four different firms. Through their participation in this program, each of these organizations has made significant contributions to the curricula and academic environment provided by the MIS Department. More importantly, their contributions directly enhance the experiences all MIS students.

Unfortunately, we have seen a major decline in participation. This is due to a variety of reasons, but the two main causes are corporate moves out of the region, and sudden transfers of the points of contact. We have not abandoned this program, and we look forward to entering the 1999 academic year with four Corporate Affiliates.

American Management Systems, Inc.

is proud to recognize

Y, Ph.D

As Our Faculty Affiliate

Figure 2. Sample plaque for faculty member's office door.

Bringing Industry and Education Together: A Case Study

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Abstract

This paper describes a cooperative effort between users of training evaluation data within a major consulting firm and faculty at a large public university. Each of the parties concerned provided talents necessary to the completion of the project. Specifically, project management at the consulting firm was familiar with the data domain and the organizational culture while the primary faculty member involved was familiar with data storage and relational database techniques. Together these individuals addressed five key concerns with regard to the Training Evaluation System involved: 1) year 2000 compliance, 2) front-end control of data entry, 3) training/procedures for personnel, 4) nomenclature within the organization, and 5) user needs for the data. This paper reviews the project and describes the benefits derived.

Keywords: Case study, survey data, data integrity, industry alliances

1. BACKGROUND

A global consulting firm, with over 75 years in business serves several service areas and market niches. One of those areas is survey research; specifically, survey design, development, analysis and evaluation. In a given year, hundreds of sessions of various courses are taught. These courses are offered both internally and externally. At the end of a course session, a survey is given to the students with the intent of providing feedback on the course, material and instructors. In most cases, sessions have standard surveys (evaluations) which are answered by a given session of students. To aid in the processing of the standard surveys, a SQL-Server database was implemented. Together with its Visual Basic front end, this system is known as the Training Evaluation System (TES).

The Training Evaluation System (TES) was developed in 1994 to store, analyze, and report on training **evaluation** survey results. TES went into use in mid-1995 and currently contains more than 6,700 data sets for courses

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and other evaluation projects. The analysis that TES produces is used to evaluate the performance of instructors, the timing of the course (too short/long), the content as it relates to the industry/business and to fulfill Continuous Professional Education (CPE) requirements.

2. DATA ACCURACY CONCERNS

TES runs on a MS SQL Server database having normalized table structure (Figure 1). The data is eventually needed, however, in flat file format for statistical analysis using SPSS. The data has been historically retrieved using an application that is designed in Visual Basic (VB). Although not a critical concern for the short term, the current application is not year-2000 compliant.

Neither the VB front-end nor the SQL Server back-end has been designed to enforce integrity rules. For example, scale codes are used to represent a given scale. For a given scale code there should only be one scale. However, the system has allowed a user to enter the same scale values for multiple scale codes. To illustrate, scale codes 5A, G and K all represent the given set of response values: 5 = Excellent, 4 = Above Average, 3 = Good, 2 = Below Average, 1 = Poor. Furthermore, once a scale code is assigned, it can be altered by the end user, compromising data already in the database.

Another area of concern with the TES System is the proper training/use of the system. Paper-based surveys are shipped to the office that houses the TES system. There are no written procedures in place to govern processing of the surveys. For example, no quality checks are established to ensure that the course number and name listed with the surveys are correct. To further complicate matters, there is turnover of personnel. Turnover is not uncommon in a large organization, but each person who leaves takes a piece of knowledge or lessons learned about the system with them. The fact that data integrity is not declarative and not controlled by the system means that it must be controlled by the user. The lack of written procedures for the system leads to word-of-mouth control, making the processing more prone to errors and contributing to a lack of data integrity. The ultimate result of the lack of this quality assurance is the loss of valuable data as well as storage of inconsistent or mislabeled data. Some data has been stored with no way of tracking the owner (i.e., different business units or service lines). This lack of identification causes problems in producing accurate data for identifying trends.

Another factor that contributed to the mislabeling of data is nomenclature. For example, one course can have many sessions. A session can be called a conduct or a course can be called a conduct. There is not a clear understanding of how to define the owner of the data. Over the five years that the TES system has been used, the tracking of the owner has changed. Data are tracked in many ways: by the person who sent the data in, by the participants business unit to or by the participant's service line (i.e., accounting, finance, etc.).

The keys defined in the model are another source of confusion. The compound key used in the data model to store the course data is not consistent (see Figure 1). If the user wants to extract the participant's responses, then a compound key of CourseNum, CourseDate and SeqNum is used. However, if the user wants to extract the question or the associated scale code for the question, then a compound key of QuestareCrsNum, QuestareSeqNum is required. The corresponding values of the course (CourseNum and QuestareCrsNum) and sequence numbers (SeqNum and QuestareSeqNum) which should be the same within one record, are not always the same. This use of synonyms and homonyms in the model is one that causes user confusion, increased storage space and greater chance for error in the data extraction.

3. THE CLEAN UP

Highlighting the major challenges of this project aided in the development of steps needed for the 'cleaning up' of this data (Figure 2). The cleaning efforts were very labor intensive and were concentrated in four domains: 1) understanding the original database domain and design, 2) acquiring access to a non-production copy of the database and enhancing and cleaning it, 3) writing programs which would prepare the clean data for use by the statisticians, and 4) considering and documenting the appropriate changes for use in the future. We had management support throughout the process and we learned to be good detectives.

There were many lessons learned in this project. We relied heavily on the existing documentation, especially the original data model. One of our goals in this project was to provide the necessary additional documentation. By taking detailed notes of our progress, we were able to understand the magnitude of the project as well as understand how to approach cleaning.

Second, to clean the data we realized that we might make mistakes. Based on secondary information available to us within the organization, we might identify a course one way, but a month later another piece of information might reveal that the course was misidentified. So we needed to "leave a trail." By leaving a trail, we chose not to change the original data such as course number, course date; instead we created new fields with the correct data associated with the original data. By using this approach, no data was lost. For example, there are fields called CourseNum and QuestareCrsNum. We created a counterpart called CourseNumberClean that we populated with the correct course number. We added fiscal year as a new field instead of editing existing date fields.

In addition to cleaning the data, we needed to identify additional variables that needed to be stored with the data. These key variables were ones that had to be correctly identified before the data could be used. For example, the current TES data are stored by course. Course number is not the smallest element of this object. Course can further be split by session. Two sessions of the same course can be delivered by different instructors. If there is no distinction between session A and session B for course 123 then there is no way to determine that instructor 1 was doing an excellent job and instructor 2 was doing a poor job because data are aggregated by course 123.

Perl programs were written to convert normalized data into flat files that could be manipulated by SPSS. This was a particularly interesting part of the process as the industrial partner best understood the nature of the data whereas the academic partner best understood the programming language. Perl works best with records that can be uniformly characterized. For instance, you cannot define fields containing spaces and then define the field delimiter as spaces as well. In some cases a course number involved six digits, in other cases, it had five characters that included letters of the alphabet. In many cases fields were left blank altogether. Obviously, it was imperative that no records were lost, but the data for every response for every respondent for every session of every course was very large and the input of the data was uncontrolled and unpredictable.

The final components of cleaning had to do with being good detectives and having management support. For a project to be successful it must have support of management. We had management in place that recognized the data issues and supported the cleaning efforts. In addition, management was supportive of developing an alternative processing system(s) as well as beginning quality checks for the continued use of TES until alternative processing has been identified. Management aided in our detective work specifically in the area of identifying the missing data elements.

Phased elimination is now planned for TES. TES's data integrity and Year 2000 compliance are the two main reasons why TES is being phased out. In order to phase TES out, alternatives for processing the surveys need to be developed. These replacement systems are "smaller" systems which are specifically designed to handle the needs of each of the service line training evaluation areas such as Tax, Audit, Industry Education, etc. The new systems will be developed using Microsoft Access or SPSS. Which platform is used will depend on client needs, budget, and volume of surveys. Each system will be designed for flexibility without jeopardizing data integrity, data archival, and use of coding conventions. The ultimate goal of the smaller systems is to append the data into a central archival system where analysis can be conducted across service lines.

There are two main sets of service line training evaluations which are still processed in TES: Local Office and Tax. Two service line teams have been established to do a "needs assessment" for each of the service lines. The needs assessment will determine the appropriate technology, the development of the standard training evaluation instrument, and project scope. Both teams expect to have operational systems by early Fall and TES will be retired.

4. CONCLUSIONS: THE BENEFIT OF ALLIANCES

Database instructors and information system specialists spend a great deal of time learning and applying the principles of good database design. The experience with the TES database revealed the related issues faced (and the problem solving skills needed) when working with a flawed design.

In an era of escalating demands and diminishing resources, academia and industry have never had a greater impetus to search for common ground. The benefits of this particular alliance and of alliances between industry and educators in general are many (Bailey et al. 1999; Bost and Haddad, 1996; Carter, 1998; Levenburg, 1996; Piland et al. 1998; Powe, 1996; Spinks et al. 1996). Educators gain first hand knowledge of real world applications and are often provided with examples that can be used in the classroom. This extends beyond the subject domain into contract negotiations, methodologies, work environment variables, etc. They gain insights into practitioner concerns, which are missing from many textbooks. Academicians may be stimulated to recognize new forms of applied research or publishing topics. Their interaction with professionals outside education may, in itself, be stimulating. They can also gain an understanding of current labor market trends, which can be useful in advising students (Figure 3).

Industry can benefit as well. By hiring consultants from academia, they have more flexibility when defining their needs and scheduling a project. Professors provide a talented labor pool whose theoretical background provides a more solid underpinning to the solution of problems. They may have less bias than consultants coming from larger, more indoctrinated firms. The connection to an academic institution can provide goodwill for a large profitable company and can give them a connection to a future information systems labor pool, which is going to be in great demand for the foreseeable future (Figure 3).

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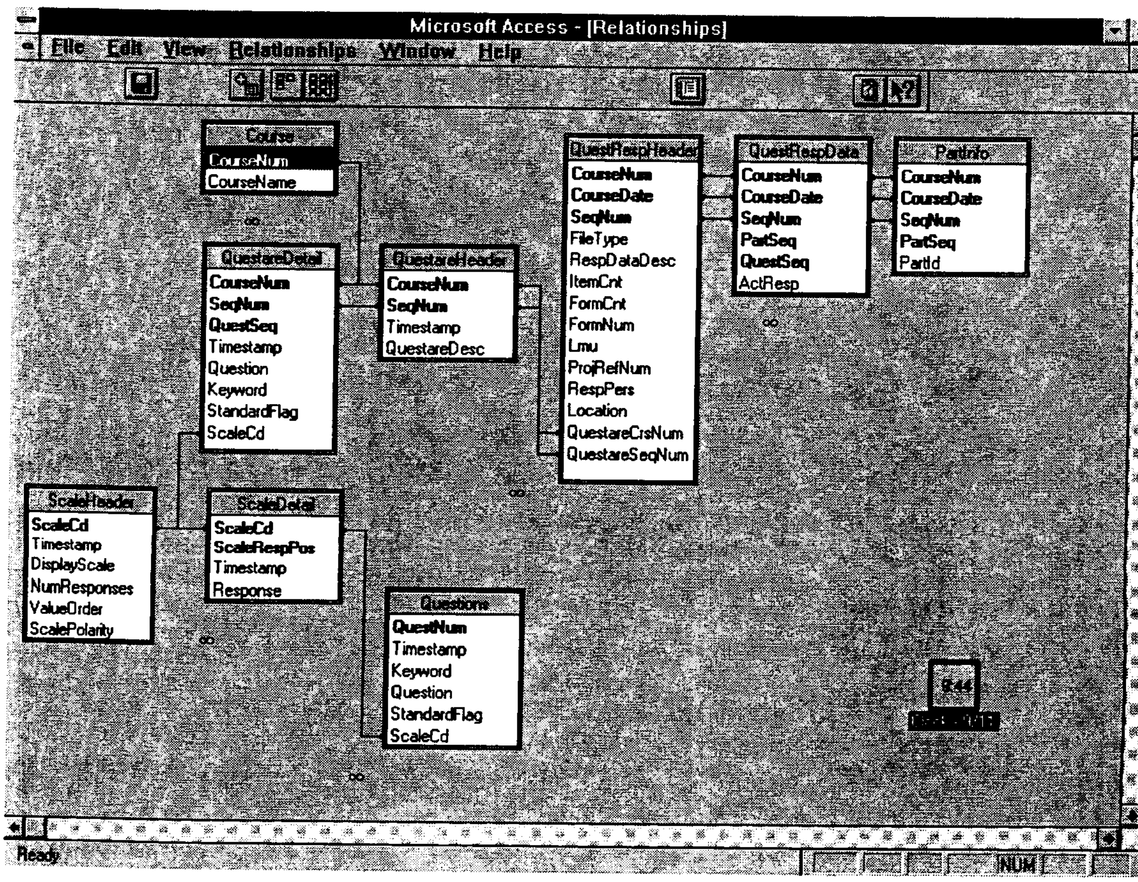

Figure 1 **TES Schema**

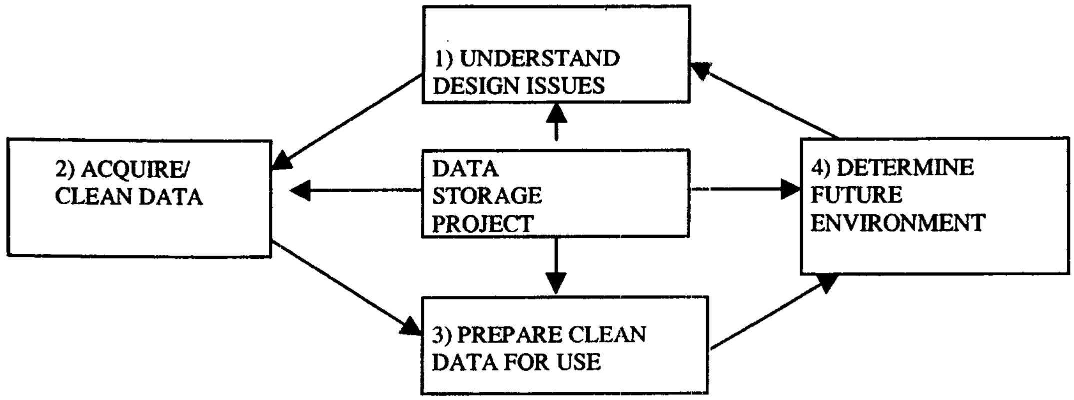

Figure 2 Activities Involved in the TES Data Storage Project

BENEFITS TO ACADEMIA	BENEFITS TO INDUSTRY
First hand knowledge	**Theoretical perspective**
Examples for teaching	**Lack of bias**
Insights into practitioner concerns	**Access to talented labor pool**
Ideas for research	**Flexible scheduling**
Interaction with professionals	**Community involvement**
Stimulation of interest	**Variety of approaches**
Understanding of labor market trends	**Connection to future labor pool**

Figure 3 The Benefits of Working Together

Developing Connections with the Business Community

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Abstract

University and college professors in Information Systems and Information Technology need to be aware of the changes in technology that may affect their programs. Professors need to interact with business professionals as well as attending conferences and reading journals and trade magazines. The faculty members in Information Systems at Dakota State University, in Madison, South Dakota feel the interaction with business professionals is a "win / win" situation as we are able to understand the skills employers require while guiding our students to acquire professional careers. This paper will describe some of the interactions that Dakota State University has with business professionals.

Keywords: Industry Interaction, students and faculty internships, advisory board

Introduction

Building strong relations between businesses, industry, government and a campus information systems department is a way of ensuring that the curriculum remains relevant. To accomplish this task, the information systems faculty members at Dakota State University have made a concerted effort to build these relationships. The interactions that Dakota State University has with business professionals are beneficial to the campus and student body. The activities fall into the following areas:

- Advisory Boards
- Student Internships
- Faculty Internships
- Campus Visits And Presentations To Students
- Professional Certification
- Faculty Interaction With Companies
- College Days
- Career Days
- Shadowing Experiences
- Visit Of Faculty To Companies
- Lunch With Recruiters

Advisory Board

Like many campuses, we have an advisory board for the College of Business and Information Systems. This board includes representatives from the major employers of our information systems graduates in the area. The board meets at least twice annually, generally with one meeting on campus and one meeting at a business or governmental site in the region. For Dakota State University, the advisory board of business / industry representatives are from the following regional companies:

Citibank - credit card processing center in Sioux Falls, SD

Schwan's Sales Enterprises - a privately held food and finance company in Marshall, Minnesota

Mutual of Omaha - an insurance company in Omaha, Nebraska

Gateway - the computer company headquartered in North Sioux City, SD

Daktronics - a leading manufacturer of electronic scoreboards and related equipment from Brookings, SD

Federated Insurance Company - an insurance company from Owatonna, Minnesota

Martin & Associates - a regional telecommunications and consulting company in Mitchell, SD

State of South Dakota - the Bureau of Information and Technology - the centralized governmental agency for computing in South Dakota

Within the formal structure, the advisory board at Dakota State University suggests changes to the faculty / staff on matters such as staffing, technology trends, languages and courses, and learning experiences. The advisory board meetings generally start with the faculty and administrative representatives from Dakota State University describing the changes to the Information Systems program since the last meeting, the introduction of new faculty in the program, information about placement and enrollment numbers. The business / industry representatives then share any changes being implemented in their companies that will effect future employment needs and discuss various topics of interest to the group. Advisory board membership is voluntary and the advisory board members are not paid, but the companies generally consider the interaction with faculty to be worthwhile to their companies.

At Dakota State University, the advisory board is not a formal decision making body, but the IS faculty have appreciated the insights and direction given by the advisory board. For example, at a recent advisory board meeting, the main topic of discussion was the move to electronic commerce, and included the business perspective as well as what Dakota State should be doing to better prepare students in that area. Another recent discussion item was the development of a masters program in information systems and its value to the employers of the region.

Internships

A second area of interaction is through the formal internship process. At Dakota State, information systems and computer science students are required to complete at least one internship experience, which are generally paid experiences and usually take place in the summer. Announcements are posted and circulated by e-mail for students and generally employers then come to campus and interview students directly for internships.

Since these internships are for academic credit, the internship coordinator from the College of Business and Information Systems attempts to visit interns at least twice times during their internship experience. The visits to interns, while primarily focusing on the individual student, provide feedback to the information system program at Dakota State. For example, we discuss what things should have been done to strengthen the student for the internship experience, i.e. more activities working in a team on projects.

Each intern is required to give a final formal presentation of his or her internship. Some companies have worked with the faculty to give that final presentation at their location and invite both the campus faculty representatives and representatives from that business. This provides an opportunity for additional interaction between the company and the campus representatives. These formal final presentations generally are about 30 minutes long and allow the student to review his/her learning opportunities for the summer. After the presentation a question and answer period continues the interaction. One of the questions that is generally asked to both the student and the employer is what could have been done to better prepare the student for the internship experience. This gives the faculty excellent insights into have we can better serve the students and the business community. Frequently the formal visit to the company will also include a short tour or meeting with alumni. The end result is a better understanding of the information systems needs of the business and how we can better prepare our students for true on-the-job experiences.

Faculty Internships

Three of the regional companies offer faculty internships (Citibank, Eros Data Center and Gateway Computers). These are generally summer work experiences for the faculty members to see the "real-world" situation that these companies (and our graduates face).

One of the faculty members in the department (and the author of this paper) has spent seven summers at Citibank in Sioux Falls. In this experience, he brings back to campus and his classes realistic experiences that enhance the learning experience. His experiences have included: programming, systems analysis, training, statistical analysis, and technical support. There can be differences between teaching from textbooks and teaching from experience coupled with textbooks.

In the faculty internship experience, faculty members participate with company teams and work on projects similar to student internships. Frequently the integration of the undergraduate curriculum into the workplace becomes more evident in these experiences. Faculty members see the systems development life cycle in work coupled with analysis and development of information systems projects.

Like so many of the other programs described in this paper, faculty internships also allow for a better understanding of what companies need, and of the future information systems needs of businesses . With many alumni of our program in these companies, it also serves to build alumni relationships as well.

Some have suggested that all faculty members have some professional or industrial experience, possibly expecting that faculty sabbaticals be used to enhance professional experiences. While this may be an impractical goal, realistic experiences such as faculty internships can bring a new dimension to a faculty member's position.

Campus visits and presentations

In recent years, several of our employers have sent their own experts to campus to give presentations in classes relating to information systems and information technology. These have been presented to classes ranging from freshmen through senior level students. For the freshman and sophomore students, these presentations help them to focus on their possible career choices, give them more information about the information systems field in general, as well as giving them information on specific employers in the region. This can also serve as a motivational tool to encourage the students to remain diligent in their studies. Frequently these visits are presented by alumni of Dakota State University with helps build rapport with the faculty and staff.

Another variation on the campus visit is when employers sponsor special events on campus for students. In the last year, companies have sponsored several pizza feeds, taco dinners, ice cream socials and related events for students to combine social events with giving the students more information about their company and their particular recruiting needs. These are frequently more informal than interview sessions or in-class presentations, but give students more insight into the information systems profession. Because of the informality, students feel free to ask questions about the company and the profession.

Companies value this opportunity to get closer to students than with the formal interview process. The cost to recruit a new employee for many companies is a significant cost, and taking the time to build relationships at a lower cost is beneficial to the companies.

Shadowing experiences

Some regional companies allow Dakota State to bring students to their site for a day or part day of shadowing. The most common model is where a group of 8 to 10 students and a faculty representative take a day at a company site. Generally the company sponsors an overview of the company and the Information Systems department, and then students sit with a programmer or an analyst, and observe what they day. At the end of the day, a group wrap up session is held to discuss the experience.

The faculty members have discussed the shadowing experience and would like all sophomore students in Information Systems to have a shadowing experience. They feel that such an experience is both motivating to the students to complete their major as well as eye-opening for students. One of the most common comments was that students were worried that computing professionals would spend all day writing programming code, but they see that the professionals spend a significant amount of time working with fellow team members, interacting with users and dealing with specifications and testing.

Faculty Interaction with Employers

Another area where Dakota State University interacts with employers is through visits to their facilities. Three of our regional employers sponsor special events to interact with faculty and / or students. Schwan's sponsors an annual College Relations Outing, where faculty from several campuses are hosted by Schwan's. During that day, we learn more about their company, and special projects. For example, at the most recent outing representatives gave an overview of how they are implementing SAP into their environment.
Federated Insurance sponsors a "Spring Fling", where several regional campuses send 4 to 6 students and a faculty representative to the Federated site to learn about their business atmosphere. This is an on-site activity, where students can shadow an information systems employee for part of the day as well as have presentations from their staff about issues in information systems, such as what Federated is doing for the Y2K problem. Great Plains software sponsors an annual "roundup" where speakers give presentations relevant to the future of the information systems field.

Professional Certification

In the recent years, there have been many certification programs developed and offered. Such programs range from Certified Computer Professional (CCP) program sponsored by the Institute for Certification of Computer Professionals (ICCP) to corporate sponsored programs, such as the Microsoft Certified System Engineer (MCSE) and Novell networking certification. While not directly related to professional interaction, the recognition gained by faculty members who are certified is noted by employers and valued.

Currently two faculty members are certified with one holding the CCP designation and the other holding the MCSE designation. Discussion has been on-going relating to additional certification of both faculty and students as exit examinations.

Lunch with recruiters

The faculty of Dakota State have also make it a point to interact with these companies when they are on the local campus recruiting students for full time employment or for internships. The faculty generally will have lunch with the representatives from these companies. With over 30 companies coming to campus to recruit our students, this gives us an overview of the range of skills and abilities that employers desire.

During the 1998-1999 academic year, representatives of the Information Systems faculty met with over 80% of the regional companies as they were on campus recruiting students. Some of these businesses are part of our advisory board, but many are not, and therefore were able to interact with faculty through this informal lunch experience.

Visit to Regional Employers

Another method that the faculty of Dakota State has used to build relationships with business and industry representatives is in a three-day visitation program. Faculty members have gone to visit several employers in the region to meet and discuss how Dakota State and the companies can interact more suitably. Because of the rural nature of Dakota State University, this involves travel. During last spring's visitation program, faculty representatives visited nine employers in three states (South Dakota, Nebraska and Minnesota) in six different cities and drove over 1200 miles. Ten different faculty members were involved in this process. The primary reason from this visitation program is to see employers in the region and get information on how we can improve the educational process and college curriculum in the effort to better prepare the students for the work environment. A secondary benefit is that the employers get to know the faculty members by name and feel free to ask us for graduates and interns, and give the faculty feedback.

The faculty members receive phone calls and e-mails from these businesses on a regular basis. The business and industry representatives feel at ease asking for references for graduates and interns. There also has grown a knowledge base of which companies might be more appropriate for which graduates or interns in terms of academic background and corporate culture. During these visits, the faculty members involved normally interact with human resource staff, information systems managers and staff and alumni of Dakota State University. Thus the visiting faculty members get perspectives from different groups that they take back to the campus to enhance the program.

Conclusion

The faculty members in the Information Systems department find all the methods described above to be beneficial to our program in Information Systems. Over the years we have gotten excellent feedback, both positive and negative, from the regional employers of our graduates and our business partners and have modified courses and the curriculum to meet the changing needs and expectations. We have also modified assignments and student experiences and our expectations of students to better prepare them for the professional environment. The faculty members that have been involved in interaction with regional businesses find that rapport has been built and enhanced. We consider this a very valuable part of our program and feel it enhances our educational experience.

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Observations and Experiences from the Trenches:
A Sabbatical Year in the Business Environment

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Abstract

During a sabbatical leave, the author was employed as a consultant by one of Pittsburgh's largest employers -- a financial institution. The author experienced current programming trends, the methods used by business to provide training to end-users, and how new employees are integrated into the business environment. The author also gained first hand knowledge of the many opinions of managers and peers regarding collegiate faculty re-entering the work place. The outcome of this experience has caused a re-evaluation of the course content and the teaching methods of computer/information systems courses taught by the author. It has also launched a research project to determine the attitudes and reasons for those attitudes of business managers regarding faculty re-entering the work place.

Keywords: Faculty Development, School Business Relationship, Off the Job Training, Professional Continuing Education

1. INTRODUCTION/BACKGROUND

The author is employed as an associate professor of computer and information systems and has 16 years teaching experience in the field. Of special interest to the author are the areas of computer human interaction, data communications and database management systems and generally these are the courses he teaches at both the undergraduate and graduate levels. Throughout his teaching career, the author has done consulting work both locally and non-locally specifically in the area of database management systems.

The author was granted a one year sabbatical leave from his teaching duties in the Computer and Information Systems Department for the 1998-1999 academic year. One goal of the sabbatical was to consult as a programmer/analyst in the business environment in order to update the author's knowledge of current industry practices. Through a local consulting company the author was able to secure full-time employment with one of the top fifteen banks in the United States. This financial institution employs some 8200 people and has an MIS staff of over 500. The author was assigned to a team of thirteen individuals, three business analysts and ten programmers. This team dealt with on-line banking, supporting such products as Managing Your Money, Quicken, and Quickbooks. The author was assigned to an enhancement and conversion project with one of the business analysts and two of the programmers. The project involved eight months of full-time work and used COBOL II, CICS, JCL and DB2 on an IBM mainframe system.

2. LITERATURE REVIEW

The idea of faculty entering or re-entering the work place to gain short-term up-to-date work experience is not new. Over the past 20 years many programs have been developed and implemented to do so particularly at the community college/vocational education level. One of the these is the Hagerstown Junior College of Maryland's (HJC) "Return to Industry" program. This project began in 1978 and was funded by a five year Appalachian Regional Development Grant. The project allowed occupational faculty to return to industrial settings to reinforce, update, or expand their skills and knowledge. The success of this project is seen by the fact that 14 of HJC's 15 occupational program clusters and 71% of its eligible faculty participated in the project during the grant period (Parsons 1979, 1983; Parsons & Ziegler 1981).

Champlain College, a private college in Vermont offering business and management programs initiated an Externship Program in 1979-1980 which placed faculty in short-term external jobs related to their fields. Interestingly, personnel from the community took on the instructional duties of the interning faculty (Bridge 1980).

In 1983, Delaware Technical and Community College released a report detailing their faculty development program. Part of the report discusses a "Train the Trainer" workshop which prepares faculty to go into industry (Burke & Winner 1983).

The School of Technical and Applied Arts at Ferris State College in Michigan developed a program for professional development of faculty in 1983 which had as one of its central components a faculty enrichment program with industry. The faculty member worked a 40-hour week, six-week internship at Prince Corporation, a manufacturer of die cast machinery and plastic components. The program allowed the faculty to renew technical skills and business knowledge as well as provide the faculty first-hand experience in working with the latest technological developments in industry (Scokasy 1983).

Thomas Nelson Community College in Virginia received a grant for 1983-84 under the State Council Higher Education's "Funds for Excellence Program." The program offered faculty the opportunity to enter or re-enter the business/industry work place to update their skills and knowledge, revamp and enhance course curricula, and improve communication between area businesses and the college. Nine faculty members from the areas of accounting, architecture, commercial art, drafting, electronic servicing, and food service participated the initial year of the program. Both the faculty involved and participating business/industry management felt that the program was a success (Hill 1985; Cooper & Hill 1985).

In the spring of 1995 at the University College of the Cariboo, in British Columbia, a Computing Information Systems diploma program faculty member arranged a work leave to return to industry. The faculty member secured employment as a systems analyst in a company that supplies wood and paper products. The faculty member was able to gain new skills and knowledge of new processes and bring these back to the classroom environment (Johnson 1996).

A faculty member in the Department of Accountancy at Boise State University secured a one-year sabbatical leave to work with the Boise Cascade Company's Internal Audit Department. There, the faculty member was able to update her skills and gain first-hand experience of the responsibilities, issues, problems, and challenges her students might face upon entry into work place. Both the faculty member and the Boise Cascade Company felt that this experience was mutually beneficial (Pearson & English 1998).

3. OBSERVATIONS AND EXPERIENCES

Attitudes of Business Toward Academe

The author interviewed with two different consulting companies and five different individuals before obtaining full-time employment. The interview questions asked had common themes: why was the experience of working in business desired, what was the real motivation, why is the experience desired now after being in academe over fifteen years, and did the author know that there was much more money to be made in industry than in academe. The majority of the individuals asked how would the author handle NOT "going into teacher mode" in the business environment, because after all, "the business environment is NOT a classroom" and, did the author know that projects, programming, etc. were not done according to the "textbook ways" in the "real world" – how willing was the author to learn and adopt the "real world" methods. One of the managers of the interviewers made the following comments: "An academic? No. What does an academic know about the real world? If he thinks that he can do this job then he can come here and prove that he can do it, but he will receive no pay. I'll give him two weeks to prove himself –unpaid."

Real World Experiences and Observations

Before being assigned to a major project, the author was given a number of small tasks to complete by two of the team's senior programmers. These included changing a number of lines of COBOL II programming code, recompiling and testing the program, and placing the new program into production. These small tasks allowed the author the opportunity to become familiar with the database and its design as well as the team's actual implementation of the standards adopted for programming and testing. The programmers who assigned the tasks oversaw all of the author's work for correctness and accuracy. They also acted as sounding boards for programming ideas and resources for answering questions. After completion of these tasks, the author was assigned to a major team project that involved the enhancement of the already existing system, a conversion from one system to another, and re-training the end-users. The enhancement of the existing system involved the alteration of five screens and their affiliated programs and updating eight substantial batch COBOL II programs. The conversion of systems involved converting some 15,000 customer records from one system to the current database system. The re-training of the end-users involved designing and writing the system documentation and designing and delivering a three-day hands-on training seminar. Two business analysts and three programmers (including the author) were assigned to this project. The author was also assigned an individual project involving a weekly purge of various records in a number of database tables.

Based on these experiences the following guidelines and observations are offered.

Necessary Programming Skills for Individual Survival

1. Have the ability to read and analyze a program that contains very little, if any documentation;

2. Have the ability to read and analyze a program that is written in a style different from what the programmer was taught, or from the way the programmer personally codes;
3. Have the ability to quickly learn and successfully implement new coding techniques;
4. Have the ability to differentiate programming code that gets the job done from programming code that gets the job done and is maintainable and reliable;
5. Have the ability to write maintainable and reliable programming code on an individual basis and in a group situation;
6. Possess excellent time management skills – there are no programs accepted late;
7. Be self-motivated;
8. Be able to admit when you made a programming error and volunteer to fix it; and
9. Be prepared to wear a beeper and support both your own and your team's programming code.

Necessary General Skills for Individual Survival

1. Understand what it means to be a team player;
2. Possess effective communication skills both oral and in written; and
3. Be flexible and adaptable.

Overall Requirements for Successful Project Completion

1. A thorough and accurate analysis of the proposed project **MUST** be done;
2. Prepare a detailed definition document of the program specifications and the parties/departments responsible for each component of the project;
3. Insure that there is agreement by all parties/departments as to the meaning and ramifications of the program specifications;
4. Prepare a thorough and meaningful test plan;
5. Insure the cooperation of all parties/departments involved/effected by the project;
6. Establish continuous and accurate communication between all parties/departments involved/effected by the project; and
7. Establish deadlines that are reasonable and flexible.

Observations from a "Teacher's Point of View"

Planning the logic of a program by means of a tool such as a flowchart, decision table, HIPO chart, etc. was at the discretion of the individual programmer. For the most part no such tools were used. Internal program documentation was rarely done. If internal program documentation did exist, it was one line briefly describing the program.

Programmers did not "sign" their work. The AUTHOR line of the COBOL II in most of the programs analyzed was either nonexistent or said "I AM AUTHOR." The entries "DATE-WRITTEN" and "DATE-COMPILED" were not used.

External program documentation was sparse. No program the author analyzed had a flowchart, decision table, HIPO chart, etc.; and no printer spacing charts existed detailing report formats. For the few programs where external documentation existed, no real consistencies were found. When external documentation existed it consisted of a laundry list. This list might include the date, the program name, the DB2 tables utilized and/or updated by the program, a brief description of the program, and where appropriate the screen layout. In only one case, for one of the most complex batch programs in the system, the programmer had created a modified decision table in the form of a grid chart to detail actions to be taken for certain circumstances.
Many of the COBOL II programs the author analyzed contained both COBOL '74 and COBOL '85 statements. Additionally, some of the logic used in these programs was extremely advanced; more advanced than that covered in an advanced programming course.

Documentation of the various projects the team accomplished did exist in two forms, a detailed definition document and the user-training manual for the project. Both of these forms of documentation were the responsibility of the business analyst assigned to that particular project. The documents were housed in a room designated as the team's library, and any member of the team could refer to them at any time. Unfortunately, the training manuals for the projects were as varied in style as the number of projects.

Usually, they were only descriptions of screens and the meanings and values of each of the fields on the screen. The author heard many comments from team members that the area of program documentation was the weak point of the system. They agreed that many hours would be saved analyzing a program if there was adequate documentation.

No form of PERT or GANTT charts were used in this system or by the team. In many meetings reference was made to the time-line for the project. This time-line was nothing more than a list of critical dates that had to be met for specific parts of the project. A time-line was not done for the entire project, just one or two components of project.

4. DISCUSSION AND CONCLUSIONS

Curriculum Considerations

The author's experiences and observations confirmed that the structure and the general content of the computer/information systems curriculum at his institution is appropriate. This curriculum was redesigned a number of years ago to include foundation courses in the programming languages, management information systems, operating systems, systems analysis and design, data communications and database management systems. To complete the major, tracks were created where students could specialize in the areas of programming, health care information systems, accounting information systems, networking, or office systems. Internship experiences are encouraged but not mandatory.

The most recent curriculum redesign included the incorporation of the Communication Skills Program in a number of courses in the computer/information systems major. This program is a college wide initiative instituted to respond to feedback from local businesses that graduating students had poor oral and written communication skills (Woratschek, 1998).

Even with the current computer/information systems curriculum and communication skills program in place, the author believes that the areas of individual versus team programming projects, communications skills and their importance in the MIS environment, and documentation still need to be addressed, especially in the specialty track courses.

It is clear that business expects its programmers to be able to function in both an individual and team capacity. Computer/information systems curricula have traditionally stressed individual development and implementation of a programming assignment. Employers expect that recent graduates of a computer/information systems curriculum are well grounded in technology, teamwork, communication skills and interpersonal skills. The old idea that technological skills alone are sufficient is no longer true.

The collegiate curriculum today must provide experiences for students that include substantial projects involving teams and communication skills. Courses must teach relevant knowledge and theory as well as build and reinforce essential skills. The author has changed the content of an advanced programming course from a traditional methodology of ten individual programming assignments to one that includes more realistic experiences for students. The students now gain experience in writing maintainable programming code, teamwork, and communication skills. The following describes two examples of changes made to the course. There are two assignments where the student must modify an existing working program to meet new program specifications. The existing program for one of these assignments is written in "spaghetti code," while the other is written in a maintainable structured format. An assignment has also been included that involves a team of three individuals. Each team member has a substantial program to complete that is essential to the success of the overall project. At completion of the project, the team is responsible for presenting their project to their peers. The peers evaluate the team's presentation. The team project assignments are all different so no one but the members of the team are aware of the project specifications.

Because courses cannot provide all the experiences necessary for success in today's business environment an internship is an essential component of the computer/information systems curriculum. An internship experience for the student should not be encouraged, it should be mandatory.

The area of documentation is extremely important. While it is the last phase of program development and the phase most forgotten, it is necessary. As mentioned earlier, many of the team members the author worked with commented that if adequate documentation existed for a program, many hours would be saved in program analysis and maintenance.

Program development tools and their use, and internal and external program documentation need to be stressed as an essential component of MIS environment. Documentation requirements must be a mandatory part of course requirements.

Attitudes of Business Toward Academe

Clearly there is a negative attitude toward academics from some members of the business community. The reasons for this attitude are unknown at this time, but something that needs to be studied. It is important to note that negative attitudes were exhibited by some of the author's managers not by any of his team members. The team members the author worked with actually had the exact opposite attitude. They believed that all professors should return to business at least once every five years. In so doing, the team would be strengthened by the professor's skills and experience and the professor would experience the current skills needed by the business and be able to take this knowledge back to the classroom environment. While it cannot be assumed that one team in such a large organization represents the company's philosophy, it was interesting and enlightening to hear their opinions.

At the completion of the author's projects, management offered continued full-time work with the financial institution. In the author's exit interview there was mention that the author's skills, professional attitude, and work ethic were valuable assets to the team and difficult attributes to find in most of today's employees. It was also mentioned that some of the higher level managers believed that academics should remain in academia and that business should be left to businessmen.

A survey is planned of the managers of the major corporations in the greater Pittsburgh area that offer student internships. This survey will attempt to determine the attitudes and reasons for these attitudes of computer/information/MIS management regarding the idea of faculty entering or re-entering the work environment on a short-term basis to update skills and gain work experience that can be brought back to enhance the collegiate curriculum. It is hoped that the results of this survey will aid in establishing better relations between business and collegiate faculty. and open the door for business to provide collegiate faculty with first hand business experience. Ultimately, collegiate computer/information systems curricula could be designed to produce graduates that better fill business' needs.

For Those That Will Follow

From the author's experiences a faculty member who wishes to enter or re-enter the work environment on a short-term basis needs to be prepared. Above all, practice your interviewing skills. Be ready to answer the "standard" types of interview questions and to aid in the more in depth type of questioning that you are likely to encounter, the following list of questions is offered.

1. What is the specific time frame of the sabbatical – 6 months, a year? Why this time frame?
2. What are your specific objectives of the sabbatical?
3. Why is now the time you chose to take the sabbatical?
4. What does the company/business you intend to interview with specifically offer in terms of experiences that meet or do not meet the objectives of your sabbatical?
5. Is one of your objectives of the sabbatical to explore the idea of NOT returning to academe?
6. How will you separate academia from your work placee experience?
7. How up-to-date are your skills? Would (a) skill(s) course(s) improve your opportunity for employment?
8. Are you willing to work for a short time (one-two weeks) with no compensation to prove that you can do the job?
9. How will you handle animosity from company management and/or your teammates?
10. How will you handle "not being in charge?"
11. What is your alternate plan if you are not hired by any business?

The author believes that his experiences have been worthwhile and highly recommends that anyone considering a sabbatical leave explore an internship/experience in the business environment. Spending a sabbatical year working for a business organization will validate what you teach, show your students that you can "practice what you preach," and increase business' understanding of our common roles and goals.

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Including SAP Enterprise Software in the Introductory Business Computer Course

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Abstract

Enterprise Resource Planning has become the buzz word for today's business organizations that are attempting to provide integrative solutions to their everyday business problems. The islands of automation that were acceptable in the past no longer are providing the information needed to survive in the competitive corporate world. Survival depends on the development of systems that provide information along the entire supply-chain management continuum. Thus, more and more businesses are resorting to Enterprise Resource Planning methodology to design, develop, and implement information systems that will provide them with access to information in real-time environments. Most textbooks now contain little or no content coverage of core business transaction processing and Enterprise Resource Planning. This paper describes how one college of business is meeting the Enterprise Resource Planning challenge by providing a hands-on exposure to enterprise software for students in the required introductory business computer course.

Keywords: SAP, ERP, introductory business computer course, enterprise software, enterprise resource planning

1. INTRODUCTION

ERP Emergence in Business World

Enterprise Resource Planning (ERP) has become the buzz word for today's business organizations that are attempting to provide integrative solutions to their everyday business problems. The "islands of automation" that were acceptable in the past no longer are providing the information needed to survive in the competitive information-hungry corporate world. Survival depends on the development of systems that provide information along the entire supply-chain management continuum. Microsoft, Intel, and Dow Chemical are a few of the companies that run their business operations with SAP software that is the leader in ERP software with nearly 40% of this software market (SAP AG).

Although a company such as Dow Chemical has about 30,000 personal computers running desktop personal productivity tools, the business transactions that turn customer orders into cash and profit are processed with SAP. Clearly, more and more businesses are resorting to ERP software to design, develop, and implement information systems that will provide them with access to core information processing of transactions in real-time environments. These ERP systems are fast becoming the key mechanism for providing basic information to the desktops of the corporate world from the order entry and receiving clerks to the chief executive officer. This requires a level of understanding of business computing that greatly exceeds knowledge of the desktop personal productivity tools.

Students Need to Become Knowledgeable about ERP

Business colleges have for more than twenty years required all students majoring in business to take an introductory business computer course. The introductory course has evolved over the years from one of being strictly a descriptive hardware/software course to one that places emphasis on the importance of information systems for a business enterprise. For many students, the introductory course represents their first exposure to computers.

Professors have struggled with attempting to cram into the course both a hands-on approach to personal productivity software and a balance of information theory and concepts. It is within the introductory business computer course that ERP concepts should be introduced. In recent years, hands-on personal productivity tools have crowded out the core transaction processing systems that are actually used to run a business. But, memos, spreadsheets, small databases, and electronic presentations are not the key enablers in the customer order to cash cycle for most businesses. This deficiency is underscored by the fact, that today, few of the textbooks on the market for the introductory computer course spend more than a paragraph on the subject or nothing at all (Alter; Gordon; Haag; Jessup; Laudon; Laudon; Nickerson; Stair).

Possible Areas Where ERP Could be Taught
The introductory business computer course usually has students representative of all business functional areas. However, regardless of their major, each student must understand supply chain management with its customer order to cash cycle and the role ERP plays in making this become a reality. Therefore, it would appear appropriate to experiment with a conceptual and hands-on SAP component within the introductory business computer course as a means of helping students to understand the role of ERP across all functional areas in the business environment and the processing of core business transactions.

2. BACKGROUND OF SAP ALLIANCE WITHIN THE COLLEGE OF BUSINESS

What the College has Done to Incorporate ERP into the Curriculum
The College of Business entered into an alliance program with the SAP AG two years ago. Faculty representative of all the business departments participated in initial training. The SAP AG assisted in supplying the software for the alliance and some of the initial training. The intent of the alliance was to create an environment in which students majoring in a business field would have a significant exposure to ERP concepts through hands-on experience using the SAP R/3 software.

Six courses in the college of business representing all functional areas were targeted as courses in which SAP R/3 would be utilized. In addition, the SAP trained faculty provided training to other faculty within the college to assist them in better understanding the integrative functions provided by ERP software, namely, SAP R/3.

What the BIS Department is Doing
The Business Information Systems Department supports the required introductory business computer course, and approximately 1,000 students are served each semester. In addition, the department has opted to design and package several SAP courses to create an ERP or enterprise software area of emphasis aside from the traditional MIS major emphasis. Some of the traditional MIS required courses have been redesigned to include ERP systems theory and design concepts into the class material.

In addition, a dedicated SAP computer laboratory was recently installed. It is used to provide support to the increasing numbers of students who are taking advantage of acquiring additional experience with the SAP R/3 software.

What Students are Doing Through a User Group
Students representing all functional areas in the College of Business have organized a SAP Student User Group. The group meets regularly to work on a variety of application problems over and above those required for their respective SAP related classes. Students learn to work in teams to solve problems using computer applications. They invite guest speakers, they solicit case problems from professors, and they design their own case problems for group solving.

3. REVIEW OF INTRODUCTORY COMPUTER TEXTS

What Textbook Coverage is Devoted to ERP
Eight current information systems management texts that may be used for the first course in information systems were examined. Of the eight, only three (Alter; Gordon; and Laudon) devoted a few paragraphs to discussion of ERP. An integral part of ERP is also the enabling software. One text (Stair) provided a table of the current ERP software on the market while only two (Alter and Gordon) made reference to supply chain management.

Most of the texts devoted some space to discussion of transaction processing systems (TPS) while three (Gordon, Laudon, and Stair) devoted an entire chapter to TPS. It is evident that future introductory business computer texts need to have more space allocated toward coverage of ERP concepts, and those concepts need to be linked to the core business transaction processing system requirements.

4. THE SAP BRIEF EXPERIMENT

An Experiment in an Introductory Business Computer Course
To develop and test a model for introducing business students to ERP concepts, a SAP Enterprise Software Brief was developed and web-based lessons were created. The web-based lesson materials are a series of three modules that provide students with an introduction to the conceptual background of ERP and SAP R/3 materials (SAP Enterprise Software, 1999).

The purpose of the Brief was to provide an environment in which students from the introductory business computer class could have a hands-on exposure to using integrated software functions. The entire Brief took students from 30 to 60 minutes to complete, with an average completion time of 39 minutes.

The learning approach used consisted of four steps. First, ERP concepts were discussed in the classroom. The instructor assembled material from several sources as the introductory text contained little ERP theory. Secondly, the students were required to go onto the web and complete the three-module introduction to SAP R/3and related enterprise software concepts. Each student was provided a worksheet to complete. The third component required students to sign onto the SAP R/3 software and complete the Brief. The last component consisted of students completing a short survey relative to what they had learned from the SAP experience.

Composition of the Brief
The model used in the College of Business to illustrate the SAP R/3 system is a business called Motor Sports International (MSI), that is a robust training database developed by SAP AG. The use of MSI provides a simulated business environment representative of a major business enterprise.

The Brief consisted of four step-by-step activities: (1) logging onto the SAP R/3 System, (2) displaying a sales order, (3) displaying product information, and (4) displaying a predefined EIS report including using drill-down and displaying a chart. For each of these activities, the students had to complete several tutorial steps and record responses to questions. These activities allowed the student to become familiar with navigation within the SAP R/3 System and to experience a typical set of screens used to support core business processing.

The Objectives to be Achieved by Administering the Brief
The SAP Enterprise Software Brief was distributed to each student in the class after completion of the web-based introductory SAP modules. The students were assigned a password to get onto the system, told where to go to complete the Brief, and told what material to return at the completion of the exercise. All of the other step-by-step instructions were in the Brief.

By having the students complete the Brief, the following objectives were hoped to be achieved. At the completion of the Brief, each student would be able to:

1) Describe what is meant by enterprise software.
2) Execute a simple navigational exercise through the SAP R/3 system.
3) Describe the relationship between ERP theory and SAP R/3 hands-on applications.
4) Evaluate the Brief through survey feedback.

5. RESULTS OF SAP EXPERIENCE

Follow-up Questionnaire
A survey was conducted to assess student perceptions and satisfaction with the use of the web-based online lessons and the hands-on Brief exercise in this course. The items included in the survey questionnaire, which was completed anonymously, are listed in Figure 1. In addition, the questionnaire included open-ended questions to obtain additional feedback about this learning experience.

A total of 305 responses were obtained. The questionnaire contained nine items, where respondents indicated their responses on a seven-point scale. For data analysis purposes, these responses were converted to numbers, with a range of 7 for "strongly agree" to 1 for "strongly disagree" (with a mid-point of 4 for "don't know/no opinion").

Responses Received
Figure 2 summarizes the results of the survey by displaying the mean value for each item. As illustrated, each item had an overall response of either positive or neutral. A negative response for item six is actually considered as a positive result, because it indicates the students did not have a problem with the amount of time required to load the graphic files into their browsers.

Table 1 presents the results to three "global" (overall) measures of the opinions about the online lessons. As indicated, most students (80%) reported they were satisfied with the online lessons and more than three-fourths (81%) of the respondents agreed that they were satisfied with the contents of the online lessons. More than half (57%) favored using the online lesson format with other courses.

Item	Survey Question
1	Which of the following best describes your overall level of satisfaction with the online lessons that introduced you to SAP and enterprise software
2	Which of the following best describes your overall level of satisfaction with the content of the online lessons in providing an introduction to the concepts and issues involved in the use of SAP enterprise software in business.
3	The online lessons are organized in a logical fashion.
4	The online lessons have been well prepared for this course.
5	The graphics used in the online lessons helped me understand the SAP concepts presented in this course.
6	The graphics used in the online lessons are too large and take too much time to load in my Web browser, relative to the understanding provided by these graphics.
7	A text only version of the online course would have loaded to my Web browser more quickly and would have provided me with a better understanding of the concepts presented in this course.
8	The online lessons simulated my interest to learn more about SAP and enterprise software.
9	In the future, I would be interested in taking other courses that use a course format which is similar to the format used with the SAP Enterprise Software online lessons

Figure 1. Survey Questions

Table 1. Overall Results

Item (survey question number)	Mean	Std Dev	% Satisfied, % Agree	% Dissatisfied, % Disagree
Overall satisfaction with lesson (1)	5.16	1.17	80%	13%
Overall satisfaction with content of lessons (2)	5.25	1.20	81%	10%
Should similar format be used with other courses (9)	4.59	1.63	57%	24%

Table 2. Specific Outcomes

Item (survey question number)	Mean	Std Dev	% Satisfied, % Agree	% Dissatisfied, % Disagree
Lessons organized in logical fashion (3)	5.68	1.09	88%	6%
Lesson well prepared for course (4)	5.48	1.23	82%	9%
Graphics in lessons helped in understanding concepts (5)	5.41	1.28	83%	9%
Graphics take too much time to load into the Web browser (6)	3.40	1.55	22%	52%
Lesson simulated interest to learn more (8)	4.65	1.56	62%	24%

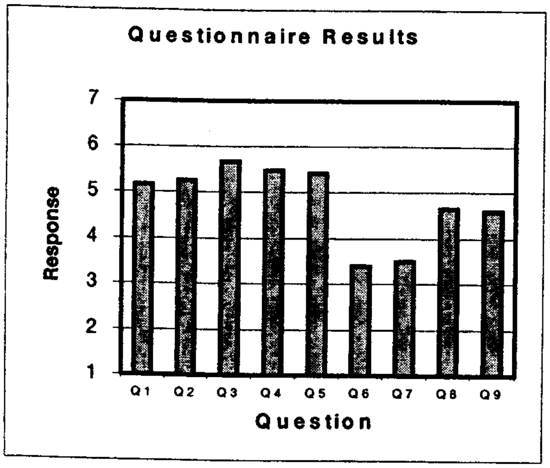

Figure 2. Item Summary

Analysis of responses
Table 2 summarizes students' perceptions about more specific aspects of the online lessons. A significant majority (88%) agreed that the lessons were organized in a logical fashion, and 82% indicated the lessons were well prepared for the course. More than three-fourths (83%) agreed that the graphics used for the online lessons helped them to understand the concepts being presented. More than half (62%) of the students indicated the online lesson stimulated their interest to learn more about SAP and enterprise software.

Various comments obtained from students in the open-ended portion of the survey offer corroborating evidence of the advantages of the use of the online lessons. The most frequent opinion is reflected in the comment of one student as the most important benefit of the online lessons: "The fact that individuals could go through it whenever they have time and at their own pace." Several students also mentioned that the online lessons "introduce the SAP R/3 System in a way that can be understood by people who know very little about SAP R/3." Another respondent said " I think the pictures make the lessons more attractive to the user and they also gave me a better understanding of the lessons." In general, these comments appear to support the responses to the specific items included in the questionnaire.

6. RECOMMENDATIONS FOR FUTURE/DIRECTIONS

What Should Colleges of Business be Doing

For a College of Business to develop an alliance with any ERP software company is costly in both money and faculty time commitments. However, because of the importance for business students to understand the integrative nature of information systems across all functional areas in business, it leaves many with no choice but to become involved.

Based on this research, it appears that teaching business students about ERP systems and providing them with hands-on exposure to enterprise software is a "win-win" proposition. In doing so, students are provided with education about an essential information systems approach, and students are given added value by providing them with a competitive edge in the career market.

What can be Done in the Introductory Course
The required College of Business computers in business class should include at least one week of material pertinent to ERP concepts. A variety of case problems, discussion activities, and/or hands-on exposure to enterprise software is also recommended. If a college doesn't have access to enterprise software, it can still provide their students with adequate coverage of the concepts. The Internet has many resources to support what the instructor might have to contribute.

Specific recommendations for the introductory computer class include:

1) Include adequate time for discussion and understanding of TPS/Basic Business Systems.
2) Designate adequate time to discussion of the need for integrative information systems across all functional areas in business and how organizations are meeting this need.
3) Create an awareness of all the ERP software on the market and how this software supports ERP across the entire supply chain continuum.
4) Introduce a hands-on experience with an enterprise software package.
5) Provide for understanding of the relationship between ERP systems and the various other information such as ESS, DSS, etc.
6) Allocate several class periods for presentation and discussion of ERP concepts.

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Closing the Technology Gap in the Lab and the Classroom: Upgrading Computer Facilities for CIS/MIS Instruction in Times of Increased Competition, Declining Enrollments, and Shrinking Budgets

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Abstract

The University of Texas at Arlington (UTA) had been growing along with the Dallas and Fort Worth area but that changed in 1985 when the end of the Baby Boom started to affect the university's enrollment. At about the same time it was becoming apparent that the demand for computer literate graduates was increasing and that the University's computing facilities needed an upgrade to better prepare its graduates for the business environment in the D/FW Metroplex. The College of Business Administration's computers and facilities were old and shabby. Their old hardware included some ATs, XTs, X286s, and even some 8080s and 8088s. The software packages weren't any better. DOS 1.1 was still installed on some of the computers and there were no data base or applications development software packages available. This paper describes how one business college managed to narrow the technology gap between what is taught in colleges and universities and what industry wants to have taught in the face of rapidly changing technology, increased competition, declining enrollments, and smaller budgets.

Keywords: Hardware and software upgrades, lab facilities, perceptual gap.

I. INTRODUCTION

The perceived gap between what is taught in colleges and universities and how it is taught, and what industry wants taught has been well-documented (Hensel 1995; Metha, Morgan and Stephenson 1997). The gap is both a technology and a methodology gap, and it has not been eliminated although it has narrowed.

This paper describes how one business college managed to narrow the technology gap in the face of rapidly changing technology, increased competition, declining enrollments, and smaller budgets.

II. THE STATE OF COMPUTING IN 1995

The University of Texas at Arlington (UTA) is located in the Dallas and Fort Worth (D/FW) Metroplex, a huge, diverse, and rapidly growing and changing metropolitan area. UTA had been growing along with the area but that changed in 1985 when the end of the Baby Boom started to affect the university's enrollment. At about the same time it was becoming apparent that the demand for computer literate graduates was increasing and that the University's computing facilities needed an upgrade to better prepare its graduates for the business environment in the D/FW Metroplex.

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In what was *de facto* recognition of the so-called perceptual gap the University formed a special committee to evaluate the computing assets and facilities of the campus in 1993. Dean MacElroy of the UTA College of Engineering headed the committee which had representatives from all of the campus academic and administrative units. The committee's report, called the MacElroy Report, was published in 1994, and it painted a dismal picture of the state of technology at the University.

The College of Business Administration's computers and facilities were as bad as those of the rest of the campus were. The computer lab facilities were old and shabby. Their old hardware included some ATs, XTs, X286s, and even some 8080s and 8088s. The software packages weren't any better. DOS 1.1 was still installed on some of the computers and there were no data base or applications development software packages available.

Three of the College departments operated their own computer labs as semi-independent entities. The department labs depended on the departments for their budgets so they were often ignored until matters reached a crisis point that had to be resolved by a special appropriation of funds. The Dean's Office operated two labs and the campus computer support organization, the ACS (Academic Computing Service) operated a large general-purpose lab facility in the business building.

There was another problem that was becoming more and more important at the same time. Declining enrollment in the University, the College, and the departments after 1985 caused budgets in the College to be smaller and smaller every year. Some of the declining enrollment was due to a smaller birth rate since 1967 in America (the end of the Baby Boom) that affected most colleges and universities (Hensel 1994). Some of the decline in enrollment was due to increased competition in the Dallas/Fort Worth (DFW) market (There were 18 two year colleges and 9 four year colleges or universities in the immediate area).

III. STARTING THE MODERNIZATION

The College was expecting an accreditation visit by the AACSB (American Academy of Collegiate Schools of Business) in 1996 and the Dean of Business formed a committee to review the College's technical capabilities. The Instructional Resources and Responsibilities Committee (IRRC) made three recommendations: First, to consolidate the CoBA computer labs and their budgets under one person, a director of information resources. Second, to upgrade the hardware and software in the lab facilities and renovate the lab facilities. Third, to form a permanent committee representing all of the college to recommend policies, plans, and procedures for the development and the use of technology in the college.

The Dean started a search for a director in May 1995. A director, called the Director of Information and Instructional Resources (DIIR), was named in September 1995 to start work in January 1996. A new organization called the Office of Information and Instructional Resources (OIIR) was created to operate the college lab facilities.

An Information and Instructional Resources Committee (IIRC) was formed in November 1995 to develop long, medium, and short-range plans for the college. The committee had representatives from the six departments and was chaired by the DIIR (Director of Information and Instructional Resources). The committee's plans were approved by the dean and implemented by the DIIR (Director of Information and Instructional Resources) when the OIIR (Office of Information and Instructional Resources) opened in January 1996.

During an accreditation visit in February 1996 the AACSB said that the campus backbone network was too slow at 10 Mbps (Ethernet) and did not support the College, there was no Internet connection in the College, and the College's lab hardware and software was old and inadequate. The AACSB put the College on probation for three years and criticized the University's and the College's support of business computing facilities.

The administration was already strapped for cash and resisted the College's request for money to support modernizing the computer lab facilities. The University was already renovating the oldest building on campus, Ransom Hall, which had been condemned because of the asbestos used in its previous renovation thirty years before. Ransom Hall was to become a central campus computer facility with computer labs on three floors of the building. ACS (Academic Computing Service), the campus computer service, was to operate the Ransom Hall lab facility.

The administration wanted the CoBA to explain why use of that facility would not satisfy the AACSB for accreditation purposes. The College said that the reasons included: insufficient space in some of the new lab facilities, too many machines in each room for a good learning environment, not enough new lab facilities to support the College's curriculum, and not enough of the software that the CoBA used in its courses available in the new facility.

Ransom Hall was already an old building that had been renovated at least once before. The new lab facilities were set up to maximize the number computers in a single room and thirty machines were crowded into each room. The rooms were arranged along their longest axis so that the rear row in each room was far away from the instructor's station and many students cannot see the instructors. Two of the rooms have a wall partition that can be moved to make a sixty-person facility that is very, very long and narrow and is not a good lecture hall.

ACS was crowding a machine for every seat into the already cramped classrooms in Ransom Hall. The CoBA found that is best to have one machine for two students in lecture rooms. That way one student can pay attention to the instructor and the other can work on a keyboard. This has proved to be very effective because someone is always able to listen to the instructor and the pair of students does not miss as much as when everyone has an individual machine.

ACS couldn't guarantee that we would have the classrooms we needed on the days and times we needed them because their facilities were to be open to every college and department. We demonstrated that we would tie up most of their new Ransom Hall labs most of the time by using an old semester schedule to show how many lab courses we offered every semester.

ACS didn't use and didn't have very much of the software that is used in many of the CoBA courses. The Accounting Department, for example, uses about forty software packages in one of its survey of accounting software courses and ACS (Academic Computing Service) had no intention of acquiring that much software that they knew nothing about.

The University was still reluctant to allow the College to operate its own lab facilities. To overcome that resistance the College made a deal with the University about the operation of the College and the University lab facilities. The College and the University agreed that the University computer support system (ACS) will operate general-purpose labs and the College's OIIR (Office of Information and Instructional Resources) will operate special-purpose labs with the special-purpose software used in business courses. The College agreed not to operate with very much of the general-purpose software available in the University lab facilities. In that way the University labs are in high enough demand to justify their operation, and the College has the lab facilities it needs for its special-purpose software and curriculum support.

III. FUNDING

Funding has been a critical issue in the planning, the implementation, and the modernization of the lab facilities improvement program. The basic budget of the OIIR (Office of Information and Instructional Resources) comes from student computer use fees, and most of it is used to pay the salaries of the OIIR personnel. After the consolidation of the department computer budgets in January 1996 the OIIR budget was about $ 230,000 for FY 96 (October 1, 1995 to September 30, 1996). The budget was cut to $ 200,000 in FY 97 but it was raised to $ 215,000 in FY 98 and FY 99 (Figure 1).

Some of the funding has been unique:

1) An audio/visual supplement of $ 60,000 from the University was used to start an equipment loan service in 1996.
2) The University promised an advance for computing technology upgrades of $ 1.385 million over three years: $ 500,000 in FY 97, $ 440,000 in FY 98, and $ 445,000 in FY 99.
3) A new student multimedia (MM) fee of $ 3 per business course was added to the student fee structure in 1997 to pay for multimedia (MM) in the classrooms and operate the loan service (Figure 1).
4) Industry players such as Motorola, Hewlett Packard, Dell, and SAP America made donations of hardware and software.

III. THE UNIVERSITY'S IMPROVEMENTS

The University installed fiber-optic cables in 1996 and 1997 and converted to Fast Ethernet at 100 Mbps using WindowsNT operating system on an FDDI collapsed star backbone network. The new fiber cables were extended to the College in 1997 and all of the college's servers, lab facilities, and staff and faculty positions are connected to the campus network.

The University opened a new computer center with 240 modern desktop machines for general purpose computing in Ransom Hall. Many of the College's basic computer courses such as Cobol and Visual Basic programming are taught in their general- purpose classrooms.

VI. THE CoBA COMPUTING FACILITIES

After two years of work to upgrade the lab hardware and software, connect to the Internet, and upgrade the University's backbone network the College's accreditation was renewed in 1998.

The newest labs are equipped with Dell Pentium II hardware; the newest servers are dual-chip Dell Pentium II's running WindowsNT as the network OS with both Windows 95 and WindowsNT available in the desktop units. Some of the labs also have ceiling-mounted LCD projectors and wall-mounted Smart Boards.

A multimedia classroom (MMCR) was started in a 120-seat classroom in August 1997. It was completed during the building renovations in 1999 by adding desk top network connections and redecorating the room.

VII. RENOVATING THE CoBA BUILDING

A building renovation program started in 1998. Almost $ 9 million is being spent to renovate the building and the computing facilities upgrades were incorporated in the renovation program. The DIIR (Director of Information and Instructional Resources) is the college's representative on the renovation coordinating committee and manages the college's moves, plans, and building requirements and requests.

Information technology is being introduced into the classrooms and lab facilities as they are renovated. Fifteen classrooms have been renovated, and each renovated classroom is equipped with a multimedia (MM) teaching station and equipment. The MM setup in the classrooms includes an integrated teaching station that contains a Pentium II-400 MHz computer, a JVC video tape player, and an Elmo document camera connected through an "A-B-C" switch to an overhead LCD projector. There is also a motor-driven projector screen, an overhead projector, and a sound system in each of the renovated classrooms. Eight more classrooms, a conference room, and two seminar rooms are being renovated and will be equipped with the same MM equipment setup. The total cost of the MM equipment setups in all of the rooms will be about $ 350,000.

We will have twenty-three MM classrooms, a MM conference room, two small MM seminar rooms, and ten MM lab facilities when the building renovation project is completed in November 1999.

Eight of the renovated classrooms and all of the lab facilities are being cabled this year for Universal Access at the desktop with an Ethernet connection at each seat. All of the college's classroom desktops will be connected to the University backbone network in 2000. The College is moving towards a hard laptop computer mandate to use the classroom connections. The university will have to provide universal access in order for it to work, and is moving in that direction with the acquisition and installation of newer, more powerful servers and software capable of supporting universal access.

The college became an America University Partner of SAP America in 1999 and will get a software grant of SAP/R3 software in the fall semester of 1999 valued at about $ 250,000. Dell Computer has made a complimentary grant of a $ 17,500 server (a Dell 6100 with dual Xeon chips) for the SAP software that will be delivered in August 1999. The Dell server will use the Windows NT operating system and run the SAP/R3 software, and a Hewlett Packard server (dual P6 chips) that is already used as an SQL server will operate with the Dell in a closed environment SAP classroom and lab facility. The first SAP/R3 classes in this facility are scheduled in January 2000.

VIII. PLANS FOR THE FUTURE

Continue the hardware and software upgrades in FY 00.

Continue and expand the loan services mission and role to a Classroom Multimedia Support Service (CMSS), as more and more classrooms are equipped with multimedia hardware and software.

Build more multimedia classrooms (MMCRs).

Provide universal access in the hallways and classrooms.

Close most of the lab facilities.

IX. CONCLUSIONS AND RECOMMENDATIONS

Upgrades are expensive and complicated, but they are necessary. In order to teach our students what industry wants (two of the CoBA's stake holders; students and industry) we have to continue to seek and provide the best educational support technology that we can afford, and we have to do it in a timely manner.

A permanent program to review and continue to upgrade computing facilities is needed. This has been done at UTA's CoBA through the implementation of a planning program. The IIRC (Information and Instructional Resources Committee) and the DIIR (Director of Information and Instructional Resources) develop, review, and publish the long, medium, and short-range plans for the college. Those plans include the direction the college will follow and the technology that will be acquired and supported (the WHAT), the way the technology will be acquired and paid for (the HOW), and when it will be acquired and implemented (the WHEN). A part of the plans is when and how to replace current hardware and software and how to pay for that replacement as part of the continuing modernization of the college's computer lab facilities.

Implementing a solid, sustainable planning function is critical to the success of a program such as this one.

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Figure 1

	Use Fees	A/V Grant	UTA Grant	MM Fees	Total
FY 96	$ 215K				$ 215K
FY 97	$ 200K	$ 60K	$ 500K		$ 760K
FY 98	$ 215K		$ 440K	$ 90K	$ 745K
FY 99	$ 215K		$ 445K	$ 100K	$ 760K
Totals	$ 845K	$ 60K	$ 1.385M	$ 190K	$ 2.480M

Total Annual Budgets

Computer-Mediated Communication Tools for Virtual Seminars in Higher Education – Survey and Comparative Review

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Abstract

Computer-Mediated Communication (CMC) has become the most convenient way to allow spatially separated participants to share knowledge asynchronously or synchronously. Many computer-mediated communications tools, such as the World Wide Web, electronic mail (Email), and newsgroups can be used to accomplish this goal. Some software packages, such as Netmeeting and CU-SeeMe, also provide real-time videoconferencing ability. This paper presents a survey and a comparative review of CMC tools for virtual seminars in higher education, concentrating on those: the Web, email, and newsgroups, that are generally bundled with operating systems. The aim of this study is to highlight different characteristics among computer-mediated communication tools, and to suggest a way to apply communications technologies assists teaching and learning. The first part of this paper discusses the advantages and disadvantages of virtual seminars using computer-mediated communication tools; then it reports a comparative analysis of tools; finally, it draws conclusions from the findings.

Keywords: CMC, virtual seminar, pedagogy, distance education, comparative review

1. INTRODUCTION

1.1 Computer-Mediated Communication

Developments in information and communications technology have changed learning dramatically over the past few years. Learners can learn through Computer-Mediated Communication (CMC) tools, and can collaborate with others to work on specific goals asynchronously or synchronously. CMC is defined as communication that occurs through the use of electronic media (Burton, 1996). It involves the transmission and reception of messages using computers as input, storage, output, and routing devices, and includes information retrieval, electronic mail, bulletin boards, and computer conferencing (Paulsen, 1995). Hiltz and Turoff (1978) point out that CMC

- does not require geographical coordination of participants,
- does not require temporal coordination of participants,
- can involve very large groups of interacting participants,
- allows fast transmission,
- allows fast (reading speed) reception,
- has an integrated memory with sophisticated retrieval capability,
- can easily transform its content into other forms, for example print out a file
- has a dynamic and adaptable structure.

Some CMC systems, for example, the Web, email and newsgroups are asynchronous: i.e. all users need not to be active at the same time. In contrast, if all users are active in real time then the communication is synchronous; this is supported, for example, by NetMeeting, by the CU-SeeMe videoconference system, or by real time chat systems, such as IRC (Internet Relay Chat). The three different group communication models currently being used are classified in table 1.

Table 1 Different kinds of group communication models

	Same place	Different place
Same time	Computer support for face-to-face meetings	Video or audio conferencing with computer support
Different time	Asynchronous group communication: Computer conferencing, Bulletin board system, etc.	

Source: Palme (1993)

This shows three kinds of communication models, same time/same place, i.e. face-to-face communication; same time/different space i.e. synchronous communication; different time/same place, and different time/different time which are both asynchronous communication. One of the main obstacles to the delivery of synchronous collaborative work is the network bandwidth available to the students/learners. Campus networks tend to provide 2 to 3 Mb/s for students, for off campus learners this can drop to 28 Kb/s or 32 Kb/s. In this circumstances synchronous communication (video and audio conferencing) may suffer greatly or be unusable (Wade and Power, 1998). Another downside of synchronous communication is that it is difficult to scale up for a large number of users. One more drawback of synchronous communication is that the users need to be active at the same time. This is difficult for students and tutors where there are limited computer resources on the campus and people work to a variety timetable. This paper examines commercial collaboration tools from the point of view of higher education, and focuses solely on asynchronous sharing features. It also analyzes asynchronous CMC tools that generally exist within systems without incurring extra expense.

1.2 Virtual Seminars and CMC

Stuart Lee (1998) suggests that in most cases the term seminar means a smallish group of students gathering to focus on some topic or task, allowing for more interactions with the member of staff and requiring more student participation than traditional lecture. By analogy, a "virtual seminar" can be defined as a small group of students communicating and discussing via Computer-Mediated Communication (CMC) tools. Brown, Collin and Duguid (1989) argue that learning involves placing experience, thought, or phenomenon in context. They also emphasize the importance of implicit knowledge in developing understanding rather than acquiring formal concepts. Learning is established and negotiated through successive turns of action and talk (Goodwin and Heritage, 1986; Schegloff, 1991). Virtual seminars provide a way to employ new technology in support of these learning outcomes. Virtual seminars not only provide same place asynchronous communications but also provide a convenient method to allow geographically separated participants to share their knowledge and learning with each other. Thus, the differences between a conventional seminar and a virtual seminar are

virtual seminars allow participants to be spatially or temporary separated, instead of communicating face-to-face;

participants communicate via CMC tools.

Althaus (1997) asserts that students using computer mediated discussion groups as a supplement to face-to-face discussions both earn higher grades and seem to learn better than students who participate only in face-to-face discussions. In 1996, Stoke and Stoke in their article 'Pedagogy, Politics, Power' indicate that mailing lists as a means of communication hold the potential to challenge traditional pedagogical relationships. They also point out that "*Using a list meant that effectively, the classes could continue outside of its allotted classroom hours*". In another example of using email communications to enhance learning outcomes. Witmer (1998) in her research "a case study of distance learning for study interns" reported that major improvements in the general quality of student report writing were observed. In her study, most students relied heavily on email to communicate with tutors and peers. She claimed that this form of distance learning enables faculty to monitor and maintain the scholarly standards appropriate for academic credit at an institution of higher learning.

1.3 Advantages and disadvantages of virtual seminars

Several studies have discussed the potential advantages and disadvantages of virtual seminars. For example, virtual seminars allow learners direct access to their tutors, and provide opportunities for participants to make contact with each other, thus overcoming their sense of isolation (Wilson, 1998; Lone, 1992). Berman (1992) performed a study using conference software called VAX Notes to create an on-going class discussion via computers. He found that virtual seminars provide a channel for students to interact with each other without face-to-face contact. He quotes a student as saying " *I feel that computer networking is good for people who are not very outgoing in society. They have a chance to speak what is on their mind without the fear of public harassment*". He said that virtual seminars equally provide an environment for self-conscious learners to express their thoughts. Taylor (1997) in his study "Using online seminars to demonstrate the social psychological impacts of computer-mediated communications" found that, because of the lack of social context cues, virtual seminars reduce evaluation anxiety and students were more uninhibited in their communication. He indicated that virtual seminars produced higher quality contributions, with evidence that many students researched the area before contributing to discussion and indicating that they spent more time on preparation for the discussion. In another study, Berman (1992) also claims that virtual seminars create a different way to share knowledge and that; participants have the opportunity to practice different forms of communication skills. In virtual seminars participants read discussion content and communicate their points of view to the group, thus learning writing style and enhancing their writing skills. Harasim (1987) reports that students perceived the advantages of computer conferencing as increased interaction, access to a group, the democratic environment it fostered, convenience of access, student control over the instructional process, the motivation to participate, and the textual natural of the computer conferencing medium.

Romiszowski and Mason (1996) suggest that, during a computer conferencing course, the teacher must adopt the role of facilitator not content provider. The facilitator needs to pay careful attention to welcoming students to the electronic discussion and reinforcing their early attempts to communicate. They also indicated that course design becomes more important, and preparations entail the structuring of conferences and topics, and the design of activities and small group work. One of the most crucial advantages of virtual seminar is that tutors can compile and extract discussion content and save it for later analysis. This feature not only improves the materials and teaching strategies, but also provides good reference data with which to analyze the students' learning process (Ou, Chen and Chang, 1998).

On the other hand, there are disadvantages of virtual seminars, for example, teacher workload is a problem. In 1988, Hiltz noted that teaching an on-line course, at least the first time, was a bit like parenthood. " You are 'on duty' all the time, and there seems to be no end to the demands on your time and energy". Another weakness of virtual seminars is that although the asynchronous offer participants the benefit of having time to think out the subject and being able to participate at times that are personally convenient, this same factor also generate communication difficulties. For example, participants may leave the response for later, or failure to respond altogether. This increase the complexity of the developing structure of discussion, students may input new comments related to different stages of the development of the topic. One more problem for instructors that they may lose control of the discussion. For example, in virtual seminars when discussion drifts off the topic, it often takes longer and is more difficult to bring the group back to the task than in a face-to-face discussion (Romiszowski and DeHass, 1989). Romiszowski and DeHass (1989) and Romiszowski and Jost (1989) analyzed the dynamics of educational computer conferences of a seminar-like nature held within typical electronic-mail environment. They found the participants experienced a loss of the "sense of structure" of the discussion. Messages came into their mailboxes in a linear stream that did not reflect the sequence of elaboration of arguments within the various parallel discussions, in this case participants only recalled recent messages and did not relate them clearly to earlier messages. Lone (1992) points out that technical support for teachers and students is a must and for conducting a computer conference, such as establishing a virtual seminar environment and facilitating the seminar process. It always frustrating to use CMC technology if learners and tutors are not familiar with CMC technology, and when online help does not meet their needs.

Table 2 Potential advantages and disadvantages of virtual seminars

Advantages of virtual seminars	Disadvantages of virtual seminars
help to overcome a sense of isolation	difficult to evaluate participants' contributions
provide equal opportunity for all participants on a course	tutors have extra workload to make virtual seminars effective
improve learning result	lack of face-to-face interaction
increase participants' motivation and participation	tutors lose control of the discussion,
help to improve skills, such as writing skill, inter-personal skill, organizational skill and planning skill	difficult to maintain discussion content
offer more opportunity for participants to access their tutors,	involves more technical support,
improve course organization and delivery strategies	loss of the sense of discussion structure, difficult to follow on-line discussion

provides mutual learning opportunity for tutors and participants	not suitable for every course

Palme and Manniko (1997), in their study "use computer conferencing to teach a course on humans and computers" reach the same conclusion as Lone. They further indicated that because virtual seminars lack face-to-face contact it is important for the teacher to monitor the progress of the students carefully. They also said it is helpful if simple software tools can mark each activity (students' contribution in virtual seminars), and to summarize these marks student by student. Harasim's (1987) research also suggested that the disadvantages of virtual seminars were information overload and delayed responses. Her students found it is difficult to follow on-line discussion because of the loss of visual cues, and reported increased access inconvenience, and health concerns about computer radiation. Virtual seminars may be difficult to scale up because of limited resources and tutors. Even for on-campus students, there may be not enough computers, response times may be slow, etc. (Mason 1998). Since virtual seminars lack face-to-face contact they are not suitable for those courses require spontaneous response, such as professional acting where student and teacher may all need to be physically present with one another (Casey, 1998). Table2 summarizes the potential advantages and disadvantages of virtual seminars.

2. CMC TOOLS FOR VIRTUAL SEMINARS

This section reports on Web-based instructional (WBI) courseware packages that support computer mediated collaboration. The products surveyed are WebCT, LearningSpace, TopClass, Virtual-U and CourseInfo. The second part discusses the Web, email, and newsgroups as tools to support virtual seminars in higher education, as well as their characteristics in relation to tutors and students. The reason for focusing on the Web, email, and newsgroups is that these CMC tools are generally bundled with most popular operating systems. Tutors can have straightforward and cheap way to do conferencing just set up a news server, or mailing list using free and standard software, have students to access server or process their discussion by their convenient communication tools. Thus, less technical support and system resources are required than for WBI packages.

2.1 Survey of Web-based instructional courseware with asynchronous features

Many WBI packages provide some features to support asynchronous communication but only a few of them are reported in the literature as being widely used for virtual seminar-type activities in higher education (Gray, 1998). Table 4, which is based on a survey by Landon (1999), compares the asynchronous features of five widely recommended WBI packages that can be used for virtual seminars. It shows that each package provides asynchronous sharing tools with different features. For example, CourseInfo only supports Newsgroups features for conferencing, and LearningSpace supports notes-style email for posting and course announcements. All these commercial products require initial training, technical support, system resource, and extra expense. By comparison email, newsgroups and the Web are simple to use and do not require the purchase of expensive multiple or site licenses.

Table 4 Survey of Web-based courseware on asynchronous feature for virtual seminars

WBI Products	Asynchronous Sharing Tools		
	Email	BBS File Exchange	Newsgroups
WebCT	1) supports searching, 2) integrated into student tracking and grade maintenance tools, 3) supports mailing list function	The conferencing tool is multi-fora, threaded, and searchable.	Supported
LearningSpace	1) supports notes style e-mail , 2) notify students of the collection of student assessments or work , 3) to changes or	1) files are most commonly exchanged in LearningSpace MediaCenter, which is the course	1) supports virtual classroom for students/teams collaborate in private or public discussions, 2) supports

	additions to the course schedule; 4) have private, off-line discussions outside of the LearningSpace CourseRoom	material repository, or in the CourseRoom as shared teamwork assignments.	threaded, meaning that they are viewed with topics and related comment threaded together for easy reviewing.
TopClass	Supported with optional additional picture file	Supported for assignments	Supports threaded discussions
Virtual-U	supports: 1) pre-addressed "mailto" emails to instructors and classmates through the browser, 2) use of the email system inherent in the browser, and, 3) form-based emails such as the Problem Report.	BBS functionality is implemented through the Conferencing System (VGroups) and the file upload/download capabilities of the Upload tool.	1) VGroups, is it's "Newsgroups" capability, 2) conferencing is supported graphically in context of assignments, 3) all users can insert multimedia elements such as video and animation into messages, 4) VGroups has file upload/download capabilities of the course structure tool.
CourseInfo	not supported	not supported	Supported and can be augmented with attachments

2.2 Characteristics of the Web, email and newsgroups

2.2.1 World Wide Web (the Web): The World Wide Web is a system for linking text documents to each other using a Graphical User Interface (GUI) and powerful linking abilities. One of the Web's great strengths is that it provides common user interface utilities. It is the most popular and the fastest growing Internet information service (Liu, 1994). Participants can upload their responses for linkage and read the message from linkage. Whenever multiple participants link documents the Web becomes a form of virtual seminars.

2.2.2 Electronic Mail (Email): Email requires less network bandwidth, hardware, and software than other Internet services (Liu 1994). It provides both one to one and one to many communications. It also facilitates private communication amongst students and tutors. With email, messages arrive chronologically and automatically. Most email system allow users to attach and send files, for example a student can submit an attached paper or other material via email to his tutors or peers, and the instructor can comment on it to the student via the same mechanism.

2.2.3 Newsgroups: Newsgroups are groups of people who subscribe to a central mailing list to share information, options, questions and answers. Newsgroups allow users to send messages to a database divided by subject heading, which facilitates electronic mail between multiple users on diverse subjects. An example of using a newsgroup for pedagogy occurred in the Department of Computer Science of the University of Leeds in 1997/1998. They used newsgroups in teaching an introduction to information systems course for first year students (Clark, 1997).

3. CRITERIA FOR COMPARISONS

In 1997, Gibson et al. performed comparative analysis of web-based testing and evaluation systems. They examined four web-based systems by testing, tracking, grading, tutorial building, implementation issues, and security issues. Based on their study there are five principal issues that need to be addressed in comparing CMC tools to support virtual seminars. Following are five principal comparison issues in this study: formatting, tracking, maintenance, implementation, and privacy issues (Gibson et al., 1997). For each principal there are two aspects: the CMC tool itself and its effect on the discussion content.

3.1 Formatting: Good CMC tools must provide a friendly user interface and intelligent online help and tutorials (Jansson, 1997). Schwan and Hesse (1997) note that a user-friendly interface metaphor can improve the learning result and allow users to generate a functional mental model of the software. Messages can been organized in two different ways, either using a linear structure or using a tree structure. What to be investigated is can CMC tool support user-friendly interface and good dialogue content structure?

3.2 Tracking: Gibson et al. (1997) suggests it is very important that a CMC tool provide tracking ability. This allows tutors to (1) monitor each individual student's activities during the virtual seminars process; (2) provide appropriate assistance; (3) store the discussion content in database for further reference; (4) analyze the interactions in virtual seminar between peers, and between peers and tutors; (5) monitor the participation of individual students. What to be investigated is whether the discussion content can be organized in specific sequences, by contributor's name, by date, or by subject. Can the tool provide enough information to enable tutors to monitor students' discussion activities?

3.3 Maintenance: CMC systems for virtual seminars should be very stable and easy to maintain. Further, for virtual seminar discussion content, CMC systems should provide better feature to maintain and reorganize for future usage (Laurillard, 1993). What to be investigated is whether discussion content can be extracted easily. Can discussion content easily be reorganized and reused?

3.4 Implementation: In order to design or adapt a course to use virtual seminars, tutors need to build a sense of "classroom community" and enhance learning by incorporating collaborative elements. Gray (1998) argues that implementation and management of an online course can be very time and energy consuming. Thus CMC tools should make it as simple as possible to establish a virtual seminar environment. In addition, the CMC tool should have good compatibility with other environments, even text- only operating systems. What to be investigated is can discussion content be accessed easily?

3.5 Privacy: Chester and Gwynne (1997) found that the use of aliases might be valuable even when self-reflexive analysis is not an explicit component of the curriculum. The use of aliases in virtual seminars offers a rich source of information for both tutors and students. It ought to allow participants to uninhibitedly express their point of view. In CMC systems, should only allow tutors have capability to identify the owner of information. Participants are able to post their views anonymously. What is to be investigated is whether dialogue content can be securely protected and whether anonymously contributions can be made.

4. RESULT OF COMPARISONS

The result of the comparison of the Web, email, and newsgroups as tools to support virtual seminars is as follows.

4.1 The Web

4.1.1 Formatting: The Web provides a friendly user interface. It provides a real world metaphor, graphical interface, and online help. It can increase the learners' learning result (Lee, 1998). The Web's discussion content can be very rich, since it provides multi-media functions such as sounds, images, and movie clips. It also can contain HTML format and linkage function. Thus, pages can be linked together. The discussion content in the Web is linear.

4.1.2 Tracking: The Web does not support tracking and cannot provide any information for tracking participants' discussion activities. The organizer of the web site may set up the capability to track visitors to a certain page or link.

4.1.3 Maintenance: Web pages are difficult to maintain. Organizer needs to put considerable effort into maintaining the web site. Discussion content is also difficult to maintain, because it may contain embedded sounds, images, and video. The hyper-linkage of multi-media information needs expertise to maintain.

4.1.4 Implementation: It is difficult to implement a web site for virtual seminars, because subject and technical expertise is needed to mount it on the Internet (Jansson, 1997). Accessibility and availability are difficult for people who are off campus and use a dial up modem to connect to the system. Since the Web is designed for full graphical capability, the user is required to have both a GUI-based computer and Internet access. Not every one has this facility (Liu 1994). Furthermore, the Web may contain graphical data, which requires time to download.

4.1.5 Privacy: The web supports anonymity, because participants can post their points of view without providing their name. However, discussion content cannot be securely protected. If the web site owner has not established any secure mechanism, anyone can access the discussion content.

4.2 Email

4.2.1 Formatting: The formatting of email depends on the individual system in use. Some email systems, such as the basic built-in mail on UNIX, only provide text-based formatting while others such as Netscape and Internet Explorer provide a user friendly format and online help. Most email systems do not provide plug-in and multi-media functions. Hence, participants can only attach limited sounds, images, and movie clips to their emails. The structure of discussion content of email is linear; responses are always added to the end of the linear chain of messages. Even where threading is supported, discussion threads are often broken if the subject line is changed (Romiszowski, and Mason, 1996).

4.2.2 Tracking: Email systems do not support any sort of function for recording participants' activities. However, the discussion content provides some kind of record of participants' activities. Tutors can sort email by subject, by date or by sender. This feature enables the tutor to track the sequence of discussion activities. Moreover, email systems provide a 'reply' function to establish context and participants can quote material from earlier messages. Through this mechanism email systems provide some tracking capability for discussion content.

4.2.3 Maintenance: Email systems are easy to maintain as they provide a less complicated method of transmitting information. They have fewer maintenance overheads, and are less time consuming to maintain than other forms of communication systems. However, discussion content is difficult to manage. For example email systems make it easy to quote the previous message automatically when a reader replies to a message but when messages are quoted two or three levels deep, the extraneous material tends to make it much more difficult to keep track of the discussion content (Woolley, 1998).

4.2.4 Implementation: It is simple to establish a mailing list environment for virtual seminars. The organizer provides mailing lists for the group or groups, and posting guidelines for discussion. Email discussions come to participants' mailbox rather than the user having to go to look for them.

4.2.5 Privacy: Email supports better security for virtual seminars. If the organizer use Privacy Enhanced Mail (PEM) feature (Liu, 1996). Because the mailing list is maintained by the virtual seminar organizer, the content of the discussion is secure. Individual needs to be in the mailing list before they can read or join the discussion.

4.3 Newsgroups

4.3.1 Formatting: Newsgroups are like bulletin boards. Participants can attach their responses directly to any message, so a discussion can potentially branch out indefinitely (Woolley, 1998). Discussion content of newsgroups can be categorized into a tree structure by threaded newsreaders. Discussion content of newsgroups is text-based in the same way as email.

4.3.2 Tracking: Although newsgroups, like email systems, do not provide any form of tracking function, the discussion contents are posted according to the date and subject in a tree structure, thus tutors are potentially able to track the discussion process. Any number of subjects can be created and contributions can be listed either threaded by subject or ordered by time of posting.

4.3.3 Maintenance: Newsgroups are difficult to maintain. In newsgroups, the discussion content is tree structured and every message can potentially be the start of a new discussion. Tree structured browsers always display one message per page making a deeply indented tree of messages that makes it hard to follow the original discussion. It is thus very difficult to extract useful messages from each discussion. The virtual seminar organizer needs to put much more energy and time if he or she wishes to maintain several subjects concurrently.

4.3.4 Implementation: The organizer needs to establish several different subject groups; it requires more technical supports and system resources. However, availability and accessibility for newsgroups are good. Because participants can subscribe to the newsgroups and can retrieve the latest messages as well as sending their view on a specific topic to the group.

4.3.5 Privacy: Newsgroups do not support privacy features. Since participants select a specific topic and then post their views under that specific topic, everyone that subscribes to the newsgroups can read the messages and recognize the sender. As with the Web, the content of discussion is not secure.

Table 5 compares the three CMC tools on the five criteria.

Table 5 Comparative results of CMC tools in virtual seminars

	Comparative criteria				
CMC Tools	Formatting	Tracking	Maintenance	Implementation	Privacy
The Web	GUI	No	Difficult	Difficult	Partial
Email	Text-based	Partial	Easy	Easy	Yes
Newsgroups	Text-based	Partial	Difficult	Difficult	Partial

5. CONCLUSIONS

In a seminar, participants must discuss what they think about a topic and listen to what others think. Virtual seminars offer students exposure to more views and perspectives than conventional seminars. This study discusses the strengths and limitations of virtual seminar in higher education. It also uses five criteria to compare the usefulness of the Web, email, and newsgroups as tools for the conduct of virtual seminars. Although none of the tools is perfect, they can all be employed for virtual seminars without incurring expense. For example, the Web has very good formatting capability but not tracking ability. One more downside of the Web is maintenance, since an effective virtual seminar via the Web requires subject-matter expertise and technical expertise. Email has the advantage of making it easy to reach many people and requires the least network bandwidth, but its linear structure makes it easy to lose the sense of the discussion. Newsgroups can provide the concurrent discussion of different subjects; on the other hand, this feature makes the maintenance of discussion content much more difficult.

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Education or Training in University IT degree programs. Why not both?

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Abstract

A common lunch room topic of conversation around University IT programs is the proper role of University programs, education or training? The Information Technology Association of America (ITAA, 1998), concluded that the university degree programs particularily four-year programs have failed to keep pace with the rapid pace of change in IT. The ITAA task force on education and training recommended a six point program for making IT degree programs more responsive to industry needs. Trauth, Farwell, and Lee (1993) also found a fundamental mismatch between IT skill needs of industry and the skill sets taught by University degree programs. This paper discusses the IT skill needs of industry and a new way of looking at four-year IT degree programs as life-long learning enterprises.

THE NEED FOR LIFELONG LEARNING

Dryden and Vos (1994) advocate a revolutionary change to our existing educational process. They advocate a life-long learning approach to education in which a University degree plays and important part in equipping graduates with the needed skill to learn new skills throughout a lifetime. This approach will be examined as a means of improving exiting educational degree programs in IT.

Dr. Ambuj Goyal, vice president of systems and software IBM research, discusses the changes in global technology. The IBM research group is preparing an interdisciplinary cross industry study of future changes of technology and its affect on the global society. One important change is the move to a true networked economy. This change will cause business winners and losers. He said the "business model life cycle is for more important the the product life cycle" (np). This has important implications on the educational process. The traditional university will have to adopt new business models where creating customer relationships is critical to success of the university. The eight important consideraations for univisity business process reform are:

1. Is enough highly specialized training being provided?
2. Is too much highly specialized training being provided?
3. Is the university teaching how to learn for a life-time?
4. Is the univeristy asking learners to read the right materials?
5. Is the university teaching how to how to work in teams effectively?

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6. Is the university teaching technical communications to communicate not to sell, and are internships effective in developing learner portfolios of work?
7. Is the university creating world aware schoars?
8 Is the affect of change on the university being adequately addressed?

University Loyalty

or FORTRAN thinking that the employer can train them in the languages they will use on the job. Such attitudes unfortunately have led organizations like ITAA (1998) to recommend to their members to look elsewhere than four-year degree programs for qualified applicants. One large company will not even consider graduates from one large Minnesota University, because only Pascal is used as a teaching language.

Trends in IT	*Problems with Degree Programs*	*Ideal IT Employee*
Decreasing need for programming as a profession transfers to business functional areas	Greater emphasis on real world problems	Intellectual depth
Using fourth generation languages	Greater emphasis on communications skills	Good interper-sonal skills
Increasing end user computing	Greater emphasis on analytical ability	Good comm-unications skills
Increasing need for business process analysis	Greater emphasis on problem solving	Functional business knowledge

Table 1: Identified Concerns for business IT skills

Many graduates of four-year institutions are extremely loyal to their universities for years after receiving their degrees. For evidence all you have to do is look at the alumni endowment fund drives sports booster clubs and class reunion activity. Universities educate learners in reasoning and higher level cognitive skills, some subject domain knowledge and in some cases subject domain abilities. This process is called education and is a prime asset of the university degree programs. One

By refusing to teach skill based courses of interest to employers Universities have excluded themselves from the estimated $13.0 billion dollar IT training market not currently being spent at four-year degree programs.. Because of the brand loyalty of their IT graduates it is reasonable to assume that they would select their own university for life long training needs if they had the option to do so in more flexible environments.

Trauth, Farwell, and Lee (1993) studied the difference between the expectations of business information systems (IS) employers and IS

IT Occupation	Tot Est. Employees	Tot Est. Shortfall	Percent Shortfall
Programmers	1,877,000	188,000	10%
Systems Analysts	918,000	92,000	10%
Computer Engineer Scientist	559,000	66,000	12%
Other	266,000	Unavailable	N/A
Totals	3,620,000	346,000	10%

of the complaints about computer science graduates found by Trauth, Falwell, and Lee
(1993) was that they were often unprepared to develop business-oriented solutions to common business problems. By treating university computer science programs as primarily educational endeavors they degree programs often deprive IT graduates of the some of the key skills, knowledges and abilities needed for success when designing business systems to solve business problems. Some university degree programs still do not teach fourth and fifth generation computer languages as part of their degree. Many schools only teach BASIC, PASCAL,

Curriculum provided by universities. The business members of the study in focus groups had concerns in the following areas in Table 1.

The IS professors in focus groups were interested in obtaining the resources needed to simulate the problem solving skills needed to provide real world experiences. The recent graduates commented that the problems given in courses did not provide opportunities to integrate systems from different business functions. (Trauth, Falwell and Lee, 1993).

The ITAA (1998) investigated the workforce needs for IT professionals and found a significant shortfall in the number of IT workers expected to be available in the new millennium. Table 2 shows the estimates for workforce needs in a telephone survey of 532 companies.

ITAA Workforce Needs and Shortages in the New Millennium

higher cognitive skill levels of synthesis, evaluation, and critical thinking skills. The ITAA (1998) task force on quality and productivity issues recommended that "educational opportunities should be expanded. and cross discipline training/retraining should be expanded" (p. 60). They also concluded that junior colleges were better at skills training than four-year universities. Also, they concluded that industry specialists need to develop the curricula for

	Occupational Cluster	*Definition*
1.	Programmers	"Computer programmers write and maintain detailed instructions that tell computers how to execute their functions" (p. 33). Common languages include, C++, C, Java, and COBOL
2	Systems Analysts	Systems analysts solve problems involving computers. They apply computer solutions to business problems of an organization. They also are involved in connecting computer systems through networks and client/server systems.
3.	Computer Engineer/Scientist	Perform similar duties as the programmer and systems analyst, but are distinguished by a higher level of expertise and theory involving software and hardware. Computer engineers often design computer equipment.
4.	Other	Project managers, Team leader, Customer support representative, Telecommunications specialist, Business analyst, Sales, IT trainers, VP of MIS, CIO, Graphics artists, and Testers

Note: Adapted from Help Wanted 2: A Call for Collaborative Action for the New Millennium, 1998, ITAA. P. 11. Copyright 1998 by Information Technology Association of America.

The implications of this shortfall is that a significant shortage of IT professionals already exist and that the University degree programs are only producing 24,000 new graduates in 1995 (MSED, 1998, p. 19). How can Universities respond to this industry need and the shortfall of qualified workers? One conclusion is that they can not respond the way education is perceived at this time. (ITAA, 1998).

According to ITAA (1998) "the changing pace of technology was the major challenge facing companies ... companies look for 'just-in-time' training for employees to take advantage of changing technologies" (p.22). Corporations experienced difficulty in "finding qualified providers" of training in new technologies (p. 23). Among the training providers cited by companies were; (a) "internal training departments" (76%), (b) "Hardware/Software training vendors" (74%), (c) "Private IT training companies" (62%), (d) Four year universities (53%), (e) "Two-year colleges & technical schools" (47%) (p. 24). The need for IT training is estimated in excess of "$16 billion in 1996" of which only $3.0 billion goes to universities. Why do universities not receive a larger share of the IT training expenditures of corporations? The answer might be the traditional reluctance of universities to engage in training in short term product specific skills compared to education at

IT degree programs because they better understand industry needs.

Another task force (ITAA, 1998, p. 62) recommended that universities"

1. Change curricula faster
2. More variety in delivery formats
3. Collaborate with higher education disciplines
4. Seek out opportunities for industry input
5. Change attitudes about industry needs for a trained work force
6. Do a better job of curriculum design by bringing IT industry needs into closer alignment with the skills taught by universities.

While the task force does note that some universities are being more aggressive about accommodating industry needs, it is the two-year degree programs that have come the farthest. Many degree programs are unable or unwilling to "manage the rapid change or expense" needed to compete in the training needs of the industry.

The occupations included in the study were three cluster groups. They defined them in the third table, "Occupational Cluster Groups in ITAA 1998 Study;." In addition to the specific occupation cluster position and vacancy estimates the survey requested global estimates of total IT positions (10,208,000, total IT vacancies (606,000) and estimate of five year vacancies to be filled (3,222,00) (ITAA, 1998, p. 13). The significance of that number is that 32% of all IT employees will change jobs over five years. This level of job change has required companies to attempt a number of strategies for retaining IT employees. Among those strategies include; (a) "retrain existing staff" (91%), (b) Use contingent workers (74%), (c) "Hire new immigrants" (40%), and (d) "Out-source to non-US firms" (16%) (ITAA, 1998, p. 20). The MDES (1998) reported similar strategies being used by Minnesota companies. Contingency workers is the current term for part-time or consultant workers serving for short term assignments, usually at higher pay but with few benefits. If not enough new IT workers are entering the work force the consequences can have tremendous impact on organizations.

Insufficient IT workers to fill vacancies and new positions has limited the growth of many firms according to MDES (1998). With the average company planning to add 19.8% additional IT jobs per year, it is clear that the supply of qualified IT workers needs to increase. University IT degree programs are an obvious source of new employees. According MDES (1998) "on a national level, there are concerns that the number of students completing computer science degrees, which are required for many IT positions, is declining" (p. 19). There were only 24,404 bachelors degrees awarded in computer science in 1995.

In Minnesota according to MDES (1998) in a survey of employers 36,520 IT workers were found in 1996 with estimated new positions of 8,000 per year. Since all of the University and junior college graduates in Minnesota totaled only 1,000 students per year. A critical shortfall in IT workers in the coming millennium is expected both in Minnesota and Nationally.

Conclusion

Universities have excluded themselves from participating in the $13.0 billion in IT training revenue because they have been unresponsive to the IT skill needs of business. By adapting a policy of life-long learning as the goal of an educational institution, not just granting degrees. We believe that the unique branding ability of universities and the loyalty of their graduates can create a unique business opportunity for both education and training revenue.

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About the Authors

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Panel:
IS'2000 Model Curriculum and Guidelines for Undergraduate Degree Programs in Information Systems: Update Progress from IS'97

Panelists:
Herbert E. Longenecker, Jr.
University of South Alabama

Gordon B. Davis
University of Minnesota

David L. Feinstein
University of South Alabama

John T. Gorgone
Bentley College

IS'97 represents the culmination of a four year effort (Davis 1997). The work now represents the official model curriculum for the ACM, AIS and AITP. The curriculum was derived from IS'90(Longenecker and Feinstein 1991). Preliminary reports were presented in 1994 (Gorgone 1994) and in 1995 (Longenecker et al 1995). Presentations of IS'95 draft, and the finished IS'97 have been made subsequently at AIS, ICIS, ISECON, IAIM, IACIS, SIGCSE, DSI, and IRMA conferences.

Work is now taking place to develop the next release of the model curriculum. Results and implications based on the following current investigations will be discussed by the panel:

1 Reviewer commentary and analysis of the IS'97 document
2 Survey of current knowledge expectations of graduates
3 Utilization of IS'97 Learning Units in universities
4 Consideration of sub-specialities within IS
5 Updating the body of computing knowledge
6 Proposed updates to the Learning Units

The panel will present recommendations for IS'2000 and will encourage participation from the audience

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Davis, Gordon B., John T. Gorgone, J. Daniel Couger, David L. Feinstein, and Herbert E. Longenecker, Jr. 1997. IS'97: Model Curriculum and Guidelines for Undergraduate Degree Programs in Information Systems. Published by AITP, Chicago 1997.

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Panel:

Methods of Implementations of the IS'97 Curriculum Guidelines

Chair
Pat Woodworth
Department of Mathematics and Computer Science
Ithaca College
Ithaca, New York

Panelists
Bart Longenecker
School of Computer Science and Information Systems
University of South Alabama
Mobile, Alabama

Wayne Summers
Computer Science Department
New Mexico Highlands University
Las Vegas, New Mexico

Bruce White
Information Systems
Dakota State University
Madison, South Dakota

IS '97 is a model curriculum for undergraduate degree programs in Information Systems (IS). developed by a collaboration of the ACM, AIS and AITP (formerly DPMA) with extensive input from academe and industry. The model curriculum provides guidelines, a set of courses, source materials, curriculum design objectives, and knowledge elements. The list of knowledge elements includes virtually everything that anyone would want to have in an information systems program. Implementing a program that includes every element could preclude a student from taking any other courses. In many institutions, this is not possible. Colleges and universities that offer programs in information systems come in many sizes and flavors. But the curriculum model can effectively serve as a high-level guide to an ideal program that each institution could then fine-tune to meet their unique needs.

The goal of this panel is to describe a variety of IS programs from diverse institutions which will serve as examples of appropriate and effective ways to implement information systems programs using the IS • 97 model curricula as a guide. The panelists represent a wide range of institutions from large to small, public to private, liberal arts orientation to professional orientation, etc and each of us has developed an IS program which meets the specific needs of our institutions and student population.

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IS '97: Model Curriculum and Guidelines for Undergraduate Degree Programs in Information Systems. Davis, G.B, et. al., (1997), Association of Information Technology Professionals, Park Ridge TN.

CAREER PLANNING: BLUEPRINT FOR SUCCESS IN CIS

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Abstract

Career paths and the associated job titles in computer-related industries have been changing at a very rapid pace in an attempt to keep up with the ever changing technology being used thereby creating a dilemma for students who are trying to plan their future. This paper addresses the need for including career planning as part of the educational program and suggests a way to include it in the existing curriculum.

Keywords: CIS curriculum, CIS Career planning, Problem solving, CIS Education

1. INTRODUCTION

Technological changes have probably taken place faster in the 20th century than in all previous centuries put together. Over the years, there have been many technological developments and/or inventions that have had a major impact on society in general. Included among these developments would be the wheel, electricity, telephone, airplane, and even more recently, the computer and the Internet. Of all of these, the computer has possibly made the greatest impact in the shortest period of time.

With the proliferation of computers in use throughout the world, particularly the United States, jobs requiring computer skills abound. To meet the demand for graduates with computer skills, colleges and universities have developed courses of study leading to a major or degree specializing in computers. Some of these degree programs are based on a foundation of engineering courses, others on a foundation of mathematics and science courses, while others are based on a foundation of business courses. These programs are most frequently referred to as Computer Engineering (CE), Computer Science (CS), and Computer Information Systems (CIS) or Management Information Systems (MIS) respectively. Although there may be similar needs for career guidance within other computer-oriented degree programs, discussion and recommendations in this paper will be limited to the business-oriented computer degree programs, CIS or MIS.

Business-oriented computer degree programs first appeared in colleges and universities in the mid to late 1960s when large-scale computers called mainframes were about the only computers in use. At that time, a graduate of a CIS degree program could look forward to starting his/her career as a computer programmer, programmer analyst, or possibly junior systems analyst. The career path in those days was rather straight forward. A person would traditionally start as a computer programmer and advance to the position of programmer analyst and then to systems analyst. From the position of systems analyst, an individual could move into a supervisory or managerial position.

With the advent of smaller, more powerful, but less expensive computers, that has all changed. There is now a multitude of job titles and a large variety of career paths available to graduates of CIS degree programs. "The problem—and it's the kind of problem that is inherent in every growth industry—is that while there were only one or two major highways to a successful future ten years ago, roads now lead to hundreds, perhaps thousands, of new and unfamiliar destinations. It's confusing. It's perplexing. It's *dizzying*" (Half 1987). "It is especially difficult for students contemplating a computer career to understand the many choices and make college and career decisions" (Scott and Chrisman 1998).

In addition to the problem relating to the large number of choices facing students today, it is further compounded when one considers that job titles and career paths are constantly changing in an attempt to keep pace with the technology being used. According to one study, many of the job titles in use today didn't exist ten years ago (Wagner and Duncan 1998).

"Students often find themselves needing to make college and career decisions without enough information to form opinions for these decisions" (Scott and Chrisman 1998). The authors are of the opinion that this type of information must be made available to students early in their academic program.

It is not enough to say that this information is available in the library, on the web, or at the career center or placement office on campus. We believe that this information should become a required topic or course in the CIS curriculum because students traditionally do not have the time and/or interest to do the necessary career planning unless it is required as part of their major.

2. USING THE PROBLEM-SOLVING PROCESS TO CREATE A CAREER PLAN

"Problem solving is responding successfully to both good and bad problems." (Fuller & Manning 1997). Applying a Problem-Solving Process (PSP) to business problems, such as career planning, is a systematic and orderly approach to solving these problems. This paper will discuss application of the Problem-Solving Process to create an effective career plan.

The authors believe that the PSP approach is versatile and can be applied readily to creating a career plan. The authors have taught this methodology and it has proved to be extremely successful for CIS majors who have followed it. For that reason, it might be appropriate to use "career planning" to introduce problem solving in a beginning systems analysis and design or programming methods course.

There are many variations to the PSP, but most involve doing the same thing in a slightly different way. For the purpose of this paper, the problem solving process as described by Fuller and Manning (1997) will be used. Those steps are illustrated in Table 1.

Table 1

PROBLEM-SOLVING PROCESS

1. Problem Recognition/ Identification
2. Generation of Alternatives
3. Evaluation of Alternatives
4. Implementation
5. Follow-up/ Control

The following sections of this paper describe how the PSP steps shown in Table 1 can be used to create a career plan model.

Problem Recognition/Identification

In problem solving, the purpose of this step is to identify and define the problem or opportunity. In career planning, it could actually mean that an individual's present position is not providing the degree of personal satisfaction desired or it might not be performing as well as expected. In that case, a problem does exist that might be corrected by changing jobs and/or the individual's career goal. For students getting ready to graduate, the problem is often one of indecision regarding which career field to follow after graduation. In either case, the "problem" is one of indecision or unhappiness with the choice of a career goal and it is time to undertake the steps of career planning.

Career planning involves the identification of an advanced position that is selected as a career goal and the creation of a plan that will lead to the attainment of that goal. "An individual looking for a job should . . . devote enough time to thinking and research before beginning the business of job hunting" (Half, 1987). In this example, an individual must think about and research a number of alternative positions in the computer field for the primary purpose of selecting an advanced position which would provide the level of personal growth and satisfaction desired. That position becomes the individual's long-term career goal. In the case of computer information systems and other careers highly dependent on the use of computers, a reasonable long-term career goal would be one that is three to five years in the future. For a college student still taking classes to complete a degree program, three years after the expected graduation date might be reasonable as a time frame for a "career goal".

Generation of Alternatives

Once the problem has been identified, the next step involves generating alternative solutions. In this case, the alternative solutions would include various advanced positions that could be considered as a long-term career goal. With that in mind, this step would involve identifying all of the skills, qualifications, and experiences that are prerequisite to obtaining a particular position—i.e., the possible long-term goal. Although a large amount of information about different career paths and positions is available in the campus library or career center or its equivalent on campus, students should be encouraged to investigate other sources of information as well. For example, information about the duties and responsibilities associated with some computer positions might be presented in various CIS courses and articles about computer careers are often found in periodicals and journals related to computers. Computer club meetings, when off-campus speakers are present, are another valuable source of information. During this research and investigation of various career paths, job descriptions associated with the desired position should be obtained and studied. Based on this study, a list of the skills, qualifications, and experience(s) that are needed to obtain the position should be identified.

Usually experience in lesser positions is required before one is qualified for an advanced position. In many cases, experience must be attained in two, three, or four lesser positions before a person has the qualifications desired in the position being considered as a career goal or position. All of the positions leading to the goal make up the career path and each of the positions along the career path must be researched to determine what skills and qualifications are needed in each. All of the prerequisite skills that have been identified in the career track make up the skill set (resources) needed to qualify for and be successful in the position identified as the "career goal".

Evaluation of Alternatives

After researching multiple advanced positions in depth to determine the duties and responsibilities to be performed as well as the skills and experience needed to acquire each, it is time to select the one that is anticipated to provide the greatest personal satisfaction. In career planning this would involve performing a self-assessment.

One aspect of self-assessment is the determination of whether the duties and responsibilities as well as the tasks to be performed are those that the student/employee would be interested in doing. For example, if one of the researched career paths involves extensive travel, it might prove to be the wrong choice for an individual who desires to be at home every evening. This step helps to substantiate whether or not the position or career path being considered is one that would be suitable based on an individual's likes and dislikes. If all of the career paths being considered require the performance of tasks that are disliked, an individual would be wise to reconsider his/her selection of alternatives at this time and return to the previous step and research other advanced positions, career paths, in CIS. Assuming that the original list of alternatives was chosen wisely, the result of this step would be the identification of the advanced position which most closely matches an individual's stated areas of interest and personal goals. This position then becomes an individual's long-term goal.

Implementation

Now that a long-term goal has been identified, implementation plans can be developed. These would include the identification of everything that must be accomplished or attained to qualify for the position desired. This step begins with the complete list of skills and experiences that are needed to qualify for the position selected as the long-term goal and identified previously.

Using this list of needed skills and experiences, another self-assessment must be performed. This involves a comparison of what skills and experiences are required for success and/or entry into the chosen career goal with the individual's present qualifications. One method that can be used here is to depict the results of the comparison in a "T" account. Every needed skill and/or qualification required and/or desired in the chosen career track would be listed on the "T" account as either an asset or a liability. If the needed skill has already been acquired, it would be listed on the asset side of the "T" account. If an individual doesn't have a required skill or, at least, not at the level desired, that skill would be listed as a liability. For example, it may have been determined that an understanding of telecommunications and the ability to program in C++ are two of the required skills in the chosen career track. Assuming that the individual has just completed an introductory telecommunications course, it would be listed as an asset. But, if the individual had never used the C++ language, that would be listed as a liability.

Table 2

T-ACCOUNT WORKSHEET

ASSETS	LIABILITIES
Team Player	Public Speaking
Writing Skills	1 Year Programming Experience

Telecommunications	C++
Microsoft Office	Java
COBOL '97	HTML
Relational Database	Object Technology
	Client/server Experience

An example of a "T" account is illustrated in Table 2. Once the "T" account has been completed, it should become readily evident whether an individual is qualified (no liabilities listed) or where the individual is deficient. All skills and personal characteristics that are listed as liabilities are those that are needed in the chosen career path but lacking—either at the level desired or totally. This list of needed, but missing skills, is then used to create a career plan that will minimize, if not eliminate, an individual's liabilities. "Clearly, you can find yourself in many career traps if you are on your way to the top of the pyramid. Without a plan you are lost" (French 1981).

A plan of action must be developed whereby each liability is overcome to the point where it can be moved to the asset side of the "T" account. In some cases, this might involve selecting a particular course as an elective (for example, C++). In other cases it might involve getting an internship with a company that uses a particular software tool or hardware. A good plan should address the "what", "how", and "when" for each listed liability. In this case, the "what" is the liability to be addressed. "How" includes the method by which this liability will be corrected or changed to an asset. "When" provides a time-line for this activity and a deadline for getting it done. Without this information in a plan, it is extremely difficult to evaluate progress or lack thereof toward a goal.

Now that a plan of action has been completed that is designed to convert each liability to an asset, that plan must be carried out. Throughout this step, progress must be closely monitored to assure that progress, in fact, is actually being made. As in business, things don't always go as planned. It may be necessary to modify the sequence of or time line for your planned activities.

The key to this step is that once most or all identified liabilities have been changed to assets, an individual has attained all of the qualifications required for the position desired.

Another benefit of using a "T" account to depict your assets and liabilities is that your present skills are readily apparent. These are the skills that should be listed and/or highlighted in some manner on a resume, because they represent what you have to offer a prospective employer at this time. As you convert a liability to an asset, your resume should be updated to reflect your total skill set. The bottom line is, these are the skills that must be emphasized when writing a resume. This resume, although not suitable for use in helping an individual get the position identified as the career goal, can be used to acquire a position that will provide some of the experience, skills, and training that will help move one or more of the listed liabilities to the asset side of the "T" account. Note: internships or other positions should not be applied for or accepted if the experiences and knowledge to be gained would not advance an individual closer to his/her ultimate career goal. The bottom line is, will this job help me toward my ultimate career goal?

Follow-up/ Control

As stated previously, once all liabilities have been converted to assets, an individual has met all short-term goals and is now qualified for the position initially identified as the long-term goal. Even before that position has been attained, the follow-up/ control step can begin. It involves monitoring the performance of the solution to assure that it is performing as expected and meeting the expectations and needs of the user. If the solution, the chosen career goal, is performing as expected and desired, then things can continue unchanged. Traditionally, once a goal has been achieved, it is time to establish a higher goal. If that is to take place, an individual should return to step one and repeat all of the steps in the PSP.

It is not unusual to change the requirements and/or expectations of the problem solution. If the individual's likes and dislikes, goals, or environment change (marital or family status, health, etc.), the chosen career may no longer be providing the level of personal satisfaction expected and/or desired. As above, if a problem is noted in the existing system (chosen career goal), then it is time to repeat the PSP by returning to Step 1, Problem Recognition/Identification. These steps are repeated over and over (a circle or "cycle") as long as the chosen career track is not performing up to expectations.

3. SUMMARY

It is no longer enough to give students the knowledge and ability to use computers, programming languages, database architecture, systems methodologies, networks, and other computer-related skills. Students must also be provided information about career planning so that they may more wisely choose elective courses and make other decisions that will help them to achieve their career goal. Furthermore, computer languages, hardware, and methodologies may become obsolete, but the principles of career planning will be relevant all of an individual's working life.

Although the authors believe that career planning is important enough to warrant a separate course on the topic, as is being done at one of the author's universities (see Appendix), much of the needed information about career planning could be incorporated into the existing CIS/MIS curriculum. The beginning "systems analysis and design" or "introduction to programming methods" course would be an appropriate place to add a segment on career planning. Table 3 illustrates how the PSP approach to problem solving parallels the steps of career planning.

Table 3

PROBLEM-SOLVING PROCESS COMPARED WITH CAREER PLANNING

PSP	CAREER PLANNING
Problem Recognition/ Identification	Identify Career Goal
Generation of Alternatives	Determine Skills Needed
Evaluation of Alternatives	Prepare Plan to Obtain Needed Skills
Implementation	Execute the Plan
Follow-up/ Control	Monitor Satisfaction in Career Goal
REPEAT ALL STEPS	**REPEAT ALL STEPS**

By assigning a problem on career planning as the first problem in a required CIS course, the PSP methodology becomes alive. Students can relate to the problem being solved and the end results will have value to them. After using the PSP approach to problem solving successfully in career planning, it will become easier for the students to use it on other, more complex, business problems. In summary, the authors believe that by doing this, it is a "win win" situation. An additional topic is included in the curriculum without adding a new course while, at the same time, providing an easy way of introducing and demonstrating the PSP approach to problem solving.

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APPENDIX

CALIFORNIA STATE POLYTECHNIC UNIVERSITY, POMONA
College of Business Administration
Computer Information Systems Department

COURSE SYLLABUS

CIS 328 Information Systems Careers

A. Course Content

Career Opportunities and specialties within Computer Information Systems. Job search preparation, strategies and techniques. Making good impressions during interviews and on the job. Career planning and enhancement. Individual or group investigation, research, studies or surveys of selected problems. 2 units. Prerequisites: CIS 267, CIS 305, and CIS 311.

B. Expected Outcomes

This course is designed to provide students with the necessary background and skills to develop a career plan and put that plan into effect. Students will learn differences between the specialty areas within the field of Computer Information Systems and be able to make an informed choice as to which emphasis is best for them. They will be able to prepare a career plan and evaluate methods for implementing it. Students will also learn how to seek out prospective employers and enhance their likelihood of being hired and promoted.

The student who successfully completes this course will be able to:

- Identify at least four areas of specialization (career tracks) within CIS and describe the qualifications needed to enter and/or become successful within each.
- Select the specialization in which he/she wishes to pursue a career.
- Create a five-year plan for attaining and becoming successful in the chosen career track.
- Develop a list of potential employers.
- Create a resume that will lead to interview opportunities for an entry-level position within the chosen career track.
- Prepare for and handle various types of interview situations.

C. Required Textbook and Materials

Text: Booher, "Get Ahead, Stay Ahead", McGraw-Hill Softcover, 1997.

Supplementary Materials: Business Section of the L.A. Times, Sunday Edition and Monday Edition (Specifically the "Cutting Edge" Section). Access to **www** and **email**.

Integrating the MCSE Certification into a Sequence of Computer Networking courses: A Value-added Degree

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Abstract

With the increased need for computer networks, there is an accompanying increased need for personnel who can assess the telecommunication's needs of businesses, design and implement a wide variety of networking systems. Many of these network specialists find that they can increase their skills and thus their marketability by obtaining network certification. In the past there were only a few network certifications. Today there are many certifications available. The Computer Science Department at New Mexico Highlands University has begun to integrate one of these certifications, the Microsoft Certified Systems Engineer, into the computer science program through an appropriate selection of computer networking courses and the addition of several short training courses.

Keywords: Certification, MCSE, computer networking.

1. INTRODUCTION

A survey conducted by the National Association of Business Economists found that "the most serious problem the U.S. economy faces today is a poorly prepared labor force..." There is an increasing shortage of skilled workers to support business in a increasing complex world of technology. There are currently over 350,000 jobs unfilled in the U.S. Analysts predict there will be over a million new unfilled jobs within the next six years (DOC OTP, 1997). Telecommunications and computer networking is one area where these trends are especially severe.

Most IS and CIS programs now teach a course similar to **IS'97.6 – Networks and Telecommunications** (Davis, 1997). Some universities may offer additional courses, but in most cases these courses are mostly theory with little hands-on experience. "Students generally complete the course lacking a full understanding of computer networks and how to implement them." (Summers, 1998)

The last several years has seen an increased need for some way to certify the knowledge of computer networking professionals. In the past there were only a few technical certifications available. Today there are a large number of certifications including Certified Solaris Administrator, Certified Novell Engineer, Cisco Certified Internetwork Engineer, Certified Linux Engineer, and Microsoft's Certified Professional and Certified Systems Engineer.

"Computer professionals who become Microsoft Certified are recognized as experts and are sought after industry-wide. For network professionals, Microsoft offers the Microsoft Certified Systems Engineer (MCSE) credential. Microsoft Certified Systems Engineers are qualified to effectively plan, implement, maintain and support information systems with Microsoft Windows NT and the Microsoft BackOffice integrated family of server software." (SIU, 1995)

Microsoft offers a number of certification programs and the MCSE is considered its most prestigious and difficult to obtain. To become an MCSE, it requires passing six exams - four that cover networking basics and operating systems and two elective exams on Microsoft technologies and products. With the passing of each exam, students earn a Microsoft Certified Professional (MCP) credential. The Microsoft Certified Systems Engineer (MCSE) is earned when all six exams are passed.

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According to a study commissioned by Microsoft and done by Southern Illinois University (SIU, 1995), more than 90% of certified individuals felt that certification was useful to planning, maintenance, software support and network administration. 70% of respondents rated certification as very or extremely useful for professional credibility. In addition, supervisors rated MCSEs as more competent than their non-certified counterparts. The mean salary for MCSE is over $10,000 more per year than non-certified professionals. Over 38% of the respondents expected an additional 10% or more raise in salary [6]. 42% of the respondents in the salary survey conducted by MCP Magazine (MCP, 1999) thought the Microsoft certification resulted in a job promotion.

2. PLACEMENT OF THE CERTIFICATION IN THE COMPUTER SCIENCE PROGRAM

The Computer Science Department currently offers a sequence of three computer networking courses: **CS456/556 Internet Services, CS457/557 Computer Networks, and CS458/558 Network Management** and will be adding a fourth course **CS460/560 Wide Area Networks** in Spring 2000. Each of these are three credit courses taken by both undergraduate and graduate students to satisfy requirements in Computer Science and MIS undergraduate programs and the Media Arts & Computer Science and the Electronic Commerce MBA graduate programs. These four courses along with the short training courses will prepare students to take exams that satisfy the requirements of the MCSE Certification. The four networking courses are designed to provide students with a breadth of knowledge about computer networking and cover hardware and software concepts and cover Microsoft products in the wider context of network operating systems. Students completing the course should be comfortable with Microsoft products in addition to UNIX and other network software. The six one-credit training courses focus on Microsoft-specific features of networking as it relates to Microsoft products.

Microsoft Certified Systems Engineers are required to pass four operating system exams and two elective exams. With the passing of each exam, students will earn a Microsoft Certified Professional (MCP) credential.

The Computer Networks and Network Management courses provide the foundation of computer networking and network management that will prepare students for three of the four required operating systems exams:

- **Exam 70-058: Networking Essentials**
- **Exam 70-067: Implementing and Supporting Microsoft® Windows NT® Server 4.0**
- **Exam 70-073: Microsoft® Windows NT® Workstation 4.0**

The Internet Services course will provide the foundation in working with web tools that will prepare students for the elective exam:

Exam 70-087: Implementing and Supporting Microsoft® Internet Information Server 4.0

The Wide Area Networks course will provide the foundation in enterprise computing and TCP/IP and will prepare students for the remaining required operating systems class as well as the elective in TCP/IP:

Exam 70-059: Internetworking Microsoft® TCP/IP on Microsoft Windows NT® 4.0
Exam 70-068: Implementing and Supporting Microsoft® Windows NT® Server 4.0 in the Enterprise

Each of these three credit courses will be followed by short one-credit, two-week courses offered between semesters to prepare students for the specified MCSE exams. These courses will be taught by the University's MCSE trainers and utilize accelerated versions of the syllabi prepared by Microsoft. These six one-credit courses are:

- **CS 411/511 Networking Essentials**
- **CS 412/512 Implementing and Supporting Internet Information Server**
- **CS 413/513 Windows NT Workstation**
- **CS414/514 Implementing and Supporting Windows NT Server**
- **CS415/515 Internetworking TCP/IP in a Windows Environment**
- **CS416/516 Implementing and Supporting Windows NT Server in the Enterprise**

3. COMPUTER NETWORKING COURSES AND MCSE EXAMS

CS 456/556 Internet Services is an introduction to telecommunications and the Internet. This course introduces the use of the Internet for both research and problem solving. The main focus of this course is on installing and using the different Internet services. Students are expected to use e-mail, telnet, ftp, and the World Wide Web to research and complete their assignments. Several assignments involve researching information in one or more of the RFCs (Request For Comments) that provide the foundation of the Internet. A major project for each student is building a web site for a client (either a local school or a local business) and then installing the site on a web server. Additional assignments include installing and using at least one Internet service, typically a web server and using some of the TCP/IP software tools. Information about this course can be found at http://jaring.nmhu.edu/NOTES/cs556/.

CS 457/557 Computer Networks is a study of the major concepts of computer networks and data communications. Topics discussed will include data communication networking, computer communications architectures and protocols as well as applications including Local Area Networks (LAN) and Wide Area Networks (WAN). Considerable emphasis is placed on knowing and understanding the layers of the OSI Model. A major focus of this course is on installing and using the hardware and software necessary in computer networking. Students are expected to install network cards and participate in the design and installation of a local area network. Additional assignments include installing and using at least one network operating system and using some of the TCP/IP software tools. Information about this course can be found at http://jaring.nmhu.edu/notes/cs457/.

CS 458/558 Network Management is a continuation of CS457/557 Computer Networks. The focus is on application of networking concepts related to the management of local area networks. Students are expected to repair, setup, manage and maintain local area networks. Several of the assignments include troubleshooting both NT and UNIX networks. Students are expected to be comfortable using several hardware and software tools for network management. Information about this course can be found at http://jaring.nmhu.edu/NOTES/cs458/.

CS 460/560 Wide Area Networks is a continuation of CS457/557 Computer Networks focusing on application of networking concepts related to wide area networks. Students will be expected to understand the nature and use of wide area networks including topologies, software and hardware used in WANs. Special emphasis will be placed on the TCP/IP Suite of Protocols. Many of the assignments will involve troubleshooting WANs using TCP/IP tools.

The **CS 411/511 Networking Essentials** course focuses on implementing, administering and troubleshooting information systems that incorporate Microsoft Windows and BackOffice products. Students will be expected to be comfortable with networking standards and terminology. They should be able to plan, implement and troubleshoot a Windows network. This course will prepare students for **Exam 70-058: Networking Essentials.**

The **CS 412/512 Implementing and Supporting Internet Information Server** course focuses on the implementation, administering and troubleshooting of information systems that incorporate Microsoft Internet Information Server. Students will be expected to plan, install and configure an IIS server. Students will be expected to configure IIS to work with a database and ISAPI applications. This course will prepare students for **Exam 70-087: Implementing and Supporting Microsoft® Internet Information Server 4.0.**

The **CS 413/513 Windows NT Workstation** course focuses on implementing, administering, and troubleshooting Microsoft Windows Workstation products. Students will be expected to plan, install and configure an NT Workstation. A lot of emphasis will be placed on troubleshooting NT Workstation systems. This course will prepare students for **Exam 70-073: Microsoft® Windows NT® Workstation 4.0.**

CS 414/514 Implementing and Supporting Windows NT Server focuses on implementing, administering, and troubleshooting Microsoft Windows Server products. . Students will be expected to plan, install and configure an NT Server. A lot of emphasis will be placed on troubleshooting NT Server systems. This course will prepare students for **Exam 70-067: Implementing and Supporting Microsoft® Windows NT® Server 4.0.**

The **CS415/515 Internetworking TCP/IP in a Windows Environment** course provides students with the knowledge and skills required to set up, configure, use, and support Transmission Control Protocol/Internet Protocol (TCP/IP) in a Microsoft Windows environment. Students will be expected to be comfortable with the different TCP/IP tools as well as setting up a TCP/IP network. This course will prepare students for **Exam 70-059: Internetworking Microsoft® TCP/IP on Microsoft Windows NT® 4.0.**

CS416/516 Implementing and Supporting Windows NT Server in the Enterprise focuses on implementing, administering, and troubleshooting Microsoft Windows Server in an enterprise computing environment. This course will be a culmination of the previous courses bringing together NT Workstation, NT Server and TCP/IP installations in an enterprise environment. This course will prepare students for **Exam 70-068: Implementing and Supporting Microsoft® Windows NT® Server 4.0 in the Enterprise**

4. CONCLUSION

Our students are always looking for a way to receive extra value for their education. This program will allow Computer Science and Management Information Systems students to receive both a degree and a MCSE certification with a minimum of additional coursework. Students completing the sequence of courses described above will not only be proficient in Microsoft products, but will be knowledgeable in other aspects on computer networking. This program will help address the severe need for more qualified computer networking professionals and provide the students with a balance of theory and hands-on experiences.

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Does MBA-CIS Graduate Programs Need Revamping?

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Abstract

Business schools with graduate programs in Information Technology provide education for individuals who can bridge the business-technology gap. But are employers really looking for MBAs in CIS? If employers are, what knowledge, skills and competencies do they expect these MBAs to have? How can business schools improve their curriculum so that the graduates can increase their ability to succeed in the workplace? This paper reviews the literature on the subject of MBAs in the IT workplace and analyzes data from a survey of employers who have potential to hire MBA-CIS graduates. The results of the survey are presented here and will further explain in what positions new graduates will find employment, what specialties they will need in CIS, which business subjects are important to employers, and which competencies are regarded as significant in the workplace. The goal of this paper is to integrate information from current literature and the survey results to present recommendations for updating the MBA-CIS curriculum in business schools.

Keywords: Information systems Curriculum, MBA curricula, MBA-CIS revision, Teaching/Training and Curricular Issues

INTRODUCTION

There has long been a discussion on whether the CIS graduate program should be highly technical, or general business and management-oriented. Choose an MBA graduate without the technical background; can he or she work in the information systems field? Or, a trained computer specialist, a technically oriented person; can he or she be effective in a business environment? Employers expect MBA-CIS graduates to be educated in business, have a through knowledge in software and hardware, and to be competent in business communications. Then, what should we teach in graduate school? Generally speaking, the Computer Science Department, and the Schools of Business are the prime source of higher education in computer systems. Schools of business having these programs within an MBA curriculum allow for better integration of the study of business and technology.

Business and information technology have become inextricably interconnected. Business magazines such as Forbes and Business Week have regular sections devoted to computer technology. Computer magazines have detailed articles describing how specific computer technologies have been used to provide "mission critical" solutions to business problems. No longer is Information Technology (IT) the domain of a small group of technologists - it has intermixed the entire business organization: from the manufacturing shop floor to Human Resources, from the payroll section to Marketing. The importance of IT is also reflected by the appearance of the designation of the CIO (Chief Information Officer) among the ranks of top management, along with the CEO, COO, and CFO.

The domination of Information Technology in every function of the business organization has increased the demand for IT oriented personnel. Some reports (such as an article in the May 97 issue of ComputerWorld) indicate that the combination of Technical skills and business is in great demand. These articles report the salary of a techno-MBA to be 20-30% higher than that of his traditional counterpart.

LITERATURE REVIEW

The challenge in designing an MBA curriculum lies not merely in training future managers, but also providing the specialties needed to get the graduates started in jobs. What do graduates need as future managers? In a series of articles in ComputerWorld and other professional journals, a common theme has been the requirement of general business competencies for top technology positions. The articles also emphasized that the merging

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of business and technology created opportunities for managers who can act as the interface between technology and business. Many other articles have discussed the role of technology in business related education. Most articles focus on the need for IT professionals to be business conscious and know business functions well. A common approach to the subject of business and technology is discussing the concept of aligning technology with business. Alignment is often seen in terms of pursuing common business goals, making IT planning consistent with overall business planning, communicating the direction of IT, and using business control mechanisms such as planning, reviewing, budgeting, etc. Clearly, all of these concepts require a thorough knowledge of business functions (Diamond, 1994).

Somewhat contrary to the findings listed above, ComputerWorld articles cited studies such as the one done by the University of Minnesota indicating that technical skills, rather than business skills, were more sought after for IS positions. However, the same article also presented evidence that this situation was changing; 50% of the companies polled indicated they were moving towards hiring more MBAs because Information Systems (IS) managers saw the role of IS becoming more closely integrated into business. The article specifically listed situations where an MBA was required; moving into IS management positions, acting as liaison between IS and corporate functions, working for an external consulting organization, and switching to a non-IS function where skills in technology are part of the management "tool kit."

Another mixed picture is presented in a study of the content of job advertisements (Todd, McKeen,m and Gallupe, 95). The authors looked at IS ads from 1970 to 1990 and analyzed the knowledge and skill requirements for three types of positions: programmers, systems analysts, and managers. They found that the content of job ads remained surprisingly stable over the 20 years. For programmers, technical requirements remained high, but on a percentage basis, more ads included at least one reference to business skills. However, the authors write, ". . . absolute number of (business) references is small compared to the overall size of the ad." Also, there was no consensus of which business skills were desired. For systems analysts, technical requirements increased, but the requirements for business skills remained stable. For IS managers, the need for business skills remained high with an increase in the desire for technical skills. With the current emphasis on the importance of business skills, as seen in their review of the literature, the authors were surprised by their findings and presented a number of possible explanations, including limiting factors such as the choice of newspapers from which the ads were taken, the use of only three IS positions, and the actual skills desired other than those indicated in the ad. These days, business knowledge is a prerequisite skill for an increasing number of positions. Among them are database administrators, consultants, and business system analysts – these positions were not examined by the study.

There are some who disagree with the idea that business oriented IS professionals are highly desirable and have an employment advantage. Some advocate that an MBA may not be adequately prepared for a rapidly changing and complex technical environment (Cusack, 92). They quote surveys that show technology based CIO's perform better -- "A good manager can manage anything, but they can't manage IS nearly as well as someone who understands the technology underneath." (Maglitta, 94)

Many articles report that managerial skills are not learned at school. In a 1988 article, Porter and McKibbin point out the lack of managerial skills of MBA graduates. Frank Shipper, in an article published in the Jan-Feb '99 issue of the Journal Of Managerial Psychology, compared the managerial skills of middle managers with MBAs with those who had other master's degrees or undergraduate degrees. They studied the relationship between 11 managerial skills and performance on the job. The results suggested that, regardless of when an MBA was received, there was no advantage in managerial skills of MBAs' over those who had received only a bachelor's degree or some other masters degree. Does this mean that the management education does not impact the ability of a manager to manage?

MBA - CIS PROGRAMS

The graduate programs in Computer Information Systems often exist within the traditional MBA format and can vary from school to school. Most of these programs emphasize business education over technical skills. More than half of the required courses are business related: management, marketing, finance and accounting. The other half are computer-related.

Many articles argue that MBA programs are not keeping pace with the changes in technology and consequently are not providing relevant technical education. Ron Gales, in a 1994 article, discussed how an MBA graduate should be a generalist, communicate well, be able to lead and think globally, and be proficient with ever-changing technology (Gales, 94). Several other articles support the idea that business education is more important than specific technology concentrations. A 1994 Information Week article concludes that there is a huge gap between employers' expectations of MBA and what the business schools actually teach. The respondents (the technology managers) indicated strongly that integration of business and technology is vital, and that business skills were much more important than technical skills gained in educational programs (Winkler, 94). Another study, published in the Interface Journal, also revealed that general business and interpersonal skills were valued over technical skills (Crockett, 95). Similar results were drawn in a 1992 survey that was sent to Fortune 500 companies: strong interpersonal and communications skills were very important. Technical skills in a specific area ranked sixth out of seven criteria.

Generally, there are several categories of students entering an MBA program. Some students return to school for better training, particularly in the business field. Some are IT staff who need managerial training. These returning students have a choice of entering a conventional program or an executive MBA program. The traditional MBA programs require students to attend the school on a "full time" basis. The executive programs can be completed by special seminars, or weekend courses. The returning techno-oriented students are not looking for technical training. The MBA-CIS may not suit the technology-oriented students because the courses are not specialized courses, and the purpose of the IT person going back to school is to learn about business anyway. Other groups of students who enter the MBA program hope to change their career directions to Information Technology. For these groups of students, the existing MBA-CIS is not sufficient because it lacks specialty or concentration. Some schools implement internship programs. These internship programs - between the first and second years – are becoming popular and have proved very successful.

Information technology has been rapidly changing but business schools are slow in revising their curricula to accommodate the changes and trends in IT. In a March, 1999 article of CIO, the author suggests that MBA programs need improvements with regard to the integration of the "information technology" in the curriculum. The same article also indicates that the limitations include shortage of qualified teachers, and "footdragging" of some faculty members.

RESEARCH STUDY

A study was conducted to gain insight into whether or not MBA programs in CIS meet expectations. The purpose is to determine the desired characteristics and expectations of MBAs in Computer Information Systems in terms of technical and general business knowledge and competencies. Since the Computer Science departments' approach tends towards highly technical computer systems utilization, structure and methodology, the research concentrated on computer technology and Business related curriculums could be called Information Systems, Business Systems, or MBA-CIS. The goal is to gain an insight into whether or not an MBA program in CIS is relevant to the realities of the current IS workplace. Based on the information gathered from literature and from a small pilot study for the research, some hypotheses were developed. The objectives of the hypothesis were to obtain answers to the following questions:

1. Into what positions are recently graduated MBAs in Computer Information Systems likely to be hired?
2. What specific computer/ technology-related skills are these MBAs expected to have to be successful in these positions?
3. What general business / managerial competencies are these MBAs expected to have?
4. Do the MBA grads qualify to apply for the jobs announced in the media?
5. What computer languages, if any, should be taught to graduate students?

The research instrument was a survey that covered four major areas - positions into which MBAs in CIS are likely to be hired, desired technical knowledge areas, desired business knowledge areas, and desired competencies.

The research was conducted in several phases. The first phase started in 1997. It is being repeated in 1999 with additional components. Since it was noticed that the demand for information systems jobs is increasing dramatically, a survey was conducted to find the scope of job opportunities in the Information Systems, as the preliminary step for the second phase.

Summary of the results of the Initial Phase

The data were statistically analyzed, and the mean and confidence interval (using a confidence level of 95%) were calculated for each group. The items were then ranked in descending order within their groups. Both the mean and the confidence interval were used to determine the rating for each item and to group items by level of preference or importance. After the data was ranked and grouped by ratings, the Z-value was calculated using the cumulative mean of the groupings and a one-tailed test was used to determine if indeed the mean of one grouping was significantly greater than the mean of the next grouping. The data collection and analysis for the 1999 data are still in progress. The following is a summary of the results.

Positions The survey question asked participants to indicate the extent to which an MBA in CIS is preferred for IS positions. The ratings for the positions range from 1 - "Not preferred" to 4 - "Highly preferred." In general, the highest rankings went to Business Consultants and Business System Analysts, the next highest rankings were for the various management positions, and the lower rankings went to programming and engineering type positions as well as Database Administrators and Sales Engineers. These results support the premise that MBAs will be more desired for analytical and managerial positions rather than specific skill oriented engineering/programming positions where more technical expertise (and a degree in Computer Science) is generally preferred. The following table (Table 1) shows the results of the Position analysis, with positions ranked from highest to lowest, for the 1997 data.

Table 1. Desired Positions of MBA-CIS Graduates

Position	Mean/Interval	Rating
Tech/Business Consultant	2.579 ± .405	Somewhat Preferred - Preferred
Business Sys. Analyst	2.579 ± .377	Somewhat Preferred - Preferred
Info Center Manager	2.550 ± .414	Somewhat preferred - Preferred
Software Proj. Manager	2.526 ± .434	Somewhat preferred - Preferred
Appl. Develop Mgr.	2.368 ± .502	Somewhat preferred - Preferred
Telecommunications Mgr.	2.333 ± .494	Somewhat preferred - Preferred
Dec. Sup. /Exp. System	2.158 ± .480	Somewhat preferred - Preferred
Sales/Account Executive	2.125 ± .502	Somewhat preferred - Preferred
Database Designer	2.056 ± .433	Somewhat preferred
Networking Manager	2.048 ± .478	Somewhat preferred - Preferred
PC Resources Manager	1.842 ± .375	Not Preferred – Somewhat referred
Software Engineer	1.833 ± .507	Not Preferred - Somewhat referred
Database Administrator	1.750 ± .373	Not Preferred - Somewhat referred
Applications Programmer	1.700 ± .405	Not Preferred - Somewhat referred
Sales Engineer	1.467 ±.324	Not Preferred - Somewhat referred
System Integrator		

Technical knowledge The survey question asked participants to indicate the importance of having knowledge and/or skills in a variety of computer related areas. The ratings for computer knowledge range from 1 - "Not important" to 5 - "Extremely important." It is difficult to detect a clear pattern or explanation for the ratings other than by matching the results to current workplace trends and a general understanding of IT and business. The "technical knowledge" rankings for 1997 data were:

Systems Analysis, Software Development Methods, Networking - LANs/ WANs, Database Theory and Design, Object-Oriented Technology, Decision Support Systems, Distributed Database Systems, Data Modeling, Using CASE Tools, File Organization and Data Structures, 4th GL Programming, Expert Systems, Physical Database Design, OSI Model-Telecommunication Standards, Telecommunications Protocols - Interfaces, broadband Services, Database Administration, ISDN, 3rd GL Programming, Telecommunication Channels, Circuit and Packet Switching.

The tentative results of the second phase of the study in 1999 show major shifts. For example, Systems Analysis and System Integration is still high on the list. But the major emphasis in System Development is on Object Oriented Technology, Internet or Web development, and Database access through web development. The second phase showed clearly the emphasis on newer technologies such as Object Oriented Technology, and Web Database Development. The importance of these skills is logical as these form the underlying foundation of software and systems development. Technically oriented programmers can be given specific coding projects and tasks and they do not necessarily need to understand the bigger issues involved in the overall project. It takes a much higher level of skill and understanding to figure out what needs to be done in the first place and to make sure that what is being done will meet the needs for which the project is being undertaken. Especially for larger projects, this is an area where it is important to have a good understanding of the business functions and organizational issues.

The use of newer software development tools such as RAD is becoming more important as organizations struggle with more complex systems. It is understandable that organizations are looking for IT professionals who can use business and managerial competencies to help organize and control complex business system integration and more complex applications. Other areas of computer related knowledge that was added to surveys by respondents in 1977 were: PC knowledge and skills, Mainframe knowledge and skills, wireless communication protocols, and Internet - HTML. Particularly, the second phase shows strong tendency towards requiring Internet, e-commerce, XML, and Java knowledge.

Business knowledge The survey question asked participants to indicate the importance of having knowledge in a variety of business areas. The ratings for business knowledge range from 1 - "Not important" to 5 - "Extremely important." The business knowledge rankings, from highest to lowest, were: Operations Management, Business Policy and Practices, Finance, Quantitative Analysis, Business Forecasting, Organizational Theory, Marketing, Research Methodologies, Accounting, Human Resources Management, Economics, International Business.

As with the previous data, in general it is difficult to categorize the rankings for this question based upon the type of knowledge or its application to IT. One possible explanation for the rankings is that they reflect the specific business needs of the organizations and the individuals who responded. In other words, the business knowledge that has practical application to the organization's business or the work of the respondent's department was an influencing factor. This group of items is also subject to the greatest level of respondent interpretation. There are no standard definitions or understandings of what each type of course entails and each respondent has his/her own understanding of what the area of business knowledge actually entails. The top rated items in this group were Operations Management, Business Policy and Practices, and Finance.

The lowest ranked item, International Business, was the only item to fall into the "Not important" range. This was surprising initially as the current emphasis is on doing business globally. Upon closer examination of the list of organizations selected, a number of them are likely to do business only locally or within the US. It is also possible that those responding to the survey might have interpreted International Business knowledge to be important for corporate executives, and the like, not necessary for the types of IT positions listed in the survey.

Competencies The survey question asked participants to indicate the importance of a number of characteristics and competencies. The ratings for competencies range from 1 - "Not important" to 5 - "Extremely important." All of the ratings within this group were relatively higher than within any other group. This category was also the easiest to explain. The competencies ranked, highest to lowest, were:
Communication Skills, Interpersonal Skills, Previous Work-Related Field, Computer Technical Skills, Planning and Organizing Skills, Managerial and Leadership Skills, Knowledge of Industry Practices,
Quantitative Analysis Skills, Previous Work, and General Business Skills.

As with most other studies, the highest ratings went to the people-oriented abilities of Communication and Interpersonal skills, indicating that these abilities are most important to employers. As this study was aimed at IT positions, it seems logical that computer technical skills are also important.

The new components of the research

New components of the research were added to the initial survey in 1999 to search the job announcements for certain jobs in CIS. Since Web searches and job recruitment have become common in use for both candidates and companies, a simple search was performed in spring 1999, for key words such as MBA, CIS, MIS and the names of different programming languages, for different geographical locations. Also, the content of IS job announcements for over a hundred companies' web sites were analyzed for the knowledge and skill requirements for Information Technology related positions.

The job descriptions were compared with the typical MBA-CIS core courses. The summary is presented in Table 2. The results of the comparison between the typical courses in an MBA-CIS program and the job requirements indicates that the majority of the content of job announcements in the information systems fields required systems analysis skills, most required Database Management Systems knowledge, and some required data and communications skills.

Table 2. The required Skills for Information Technology Jobs

Courses in the CIS-MBA	Core required the skill
Systems Analysis/Analysis of Comp. Info Systems	80%
Database/Database Management Systems	62%
Decision Support/Expert Systems	3%
Data Communication	38%
Research in Info Systems	10%
programming	80%
COBOL	8%

For programmers, technical requirements have changed. Ads included at least one reference to business skills. Although, there was no consensus of which business skills were desired. For systems analysts, technical requirements were a must, but the requirements for business skills varied. For IS managers, the need for business skills was high with an increase in the desire for technical skills.

The result of a simple search for certain jobs as an exploratory tool was interesting. The summary is presented in table 3.

Table 3. Search Hits for Jobs

Keyword	Location	No of hits
MBA	Bay Area	300
MBA	Nationwide	More than 1000
CIS/MIS	Nationwide	37
COBOL	Nationwide	187
C ++	Nationwide	More than 1000
Visual/BASIC	Nationwide	232
JAVA	Nationwide	More than 1000

Although, this method lacks the rigor necessary for a scientific research project, it gives an idea of the initial reaction of the MBA-CIS job seekers who are looking at the job announcements.

Programming Languages In the 1997 survey, approximately 80% of the respondents indicated that they expect MBAs in CIS to have programming experience. The programming languages mentioned most in 1997 were C or C++ and COBOL. But the programming languages mentioned most in 1999 survey were C++, JAVA and Visual BASIC. This result is not surprising. Even the job searches on the web will give similar results. COBOL programmers are still in demand, but only the experienced ones, to fix the Y2K problems. However, there seems to be somewhat of a contradiction between the high number of organizations that expect MBAs in CIS to have programming experience and the relatively low rating of the importance of programming skills within the computer knowledge question.

IMPLICATIONS FOR THE MBA-CIS CURRICULUM

The curriculum in many institutions has successfully provided the necessary educational background for many graduates who are seeking higher education in business. However, since the information system technology is changing almost everyday, the curriculum for a technology oriented program must be dynamic. The diversification within the field-- end-user computing, 4th generation development, Object-Oriented Technology, System Integration, and Telecommunications-- makes it even more challenging for the designer of the curriculum. The program must constantly respond to the changes and trends. It is not an easy task to design a curriculum in a moving target field, and to meet the needs and expectations of both graduates and employers, particularly, when a curriculum requires a multi-disciplinary approach. On one side, the graduates are expected to have a thorough knowledge of business functions. On the other, the graduates are required to be fully specialized in their field -- Computer Information Systems.

Designing an MBA-CIS curriculum is challenging. Although the field of Information Technology is changing rapidly, the major structure of MBA has not changed. With rapidly changing technologies and business environments, schools need to make special efforts to make sure that what they teach is both current and relevant to whatever is expected from them. When an institution tries to make changes to an MBA program, both content and teaching methods should be evaluated to make sure that both are optimal for their objectives and the educational process. Taking into consideration the materials gathered in the course of this research, there are a number of related implications that can be drawn with regard to the teaching of CIS within an MBA program. There is no consensus as what field the majority of MBA-CIS students find employment in when they start their career. The situation becomes more complicated when a new branch of technology emerges every day. A graduate may start employment in the following fields:

- Business Systems Analysis, or Information Systems Analysis and Design
- Database, Database Management Systems, Database Design, or Database Administration
- System Integration, Business Integration
- Software engineering
- Web Design and Development
- Consulting, Coordinating, or advising
- Programming
- Telecommunication, LAN, WAN and TC administration
- Application Development/project management
- Technical Writing
- Information Center Management
- Decision Support or Expert Systems Design and Development
- Sales Engineering
- Research in the Information Systems

Furthermore, the CIS-MBA curriculum is expected to cover knowledge of business functions and general managerial competencies as well as technical knowledge in a particular area in the Information Systems.

The greater value in getting an MBA in CIS, as opposed to a more technically-oriented degree in Computer Science, is understanding technology from a business perspective and gaining the ability to act as an interface between the two. However, most MBA graduates start working in a specialized area and then move up to higher positions or to the management level. Technical training is needed to start employment in a specific area, but business education is needed to function and excel in the job.

The general business education in an MBA program must be regarded as just one of many elements that an individual brings to a job for future advancements. However, since the graduates need to start employment in a specific technical area, the MBA-CIS students need more technical background to start a career. But the question arises over the degree to which, and in what specific area the technical background should be in. This is difficult, considering the fact that it is not possible for a one or two year educational program to provide the level of technical expertise and experience that employers want for IT positions.

With the rapid change that characterizes the world of Information Technology, constant attention must be given to keeping up with those changes. In other words, the curriculum development must be a dynamic process in an environment that is dynamic in nature. The two-period study clearly showed the shift/changes and the dynamic nature of technology.

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Do Formal Ethics Courses Make IS Students More Ethical? Preliminary Results

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Abstract

As a part of a new Masters of Science in Information Systems Management program, an Ethics and Information Systems course was created to be an integral part of the curriculum. A short survey was created in order to gather what the student values and beliefs were before taking the course, and then submit them to the same survey after taking the course. It is hoped that by comparing the before and after results, one might conclude whether the exposure of the students to this type of ethics course had any significant influence on their personal value system.

Keywords: Ethics, Business Values

1. INTRODUCTION

There has been an increased concern by many schools to include ethics classes as part of their program, or to include ethical topics across the curriculum, both on the undergraduate or graduate level for IS majors. There are several questions that come to mind upon hearing about this type of curriculum change. When such courses are offered, what is the school assuming about the students in these classes? Are the students regarded as being unethical? I doubt that very much. If a more positive assumption is made regarding the ethical standards of these students, then why are they taking this course? And if they take such a course, are they then ethical or more ethical after taking the course? These and others questions are rather interesting to pose in regard to this somewhat new area. Unfortunately, I don't think there are any one generic satisfactory answer to any of the above questions.

Why then are so many schools offering ethics courses in their programs? For some this type of offering, is not new, but has been a major component or part of the core requirement of many parochial programs. Some of the public institutions have also started to offer this type of course, mainly because various professional trade associations have published suggested curriculums for the profession, and in turn have included a course or two of this nature in the suggested curriculum.

2. NEW MSISM PROGRAM

As part of our new Masters of Science in Information Systems Management program, we have a required ethics course component. This was included because our MBA and undergraduate programs have always has an ethical component. Originally, we allowed the students to fulfill this requirement by taking the existing Business Ethics course that was offered in the MBA program. In keeping with the theme of this master's program, a special ethics course was offered for the first time this past spring quarter of 1999, entitled "Ethics & Information Technology". The program director felt that a course offering of this nature was very appropriate to the mission of the program and school. This course can be taken as an elective within the MBA program, but it is strongly suggested that those students who are formally enrolled in the MSISM program take this Ethics & Information Systems course to satisfy their ethics requirement.

3. SURVEY DESCRIPTION

Having the opportunity to teach this course, I decided to create a little experiment. Each student was asked to fill out five different lists before coming to the first class. Each list is composed of various terms representing general personal values as well as values and concerns pertinent to the information systems area. My plan is to have the students complete the same set of lists during the last session of this 10-week quarter course. The plan is to compare how each student ranked the various items in each list. It will be of interest to see whether the exposure of the students to the material of this course had any significant affect on their ranking of these items included on these lists.

The basic null hypothesis of this test would be that the rankings are basically the same, and therefore there is no difference. If the alternative hypothesis were true, then this would indicate that there is a significant difference of the rankings. This significant difference might indicate that the exposure of the students to this course material had a significant impact on their value system.

The instruments that I am using for this testing are attached (Appendix A). Again my main purpose is to see whether there will be any significant difference in the rankings of these items in the list by the students before and after the course. A secondary point of interest is just the overall patterns of ranking of these items on each individual list. This is definitely an interesting result in it self. I really can not project or interpret what that might mean at this particular time. I would hope that by the time that the conference is held in October of 1999, I would have at least some comparative results.

4. PRELIMINARY RESULTS

The results of the survey of personal values - Part #A- represent the "before" tally of how the students felt in regard to these factors. [1] There were 20 students who responded out of 22, and there was a mix of 10 males and 10 females. Table A represents the average ranking of personal values. The smaller the average values the greater the degree of importance.

Table A

Categories	Average Value
Self-respect	3.45
Security	3.85
Love	4.50
Health	4.70
Union with God	5.79
Accomplishment	6.65
Freedom	6.65
Achievement	8.50
Recognition	9.65
Pleasure	9.65
Equality	10.95
Cooperation	11.05
World at peace	11.75
Dollar Rewards	12.00
Beauty	12.35
Possessions	13.30

The reaming four list show the average ranking of the student values that were listed in each list. Each list was composed of terms that were definitely focusing in on terms, concepts, and ideas pertaining to the information systems & technology area.

IS Values #1

Categories	Average Value
Data gathered without your knowledge	3.86
Accuracy of data stored about you	4.43
Privacy of files on your computer	4.52
Data Gathered & sold to others	5.19
Privacy of e-mail	5.19
Data gathered about you	5.48
Credit for intellectual property	7.85
Bugs in software	8.05
Accessibility of poor to computers	8.35
Use of Internet cookies	9.00
Misrepresented software features	9.33
Illegal copies of software on your Computer	10.10
Ergonomics at the work place	10.69
Accessing non-work Internet sites	11.86
Playing computer games at work	12.30

IS Values #2

Categories	Average Value
Highest quality system	2.90
Security/Access controls	3.20
On-time delivery	3.35
Business Benefits of the system	3.60
Consistency with the corporate direction	4.20
Respect from business unit(s) people	5.40
Respect from IT people	6.05
Elegance of code	7.08

IS Values #3

Categories	Average Value
Self-respect and desire to do more than "just enough"	2.53
Balance personal/family/professional Commitments	2.85
Doing what is right even when it is unpopular	3.85
Doing good for others while doing well for self -they are not mutilate exclusive	4.21
Achieving personal growth in a responsible Manner	4.35

Creating win-win rather than win-lose business relationships	5.05
Practicing your profession as if children were watching while you did it - would you feel proud of what they saw?	5.30
Think global - act	7.11
The Amorality of technology - local - its people that makes decisions	7.95
Leaving the world better off than it would without I/T	8.28

IS Values #4

Categories	Average Value
Happiness	3.52
Trust	3.52
Health	4.00
Balance	4.76
Knowledge	5.10
Privacy	5.95
Understanding	6.05
Goodwill	6.85
Flexibility	7.00
Fellowship	7.60

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APPENDIX A

Student Name ____________________

First Class Exercise

This exercise is designed to help you better understand your own personal values, and to see how these values and personal experiences support or conflict with your life goals. For assignment #1 do Part A and Part B, and submit them before the first class using the following e-mail address: **xxx@xxx.edu**

Assignment #1- Part A
Rank Ordering of Personal Values

Rank the following sixteen personal values in order of importance to you, that is, insofar as they are guiding principles in your life. Study the list of values carefully. Place a 1 in front of the value that is most important to your life, a 2 in front of the next most important, and so on. The least most important value for you should be ranked 16. If you change your mind, feel free to change the rankings.

When you are finished, the list should roughly indicate the importance of the various values in your life. If you feel there is an item missing that is important to you, please feel free to add that item at the bottom of the list (notice there are three blank spaces).

_____ Achievement (promotion at work)
_____ Beauty (natural and artistic beauty)
_____ Cooperation
_____ Dollar rewards (money and salary)
_____ Equality (equal opportunity for all; everyone as equal)
_____ Family security (taking care of and being with loved ones)
_____ Freedom (independence)
_____ Love, friendship and intimacy
_____ Physical health and well-being
_____ Pleasure (sensually and sexually enjoyable personal life)
_____ Possessions (good car, clothes, home, many material goods)
_____ Recognition (respect, admiration from others)
_____ Self-respect (A good self-image, self-esteem)
_____ Sense of accomplishment (making lasting contribution)
_____ Union with God (prayer, striving to be a good person)
_____ World at peace (lessening of war and conflict)
_____
_____
_____
_____

Assignment 1 - Part B
Life Goal Inventory

This inventory is designed to help you examine your life goals. Describe fully as possible your aims and goals in all areas of your life. List all goals that are important to you, whether they are fairly easy or difficult to attain. Be honest in this assessment; only then will the inventory be useful to you. For example, if your goal is to enjoy leisure satisfaction, indicate this, so as to better understand and assess yourself. In your own words, describe two to five goals in each of the following areas over the next year or two. The categories are a guide; feel free to change them to suit your own goals.

Career Satisfaction
Goals for future job or career; specific positions aimed for.

1.
2.
3.

Personal Relationship
With friends, parents, spouse, colleagues, others.

1.
2.
3.

Leisure Satisfaction
Vacations, sports, hobbies, other interests.
1.
2.
3.

Learning and Education
New skills you would like to learn or areas of knowledge you would like to study.
1.
2.
3.

Spiritual growth and Religion
Relation to God, prayer, giving self to others, larger questions
1.
2.
3.

IS Value List #2

Review the list below and then rank them from 1 to n with one (1) being the most important and "n" the least important. If there is any phrase or word, which you **do not understand**, then simply put **DNU** to the left of it in place of a number.

_______ Beauty/Elegance of the code
_______ On-time delivery
_______ Highest quality system
_______ Consistency with the corporate direction
_______ Business Benefits of the system
_______ Security/Access controls
_______ Respect from business unit(s) people
_______ Respect from IT people

IS Value List #3

Review the list below and then rank them from 1 to n with one (1) being the most important and "n" the least important. If there is any phrase or word, which you **do not understand**, then simply put **DNU** to the left of it in place of a number.

_______ Leaving the world better off than it would be without I/T.
_______ Creating win-win rather than win-lose business relationships.
_______ Achieving personal growth in a responsible manner.
_______ Doing good for others while doing well for self- they're not mutually exclusive.
_______ The amorality of technology - it's people that make decisions.
_______ Self-respect and the desire to do more than "just enough."
_______ Balancing personal / family and professional commitments.
_______ Doing what's right even when it's unpopular.
_______ Think global - act local (stolen from a bumper sticker)
_______ Practicing your profession as if your children were watching while you did it – would you feel proud of what they saw?

IS Value List #4

Review the list below and then rank them from 1 to n with one (1) being the most important and "n" the least important. If there is any phrase or word, which you **do not understand**, then simply put **DNU** to the left of it in place of a number.

_______ Fellowship
_______ Knowledge
_______ Understanding
_______ Privacy
_______ Happiness
_______ Balance
_______ Health
_______ Goodwill
_______ Trust
_______ Flexibility

YES: Women Do Have an Aptitude for Programming!

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Abstract

The ratio of women involved in computing has been historically moderate, and has receded at an alarming pace over the past decade, contributing to the critical labor shortage in the computing field. This paper investigates whether females lack aptitude for computer programming, or conversely whether they possess an aptitude for the discipline and could thus provide critical services within this high paying occupation if they chose to do so. Results demonstrate that females and males possess substantially the same level of aptitude for computer programming, and that for both groups a substantial portion of applicants from non-computing backgrounds demonstrated reasonable levels of programming aptitude.

Keywords: Career selection, women in computing, programming aptitude, self-efficacy

1. Introduction

The field of computer programming is not attracting sufficient recruits into its ranks to fill open positions. According to the U. S. Department of Commerce (1997, 1998), the Information Technology Association of America (ITAA), and others, the Information Technology (IT) arena is facing its toughest challenge ever. There are approximately 400,000 jobs in this occupation that are currently unfilled (ITAA, 1998). Government estimates suggest the need for about 138,000 new workers each year through 2006, resulting in the need for 1.3 million new IT workers between 1996 and 2006. At the same time, institutions of higher education are only producing 40,000 graduates per year who are skilled in related disciplines (ITAA, 1998). Curiously, this opportunity rich and high paying occupation is not a top choice of high school students taking the ACT college entrance exams as only 6% of males and 2% of females indicate an interest in computing related disciplines (ACT, 1998).

Of particular concern is the large disparity in the proportion of male versus female students demonstrating an interest in computing careers. Although women are more than half the population, they are a significantly underrepresented percentage of the population earning computing degrees, and hold only 31% of computer programming jobs (U. S. Department of Commerce, 1998). According to the National Science Foundation (Hill, 1997), during the past decade we have witnessed a 51% decrease in computing degrees awarded to women. Whereas Computer Science degree awards to women has declined, the critical labor shortage in the computing profession could be diminished if women were effectively encouraged to participate equally with men in the profession.

Distressingly, this pattern of declining female enrollment is counter to aspirations to promote gender equity in pay while also placing the national economy at risk in an era of increasing technological importance and global competition. Research on women and career choice suggests culturally induced lack of interest (Gollnick and Chinn, 1997) and low self-efficacy [Hackett and Betz, 1981] expectations affect the career choices of women. Along these lines, the Information Technology Association of America (ITAA, 1998) has convened special task forces to promote an enhanced public image of IT work and to

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attract under-represented groups, including women, to careers in IT. Similarly, prior research supported an association between academic self-efficacy and the selection of computing related majors by college females (Chrisman and Schambach, 1998). Efficacy expectations are beliefs concerning whether one has the ability to successfully perform a given behavior. These efficacy expectations determine whether or not behavior will be initiated, how much effort will be expended, and how long behavior will be sustained in the face of obstacles and difficult experiences. Self-efficacy helps explain why women of ample intellectual and academic ability may self-select out of an occupation or college major due to limitations in self-perception. Thus, women might avoid computing careers based on perceptions of inadequacy rather than based on actual deficiency in capability.

Could it be that females have less aptitude than men for programming, or other IT work? The basic premise in self-efficacy discussions concerning women in technology careers is that, in general, women inherently have the same intellectual ability and aptitude as men to perform the work. Documented support of job success and aptitude are potential interventions designed to persuade female students (or career changers) that they have the potential to be successful in IT occupations. The intention of this study is to evaluate and provide documented evidence regarding female aptitude for computer programming.

This research seeks to discover answers to the following question: Do women have the same computer programming aptitude as men? The research hypothesis is that no significant difference will be found between female and male programming aptitude.

2. Method

Participants: Participants in the study include 172 applicants (100 male and 72 female) responding to three newspaper advertisements that announced openings for a computer programming training program. The training program represented potential employment by one of three companies offering the training to people who had no experience with programming computers. The ad indicated that trainees would receive a salary and benefits while they were trained in a special fast-track career transition program at a large mid-western university.

Participants in this study were those applicants selected to participate in a programming aptitude test. Those selected to test, from a pool of over 700 applicants, were judged by application reviewers to have some demonstrated history of success in employment and some demonstrated ability to learn new concepts. Gender was not considered in the selection process.

Measurement: The Berger Aptitude Test for Programmers (B-APT) was used to measure applicants' aptitude for computer programming. The B-APT consists of three separate timed parts of ten problems each. The B-APT is designed so that examinees with no computer background can first learn the test's programming language and then use their new knowledge and base aptitude to solve the thirty problems. As such, the B-APT is a work sample test. It requires learning to write coded instructions to a "computer" in a logical sequence in order to implement program requirements. Examinees take the test by writing short "programs" in the test booklet. They are given a brief list of program language instructions, a brief overview of enacting the language instructions to solve problems, practice exercises, and examinees then apply the principles and syntax they have learned to solve the problems. By the time they reach the end of the B-APT, examinees have been taught to code, loop, increment, and branch. Total administration time is under 2 hours.

Predictive power of the B-APT exam has been previously established by its publishers. In a study involving 138 military officers and Civil Service employees the B-APT and sixteen other measures were administered to trainees at the beginning of a programming course, and the measures were later correlated with grades received in training. The correlation of the B-APT with training grades was .71, accounting for nearly all the predictive power of the battery of measures. Thus, the B-APT has shown to be a relevant predictor of programming aptitude.

3. Procedure

Selected applicants were invited to one of a number of testing sessions conducted at the conference center on a university campus. Test sessions consisted of up to 25 examinees, an administrator, and a proctor. The B-APT publisher provided administrator training along with standard exam instructions and procedures for the test sessions. Thus, there was little variation in testing environment. Completed examination booklets were sent to the publisher for standardized grading. Test scores captured included one for each of the three parts of the exam as well as a cumulative score for the three sections. The cumulative score was subsequently used in determining whether the applicant had demonstrated programming aptitude and if the applicants should be asked to participate in a face-to-face interview (the last step in selection process).

4. Results

Descriptive statistics, frequencies, and a one-way ANOVA were examined to evaluate overall group performance on the B-APT exam, and to determine whether there were any gender related differences in exam scores. Primary evaluation was conducted using the cumulative score (CS). CS could range from 0 (none correct) to 30 (perfect score) on the B-APT. Frequencies confirmed indications from prior exams that CS scores of applicants form a bi-modal distribution; a sizeable portion of examinees scored below ten, only a few scored in the teens, and then the largest proportion score twenty or higher, but only a few obtain a perfect score.

Gender segmented frequencies demonstrated minimal differences in exam scores by gender. Table 1 illustrates a categorized view of the frequencies by gender. Although fewer males than females scored in the lowest category, there seems to be an equivalent proportion of females and males in the range typically considered to show reasonable aptitude (those scoring 20 and above). For the high aptitude candidates (scored 27 or above) the proportion of males and females is almost identical, and in the perfect score category females show superior representation. An interesting finding is that over 70% of both female and male examinees demonstrated a reasonable level of programming aptitude.

Score Category	% of Females	% of Males
Scored ten or less	18	10
Scored > 10 and < 20	10	16
Scored twenty or above	72	74
Scored 27 or above	31	32
Perfect score (=30)	6	2

Table 1. Score Category Frequencies by Gender (should not add to 100).

Table 2 (see attached) illustrates the mean, standard deviation, minimum and maximum scores for CS and the three component parts of the B-APT. Mean scores suggest a somewhat higher average score for males; however, the standard deviation suggest that increased variance may explain the difference. Recall from Table 1 that a larger proportion of females scored in the lowest category but that a comparable number of females and males rated in the reasonable aptitude and high aptitude categories.

A one-way ANOVA was conducted to determine whether significant differences existed in the average scores and variances between females and males. The cumulative score difference between females and males was non-significant, $p=.314$ ($F=1.019$, $df=171$). Similarly, non-significant gender differences were found for each Part Score on the B-APT exam. Thus, there were no statistically significant gender differences in aptitude.

Table 2. B-APT Score Descriptive Statistics by Gender. (CS: Cumulative Score)

	Females				Males			
	CS Score	Score Part A	Score Part B	Score Part C	CS Score	Score Part A	Score Part B	Score Part C
Mean	**21.11**	8.47	7.15	5.46	**22.26**	8.70	7.75	5.74
Std.Dev	**8.08**	2.17	3.46	3.36	**6.80**	2.03	3.00	3.03
Min	**1**	0	0	0	**0**	0	0	0
Max	**30**	10	10	10	**30**	10	10	10

5. Limitations

Some degree of self-selection took place regarding what type of candidates responded to the three ads used to gain applicant interest. While the overall results provided a reasonable representation from both genders we would have preferred female representation in proportion to the overall population. Furthermore, it is reasonable to assume that for both genders the self-selection factor, in combination with application review and selection procedures, is likely to have increased the level of capability demonstrated by examinees. Thus, it would be unrealistic to believe that over 70% of an unfiltered sample would achieve scores suggesting at least reasonable aptitude for computer programming.

6. Conclusions and Future Research

Based on the findings of this study a commensurate proportion of women and men demonstrate reasonable or high aptitude in regard to computer programming.
Differences in self-perceptions correspond to variance in career targets. Data in this study suggest that women are equal to men regarding their aptitude, thus insufficient self-confidence, interests, or some other personality factor is restricting females from entering the computing discipline. Thus, interventions that increase intellectual self-confidence may increase female enrollments in computing courses and majors. In a technology dependent global economy it is incumbent upon families, communities, and faculty members (advisors) in high schools and colleges to find ways to enhance the self-

confidence of female students especially in regards to their science, math and technological capabilities.

Furthermore, for both genders a relatively large (over 70%) proportion of examinees demonstrated at least reasonable degree of programming aptitude. This finding suggest the substantial possibility of transitioning persons to the computing professions even if their educational background is not in a computing related field. Although not detailed in this paper, the candidates who participated in this study came from a wide variety of occupational backgrounds. A future study will evaluate whether differing occupational backgrounds plays a significant role in predicting computing aptitude.

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Effectiveness of Web-Based Instruction for ESL Students: An Empirical Study with Focus on Gender, Ethnicity and Instructional Media

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Abstract

Students with English as a Second Language (ESL) make up a growing student population across the U.S. As Web-based instruction continues to gain wide acceptance, educators need to ensure that ESL students are not placed at a disadvantage due to language and cultural barriers. This study compared the performance of ESL students in three different settings - Web, lecture, and lecture with Web. The results showed that the lecture group performed significantly better than the Web group. Ethnicity contributed to a significant difference in performance in the lecture group. The study found no differences in performance due to gender. Students with PC ownership with Internet access and those with longer residency in the U.S. performed significantly better irrespective of the setting. The paper concludes with lessons learned and offers helpful suggestions in teaching Web courses to ESL and minority students.

Keywords: Web-based instruction, English as second language, gender, ethnicity

1. INTRODUCTION

The phenomenal explosion of technology has now given educational institutions new tools to carry out the mission in ways never conceived before. Distance education is one such approach. Distance education is the process of instruction and learning via virtual classrooms where teachers and students are separated in space and sometimes in time (Porter, 1997). Today, distance education plays an important role in the rapidly changing society that places continual demands on learners. With the recent advances and popularity of the Internet, Web-based instruction has become the method of choice for the delivery of distance education (Sopova, 1996). The Internet's ability to deal with text, hypertext, graphics, multimedia, e-mail, relay chats, hypernews, all provide great appeal.

Over the past decades, research in distance education has focused on (i) its effectiveness (Kuramoto, 1984; Souder, 1993; Moore and Kearsley, 1996), (ii) course designs (Hezekiah, 1986; Coldeway, 1988, Holstein, 1992), (iii) instructor role (Baird, 1995) and (iii) cost-benefit (Rule, *et al.*, 1988; Phelps *et al.*, 1991). However, many of the studies evaluated the effectiveness of correspondence, radio and television broadcast and teleconferencing courses. Web-based instruction is a recent phenomenon and research in the area remains in its infancy (Porter, 1997). More research is needed to build a theoretical foundation for Web-based instruction that can benefit educators in design and delivery of Web-courses in a variety of settings and student audiences (Firdyiwek, 1999).

The Internet has the potential to reach a vast audience at low cost compared with other distance education technologies. With 206 million dial-up and 17.5 million

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permanent connections expected by the year 2005 (Ovum, 1998), new research in Web-based instruction takes great significance and urgency.

2. ESL STUDENTS

One area that has not received sufficient attention is how distance instruction affects learning performance by minorities and ESL (English as Second Language) students. Many of the earlier studies have shown that student performance is at least as good in distance learning settings as the traditional classroom (Chute *et al.*, 1989; Cheng *et al.*, 1991; Martin and Rainey, 1993). But the population sample used in these studies had little or no representation of minorities or ESL students. Therefore, the conclusion reached in these studies may not be generalizable.

This uncertainty about the effectiveness of distance learning for minority and ESL students must be of concern today. Across the U.S., the student population is increasingly becoming diverse with varied cultural backgrounds, differing educational aspirations, and above all varied levels of English fluency, which still remains the primary language of instruction. During the 1980's, Maryland, Florida, Virginia, Georgia, Texas, New Mexico, Nevada, California, and Alaska all had more than a 50% increase in their foreign population (Rong and Preissle, 1998). The percentage of students with Limited English Proficiency (LEP) in the 5 to 17 years olds immigrant children stands nationally at 37.8% (US Bureau of Census, 1993). Thus, educators and policy planners need to know how Web-based instruction will impact the learning performance of ESL students in order to make changes in the way education is delivered.

3. FACTORS INFLUENCING PERFORMANCE IN ESL STUDENTS

Various factors that adversely affect learning performance among ESL students may be amplified in Web-based instructional settings. The primary one is the language factor. Studies have shown that recent immigrants and foreign students experience language barriers during their early years in the U.S. (Fischer, 1990, Stevens, 1994). They compensate their difficulty in comprehension through better use of face-to-face interaction and of non-verbal contextual cues (Collins, 1988; Chizhik, 1998). But these are lacking in Web course instruction. The good news, however, is that research has shown the language barrier disappears with the length of residency in the country (Jasso and Rosenzweig, 1990).

Another factor that affects performance in the Web-based instructional setting is the widely varied level of computer literacy among the ESL students. In a study by Hawkins and Paris (1997) of 570 undergraduate students, it was found that minority/ESL students enter the university with fewer info-technology skills and are less familiar with computers than are their English fluent Caucasian counterparts. They also noted that these differences in computer usage and familiarity are not minimized by collegiate experience and may even be increased. They found that students with less computer proficiency preferred Macintosh to IBM compatible Personal Computers (PC). Thus, some students may need to be trained in Internet use at the start of Web courses for learning to be effective.

Since Web courses require at a minimum a PC and subscription to an Internet Service Provider, access to technology is fundamental to Web-based instruction. This is an important factor to be considered while designing a Web-based curriculum. In the U.S., African Americans and Hispanics lag behind Whites in PC ownership and online access by 21.5% (Muzzio, 1998). Hence, one needs to evaluate if learning performance would be adversely affected due to lack of access to Web-based courses.

A distinguishing characteristic of ESL students is the heterogeneity of their ethnicity and culture. They may bring along a variety of anxieties at having to prove themselves in a mainstream environment. They differ in academic self-concept, aspirations to higher education, family and peer influence (Kim *et al.*, 1998). Their preferences in adopting public vs. private academic programs are also different and influenced by their varied socio-economic backgrounds. Gender also plays an important role. Being male in some cultures created even more pressure to succeed educationally.

It is important to undertake research in understanding these factors. It is fundamental to designing Web-based curricula with a student audience that has a significant representation of minority and immigrant students. This study helps to fill a void in the literature by contributing to our understanding of how Web-based instruction influences ESL student performance. It is expected that the findings will be applicable to minority and immigrant students as well.

4. OBJECTIVE

This main purpose of this paper is to study the effectiveness of Web-based instruction on learning performance among ESL students and compare them with traditional lecture outcomes. Three instructional settings - Web only, lecture only, and Web plus lecture - were used as the experimental treatments. The objective is to identify which setting has the most effect on learning performance in ESL students and if there are significant differences among them. In addition, the study will explore if ethnicity, gender, access to technology, and length of residence in the U.S. influence performance in Web-based instruction. The following hypotheses were tested:

H1: There is no difference in performance among the ESL students who i) attend lectures, ii) use the Web, or iii) attend both lectures and use the Web.
H2: In each of the above three groups, there is no difference in performance among the ESL students due to ethnicity.
H3: In each of the above three groups, there is no difference in performance among the ESL students due to gender.
H4: ESL student who owns a PC with Internet access from home perform better than those who have access only at the university.
H5: Performance increases with years of residence in the U.S.

5. METHOD

The subjects for this study were ESL students selected from an undergraduate business computer concepts and applications course. The course was offered in two alternative formats, one that used traditional lectures in a classroom and the other that used Web-based format alone. The same instructor used the same textbook for both formats and covered the same content. At the beginning of the course, students were asked to choose one of the following treatments to take the course: i) attend only lectures, ii) study Web materials along with email, Hypernews (Figure 1) and Internet Relay Chat, or iii) attend both lectures and use Web materials. At the end of the course, all students together were administered the same test in a lecture hall. The test scores measured performance.

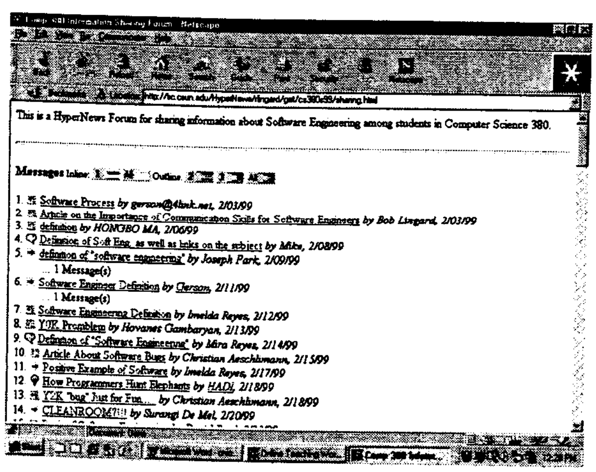
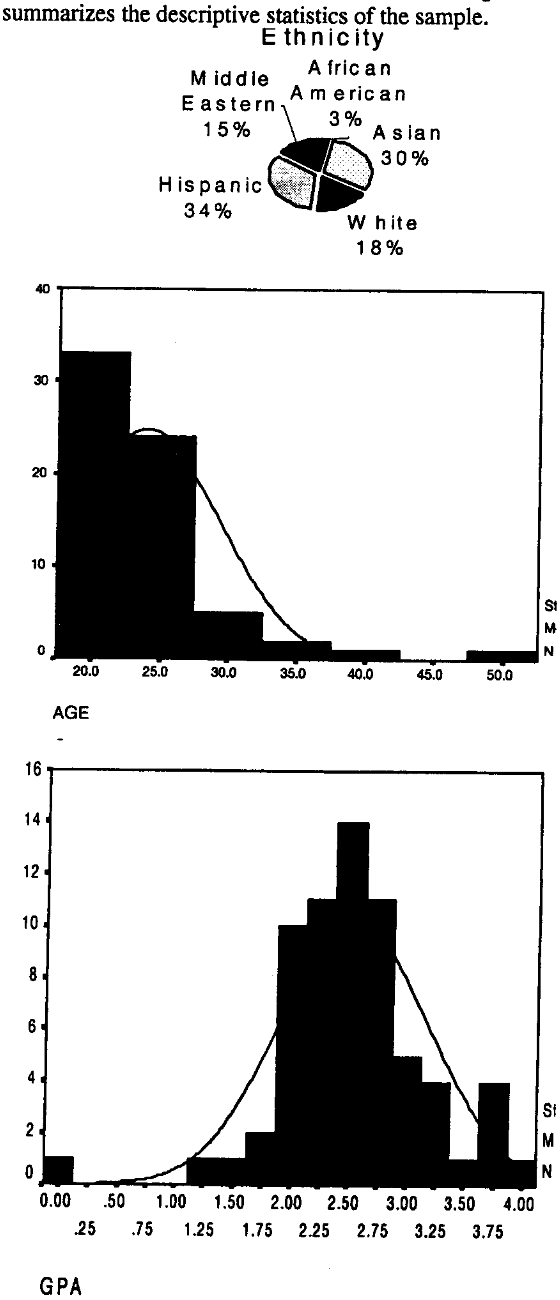


Figure 1 Hypernews: A Forum for Information Sharing

Student data on GPA, age, gender and ethnicity was available in the university admissions database. Additional background data such as years of residency in the U.S., ownership to PC, and access to Internet from home was collected using a survey.

Sample

There were 66 ESL students in the sample from a class of 116 students, of which 26 were men and 40 were women. The mean age of the sample was 24 years with a standard deviation of 5.3. There were 2 African Americans, 20 Asians, 12 Whites, 22 Hispanics, and 10 Middle Easterns. Nineteen students had a residency of 5 years or less in the U.S., 32 had a residency between 5 and 10 years, and 15 had over 10 years. The five-year residency intervals were chosen because they were found to differentiate best the language proficiency and cultural integration among international and new immigrant students (Sankaran and Bui, 1999). The mean GPA was 2.54 with a standard deviation of 0.64. The maximum score attainable on the test was 75. Figure 2 summarizes the descriptive statistics of the sample.



GRADE

	N	Mean	Std. Deviation
Web Group	15	37.7333	9.7282
Lecture Group	28	45.5000	7.7196
Lecture+Web Group	23	43.3478	6.2929
Total	66	42.9848	8.2266

Figure 2 Descriptive Statistics of the Sample

6. RESULTS

H1: Influence of instructional format

One-way analysis of variance (ANOVA) and Scheffe's multiple comparison were conducted to determine if there were significant differences among the test scores of the three groups (H1). The results are shown in Table 1a.

It can be seen from the table that the mean scores for the Web, Lecture and the Lecture-Web groups were 37.7, 45.5 and 43.3 respectively. The ANOVA shows that the F-ratio was 4.916 (p=0.010) and was significant at 0.01 level. Therefore, the hypothesis (H1) that there would be no difference between test scores among the three treatment groups was rejected. The Scheffe's test for mean differences between the Web group and the Lecture group was significant at 0.05 level, with the Lecture group scoring 7.67 points above that of Web group.

Dependent Variable: GRADE
Scheffe

(I) W_L_LW	(J) W_L_LW	Mean Difference (I-J)	Std. Error	Sig.
Web Gp	Lecture Gp	-7.7667*	2.487	.011
	Lecture+Web	-5.6145	2.579	.102
Lecture Gp	Web Gp	7.7667*	2.487	.011
	Lecture+Web	2.1522	2.187	.618
Lecture+Web Gp	Web Gp	5.6145	2.579	.102
	Lecture Gp	-2.1522	2.187	.618

*. The mean difference is significant at the .05 level.

Table 1a Results for H1

The performance of ESL students was also compared with that of the non-ESL students. The *t*-value was .837 (p=.404). This showed that there were no differences in scores between the Web and lecture groups due to ESL as a factor (Table 1b)

H2: Influence of ethnicity

ANOVA was performed to find if there were differences in the test scores in each of the three treatment groups attributable to ethnicity. The results are discussed below in the group order - Web, lecture, Web and lecture.

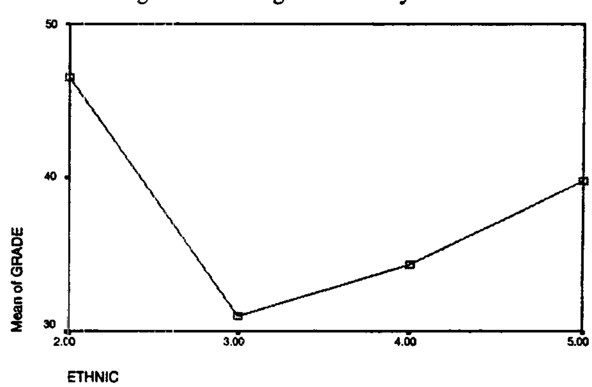
Web group: The mean score for the Asian ethnic group was 46.5, White 31, Hispanic 34.3 and Middle Eastern 39.75 (Table 2a).

Dependent Variable: GRADE

NEWW_L	ESL	Mean	Std. Deviation	N
Web	Non-ESL	45.8500	9.2240	20
	ESL	41.4615	8.1840	26
		43.3696	8.8301	46
Lecture	Non-ESL	44.2121	10.1697	33
	ESL	44.8649	7.4093	37
		44.5571	8.7587	70

Table 1b ESL as an influencing factor

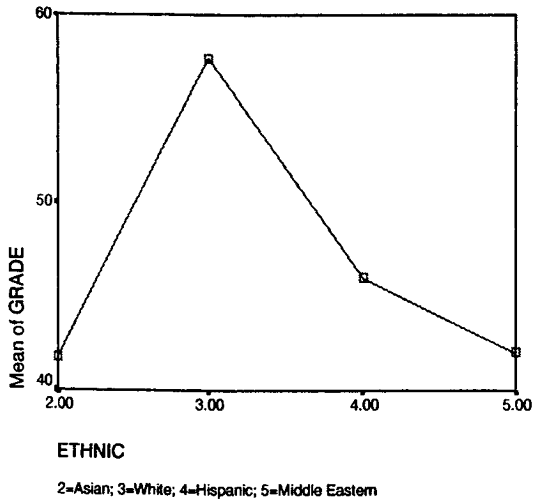
There were not sufficient observations for the Black students and hence they were not included in this part of the analysis. The F-ratio was 2.408 (p=0.128) and was not significant at 0.05 level. Therefore, the hypothesis that there was no difference between test scores among the ethnic groups (H2) was supported for the Web group. Even though the mean score of the Asians was notably higher than the other ethnic students in the Web group, the large variability in the individual scores did not render it significant enough statistically.



Grade (ANOVA)	Df	F	Sig.
Between Groups	3	2.408	.128

Table 2a Results of H2 (Web Group)

Lecture group: The mean score for the Asian ethnic



GRADE

	df	F	Sig.
Between Groups	2	4.916	.010

group was 41.7, White 57.6, Hispanic 46 and Middle Eastern 42 (Table 2b). The ANOVA showed that the F-ratio was 4.675 (p=0.011) and was significant at 0.05 level.

Therefore, the hypothesis (H2) that there was no difference between test scores among the ethnic groups was not supported for the lecture group. Scheffe's test shows that Whites did better than Asians and Middle Easterners by 15.9 and 15.6 points and that it was statistically significant. It can be observed from the table that Whites scored higher than Hispanics also by 11.6 points but it was not significant.

Lecture and Web group: The mean score for the Asian ethnic group was 41.4, White 45.6, and Hispanic 42.8. There were not sufficient observations on Middle Eastern students thus they were not included for this analysis. The F-ratio was only 0.657 (p=0.53) and hence was not significant at 0.05 level.

Table 2b Results of Hypothesis (Lecture Group)

H3: Influence of gender

ANOVA were performed to find if there were differences in the test scores in each of the three treatment groups attributable to gender. Similar to the discussion on H2, the results are discussed below in the group order - Web, lecture, Web and lecture.

Web group: The mean score for women in

Group Statistics

	GENDER	Mean	Std. Deviation	Std. Error Mean
GRADE	Women	37.33	9.7297	3.9721
	Men	38.00	10.3078	3.4359

a). est for independent samples was used. The t value came out to be .125 (p=0.902) and was not significant at 0.05 level. Therefore, the hypothesis (H3) that there was no difference in test scores due to gender was supported for the Web group.

	GENDER	Mean	Std. Deviation	Std. Error Mean
GRADE	Women	46.1053	8.3593	1.9177
	Men	44.2222	6.4183	2.1394

Table 3a Results of H3 (Web Group)

Dependent Variable: GRADE
Scheffe

(I) ETHNIC	(J) ETHNIC	Mean Difference (I-J)	Std. Error	Sig.
Asian	White	-15.9524*	4.546	.018
	Hispanic	-4.2857	3.133	.607
	Middle Eastern	-.2857	3.857	1.000
White	Asian	15.9524*	4.546	.018
	Hispanic	11.6667	4.252	.084
	Middle Eastern	15.6667*	4.811	.031
Hispanic	Asian	4.2857	3.133	.607
	White	-11.6667	4.252	.084
	Middle Eastern	4.0000	3.506	.731
Middle Eastern	Asian	.2857	3.857	1.000
	White	-15.6667*	4.811	.031
	Hispanic	-4.0000	3.506	.731

*. The mean difference is significant at the .05 level.

Lecture group: The mean score for women in the lecture group was 46.1 and for men 44.2. The t-value was 0.596 (p=0.557) and was not significant at 0.05 level (Table 3b). Therefore, the hypothesis (H3) was not rejected.

Table 3b Results of H3 (Lecture Group)

Lecture and Web group: The mean score for women in this group was 43.3 and for men 43.4. The F-ratio was 0.056 (p=0.815), not significant at 0.05 level. Thus, the hypothesis (H3) was not rejected for those who took the lecture plus Web format.

	OWNP	Mean	Std. Deviation	Std. Error Mean
GRADI	No	34.0000	9.0000	5.1962
	Yes	43.4127	8.0154	1.0098

H4: Influence of PC ownership and Internet access

This hypothesis was intended to test if students who own PCs will perform better. The descriptive results show that those who owned PC had a mean score of 43.4 whereas those who did not scored 34 (Table 4). Since the hypothesis was directional, one-tail test was used. The t-value was -1.979 (p=0.026). Thus, H4 was supported.

Table 4 Results of H4

H5: Influence of length of residency

ANOVA and Scheffe's multiple comparison were conducted to determine if there were significant differences among the test scores of the three groups with different years of residency. It can be seen in Table 5 that the mean scores for those who were residents for less than five years was 32.9, five to ten years was 44.3, and greater than 10 years was 52.9. The F-ratio was 118.5, significant at 0.05 level. The Scheffe's test for mean differences between each group was also significant. Therefore, the hypothesis (H5) that the test scores will improve with length of residency in the U.S. was supported.

ANOVA

GRADE

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	3475.387	2	1737.7	118.5	.000
Within Groups	923.598	63	14.660		
Total	4398.985	65			

GRADE

	N	Mean	Std. Deviation	Std. Error
<5 years	19	32.89	5.2376	1.2016
5-10 years	32	44.31	2.9451	.5206
>10 years	15	52.93	3.3905	.8754
Total	66	42.98	8.2266	1.0126

Dependent Variable: GRADE
Scheffe

(I) YRSRES	(J) YRSRES	Mean Difference (I-J)	Std. Error	Sig.
<5 years	5-10 years	-11.4178*	1.109	.000
	>10 years	-20.0386*	1.322	.000
5-10 years	<5 years	11.4178*	1.109	.000
	>10 years	-8.6208*	1.198	.000
>10 years	<5 years	20.0386*	1.322	.000
	5-10 years	8.6208*	1.198	.000

*. The mean difference is significant at the .05 level.

Table 5 Results of Hypothesis H5

7. ADDITIONAL ANALYSIS AND IMPLICATIONS

Billings (1989) proposed a model for correspondence courses where GPA was a student background factor that would positively influence a variable referred to as Course Completion. Assuming the test scores in our study represented a measure of the same concept as course completion, a correlation analysis was done between GPA and test scores. The Pearson *r* came out to be 0.431 with p=0.000. Such high significance as indicated by the p-value not only validates Billings model as extensible to Web-instruction but also adds external validity to the current study.

A recent study by Ede and Panigrahi (1998) on minority students showed that there was a positive correlation between Age and GPA. The same relationship was tested in our sample to find out if this is true for the ESL students as well. As mentioned in the methodology section, data on GPA and age of all the students who participated in study was collected from the university admission records. The Pearson *r*-value of 0.206 (p=.096) was significant at 0.10 level. Such conformance to earlier finding obtained by independent researchers adds further validity to the current study. The students in our study were allowed to choose which course setting - Web, lecture or lecture and Web they were going to adopt for the course. To lend credibility to the conclusions made on the five hypotheses, it thus became necessary to verify whether group memberships were randomly distributed. ANOVA performed on the data showed that both GPA (F=1.146; p=0.324) and age (F=0.379; p=0.686) were indeed randomly distributed. This ensured that conclusion reached in H1 was truly contributed by the instruction settings alone. This brings us to the single most conclusion of this study: ESL students, especially those who have been in the U.S.

only recently, perform better when they take the course in the traditional lecture setting. This appears to be a reasonable conclusion as well considering that ESL students do learn better when they have opportunities to gather information through non-verbal cues and personal interactions which are missing in a Web setting.

It was reported while discussing H2 that the mean score of the Asians was notably higher than others in the Web group.Yet the hypothesis could not be rejected due to the large variability in the individual scores. The data was further analyzed for the source of this variance. The answer was traced to the wide range in the length of residency in the U.S. of the individual students. This in fact provided additional support for conclusion reached in H5.

It was seen in H3 that there were no differences in scores between men and women in each of the setting they took the course. Additional analysis was done to compare the overall test scores between gender irrespective of what format they attended by aggregating the individual group data. The F ratio was 0.134 ($p=0.716$) and was not significant inferring that there was no statistical difference in performance between men and women irrespective of what format they took the course.

Several lessons were also learned in this study. In our data sample, PC ownership and Internet access was over 90%. With such widespread accessibility, Web courses do offer a feasible alternative to traditional teaching. With longer ownership, students are more likely to have polished their computer skills that will be helpful while taking Web courses. There are also lessons for designers of online courses. Web pages should have detailed narration and interactive capabilities built into it. Video streams can also better convey information than static slides. Since the biggest barrier in a Web setting for a ESL student is the lack of a human tutor who could clarify as the study progresses, universities must offer an online or a toll-free telephone help line operated by tutors that students could use for this purpose.

However, ESL students who have been in the U.S. fewer than five years should be advised to take lecture classes where they are most likely to perform better. Otherwise, universities can provide additional support mechanisms to compensate for the language barrier. Further, in this study, student performance was correlated to their GPA. Assuming GPA to be an indicator of self-direction and motivation, Web courses seem to be more suited to students with above average GPA. Students perform significantly better in Web classes if they have a PC with Internet access at home; therefore, universities may consider lending PCs to students. They may also negotiate with Internet service providers for better student pricing.

8. CONCLUSION

It would be useful to replicate the study with a larger sample. Comparison of the results with those of non-ESL students indicate that the Web design used in the study was equally effective as the lecture and did not contribute to any confounding. Similar studies should also be undertaken across regions that have different demographic make up and technology diffusion levels. Various university support mechanisms specifically designed for ESL students taking Web courses in distant learning mode should be implemented and their effectiveness on performance should be evaluated. Earlier studies in correspondence and teleconferencing have shown that distance learning reduces drop out rates (McGowan, 1992) and it will be appropriate to see if Web instruction has similar impact. It is also important to investigate how course content (e.g., theory vs. lab courses) impact on Web design, especially when ESL students are the audience. There must also be an ongoing program for research into adapting evolving Internet technologies and provide insight into the changing role of the instructor. Finally, there is a wide diversity with in the ESL population, in terms of culture and computer preparation that make them an important pool of subjects for studies to benefit one of the fastest growing student population in America.

Web-based instruction is ushering in an educational revolution today. Demographic data indicate our society is undergoing large ethnic transformations as well. To be able to reap the full benefits of distance education, it is important for educators to match technology with the background and needs of the learners if education is to be effective. Despite the language barriers, ESL learners work hard constantly trying to adapt in order to fulfill their goals and aspirations. For those of us who are educators, it is our solemn duty to help them fulfill their American dream.

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Retention of Women in Technology through Industry Partnerships

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Abstract

Much discussion and experimentation has been undertaken to solve the problem of the retention of women in the technical sciences, but definitive solutions have yet to be developed. Analogies to the other, once dominated white, male professions, as doctors and lawyers, that currently have equal representation of women are frequently made. The term, *critical mass*, is applied to the magic number of role models needed to demonstrate the profession universally as an achievable one for women. The paper presents a proposed plan based on the hypothesis that strategic placement of female role models during the freshman programming sequence increases retention among female students.

Keywords: Women in Technology, internships, industry partnerships, role models.

1. PROBLEM

The retention of women in the computing sciences has been an area of concentrated study in recent years. Many theories exist to explain why women are not attracted to the more technical disciplines or complete degree requirements once begun. In 1992, 49% of all high school graduates were women prepared and interested in the computer science and engineering disciplines. Of the Bachelor of Science degrees awarded, only 31% went to women in these fields of study. Women represented only 28% of the master's degrees and 11% of the Ph.D.s awarded during that time.[O'Rourke 1993] The following year, 1993, reported a drop of women earning B.S. degrees to 28%, with 27% and 14% of master's and Ph.Ds degrees awarded, respectively, to women.[INSF Homepage]

"A characteristic of human cognition is that we synthesize our notions of concepts by generalizing based on examples."[Hemenway 1995] It has been suggested that women and minorities may mentally, at some subconscious level, associate white males and maleness as possessing the attributes of distinguished scientists; so that when they think of people who have potential to become distinguished scientists, they tend to think of white males.

This tendency to generalize based on examples also plays a role when evaluating one's own potential. When setting our own goals, the tendency is to think about the members of groups we might desire to join, and the similarity to us or the dissimilarity from us of the group members impacts our assessment of whether we are potential members of the group, as well as our desire to join the group. [Hemenway 1995]

Additionally, the

> *...lack of appropriate role models inhibits our ability as well as our desire to do anticipatory socialization, which is a process whereby a person who aspires to join a group adopts characteristics of that group.... When women do not perform the anticipatory socialization that implicitly may be expected of aspirants to a position, that failure may be viewed as evidence that they are not qualified or interested.[Hemenway 1995]*

A 1990 study sponsored by the American Association of University Women suggests that a major problem in attracting and keeping women and minorities in computer science is the lack of role models at all levels [Pfleeger 1995] One way to adapt the culture of science to include more women is to "provide role models for girls to emulate and to stimulate their motivations, models of young women scientists who have survived college or are 'living the life of the mind'"[Tobias].

Appropriate role models can increase the retention rate of females. Role model effectiveness is largely dependent on whether the model presents an image to which the target student would aspire to imitate. Increasing the number of role models in technology would increase the probability that female students would identify with one or more; and therefore continue pursuit of the technical degree.

Much discussion and experimentation has been undertaken to solve the problem of the retention of women in the

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technical sciences, but definitive solutions have yet to be developed. Analogies to the other, once dominated white, male professions, as doctors and lawyers, that currently have equal representation of women are frequently made. The term, *critical mass*, is applied to the magic number of role models needed to demonstrate the profession universally as an achievable one for women. The proposed plan is based on the hypothesis that strategic placement of female role models during the freshman programming sequence increases retention among female students.

2. INTERNSHIP PROGRAM

The University entered into an industry partnership agreement in the spring of 1995 to develop an internship program. The internship program represents a positive step in developing partnerships with education and industry to provide education and training that is impossible to provide with either environment alone. The program began with 20 students, and continues with over 50 students participating annually. The program has been a win, win, win opportunity; the university is able to provide a unique opportunity for students that few other universities can match; the industry partner has a man-power resource and the opportunity to provide timely feedback as input to curriculum decisions that influence the training of future employees in our community; Students gain confidence in their ability to be competitive while learning to apply classroom content to real-world problems.

Program Goal

The purpose of the partnership with industry is to provide educational opportunities for students in the technical disciplines to apply classroom theory to practical problems. Lessons learned from industry benefit all students through intern contributions to classroom discussion and group projects.

Objectives

- Students will apply classroom knowledge to real world problems.
- Students will share knowledge gained in the industrial environment with all students through class participation and project presentations.

Students will practice communication and team building skills in the workplace.

Industry partners will provide role model/mentoring resources for students, with an emphasis on underrepresented groups in the technology-based disciplines.

In addition to the specific program objectives, positive side effects of the program include strengthening of the awareness of education as a community responsibility and improved quality of education resulting from direct communication links between the educational institution and the potential employer. The institution--industry partner communication channel provides constant, real time feedback for curriculum refinement.

3. STRATEGY

In an effort to provide additional role models for women in computer science, an agreement to expand the internship program to allow freshmen women to enter the program was reached in the spring of 1998. The eligibility requirements for the intern program include a minimum gpa of 2.75 and successful completion of the advanced data structures course. These eligibility requirements are waived for the freshmen females.

The industry partner agreed to interview and give preference to any freshmen women interested in the program. The placement of the female interns is in positions where female role models exist. Because of the limited number of intern positions designated for the retention of women in technology (WIT) program, selection criteria was developed to increase the probability that the women with the greatest potential to succeed would be given first priority. Although the standard eligibility requirements were waived, the requirements for the WIT program included a minimum high school GPA of 3.0 or an ACT (or SAT equivalent) of 23. Of course, if the intern changed majors, she would no longer be eligible to remain in the program.

4. CURRENT STATUS

Over the program's three-year history, 140 students have participated in the program, 112 males and 28 females. Currently 49 students are in the program, 37 males, 12 females. Five of the twelve females entered through the WIT program.

Of the 91 former interns, 68 graduated (13 females, 55 males). Five (2 females, 3 males) were dismissed from the intern program because of poor academic performance. All five subsequently withdrew from the university. Ten students (9 females, 1 male) left the intern program voluntarily and continue to pursue their degrees. The reasons for leaving the program ranged from accepting on-campus jobs to needing more time to devote to studies. Three students (all male) were dismissed for poor job performance. Four students (all male) withdrew from the university. One male student, a single parent, left the program because he needed full-time employment, and is currently a part-time student. (Figure 1)

FORMER INTERN STATUS BY GENDER

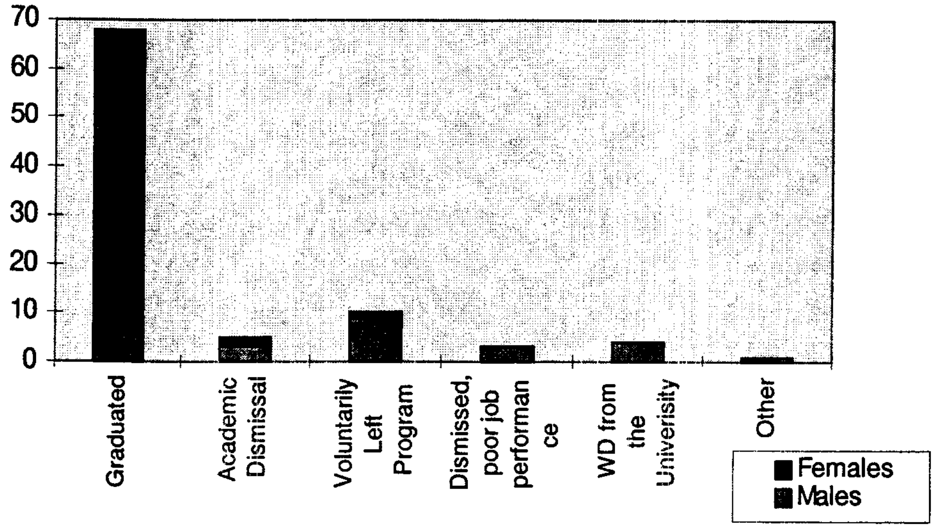

Figure 1

5. FUTURE

Plans for the next academic year include:

1. The program is to be expanded in the Fall of 1999 to include ten WIT participants.
2. A survey will be used to determine if the intern program has an impact on the WIT participant's retention in the discipline.
3. Retention and performance data will be collected and analysized as the WIT participants progress through the degree process to determine if the retention rate of the participants differs from non-participating women.

The long-term plan is to create positions for the WIT participants on campus as lab assistants and tutors in the freshman and sophomore programming classes after completion of two years in the intern program. Additional women in these high visibility roles on campus, plus the continuation of the WIT intern program will increase the number of role models for our incoming freshmen women. It is strongly believed that this effort could significantly increase the size of our pipeline of women in technology to make real strides toward attaining that "critical mass" enigma for the representation of women in computer science.

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Analyzing The Gap Between Student Satisfaction and Students' Valuation of the Factors Affecting Satisfaction

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Abstract

Student satisfaction is an important piece of information for evaluating the success of an educational institution, particularly as it can be related to retention of students. The quantification of this information is difficult considering the subjectivity and vast variance of the data. The gap between expectations and reality is a common source of this variance. This study measures student satisfaction and weighs it using the students' input as to the relative importance of factors impacting satisfaction. The conclusions herein lead to a discussion of the application of these results toward affecting student retention as well as suggestions for future research.

Keywords: Student satisfaction, student success, student retention

1. Introduction

The purpose of this study is to better quantify student satisfaction as a means to improve the delivery of educational services at an institution of higher learning. Long considered an important contributor to student retention, the satisfaction level of students has a deep impact on the success of an educational institution. As many businesses use various techniques to increase market share, build customer loyalty and promote good will, so must an educational institution look toward surviving in a competitive industry.

Student attrition is the measure of those student/customers failing to reach the ultimate goal of a degree at that particular institution. Student retention is the inverse of student attrition and will be the term used henceforth to describe the gap between those who complete and those who do not complete. Retention has a more positive connotation in light of the goal to improve services as a means to better serve the customer. By looking at the student as a customer, it can be stated that educational institutions provide customer service at a level lower than that of nearly any other type of business. While the product is an education, not necessarily a degree, the customer's goals, realistic or not, are almost always geared toward obtaining that degree.

At most institutions of higher education, evaluating institutional effectiveness is now a basic requirement for & Hellmich, 1996). There is a difference between academic preparedness and being ready to persist and succeed academically (Noel and Levitz, 1998).

accreditation. Often, a central component of evaluating institutional effectiveness is the careful study of retention rate (Wyman, 1996). There appears to be a rising tendency for many full-time undergraduate students to take more than four years to graduate (Volkwein and Lorang, 1996). College students are faced with a variety of experiences that can interfere with their learning and achievement in future situations (Menec and Perry, 1995).

New college students face many obstacles to successfully transition from high school to college: There are the external stresses of obligations to family, employment, and financial as well as the traditional stresses brought on by course work, peer pressure, social interaction, time management, and more independence because of being away from home (Doran, Daigle and Robinson, 1997). A major disconnect is caused by the premise that for faculty, college education is the goal while for students, college is a means to achieve a goal (Noel and Levitz, 1998)

One of the reasons students do not do well in school is that they haven't been able to integrate their social lives with their academic lives. In many cases, school hasn't been their number one priority, particularly if they come from environments where there are too many distractions such as low peer group value for education (Kleupfel, 1994).

Underprepared students requiring remediation often have not developed life skills that directly influence their ability to succeed academically in college (Grunder

Among the contributors to student attrition is a gap between student expectations and reality. This can be illustrated in the Figure 1 (Noel and Levitz, 1998).

	Expectations-%of students expected to:	Reality-Campus based data
Fail a course	1%	12-18%
Take extra time to complete a degree	8%	50-75%
Change majors	13%	60-75%
Drop out of college	1%	34%

Figure 1.

Student retention is the greatest factor impacting the revenue stream of an educational institution. Reports from institutions of higher education throughout the nation show that student retention rates over the years have ranged from as high as 50 percent (Cope and Hannah, 1975) to as low as 33 percent (Bynum and Thompson, 1983). Today, even the low-end figure is considered successful. DeVry Institute is a proprietary technical college in North Brunswick, New Jersey, granting Associate degrees in engineering, business, telecommunications and computer information systems. It is part of a system of 15 institutions located throughout the United States and Canada. The current completion rate among DeVry students is approximately 36 percent. This is almost at the median of DeVry institutes nationally. Figure 2 shows the retention for day students nationally and at the individual institutions expressed as "sits" (students returning for a subsequent semester) through six semesters. There is a marginal attrition rate beyond this point of approximately two percent.

Campus	Total # of Sits	1st term Sit %	2nd term Sit %	3rd term Sit %	4th term Sit %	5th term Sit %	6th term Sit %
Missaugua	451	100.0	78.0	62.3	59.8	60.1	53.8
North York	343	100.0	81.6	66.2	60.7	54.6	53.3
Scarborough	413	100.0	80.6	62.0	55.2	57.9	50.0
Long Beach	1,536	100.0	81.3	68.2	59.3	52.9	49.8
Calgary	983	100.0	82.1	65.1	57.4	48.9	49.0
Phoenix	2,687	100.0	77.7	61.9	56.8	52.0	46.9
Pomona	2,406	100.0	78.2	63.1	56.2	49.5	45.8
Kansas City	1,736	100.0	76.6	58.9	53.5	47.5	40.9
No. Brunswick	2,910	100.0	72.0	54.5	48.7	41.7	38.7
System Total	25,238	100.0	74.8	57.1	50.3	43.4	38.4
DuPage	2,355	100.0	77.0	60.1	52.8	44.9	38.0
Chicago	2,641	100.0	68.8	52.9	46.8	39.5	33.2
Columbus	2,220	100.0	76.4	52.9	43.8	37.3	30.6
Dallas	2,069	100.0	70.5	49.2	42.0	33.8	28.1
Decatur	2,245	100.0	67.4	46.8	38.9	31.4	25.6
Alpharetta	243	100.0	69.8	53.1	43.9		

Figure 2.

The average enrollment of a non-completing student is between one and two semesters of a five-semester program. Using the two-semester figure as a conservative estimate, a rise in completion rate to 41 percent would increase revenue from tuition by 4.8 percent. DeVry has a goal of a 50 percent completion rate by 2002. That would result in a 13.6 percent increase in revenue based on an additional 14 percent of the student population staying an average of three additional semesters.

Student satisfaction is one of the major contributors to student retention, along with financial and academic success issues. Over 46 percent of college dropouts have a grade point average below 2.00. Among these three, the issue of student satisfaction is an area in which the institution may have the greatest impact and as a result, the greatest control.

The specific goal of this study is to investigate the tools used to measure student satisfaction. The findings will show a need to weigh the importance of the factors contributing to satisfaction. A survey of students will be analyzed using the weighted factors, to provide a more accurate picture of what improvements would have the greatest positive impact on satisfaction. This method will allow the institution to place its efforts in the areas having the greatest impact thus, more efficiently attacking these problem areas. Given the limited resources available in most businesses, this would be, at minimum, a sound financial decision.

The study will further discuss some of the methodologies used currently to increase satisfaction in the key areas. While the primary focus is measurement, no study of student satisfaction would be complete without a discussion of corrective measures.

2. Literature Review

There has been a tremendous volume of research done with relation to student satisfaction, student retention and the measurement and corrective approaches of these subjects. These areas of educational thought stretch into studies of psychology, sociology, economics and nearly any other social science. Specific studies applying research of this nature to students in higher education boomed in the second half of this century. Individuals such as Ernest Pascarella (1991) and Vincent Tinto (1975) have achieved fame for the depth and quality of their research in the study of the causes and effects of student retention.

For example, we know from retention research that students who are involved in organizations and who participate in extra class activities are much more likely to be retained (Kleupfel, 1994). Some schools even require freshman to participate in at least one campus organization as part of a freshman seminar course. The first six weeks on campus are the most important and critical in determining whether the student is going to stay or leave. To get students to stay, you must get them started right (Noel and Levitz, 1998). The key is not keeping more students, but educating those who stay (Tinto, 1998).
In order to decrease student attrition, a comprehensive picture of the characteristics of undergraduate students who withdraw from universities is necessary. Previous attrition/retention research has, unfortunately not adequately described faculty differences in university withdrawal (Johnson, 1996).

The Community College Experiences Questionnaire (CCSEQ) measures the amount, breadth, and quality of effort students put into taking advantage of the resources and opportunities available in the college setting. It measures the quality of effort students put into course related activities; the library; contacts with faculty, counselors and other students; activities related to art, athletics, music, etc.; and campus clubs and organizations (Friedlander and MacDougal, 1992).

Previous studies of student retention have been far reaching in their search for causes and reasons. The goals of any intervention in fact, should be to predict dropout proneness <u>before</u> the student drops out and predict academic difficulty <u>before</u> it occurs (Noel and Levitz, 1998). In an ideal world, attrition research would enable colleges to identify early leavers before they are enrolled and design intervention strategies to retain them (Romano, 1995). Early works by Tinto (1975) define terminology and attempt to separate the major factors from the minor ones. Castle (1993) continued the evolution of the process by evaluating these factors into areas within the scope of institutional control and those external to that control. From here methodologies were developed by Rickinson and Rutherford (1995) and Tinto and Russo (1994) to affect institutional policy in order to better facilitate retention.

Some researchers continue to study and refine the works of Tinto and others. Most research related to the causes of student attrition is geared to specialized areas where the factors may deviate from the norm (Bynum and Thompson, 1993; Grunder and Hellmich, 1996; Volkwein and Lorang, 1996). The majority of the research done today deals more with solutions to retention difficulties (Friedlander and MacDougall 1992; Doran , Daigle, and Robertson, 1997; McCarthy, Smuts, and Cosser, 1997). Yet it should be remembered that there is good attrition as well as bad attrition. Screening is yet another hot area of research. It has been established that many students leave their institution before they have been determined to be high-risk. Some leave even though they do not fit a high-risk profile. Some corrective measures are hard to evaluate, are ineffective, or are not economically feasible. Many causes of attrition are beyond the control of the administration, faculty and staff of the institution. All of these factors and more form the basis of current research.

A wide range of student characteristics has been implicated in undergraduate withdrawal. These may be classified under the following four main categories:

Academic Factors
- Limited hours of study
- Insufficient study skills
- Absenteeism
- Marginal academic prerequisite competencies
- Vague educational goals

Personal Variables
- Poor health
- Financial stress
- Employment demands
- Family responsibilities
- Gender
- Age
- Ethnicity
- Lack of outside encouragement

Campus Integration
- Make friends
- Join campus clubs
- Campus social life

Institutional Variables
- Instructor behavior
- Student body size
- Support services (Johnson and Buck, 1995)

As completion rates slide slowly down, the emphasis on solutions to the problem have shifted into high gear. The USAGroup, created by Noel and Levitz is the leader in consulting with educational institutions about their retention rates. Universities are setting up working parties even to examine patterns and trends of student attrition and to make recommendations for the management of their situations (Rickinson and Rutherford, 1995). It should be remembered as pointed out above, that even slight increases in retention rates can mean substantial increases in revenue.

3. Analysis

When developing retention programs, a school needs to begin with an assessment of the problem. In making these decisions, it becomes very important to get data about the students and about the institution. To promote student success and retention you need to know a lot about the students and you need to know it early. This is not just information on academic performance but also the more affective kinds of information for determining a student's motivation, interests, goals, etc. (Kleupfel, 1994).

The data used in the present study was obtained through a survey of DeVry Institute students. The survey was prepared and administered by USAGroup Noel-Levitz, Inc., a consulting firm based in Iowa City, Iowa. USAGroup has national centers consulting in Enrollment Management, Student Retention, Staff Selection and Development, and Strategic Planning and Resource Development. USAGroup has been the leader in this type of research and consulting since their founding in 1984. The firm, founded by renowned researchers Randi Levitz and Lee Noel, has consulted with over 1,400 colleges and universities.

One thousand nineteen DeVry Institute students were surveyed for their responses to 73 questions designed to measure their relative satisfaction and the relative importance of those factors as contributors to campus satisfaction. This Student Satisfaction Inventory also included several questions for the tabulation of demographic information. Assessment approaches should consider the needs of culturally, ethnically, economically, religiously, physically, and linguistically diverse student groups (Cress, 1996). Researchers have identified many conditions that contribute to minority student attrition (Castle, 1993). This can be used for additional research, particularly to target specific problem areas or specific problem groups. The 73 survey items are subgroups of factors based on 11 scales, which in turn are subgroups of potential contributors to campus satisfaction. These scales are based on the USAGroup's many years of research and are the result of countless studies. The Student Satisfaction Inventory shows exceptionally high reliability. Cronbach's coefficient alpha is .97 for the set of importance scores and is .98 for the set of satisfaction scores (Noel and Levitz, 1996). These scales include:

- Instructional Effectiveness
- Registration Effectiveness
- Safety and Security
- Recruitment and Financial Aid
- Campus Support Services
- Academic Advising
- Campus Climate
- Concern for the Individual
- Student Centeredness
- Service Excellence
- Campus Life

This present study is based upon an analysis of student satisfaction at DeVry Institute, a proprietary technical college in North Brunswick, New Jersey, offering associate degree programs in Telecommunications Management, Electronic Engineering Technology, Computer Information Systems and Business Information Systems. DeVry Institute also runs non-degree programs in Electronics Technology. This latter program, and its students, were not considered in the present study. The survey takes 20 to 40 minutes to complete.

Satisfaction, it should be noted, is a relative term and is used in this study to measure how a student feels about the positive or negative aspects of a series of factors affecting the student's experiences at DeVry Institute. A scale is used with seven points ranging from "not satisfied at all" on the low end to "very satisfied" at the high end. "Neutral" is in the center of the scale giving students three levels of choice to discriminate among levels of dissatisfaction and three levels to discriminate among levels of satisfaction about the college/university experience.

Relative importance is used in this study to measure the impact a student perceives a factor to have relative to other factors affecting a student's experience at DeVry Institute. A scale is used with seven points ranging from "not important at all" on the low end to "very important" at the high end. "Neutral" is in the center of the scale giving students three levels of importance and/or non-importance.

Student retention was also assessed in the present study. It was defined as the percentage of students who enroll in a given semester, who return for a subsequent semester. This is tracked on a semesterly basis already in order to measure short-term changes in retention. Student attrition is the inverse of student retention, the percentage who do not return. Completion rate information was also collected. This is the percentage of enrolled students who eventually complete a degree program at DeVry Institute. The completion rate varies from the figure arrived at by calculating the cumulative percentage of semester retentions. Resume students are those who left school and were counted as attrition in the semester that they left, but subsequently return to complete their program of study. These resume students, counted as both attrition and completions because of this small variance.

One statistic computed is the performance gap. For the purposes of the present study, it is the importance rating minus the satisfaction rating. The size of the performance gap shows the weighted results in order to indicate areas of greatest need for improvement by the university. The statistical significance of this variable is limited in that it only has meaning when positive. In any area where the importance rating is equal to or less than the satisfaction rating, the performance gap loses integrity as a meaningful variable.

The present study has added an additional feature to enhance the usefulness of the Noel/Levitz survey data. The corrected performance gap is a value used to correct the limitations of the performance gap variable by multiplying the performance gap by importance. It accounts for factors like satisfaction levels and disparate importance levels, as well as those factors where the satisfaction level exceeds the importance level. These limitations are rare based on the distribution of the survey responses, however improved accuracy can lead to more effective application of the results.

The ratings for importance and satisfaction are a simple average of the survey results. The performance gap, as mentioned above is the difference between importance and satisfaction. This measure had limited value, and was used only in unusual cases, none of which were major factors here. The corrected performance gap uses the information to weight these differences in order to more accurately reflect the data.

An example of the problems associated with the performance gap variable would be a situation where two cases of importance and satisfaction are extremely close, but one case has high ratings, and the other, low. Even though there would be a greater level of satisfaction in the more important case, further improvement here for the student would have a proportionally greater return based on the higher degree of importance attributed to this factor. This can be corrected by weighting the performance gap by multiplying it by the importance variable, thereby creating a more useful ratio. Another limitation of the performance gap variable is where satisfaction exceeds importance. The term "gap" implies an absolute value and this does not accurately depict the proper ratio between importance and satisfaction. By reflecting this gap as negative where applicable, the corrected performance gap is more meaningful.

Scale	Importance	Satisfaction	Performance Gap	Corrected Performance Gap
Registration Effectiveness	6.19	4.67	1.52	9.41
Recruitment and Financial Aid	6.13	4.77	1.36	8.34
Academic Advising	6.09	4.86	1.23	7.49
Service Excellence	5.92	4.76	1.16	6.87
Concern for the Individual	5.99	4.85	1.14	6.83
Instructional Effectiveness	6.27	5.18	1.09	6.83
Campus Support Services	6.10	5.03	1.07	6.53
Campus Climate	6.03	5.06	0.97	5.85
Safety and Security	6.18	5.23	0.95	5.87
Student Centeredness	5.99	5.07	0.92	5.51
Campus Life	5.45	4.59	0.86	4.69

Figure 3.

4. Results

By weighing the corrected performance gap variable, we are left with a road map of the areas providing the greatest potential for return for the university. Figure 3 shows the items on the scale sorted in descending order by corrected performance gap. In this particular survey, the corrected performance gap occurs in the same order as the performance gap. Still, one can see that with enough variation in the importance rating, this may not always be the case. The performance gap for the "Concern for the Individual" category is greater than that of "Instructional Effectiveness" while their corrected performance gaps are equal. This demonstrates the corrective nature of applying the multiplicative effect of importance.

Some examples will better illustrate the importance of this weighting process. The survey responses to the particular item "I am able to register for classes I need with few conflicts", revealed the largest performance gap out of the entire survey. The performance gap for "Computer labs are adequate and accessible" had a large gap, but somewhat smaller than the first example. When using the corrected performance gap figures, the second survey item is shown to be of greater significance to the students. While both problem areas require addressing, the solutions and distribution of resources needed to attack each problem differ greatly. The results and analyses contained herein are meant to be exploratory. A comprehensive statistical analysis would be required to fully evaluate the effectiveness of corrected performance gap. This would be an area for future research.

These results give the institution the power to more effectively intervene in the level of student's satisfaction by attacking the areas that can offer the most return. In this example for instance, efforts aimed at "Registration Effectiveness" have the highest potential for impact. Corrective measures here could include programs to increase satisfaction such as:

- Customer friendly registration procedures
- More/improved student activities
- Improved service by the Financial Aid Office

or perhaps take some steps to lower student's expectations in order to change the ratings of importance attributed to this factor by:

- Improved/earlier orientation
- Modernized training for Admissions Department
- Freshman advising

5. Conclusions

Many approaches to improving student retention have been researched and are cited below. It is useful to consider many of these techniques when addressing the present findings. It is not the purpose of the present study to develop new strategies, but to better isolate the areas of greatest concern for the institution. Still, it is difficult to enter into any analysis of student satisfaction without some discussion of possible solutions and their effectiveness. Supplemental instruction, student-centered learning, cooperative learning and mentoring are just a few of possible methodologies.

Coordinated Studies Programs (CSPs) at Seattle Central Community College call for students to register for a common set of thematically linked courses. Though students enroll as if they were taking separate, discrete courses from different disciplines and fields, they attend the CSP as one course that meets a total of 11 to 18 hours each week in blocks of 4 to 6 hours over two to four days. In most cases the CSP's are team taught by two to four faculty members who are present and active in all class sections (Tinto and Russo, 1994). This provides connectivity between students as well as between faculty and students.

Supplemental Instruction (SI) focuses on high-risk classes, not high-risk students. In this way, no individual or group is singled out and made to feel conspicuous or made to feel differently from other students. High-risk classes are those introductory classes in which 30 percent or more of the students enrolled typically receive grades of D, F, or W for withdrawal (Congos and Schoeps, 1993). These classes receive additional contact time with a faculty member to be used for recitation purposes. This is to provide an alternative approach to students with poor study skills. The United States Department of Higher Education has reputedly validated SI as an academic assistance program. Students attending SI sessions earn higher mean final course grades than students who do not participate in SI (McCarthy, Smuts and Cosser, 1997).

One way to personalize education and maintain the human element is through mentoring. When you take a special student under your wing, looking out for their best interests, guiding them through the curriculum, ...you are mentoring them in an informal way (Doran, Daigle and Robinson, 1997). Any corrections must be targeted appropriately. Some students will leave no matter what you do and some students will persist no matter what you do (Noel and Levitz, 1998), but mentoring can make a difference for some.

Setting up these potential improvement programs can be difficult. Resources, whether financial or personnel, are needed. Since these resources are limited commodities, decisions and sacrifices must be made at the college and/or university level. This is true under any circumstances so it is at least beneficial, as was done here, to know the most effective place to apply these resources. Buy-in from all involved parties is also necessary to the solution of any problem, so imparting the rationale of any changes to the students, faculty, and administration could be a large factor in its subsequent acceptance. One limitation of the present study was the quality of the survey responses. Many students did not take the survey seriously. Many answer sheets were left blank or incomplete or even had artistic designs made up in the response categories.

Continuous measurement is an important next step. The present study provides benchmarks for comparisons for future surveys. The proof of positive results is necessary to the justification of resources in today's business environment. Other assessment tools may also be possible, but whatever these tools may be, they need to be determined prior to the implementation of any corrections. This will help avoid bias or unproven assumptions. Program completion rates are the most obvious measure of increased satisfaction. These statistics take time to gather. Relying on student anecdotal evidence provides faster responses but can be woefully inaccurate. Individual correction approaches can also have built-in evaluative tools to help answer some questions. The relative frequency of the use of support services, advisors, or club enrollments are easy to quantify and could help.

In applying solutions to the problems illustrated in this analysis, special attention must be paid to the level of control the institution has with respect to the factors in question. Many of the corrective methodologies mentioned are designed to take place in the classroom or as a direct result of personal contact between the student and an agent for the institution. The results of some of these methodologies are more apparent than from others. The greatest difficulty here lies with those factors that are outside the control of the institution. These could be based on limited resources, which could impact registration effectiveness or general perception issues such as campus climate, etc. If the level of institutional control could be somehow quantified, this may serve as an additional discriminator in measuring and assessing the performance gap.

6. Future

There has been a large volume of research in the measurement of student satisfaction at the college level. As education evolves, this research will continue. Based on the limited resources available to both institutions and students, the need for more refined research will grow in the area of student satisfaction and retention. The gap between expectations and reality is at the heart of the relationship a student has with his institution. Closing that gap can lead to minimizing the importance of some factors and raising the satisfaction level of others. There is a need for further research into the methods institutions can apply to first assess why students leave and how colleges and/or universities can take greater control of factors impacting student satisfaction. A partnership between institutions and customers is paramount to increasing student satisfaction and understanding that satisfaction.

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Software Project Management: A Reality-Based Approach

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Abstract

Many Management Information Systems programs contain a course with a title such as Software Project Management that attempts to familiarize a student with the tasks involved in the activities of the systems development life cycle, typically using an approach which prescribes methodologies to be applied during the various stages of software development. Similarly, many Computer Science programs include a course with a title such as Software Engineering that covers the same type of material, but uses a more theoretical approach such as using mathematical models for predicting software development time and cost. This paper proposes the use of a semester-long case project that exposes senior-level MIS students, who have completed both a COBOL language programming course and a systems analysis and design course, to the realities experienced by members of a custom software development consulting firm as they vie for a contract and, after obtaining the contract, are required to perform the tasks require to bring the project to a successful conclusion, and describes the results of using this approach.

Keywords: Project management, COBOL implementation, software project team

1. BACKGROUND

In 1985 the author designed and implemented the original MIS curriculum of an AACSB accredited College of Business in a California State University. Over time the curriculum was mildly revised twice. One required course in the original program remained required and with its content and format unchanged through both revisions. The course was Software Project Management.

2. COURSE FORMAT AND CONTENT

Setting The Stage

On the first day of class the students are told that by the next class meeting they are to have formed teams of from three to five students, selected a project manager and decided on a name for their firm. They are told that they will perform as a software development consulting company and virtually live together for the rest of the semester. As preparation for the course each semester, the professor develops a Request for Proposal (RFP) for custom software development, which is given to the students at the first class meeting. Since the professor has extensive MIS business and consulting experience, he is able to develop an RFP for a firm in a different type of industry each time the course is offered. The RFP gives a description of a firm that has an existing system that needs to be re-designed, documented, coded, tested and installed on the firm's computer. An RFP used in a recent semester and the scoring sheet used to evaluate a proposal are shown as Appendices A and B. Available on reserve in the campus library are copies of proposals for similar projects submitted by previous class groups, complete with a filled in scoring sheet with both critical and praising comments for each proposal so the groups are aware of the criteria used and examples of good and less-than-good proposals.

In addition, each project manager is required to provide team members with an agenda for each team meeting and to keep minutes of each meeting to document decisions reached and assignments given to team members. These agendas and minutes must be turned in at the end of the semester.

Developing The Software Proposal

The next few classes cover the sections of a standardized proposal format that the students must follow, "customizing" the proposal to relate it to the type of firm involved and to adapt it to the needs of the potential client that issued the RFP this semester.

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The traditional software development process must be followed by the teams, i.e., prototyping or Rapid Application Development (RAD) is not used in this course.

Students are made aware that most consulting companies have a standard proposal format, and that this template is modified to fit each RFP the consulting firm decides to respond to. The proposal therefore contains two sections that are unique to the RFP for the semester, the PERT/CPM analysis and the detailed project budget. Each team is required to independently determine which tasks its members feel need to be performed to complete the project, the estimated time necessary to complete each task and the interdependencies between all of the tasks. An example of a list of tasks is provided to the groups for them to consider, since they have never been involved in a project that includes all of these activities. A copy of that example is provided as Appendix C and a PERT worksheet provided to the teams is shown in Appendix D. The project budget must be developed using a spreadsheet from the PERT data, showing the number of hours for each type of professional needed for the completion of each task and the hourly cost (if the consulting firm wishes to compute its cost then add an amount for profit to develop its bid price) or hourly billing rate (if the consulting firm wishes to use a billing rate developed by determining the amount at which it must charge out each type of professional based upon the person's pay and a mark-up to cover overhead and profit) for each type of professional. The "Assigned To" column of the PERT worksheet is used to indicate the classification of the individual(s) that will perform a specific task, thereby assisting the teams in developing the project budget data.

The proposal is also to contain examples of deliverables that will be provided in terms of sample system specifications, COBOL code, user instructions, etc. for the client to review to determine if they are acceptable to the client.

It is worthy of note that using an in-house software frame of reference may occasionally require that an MIS area prepare a PERT analysis. However, the preparation of a complete proposal which also contains a budget and deliverable examples is unique to the world of consulting. This approach adds a dimension and rigor that simulating in-house development would lack.

Upon submission of the proposals to the client representative (the professor), all teams are told they have been selected to complete the project.

Designing The System

The RFP given to the students states that the system must be capable of performing specific tasks and must be developed using keyed-sequential data sets. In order to keep the project manageable in a semester, only three programs comprise the "system" to be designed, coded and tested. The first program allows the user to interactively create a file of transaction and file maintenance records. The second program processes those transaction and file maintenance records against multiple keyed-sequential files in a random manner, with some transactions requiring concurrent posting of data to more than one master file. The third and final program extracts data from multiple master file records to create sort work file records, which are then sorted and used to print a report. The rationale for requiring the application to be of this nature will be discussed later.

The professor leads the class through defining the general system logic, then the processing requirements of each program, designing the layout of all records for all files and the edits to be performed on transaction and file maintenance records to assure the master files do not become contaminated. The layout of the Error and Exception Report that will contain information about errors detected in transaction and file maintenance records is designed in class. Also, the management report that is the output of the third program is designed in class, after the concepts of sorting sequences, control breaks and multiple levels of totals are reviewed. After these discussions, in which students are active participants, each team must develop a set of program specifications that theoretically would be passed to the programming group in their consulting firms. Once again, examples of specifications from previous classes are available for student teams to use for reference and a scoring sheet is provided to assure that the teams submit all of the necessary items. A sample scoring sheet is in Appendix E. The specifications are then submitted to the professor for grading as to accuracy, completeness, soundness of logic and clarity of presentation of the material. The teams then use their copies of the specifications to begin the program development stage.

Programming The System

The three programs are written in COBOL and in a batch processing manner. Some may consider that it would be more appropriate to have the programs written for interactive execution, with error messages displayed on the monitor for example. However, in order to assure the programs functioned properly in that environment, they would have to be executed while first the students watched to debug the program, then the professor watched to confirm the correctness of the program logic. By requiring the programs to be designed and programmed in the batch processing manner, before and after file printouts can be used by the students to confirm the programs executed properly and to submit as part of their final deliverables package to the client. Further, the interactive approach assumes that the person entering data can be expected to properly respond to a message such as "The per unit cost you entered is too large. Re-enter the per unit cost for the item." In many industry applications the person entering the data is merely keying in data from a form and has no knowledge of how to correct what the program has defined as an error.

In addition to the programs required by the specifications, programs must be written to create examples of the master files against which the supposed production programs will process the data. These programs, which are referred to as "support programs", are not included as "deliverables" but considered "throwaways" since they have no value after the system has been completed.

Each team allocates tasks to its members, sets due dates for specific items to be developed and the Project Manager both performs tasks and monitors the progress of team members. To assist the teams in meeting deliverable due dates, the tasks that should be completed by specific dates are shown on the course schedule.

Documenting The Correctness of The Programs

In a manner similar to that followed in a consulting firm's team, the Project Manager oversees the development of the FD's for all files and has them placed in a source statement library for the team. When a member of the team develops a program, whether a support program or a production program, the program then copies the necessary FD's into the Data Division ensuring that the system does not have data incompatibilities.

After the Project Manager is assured by members of the team that all programs are correct, s/he requires the member(s) of the team that developed each program to document the correctness of the processing to provide evidence to the client that the system is operationally sound. This is done by printing a list of the test transactions and file maintenance records to demonstrate that the required records were created in the proper format. Then that listing and the contents of all master files, both before the second program is executed and then again after the program is executed, are printed. The person(s) who developed the second program that processed the input records against the master file then prepares a narrative that, for each input record, numbers the record sequentially, describes the purpose of the record and then, by highlighting and placing the number of the input record alongside the affected master file records before and after the input record was processed, demonstrates that the program processed the record correctly or, if an input data error condition existed, notes that it was detected and highlights the associated error message on the Error and Exception Report.

The systems specifications are required to define the processing for all the types of input records and all the data edits one would require in a production system. However, requiring the student programs to meet all of the conditions in the specifications would result in programs that would take much too long to develop. As a consequence, the programs are only required to be capable of processing a subset of transactions and testing for only a few input data error conditions selected by the professor.

The records of the files used to create the report in the final program are listed prior to the program executing. The records of the unsorted sort file are required to be printed during the creation of the sort file. When the file is read in after the sort has been executed on the records to create the report, the records are required to be printed. This demonstrates that the correct data was extracted, the records created contained the correct data and that the correct sorting sequence was called. The report contains the sorted records, which typically contain at least one field on which control breaks and subtotals are required and a grand total is computed. The values to be added from the sorted records are required to be totaled manually then compared to the printout totals to provide evidence that the program computed subtotals and totals correctly, and inserted control breaks where required.

Client Meeting and Change Control

The course schedule shows periodic "Progress Reports with the Client." At these sessions each Project Manager indicates whether the team is on schedule, ahead of schedule or behind schedule, and provides details. To inject further realism into the project, about three-fourths of the way through the programming phase the professor, representing the client firm, requests a change in the sorting sequence and the format of the report generated by the last program. A discussion and negotiation ensue, and the change is accepted for implementation, but the final deliverable deadline is extended by one week.

The Final Deliverable

After a team is satisfied that the system is correct, it must then develop a "package" that contains the source code for each program and the test documentation for each program. Also required is a set of User Instructions that describes to a novice how to execute the programs in the system and how to interpret (a) the Error and Exception Report messages and (b) the report generated by the third program. Once again, completed examples from previous classes are provided on reserve in the library, along with scoring sheets and the professor's comments for each package. A sample scoring sheet for this documentation is provided in Appendix F.

3. POST PROJECT REVIEW

After submitting its final deliverable package, each team is required to prepare a Project Retrospective. In this report the team is to reflect on the three phases of the project (1) Project Proposal, (2) System Specifications and (3) Program Coding and Testing. For each phase the team, as a team, is to state, for each task that went right (a) what went right, why did it go right and what would you do the next time you were involved with a project to make sure it went right again and (b) for each task that went wrong, what went wrong, why did it go wrong and what would you do the next time you were involved in a project to make sure it didn't go wrong again.

4. RESULTS

This course had the reputation of "The Course From Hell" among MIS majors, yet students regularly reported that it was the one course in the curriculum that tied all of the material together into one course and experience. It was, they reported, the course that made them understand and appreciate the separate bodies of knowledge they had learned in previous MIS courses and to see the interdependencies involved. In some cases the friendships developed in teams during the semester carried over not only to team projects in other courses, but after graduation as well.

Each team member was encouraged to make a personal copy of all materials submitted during the semester for use in recruiting interviews not only upon graduation but for possible interviews later in their careers. Students frequently reported that when they submitted their course materials to corporate recruiters on campus the materials were reviewed in detail and recruiters were impressed by the thoroughness and professionalism of the documentation. Recruiters also began to use the course grade in this course as a discriminator among MIS graduates. On several occasions when graduates visited the campus after working as employees of consulting firms in the MIS field they stated that the Software Project Management course experience was almost identical to their responsibilities in the workplace.

5. REFLECTIONS

Teaching the Software Project Management course in this manner requires true dedication. Students sometimes find themselves "lost" and cannot make any progress until they receive help. As a consequence, I have allowed them to call me at home during "normal" hours on weekends and during evenings of weekdays. I have found that they have not abused this offer, and I can typically get them back on track in a few minutes, for which they are extremely grateful.

In order to teach this course one should have practical knowledge in the MIS field. First, each semester one has to develop a new scenario for an RFP from a client looking for custom software development. Next, one has to guide the teams through the design of a system that, while small scale, addresses all of the issues one must consider during an actual software development project. The author has developed an RFP for such companies as an auto restoration firm, a car rental agency specializing in exotic cars, a modeling agency, a CPA firm, a company that brokers freight hauling between customers and hauling firms, and an industrial crankshaft re-manufacturing firm, to mention a few.

It is suggested that teaching the Software Project Management course in this fashion is also a method for having true involvement by students. It is very difficult for them to remain detached when they are on a team with deliverables due according to a defined time-table.

Copies of appendices will be available at the conference and/or from the author via E-mail.

Changing the CIS Academic Culture: Using Senior Design Projects to Unify the Curriculum

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Abstract

Recently we initiated an effort to create a synergistic relationship between the senior design sequence and the sophomore software engineering course that resulted in a cultural change to our CIS academic community. Because of the enthusiastic response from students and faculty, we are extending this initiative to generate early interest among freshman and sophomore majors for electives in artificial intelligence and decision support. With hardware acquisitions obtained through an Instrumentation Laboratory Improvement (ILI) grant from the National Science Foundation, teams in the Senior Projects capstone sequence are preparing projects that will be employed in early courses in the curriculum. The projects will be used to provide students with insight about each of the elective areas of the curriculum through demonstrations and activities. This paper describes the five project initiatives and how the projects will be employed to generate interest in the elective areas.

Keywords: CIS curriculum, artificial intelligence, decision support, database, software engineering.

1. INTRODUCTION

Motivation

While students often view individual courses in isolation, curricula models are plans for the careful integration and the iterative development of concepts to higher levels of knowledge (Bloom 1956). The integrated laboratory experience (Doran 1994b, 1995, 1997a, Langan 1996), using a cognitive-based framework, illustrated how a hands-on approach can re-enforce topical contents to accomplish a depth-of-knowledge approach. Whereas this pedagogical approach serves the curriculum well at the introductory course level, the initial benefits disappear unless there is reinforcement throughout the remainder of a curriculum.

Although a cognitive-based approach is primarily focused on depth of knowledge, curricula should also provide for a breadth-first approach in some areas. Students who are exposed to the many facets of a curriculum can understand expectations of later courses and to make practical sense out of abstract concepts. This knowledge of future use of basic concepts and options of study can also serve as a motivation for students to build the necessary foundation to insure success later in a curriculum.

The use of collaborative, cooperative approaches (Daigle 1999, Landry 1997) and the use of informal and formal mentoring approaches (Daigle 1997, Doran 1994a, Doran 1996, Pardue 1991) are additional means of supporting student success throughout a curriculum.

The remainder of the paper will explore how we have attempted to further enhance the curriculum by addressing these issues. We will discuss the focus of a recently awarded NSF-ILI grant that extends the hands-on laboratory beyond the introductory levels to advanced levels of the curriculum. The projects from these upper level courses will be integrated back into the lower courses to challenge the "isolated view" of courses and to incorporate a breadth-first view in the introductory courses. Faculty mentoring of the development and implementation of the projects are critical for extending elective course experiences to meaningful applications.

2. *BACKGROUND*

A prior paper (Daigle 1997), described a novel approach to modeling relationships among courses in curricula. This approach involved establishing a formal relationship between members of a sophomore software engineering

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course and a senior design project course. The resulting "synergy by design" produced benefits for both classes: Software engineering students were introduced to the expectations of the senior design sequence early in the curriculum; senior design students were peer-reviewed. The early preview generated awareness in sophomores for the importance of intervening courses to prepare for the senior capstone experience. This paper describes an extension to the original approach to acquaint sophomores with the elective areas of the CIS curricula.

About the University of South Alabama

The School of CIS, one of nine academic units on the campus of the University of South Alabama, provides a choice of specialization areas for undergraduate students in: Computer Science (CS), Information Science (IS), Information Technology (IT) and Computer Engineering (CpE). Students of each specialization initially share a common core of courses in the first two years and then, after two years of courses specific to a specialization area, they share a common senior capstone experience. Specialization curricula are supplemented with elective CIS courses including artificial intelligence (AI), decision support systems (DSS), Advance Database and Real-time Computing. Typical enrollments for these elective courses are 20-25 per year. The senior capstone experience is a two-semester senior design project course sequence in which students (perhaps from different specialization areas) work in teams to undertake real-world projects and to produce production quality systems for a wide range of applications. Successes have been reported in the literature (Daigle 1997, Doran 1997b, Holt 1996).

Curriculum Structure and the Role of Electives

CIS curricula, such as the ACM model (ACM 1991) and the 1998 IS model (Longenecker 1996), address an agreed upon body of knowledge with activities that provide breadth and depth of knowledge. A specific implementation of these curricula result in a required core set of courses in the major as well as a set of required and supporting courses from other disciplines. CIS electives are an opportunity for a student to customize, at least a portion, of the curriculum in the direction of their special interests.

It has been observed through student advising that, in general, students decide to enroll in an elective course for a variety of reasons: personal interest in the course content, recommendations from members of a previous class or from an advisor, publicity by the instructor, perception of ease in grade assignment, perception of importance for job search, or availability in the course rotation. Of course, a selection based on interest is generally regarded as optimum. Once the class is

sophomore

formed, the instructor begins a familiar battle to generate student enthusiasm and motivation in students with diverse expectations who may not be truly committed to the study of the elective material. How does a student, immature in the curriculum, identify an area of interest early so that direction of special interest can be identified and nurtured early? We elected to develop projects in the senior design sequence, that could be used to provide insight, through activities and assignments in the freshman and sophomore courses for CIS elective courses such as Artificial Intelligence, Decision Support Systems, Advanced Database topics, and Real-time Computing.

The ILI Grant

In the past, the specific elective areas, AI, DSS, Advance Database, and Real-time Computing were taught with limited hands-on experience. The primary obstacle to extending the notion of "synergy by design" was the absence of sophisticated laboratories to provide advanced hands-on experiments for the upper division undergraduate students in the junior/senior electives and the capstone sequence. In order to meet the special resource needs to carry out the objective, several members of the School of CIS collaborated to prepare an ILI grant, which was subsequently funded by the National Science Foundation.

The plan for utilizing this equipment in the target courses will be accomplished as follows. Juniors and seniors who take elective courses will build upon these elective experiences in the senior design sequence, combining theoretical concepts and hands-on applications to prepare projects that can be used in the lower end of the curriculum. During the development of the senior project, sophomore software engineering students will be given class assignments, e.g. documentation review or test case development, that require interaction with senior design project teams. Selected core courses from the first two years would use the completed project for a breadth-first learning approach, directed to creating an awareness of the elective areas that relate to the project. The elective courses would make use of the completed project for a depth-first learning approach, examining the implementation strategies, replacing modules, extending the functionality of the project, or reverse engineering the project.

3. Methods

Four projects are under development in the senior design sequence; one project is under development in a directed study. A primary goal is to create a resource that could be used in the current curriculum and that could be further developed by students as senior projects, directed studies or other undergraduate research activities.

AI Projects
Two senior projects that directly focus on AI and Real-time Computing are under development: one involves simulation and the other specialized hardware.

RoboCup Simulation Project: The Robot World Cup Initiative (RoboCup) is an international research and education initiative to foster AI and intelligent robotics research by providing a standard problem, virtual soccer, in which a wide range of technologies can be integrated and examined. A senior project team composed of individuals, who recently completed the AI and Real Time courses, has committed to leveraging the RoboCup initiative to provide project-oriented activities involving AI. The project team will address problem areas that include improving the user interface to the RoboCup simulation system and developing a collection of decision support modules (FININ 1992).

Hexapod Walker Robot Project: Specialized hardware and accompanying controlling software present additional opportunities for examining AI concepts. The objective of a second senior project team is to create stand-alone tools and software libraries for activities to control a hexapod walker robot. Demonstrations would employ prepared activities for the hardware and collaborative experimentation with the controlling software (Flynn 1993).

Decision Support Systems, Advanced Database
The DSS part of the ILI grant focuses on the development of two major resources: a data mart using Oracle 8.0 and a medical decision support system.

The Data Mart Project: Inman defines Data warehouses as a "subject-oriented, integrated, nonvolatile, time variant collection of data in support of management decisions". A data mart is a subclass of the data warehouse that focuses on a narrow part of a business activity. The data mart, implemented using Oracle 8.0 made available through an academic agreement, will consist of an accumulated set of several years of sales records donated by a local direct mail order company. The goals of the senior project team are to establish the data mart, to implement an advanced visualization (multidimensional) application, to implement drill-down capabilities, and automatic updating when new records are added to the data mart

Medical Decision Making Project: The ILI grant also supports the development of resources for decision making curricula. This project, developed in collaboration with a local heart rehabilitation clinic, was initially explored in a past senior design project and is presently a subject of a directed study. The intelligent part of the project, a system to support medical decision making in risk analysis and therapy planning, involves the development of medical logic modules (MLMs) in a standard ASCII format called the Arden Syntax. An additional project is directed to the development of voice-recognition applications for use in rehabilitation. These knowledge-based tools will be linked to an existing patient database and will provide students with an opportunity to investigate how data and knowledge are linked to provide decision support.

A Hybrid Project
The last project we will describe, an intelligent web-crawler, is one that spans many core and elective areas in the curriculum: AI, Decision Support Systems, large-scale databases, Real Time Computing, and web-based applications. Because of the complexity involved in this project, it is expected to be an on-going project several years.

This project will focus on the issues relevant to existing web search tools: huge, unsorted databases with dramatic storage growth rates and impersonal, general query strategies that provide users with a large number, mostly irrelevant, web sites. By combining standard web crawling, artificial intelligence-based sorting and sifting of data, and a client-server database-centered user group subscription services, the senior design team will prepare a user profile management system coordinating personal web robots discoveries for group-oriented collaboration. This team's objective will be to work with faculty mentors to develop a vision and a framework for the project and to implement a web crawler, a prototype database, and a query/filter component for a limited number of specific web site types.

4. DISCUSSION

Students should be exposed to large complex systems throughout the curriculum. The laboratory experiences that the authors are directing will accomplish this at the breadth-level and depth-level of learning.

In the early part of the curriculum, the initial interactions with these systems will provide breadth-level experiences of many diverse topics. Demonstrations and assignments based on the projects supplement the depth-level experiences from the use of an integrated laboratory experience and a cognitive-based approach. Sophomore software engineering students will have assignments, such as design review and test strategy design, involving upper classmen working on real projects. These initial interactions provide an awareness of later course requirements and objectives. Specifically, the proposed projects will give students a pre-enrollment understanding of the topics in electives such as AI, DSS, or Advanced Database and the expectations of the senior design sequence. This look-ahead is a major advantage of the breadth-first approach to the curriculum. We feel that in this approach we can achieve the best of both the breadth and depth approaches.

Later in the curriculum, these projects can be used for depth-first experiences in the elective courses. Studying various aspects of the projects, reviewing alternative design strategies, and revising original code provides a higher basis for experimentation in these courses. The projects provide evidence to the maturing student of the importance of extending the cognitive-based approach to advanced courses.

Students in the senior design sequence interacting with sophomore software engineering students are accountable to their peers as well as to the course instructor. Moreover they have a mechanism for giving back to the curriculum which nurtured them.

Senior design students who have completed one or more of the electives were motivated to volunteer for a related project using the resources made available by the ILI grant. Based on the time invested and the quality of the specifications produced, these students have already demonstrated a high level of commitment to the projects.

The role of mentoring has expanded in this approach. Recruiting faculty mentors to provide guidance and expertise for the student projects is a standard practice. However, with encouragement from the instructor, senior project groups have extended invitations to underclassmen who expressed an interest in their project. Thus, in an informal way, a student-to-student mentoring has been initiated.

The entire process has led to a change in the learning culture of our CIS program. These projects have been allocated dedicated work pods and needed equipment and resources. As these projects are developed the students are keenly aware of the impact they will have on future students and courses in the curriculum. A consequence of this awareness is a better understanding of the contributing role of each course to the learning objectives of the curriculum. As discussed by Aiken (1991), this introspective view of all topics is the true capstone to the educational process.

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A Process for Modeling the Analysis of Information Systems with the Unified Modeling Language

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Abstract

A two-phased process for modeling the analysis of an information system by means of the Unified Modeling Language has been developed from over two years of experience with a Systems Analysis and Design course. The first phase of this process, Requirements Analysis, involves the application of a Use Case Diagram and a Sequence Diagram. The second phase of this process, Domain Analysis, includes the application of a Class Diagram and a State Transition Diagram. This process is still evolving and, hopefully, will continuously improve in the future.

Keywords: Use case diagram, sequence diagram, class diagram, state transition diagram

1. INTRODUCTION

Currently, no standardized process exits for the modeling of information systems by means of the object-oriented Unified Modeling Language (UML). UML is not a process in itself, but primarily a graphical notation that is used to express the designs of an information system (Fowler 1997).

In spite of this limitation, I have developed a two-phased process for modeling the analysis of an information system as a result of over two years of teaching an undergraduate course in Systems Analysis and Design.

Throughout the two phases of requirements analysis and domain analysis, I have used a College Course Registration System as an example for the student assignments. The students relate well to this information system because they use it several times during the academic year.

2. MODELING PROCESS

The first phase of this process, Requirements Analysis, involves the application of a Use Case Diagram and a Sequence Diagram for analyzing the requirements of the information system. The purpose of this analysis is to create a better understanding of what the users want from the new system (Eriksson 1998).

The second phase of this process, Domain Analysis, includes the application of a Class Diagram and a State Transition Diagram for analyzing the domain of the information system. The purpose of this analysis is to achieve a better understanding about the world that the new information system is supporting (Eriksson 1998).

The four UML diagrams mentioned above are drawn by the students with the "AutoShapes" feature in the WORD 97 software. WORD was chosen over the two software engineering tools mentioned below because it was easy to use and readily available at a low cost.

The Object-Oriented Software Engineering package, which is free on the Internet for a demo version from the Rational Rose Company, was not used because it is limited to 10 use cases in the Use Case Diagram and will not draw a State Transition Diagram.

The Visible Analyst Workbench software, which is $99 for a student version from the Visible Systems

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Company, was not used because it will not draw a Use Case Diagram nor draw a Sequence Diagram.

3. REQUIREMENTS ANALYSIS

In the Use Case Diagram of Figure #1, the students are required to have 5-10 actors (stick persons), 10-15 use cases (ovals), and 2-3 extends (ovals). An actor, such as a Student, is an object that interacts with the Course Registration System, but is not a component of this information system.

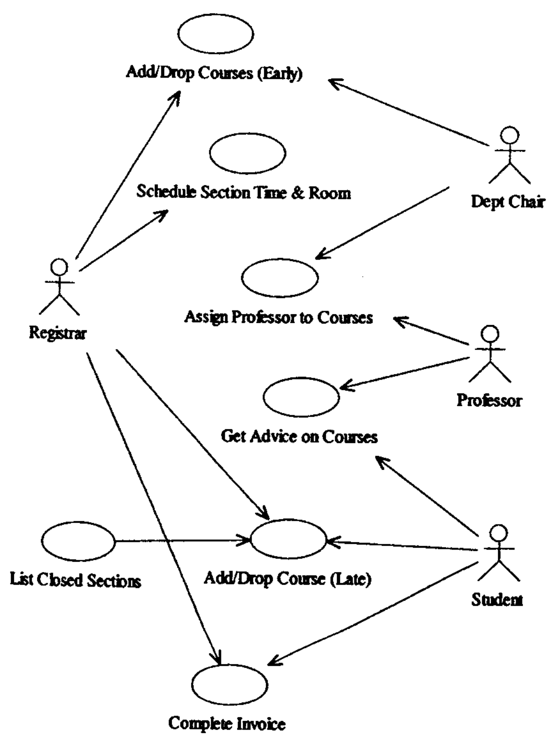

Figure # 1 - USE CASE DIAGRAM

This actor initiates a method or a use case, such as the adding or dropping college courses, in order to yield a measurable result. Interaction between two use cases is called an "extend", such as the listing of the closed sections for a course.

The Use Case Diagram concentrates on many methods, whereas the Sequence Diagram takes only one of these methods and looks at the interaction among many objects. An object, such as a Course Schedule, is a set of people, places, or things that performs common methods and shares common data attributes.

In the Sequence Diagram of Figure #2, the students are required to have one actor, one use case, 5-7 objects (rectangles), 5-7 time lines (vertical lines), 10-15 messages (straight arrows), and 2-3 self-messages (backward arrows). A time line represents one object, and the distance between two time lines represents the start and stop time between two objects during their interaction.

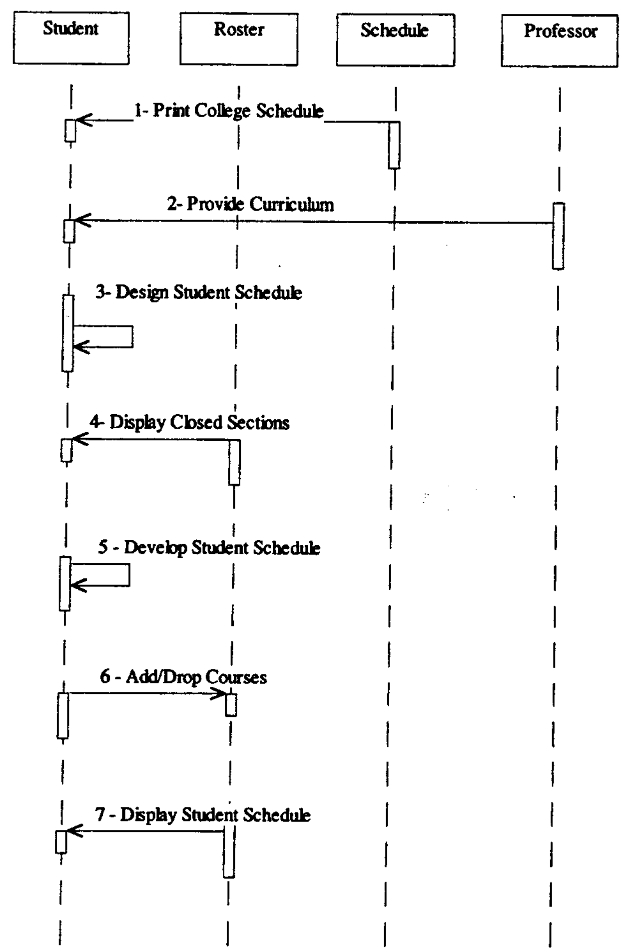

Figure # 2 - SEQUENCE DIAGRAM

This interaction between two objects is represented by a message, such as the printing of a Course Schedule for a Student. A self-message, on the other hand, is an interaction that an object performs upon itself, such as the designing of a student schedule by the Student.

Briefly, the first phase captures and describes the user requirements for the new information system. This phase documents the requirements by a Use Case Diagram of many methods and many Sequence Diagrams of one method with many of its objects.

4. DOMAIN ANALYSIS

In conjunction with the first phase, the second phase defines the real world environment or domain, such as a College, which uses a Course Registration System. This domain is documented by means of a Class Diagram of many objects and State Transition Diagrams of one object with many of its methods.

For the Class Diagram of Figure #3, the students are required to include 10-15 classes (rectangles), 5-10 associations (straight arrows), 1-2 reflexives (backward arrows), 2-3 aggregations (diamond on arrows), and 2-3 inheritances (triangle on arrows). Each class in this diagram should contain about 2-3 data attributes and 1-2 methods.

A class, such as a College Course, represents a group of objects, which contains instances of this class, such as the college courses of CM 2114, CM 3103, and CM 4146. When comparing the object oriented to the traditional systems approach, it is interesting to note that a class is analogous to a data file and an object is analogous to a data record.

The relationships in Figure #3, for example, involve (1) a bi-directional association between the Student and Section, (2) a reflexive relationship of the Course upon itself, (3) a "whole-part" aggregation among a Course and its component Sections, or (4) a "parent-child" inheritance where a Student is either Full-time or Part-time. Each of these relationships, except inheritance, has their multiplicity, such as one (1..1) Student is taking one or more (1..*) College Courses.

In the State Transition Diagram of Figure #4, the students are required to have one primary object, 15-20 events (arrows), 2-3 self-events (arrows), 10-15 states (rectangles), one start state (small circle), and one or more stop states (small double-circles).

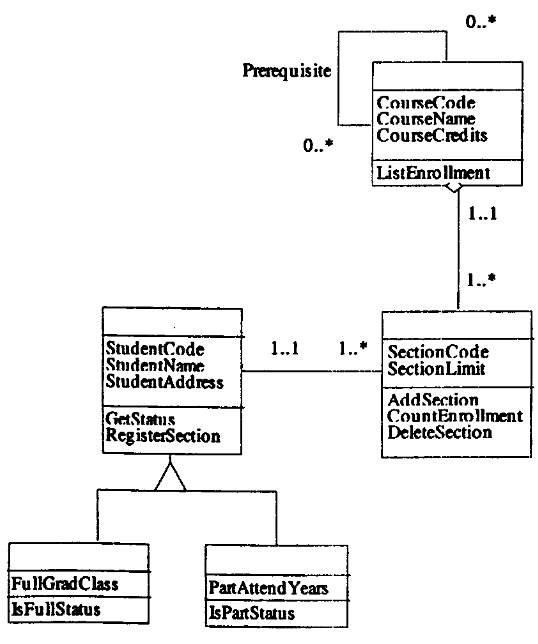

Figure # 3 - CLASS DIAGRAM

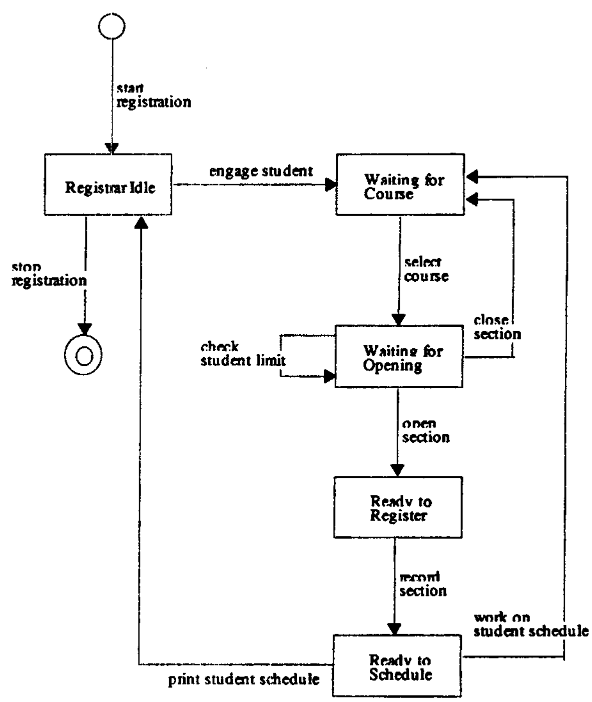

Figure # 4 - STATE TRANSITION DIAGRAM

An event represents a message sent between two objects, whereas a self-event is a self-message that an object performs upon itself. A message can also denote a request to perform the method of another object, such as the selection of a course from the Course Schedule. A state is the result of an event, such as waiting for a course to have an opening.

It is important to mention that the second phase is not a detailed design of the entire domain for the information system. For the student of a Systems Analysis and Design course, this phase, for example, should define only about 80 percent of the most significant objects and methods in the Course Registration System.

5. MODEL EXTENSIONS

In the first phase of this UML modeling process, the Use Case Diagram was used because it simplifies the traditional Data Flow Diagram (DFD) by including only the actor/end-user and use case/method in describing the requirements of an information system. The input documents, data files, and output reports are named only within the use case itself.

The Sequence Diagram was used because it details the Use Case Diagram by taking one use case/method apart to show the dynamics among its objects. Note that the Sequence Diagram is very useful in the early analysis phases of system development. As an extension to this diagram, a Collaboration Diagram may be used to display the same material, but with an overall design phase perspective.

In the second phase of this UML modeling process, the Class Diagram was used because it extends the traditional Entity Relationship Diagram (ERD) by including not only the data attributes, but also the methods of a class. As an extension to the Class Diagram, a Package Diagram may be used to organize classes into groups.

The State Transition Diagram was used because it details the Class Diagram by taking one object apart to explain the dynamics between its events/methods. As an extension to both the Sequence Diagram and the State Transition Diagram, an Activity Diagram may be used to illustrate the complex dynamic interaction among many objects and many methods simultaneously.

6. CONCLUSION

In an effort to make the assignments in the Systems Analysis and Design course more like the real world, an industry-based case study was also given to the student. The New National Bank case, for example, allows the student to learn more about the information processing inside a bank and its unique vocabulary. Other cases in wholesale distribution, manufacturing, and hospital administration are planned for this course in the future (Vitalari 1995).

It is important to point out that it is not necessary to model the business processes before the analysis of an information system. However, this modeling would help provide a better understanding of the user requirements when creating the Use Case Diagram in a business domain (Bahrami 1999).

In conclusion, this two-phased process for modeling the analysis of an information system is still evolving and, hopefully, will continuously improve with each course in Systems Analysis and Design in the future.

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Teaching Operating Systems Through Role Play And Textbook Authoring

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Abstract

In this paper I describe a rather novel idea for teaching an operating systems course using role-play, class presentations, and textbook writing by the students themselves. The purpose was to stimulate students into active participation and not mere absorption of the facts.

Keywords: Operating systems, role-play, textbook writing

1. INTRODUCTION

Anyone who has ever had to teach an operating systems course probably knows of the wide body of theory which traditionally is being passed on to the students through lecturing. As evidenced by much research (Bork 1997; Caftori 1997; Paprczki 1996), lecturing is not pedagogically sound. Involving students actively has been proven to be a most effective learning and teaching tool.

How does one keep students involved in a course that has so few opportunities for exercise? Fortunately the theory covers the behavior of the various programs of the operating system, which include job scheduling, memory, CPU, I/O (input/output), and file management. All these programs represent numerous components which are hard to keep track of unless represented somehow graphically or physically.

2. EXPERIENTIAL LEARNING

Graphic representations appeal to many people who are visually oriented. By physical involvement in learning I mean experiential learning, a learning that is not soon forgotten. A comparison can be made to learning to bike. Learning the theory behind biking will not advance one very far as opposed to actually mounting the bike, pedaling and maybe falling a few times. Many of us use the expression "it's like riding a bike". One does not forget how to do it once one knows it, even after many years of not riding. If we carry this philosophy of experiential learning to the classroom whenever possible, we can accomplish this rare achievement of having students remember what they learn many months or years later. Of course we are talking here about cognitive learning and not only physical exercise, however since the life of a job resembles the life of a human, we may learn by analogy.

Role Play: **The idea was to give each student a part in a "play" where the play is about processing jobs. The stage, or the center of the classroom, represents the internal memory of the computer. Depending on the number of students, as few as five, and as many as a couple dozens can easily accommodate many situations. Students in excess of the players are part of the audience. By observing their friends act, they learn too and provide an additional incentive to the players to better perform.**

An area is designated for the input queue, and students representing waiting jobs line up there even in their seats. The actor representing the operating system may designate helpers, or routines, to help him or her to carry on the task of the overall management. An initiator/terminator routine for example, will load the first job off the input queue into internal memory, or center stage. There too we will have a line of waiting processes, a ready queue. The CPU (Central Processing

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Unit) may be one (or more, in a multiprocessing environment) person who can process one process at a time. Representing processing may be done in several diverse formats:

Examples of Scenarios

- One way is to represent the CPU as a **cashier** at a cash register in a **store**, and a process as a person purchasing groceries. The operating system is the store manager orchestrating most of the comings and goings. Customers line up at the cashier as a ready queue. Whenever a request for a price check or a special item is made, the cashier has to stop entering data (interrupt) and the purchaser needs to wait for a search (or I/O) by a clerk or I/O routine. If it's at the deli counter, the customer may need to take a number and wait for the I/O device. Once the item or the price check is obtained the purchaser is back at the ready queue waiting for the cashier/CPU to process him/her again. If all items are finally entered by the cashier and the bill is paid, the customer/process may leave (is terminated) the store. Since room in the store is limited a long-term scheduler may be at the door letting in new customers as old customers leave.

- Another popular scenario chosen by my students is at a **restaurant.** Different parties of people are in line to be seated. The host/ess, or the operating systems long-term scheduler, sits each down, as tables of different sizes become available. Once seated (in the ready queue) the patrons are waiting to be served by the waiter or waitress (the CPU). The CPU will take their order (execute) after first offering the menu, water, and drinks being interrupted throughout. The waiter or waitress can serve only one table at a time. Other tables are then waiting for the CPU/waiter (ready queue) or waiting for I/O (food, drinks). Once a party finishes eating, the host/ess (terminator part of the operating systems) takes their money and greets them farewell (termination). It seems to be faster to have smaller parties with smaller demand for food (I/o-bound jobs versus CPU-bound jobs).

- A **traffic** situation is fairly common: A cop is placed in a busy intersection (maybe a six-way). Big trucks may be compared to CPU-bound jobs, and sport cars likened to I/O-bound jobs. The cop has to alternate between them so the traffic will flow smoothly. Red lights mean the time slice is over.

- Another scenario is of a **tutor** (CPU) who can only tutor one student at a time. Since s/he is very efficient s/he gives her students exercises (I/O) so that s/he can take care of the next student, and keep the room full of students at various stages of progress.

- The tutor example leads to a very convenient example for Round Robin scheduling: A **professor's office hour** where each student gets attention for only two minutes of a time quantum before the student needs to go back to the end of the waiting line outside the office. A difficulty with RR that my students encountered was that from a table given on paper, as in table 1; they could not place the end of the line easily:
  (See Table 1 in the appendix).

See also the corresponding Gantt chart in Table 2:

Very commonly however, before role-playing was ever introduced, my students produced an erroneous Gantt chart as in Table 3:
A more elaborate arrival-time table, such as in table 4, can help lead to the correct solution. However role-playing was found to be the most convincing.

More examples: I keep being surprised by innovative scenarios suggested by my students. One such scenario is situated in the **chemistry lab** where the Bunsen burner is the CPU and the test tubes with water in them are the processes. Most other examples bring up normal life situations that we encounter daily where the management and the scheduling of activities are involved. Examples abound and range from the lawyer's office, bank teller, mother's day, to the US immigration office and the car-repair garage.

Multiple-queues algorithms can be nicely demonstrated by an airline check-in counter where first-class customers get privileged service while their counterparts stand in another line.

Deadlock prevention and avoidance can also be easily demonstrated through examples of children fighting over toys, gridlock in traffic, and more.

3. TEXTBOOK WRITING

At ISECON '98, we learned that students in a systems analysis course wrote a successful textbook. As of the writing of this paper, the same idea is used in my current operating systems class. I adopted this ingenious idea, as I've been dissatisfied with our current textbook, which is the best available so far.

Northeastern Illinois University is known nationally as the most ethnically diverse campus in the US. Many of my students are new immigrants whose mastery of the English language is very poor. Students self chose the chapters they wanted to cover and divided into teams accordingly all in making sure one amongst them has a good control of the English language. Six students (out of a total of 37) volunteered to be on the editorial staff. They will review the written chapters.

4. CLASS PRESENTATIONS

One final chapter of the textbook is dedicated to the diverse operating systems currently or previously available on the market. Operating systems teams have worked since the beginning of the semester on a class presentation about particular operating systems and for the final chapter. In the past these class presentations have been the most applauded by the students judging by their anonymous evaluations. Students have enjoyed seeing their peers present and learn about all the operating systems they constantly keep hearing about in the media. An extra motivator for good attendance at these presentations is the requirement to turn in summaries.

5. FUTURE TEACHING

I agree with Paulo Freire describing the current learning situation:

> *"Education thus becomes an act of depositing, in which the students are the depositories and the teacher is the depositor. Instead of communicating, the teacher issues communiqués and makes deposits which the students patiently receive, memorize, and repeat." (Freire, 1993)*

I would like to believe that this is not the situation of my class. In this course I attempted to involve the students physically as well as academically. These students will retain more from this course than their predecessors just for this reason. Although students evaluate the course at the end of the semester only, their enthusiasm is shown more than in a traditional class and provides me with encouragement. In the future I will have the students prepare scenarios in small teams to be presented to the entire class and possibly involving more people from the audience in order to convey their idea. It's by working together that learning can take shape and become a reality.

6. CONCLUSION

Active participation by students in learning has always been a primary motivation for me. Role-play happened to be a natural way for me to visualize what was going on in the memory of the computer. In the past I have given examples to the students which helped some, but only when I made the students act the examples up that I noticed real learning happen on a larger scale. I would like to hear from other educators who have tried this strategy, and see if we together can improve teaching and learning of operating systems.

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8. APPENDICES

Table 1

Process	**Arrival Time**	**Burst Time**
A	0	5
B	1	4
C	3	3

Table 2

Remain time	3	2	1	1	0	0	0
Gantt	A	B	A	C	B	A	C
Time limits	0---2	2---4	4---6	6---8	8---10	10---11	11---12

Table 3

Remain time	3	2	1	1	0	0	0
Gantt	A	B	C	A	B	C	A
Time limits	0---2	2----4	4----6	6----8	8----10	10---11	11---12

Table 4

Process	**Arrival-time**	**Remaining Burst time**
A	0	5
B	1	4
A	2	3
C	3	3
B	4	2
A	6	1
C	8	1

Panel:
Using Software Alliances and University Programs to Enhance the IS Curriculum

Moderator and Panelist
Albert L. Harris, Appalachian State University

Panelists:
Mark Hensel, University of Texas at Arlington
Jack Russell, Tarleton State University
Brock Ballard, Sterling Software
Other Panelist from universities and vendors to be named

Anticipated software alliances and University Programs to be discussed:

- Sterling Software's University Program – COOL:Products
- Oracle's University Program – Oracle Products
- SAP Alliance – SAP ERP System
- IBM
- Microsoft

Abstract

This panel session will focus on the use of software alliances and university programs to provided needed software to enhance the IS curriculums at colleges and universities. Panelists will include faculty members from universities using software alliances and university programs and vendor representatives. University representatives will discuss the impact and value of these programs to their universities. Vendors will discuss their programs and the use of their software by universities.

Panel Overview

Several large software companies have created software alliances or university programs that allow colleges and universities to enhance the IS curriculum by providing their software at a drastically reduced cost. Without these alliances or university programs, most colleges and universities would not have the money to acquire the software for use in their classes. These programs create excellent opportunities for colleges and universities to teach the latest in commercial software that is used in companies hiring college graduates.

There are three major problems associated with using software in the academic environment. The first is the initial cost of the software, which is usually beyond the reach of most colleges and universities. The large number of copies of the software that is needed for classes adds to the cost problem. The instructor(s) need a copy and, in come cases, every student needs a copy at his/her work station, therefore, 30 or 40 copies of the software may be needed. If colleges and universities are charged on a per copy basis, the licensing costs could get very high. As a result, commercial cost of the software for the number of copies needed can run from several thousand dollars to many millions of dollars. A second problem is training. Most large software products require that a professor attend one or more training sessions on the product. Part of the alliance or university program with most software vendors is reduced training fees or costs. In some cases, tuition at company run training seminars is free, while others drastically reduce fees to enhance use of their products. A third major problem is technical support. As with the training, part of the alliance or university program with most software vendors is free or reduced cost technical support. Several academic list serves have grown from the need for technical support for these products.

What does a college of university get from these programs? How much does it really cost to join a software company's alliance or university program? How is training and technical support handled in these programs? How can these programs enhance the IS curriculum? These are just some of the questions that will be explored at this panel discussion session.

Intended Audience

Educators who are interested in learning more about any of the products supplied by the vendors represented. Educators that want to know how the software alliances or university programs work in other universities.

Panel Goals

Panel members will describe the programs from their respective perspectives. Questions and participation of the audience will be encourages. At the conclusion of the panel session, participants should have information about the programs and be able to pursue the programs for their universities.

Panel: The Future of IS Education: Roundtable Discussion

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Abstract

This panel session deals with the future of IS education. Ten years ago, I chaired the panel at ISECON looking at this same topic. At that time, the panel suggested that future might include features, such as the following:

- Dorm rooms with Internet access
- special computerized instructional settings (both lecture and hands-on classrooms),
- movable computerized display projectors,
- special purpose public computer laboratories,
- an integrated network to all of the campus computers,
- computer access points in faculty offices and elsewhere,
- computerized student records and enrollment

These visions of the future have come to pass and now sound obvious. The panel in this roundtable will look at a fresh set of influences on IS education and explain how they expect future IS education to be different than it is now.

Here are some of the factors that will bring about these changes:

- Influences of globalization, in jobs, culture, and education,
- The new competition for university education
- The new competition for IS students and topics on campus
- The widespread availability of high tech tools
- The rapid change and proliferation of topics

Keywords: IS Education, Future, Change, Globalization, Competition, Students, Faculty

Roundtable Overview

This workshop (panel) will cover or address the following topics:

1. What is the current state of IS Education?
2. Who are our colleagues?
3. Where do we think IS education is going?

Intended Audience

- Educators who are interested in continuing to have a job.
- Industry trainings who want students to possess skills needed to succeed in industry.

Roundtable Goals

The facilitator will help the attendees to explore their various views.

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Teaching Soft Computing Methods: Problems, Issues and Practical Experiences

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Abstract

Soft Computing is a relatively young discipline and, as a consequence, there is no clear consensus yet within the academic community as to its scope and its relationship to other related disciplines. It is seen by some, for instance, as merely a sub-discipline of Artificial Intelligence (AI) while others see it as a complementary discipline to AI. The relationship between soft computing and other related areas such as computational intelligence also remains an issue without broad consensus. There is a need, therefore, for debate concerning the nature and purpose of soft computing, the definition of its basic terms and core concepts, and its place within the curricula of computing courses. Although the need for soft computing education has been recognised, there has been very little discussion of curriculum structures, course content and subject syllabi for the teaching of soft computing. This paper discusses problems and issues in the teaching of soft computing, and offers some guidelines for curriculum and course content. The paper draws from the discussion at a panel session conducted by one of the authors at ICONIP'97 (the 4th International Conference on Neural Information Processing, Otago, New Zealand, November 1997), from the authors' practical experiences in teaching soft computing, and from the soft computing and AI education literature.

Keywords: Soft computing, fuzzy logic, connectionism, computational intelligence

1. INTRODUCTION

Soft Computing is a new and emerging discipline that attempts to address the need for computational methods that can capture the inherent uncertainties in real life problems (Vemuri 1993). The term soft computing was proposed by Lotfi Zadeh, the originator of fuzzy logic (see Zadeh 1994 a). Soft computing represents a shift from traditional "hard" or "crisp" thinking about computing towards a "soft" approach. According to Zadeh, the precision and certainty required by traditional computing approaches carry costs, and in order to avoid these, computing should exploit tolerance of imprecision, uncertainty, and partial truth. At the core of soft computing are fuzzy logic, neural networks and probabilistic reasoning, with the latter including genetic algorithms, belief networks, and chaotic systems (Zadeh 1994a).

As an emerging discipline, however, soft computing is subject to the problems associated with a field that is still developing and maturing. There is a lack of consensus within the academic community concerning its scope and status as a discipline and its relationship to other related disciplines and areas. Some researchers see it as merely a sub-discipline of Artificial Intelligence (AI), while others see it as a complementary discipline to AI. Its relationship to other related areas such as computational intelligence also remains an issue without broad consensus. Although the need for soft computing education has been recognised (Jagielski 1994) and it has been taught in a number of computer science and information systems courses at both undergraduate and postgraduate levels, there has been very little discussion of curriculum structures, course content and subject syllabi for the teaching of soft computing. This is no doubt due to the relatively recent emergence of the discipline. However, it is essential that a general consensus concerning the nature of soft computing and its place in computing education is developed and that the nature of appropriate curricula and course content for its teaching is established. The purpose of this paper is to contribute to the debate concerning both of these issues and to offer some guidelines for soft computing curriculum and course content.

The initial motivation for the paper was provided by a panel session entitled "Challenges in the Teaching of Connectionism and Other Soft Computing Methods" which was organised by the first author and held at ICONIP97 (the 4th International Conference on Neural Information Processing run jointly with ANZIIS/ANNES97, Otago, New Zealand, November 1997). The panel session was intended as a forum for sharing and discussing practical experiences in the design of curricula and the use of teaching methods in soft computing courses. The number of attendees at the session and the lively discussion clearly indicated that there is much interest within the general AI and neural network search communities in issues concerning the teaching of soft computing. This paper is based on the discussion at the panel session. It focuses on the nature of appropriate soft computing course structures and subject syllabi and draws from the discussion at the panel session, from the authors' practical experiences, and from the soft computing and AI education literature in particular.

The paper first discusses soft computing, including the various views of its fundamental nature and core concepts, how it fits into the broader field of computing, and its relationship to other related areas. The third section of the paper presents a discussion of the design of the curricula, course structures, and subject syllabi at the various universities of the panel members as well as the key issues raised during the discussion at the panel session. The fourth section identifies some guidelines for soft computing course content and curricula based on the issues which emerged at the panel session, on the authors' own experiences in teaching soft computing, and on the relevant education literature. The paper concludes with a summary of issues requiring further discussion in order to help develop course design and teaching within the area.

2. SOFT COMPUTING EDUCATION: DEFINING THE DISCIPLINE

Although soft computing has gained acceptance within the academic community as a valid area for research, it does not yet have the status of fields such as artificial intelligence or software engineering. At many Australian universities academic research in neural computing and other soft computing methods represents the work of individuals working independently rather than the concerted efforts of formal research groups. Similarly, the teaching of subjects in soft computing methods has tended to be initiated by interested individuals. The subjects are either included as one part of an artificial intelligence course or else are stand alone subjects often only loosely related to the overall course structure.

Soft computing and soft computing education are subject to the problems that are usually associated with a new area that is developing and maturing. First, there is no clear consensus within the academic community concerning the exact meaning of the term soft computing and the core concepts it encompasses. Second, the relationship between soft computing and other related disciplines such as AI and computational intelligence remains an issue without broad consensus. There are differing perceptions of how connectionism and other soft computing methods fit into the broader field of computing. Third, there is a lack of commonly accepted curricula and course structures for the teaching of soft computing methods. Some academics, for example, believe that it is premature to form independent subjects or courses within computer science studies that focus on neural networks, and that neural networks should form just one part of an AI curriculum (for example, see Wu 1994). Others advocate the creation of independent undergraduate courses in soft computing comprising neural networks, fuzzy logic, and evolutionary computing (see for example Jagielski 1994). There is clearly a need, therefore, for debate on the scope of the soft computing area, the precise meaning of its basic terms, the nature and components of curricula and courses within the area, and appropriate methods of teaching soft computing. The debate should include a review of perceptions regarding soft computing as a discipline, the sharing of course design and teaching experiences, and the communication and discussion of various points of view. In this section, the core methods of soft computing (fuzzy logic, neural networks, and evolutionary computing) are described and the nature of soft computing, its status as a discipline, and its relationship to computational intelligence in particular are discussed.

The Origins of Soft Computing

Lotfi Zadeh, the originator of fuzzy logic, first proposed the term soft computing to describe an approach to computing which exploits tolerance of imprecision, uncertainty, and partial truth, and which provides a better response to the vague, uncertain, fuzzy and often non-deterministic world in which we live than that offered by traditional computing approaches with their demand for precision and certainty (Zadeh 1994a). According to Zadeh the popularity of traditional AI approaches has been declining while neural networks and fuzzy logic have been attracting considerable attention. This trend, he believes, is a reflection of the ineffectiveness of the purely symbolic methods of AI in dealing with complex real world problems (Zadeh 1992). Traditional computing systems use conventional two-valued logic with the values either "completely true" or "completely false". Problems such as robotics, computer vision, speech recognition, and commonsense reasoning are too complex and too imprecise for solutions using traditional methods based on symbol manipulation and binary logic. Intelligent systems, like human decision makers, should be able to reason and make decisions even when the available information is imprecise and incomplete. Zadeh describes the essence of soft computing as follows: "The guiding principle of soft computing is: exploit the tolerance for imprecision, uncertainty and partial truth to achieve tractability, robustness, and low solution cost" (Zadeh 1994b). Low cost is a result of a solution which is precise enough but no more than is necessary. Soft computing generally consists of fuzzy logic, artificial neural networks, and evolutionary computing. These are described below.

Soft Computing Methods: Fuzzy Logic, Neural Networks, and Evolutionary Computing

Fuzzy logic is an extension of two-valued logic in which truth is a matter of degree, so that truth values between "completely true" and "completely false" are possible. It provides a means of representing and inferring from knowledge that is uncertain, incomplete and unreliable, and it corresponds well to our intuition since we live in an analog world, not a digital one. An important area of fuzzy logic application is fuzzy systems. Fuzzy systems can represent vague and imprecise knowledge through the use of fuzzy if-then rules and fuzzy variables. Fuzzy systems based on fuzzy logic have been applied to a broad range of problems including fuzzy control, and fuzzy rule based systems (Pedrycz 1998) and decision making (Cox 1994). In the field of decision support, fuzzy logic is particularly suitable because decision-making often requires the use of information that is incomplete and contradictory and where the parameters are estimated values.

Connectionism or neural computing is a computational paradigm roughly modelled after the massively parallel structure of the human brain. Neural networks are numerical model-free estimators (Kosko 1992). They estimate mapping functions that map inputs to outputs from sample data by the process of adapting the weights of their connections. Neural networks are trained rather than programmed, and are renowned for their ability to "learn and generalise" from noisy and incomplete information. They have been successfully applied to pattern recognition, robotics, process control (see, for example, Proceedings of IIZUKA'96). In the area of decision support neural networks have been applied, for example, to bankruptcy prediction, financial modelling (Beltratti et al. 1996), and credit card risk assessment (Jagielska and Jaworski 1996). They are particularly useful in the context of decision making where decisions are made on the basis of a large amount of historical data. Human decision makers have difficulties integrating such data, and their decisions are susceptible to a number of biases.

Evolutionary computing is a powerful method of computation inspired by the processes of biological evolution. It includes genetic algorithms (GA), genetic programming, and evolutionary strategies (Holland 1975; Koza 1992; Pedrycz 1998). It relies on developing systems that demonstrate self-organization and learning in a similar, though simplified, manner to the way in which biological systems adapt. Genetic algorithms essentially optimise complex problems by generating populations of solutions that can compete. They can be applied to a very broad spectrum of problems including distribution, scheduling, project management, investment analysis, and stock market forecasting.

Although conceptually different, these methods share similar, inexact, approximate reasoning approaches in attempting to solve vague, uncertain, stochastic and fuzzy problems. Tolerance for imprecision and uncertainty is characteristic of intelligent systems. Our ability as humans to make rational decisions in an environment of uncertainty and imprecision derives from this, as do our abilities to understand speech, recognise images, decipher hand writing, and drive a vehicle. Fuzzy logic, neural networks, genetic algorithms techniques are complementary rather than competitive methods. They can be combined in various ways in order to increase the capabilities and effectiveness of computer systems. Through hybridisation of these techniques, more complex problems can be addressed. For example, neural networks and genetic algorithms have been combined with fuzzy logic and applied to knowledge acquisition for classification problems (Jagielska et al. 1999). For more examples of hybrid systems see Aminzadeh and Jamshidi (1994) and Pedrycz (1998). These hybrid systems can have advantages over soft computing methods applied separately because each method can complement the shortcomings of the others.

Soft Computing and Computational Intelligence: Related Disciplines

Although the terms soft computing and computational intelligence are in widespread use today, there are no commonly accepted definitions of these terms and there is no general agreement within the academic community as to which term should be used to describe the computational methods that use inexact, approximate reasoning approaches in attempting to resolve complex problems. The term soft computing is controversial because the word "soft" is often taken to mean "easy". Like soft computing, though, the term computational intelligence is relatively recent. It was first used by Bezdek (1992). Eberhart (1995) defines computational intelligence as a "methodology involving computing (whether with a computer or wetware) that exhibits an ability to learn and/or to deal with new situations such that the system is perceived to posses one or more attributes of reason, such as generalisation, discovery, association and abstraction". Computational intelligence systems generally consist of hybrids of methods such as neural networks, fuzzy systems, and evolutionary computing.

As can be seen from the discussion of soft computing and computational intelligence, their main constituent technologies are the same. However, the emphasis of each is slightly different. Soft computing focuses on the uncertainty and imprecision which is inherent in complex real life problems. The main aim of soft computing is to build systems that can tolerate and deal with imprecision, uncertainty, and incomplete information. Computational intelligence, on the other hand, emphasises the intelligence aspect of this area of computing. It is concerned with building systems that exhibit intelligent behaviour in the form of learning, reasoning, generalisation and discovery (Eberhart 1995).

3. TEACHING SOFT COMPUTING: EXPERIENCES IN THE DESIGN OF COURSES, CURRICULA AND TEACHING METHODS

This section reports on the panel session entitled "Challenges in the Teaching of Connectionism and Other Soft Computing Methods" which was organised by the first author and held at ICONIP'97. The panel session was intended as a forum for the identification and discussion of issues and problems in the teaching of soft computing, for sharing practical experiences in the design of curricula and the use of teaching methods in soft computing courses, and as a means of stimulating further debate and development of teaching within the area. The panel members were six leading soft computing academics and researchers from universities in Japan, Finland, the USA, New Zealand, and Australia[24], representing departments that are actively involved in soft computing research and at the forefront of soft computing teaching. A large audience of interested conference participants attended the session and contributed to the discussion. The panel session focused on three topics in particular:

- Perceptions concerning the nature and scope of soft computing as a discipline.
- How soft computing fits into the broader field of computing and other related disciplines which are taught in computer science and information systems courses.
- Experiences in the design of curriculum and teaching methods for soft computing courses.

During the panel session the panel members described and discussed the soft computing and related subjects offered by their departments and the views of their departments concerning the place of soft computing in their undergraduate and postgraduate programs. Four of the panel members provided detailed information about their departments' soft computing teaching. A summary of the soft computing offerings of these departments is presented below, including an outline of the subjects available, the levels (undergraduate/ postgraduate) and courses in which they are offered, and the department's view of how soft computing fits into their teaching programs. The key problems, issues and points of agreement concerning the teaching of soft computing which emerged during the discussion at the panel session are identified and discussed in section four of this paper.

24 The panel members were Professor Vladimir Cherkassky (University of Minnesota, USA), Professor Masumi Ishikawa (Department of Control Engineering and Science, Kyushu Institute of Technology, Japan), Dr Rom Jagielski (Department of Computer Science, Swinburne University of Technology, Australia), Professor Erkki Oja (Department of Computer Science, Helsinki University of Technology, Finland), Professor Nikola Kasabov (University of Otago, New Zealand).

Department of Control Engineering and Science, Faculty of Computer Science and Systems Engineering, Kyushu Institute of Technology (KIT), Japan

The Department of Control Engineering and Science at KIT offers a very extensive range of soft computing subjects in both its undergraduate and postgraduate courses. The department also stresses the importance of traditional computational approaches and provides a number of subjects covering symbolic artificial intelligence methods. The department adopts the view that symbolic and connectionist approaches have complementary characteristics, and that students should be exposed to both information processing paradigms in order to have an understanding of the strengths of each and how they relate to each other.

Undergraduate course subjects

Subjects available to undergraduate students include:

- Neural Networks,
- Fuzzy Systems,
- Neural information systems I,
- Neural information systems II.

The department believes that the purpose of teaching soft computing in the undergraduate courses at KIT is to provide an overview of new and alternative approaches to information processing. The subjects introduce students to the basic concepts of artificial neural networks, biological neural networks, and fuzzy systems.

Postgraduate course subjects

A large number of subjects is available to postgraduate students. These include:

- Information theory of neural networks,
- Theoretical approaches to nonlinear systems,
- Advanced neural networks,
- Fuzzy information processing,
- Advanced neural information processing,
- Advanced biological information devices,
- Advanced intelligent sensing systems,
- Information processing in sensory systems.

The objective of the department's postgraduate subject offerings is to enable students at this level to study the mathematical fundamentals and the more advanced features of soft computing methods. The subject curricula concentrate on theoretical foundations of artificial neural networks, biological neural networks, fuzzy systems, chaos systems, genetic algorithms, and on the hardware implementation of these computing methods.

Department of Computer Science and Engineering, Helsinki University of Technology (HUT), Finland

The Department of Computer Science and Engineering at HUT is the major computer science department in Finland. The core computing curricula in the department are in the areas of software engineering and software specification methods, database systems, data structures, programming languages, and telecommunications. Due to the need to include in its undergraduate teaching what it believes are the essential subjects in computer science (programming languages, data communications and software engineering) the department believes that at present there is no room in its undergraduate courses for a mandatory soft computing program. Soft computing methods are currently only a part of other computation and AI courses at the undergraduate level.

Undergraduate course subjects

No separate soft computing subjects were offered by the department at the undergraduate level.

Postgraduate course subjects

At the postgraduate level the department offers students one specialisation stream called "Learning and Intelligent Systems" which includes soft computing methods. The purpose is to ensure that postgraduate students have the opportunity to study the area if they wish. This specialisation includes the following subjects and topic areas:

- Neural networks, with applications in pattern recognition, function approximation and/or control,
- Fuzzy systems, especially control systems,
- Genetic algorithms,
- Probabilistic methods, including Bayesian decision graphs,
- Symbolic logic, knowledge based systems.

The department also has a number of students from areas such as electrical engineering, automation, and physics who are keen to undertake this specialisation stream.

School of Information Technology, Swinburne University of Technology, Australia

The School of Information Technology at Swinburne University has recognised the importance of including soft computing in its teaching. It first introduced a complete subject covering soft computing in 1995 in its undergraduate program. The subject is offered to software engineering students in the third year of their computing studies.

Undergraduate course subjects

A third year undergraduate subject, Soft Computing, is offered to software engineering students. The objective of the subject is to introduce students to a set of computational methods, including fuzzy logic, neural networks, and genetic algorithms, which can provide techniques for solving complex problems. The subject may be considered an extension of the subject Introduction to Artificial Intelligence which they should have already undertaken. The subject syllabus includes:

- Methods of inference, deductive logic, induction, approximate reasoning, symbolic and sub-symbolic processing,
- Neurocomputing: parallel processing in networks, perceptron, multi-layer networks (back-propagation), the associative memory problem (the Hopfield model), unsupervised competitive learning, other neural network architectures.
- Evolutionary computation: foundations of evolutionary computation, genetic algorithms, genetic programming, applications of evolutionary computing,
- Fuzzy systems: fuzzy sets, fuzzy logic, basics of fuzzy systems, fuzzy systems applications,
- Hybrid systems.

Postgraduate course subjects

No separate soft computing subjects were offered by the department at the postgraduate level.

Department of Information Systems, Faculty of Computing and Information Technology, Monash University, Australia

The teaching programs of the Department of Information Systems (now the School of Information Management and Systems) at Monash University focus on the organization, management, and use of information and information technology, in particular the design and delivery of information systems. The department is one of the largest information systems departments in Australia. It has offered elective subjects in neural networks and soft computing methods at both the undergraduate and postgraduate levels for a number of years. These subjects can be taken by both its own information systems students and students undertaking studies in computer science and software engineering. Three subjects in the area of soft computing (one undergraduate and two postgraduate) were offered by the department. All of the subjects offered by the department strongly emphasise the applied aspects of soft computing and computational intelligence, as its focus as an information systems department is on organizations and the design and management of their information systems. This differs from the focus of computer science departments, which is on algorithms and systems software.

Undergraduate course subjects

One subject, Neural Computing, was offered to all computing students in the Faculty of Computing and Information Technology as a third year elective although it was mainly targeted at computer science students. The Faculty's computer science major includes a core subject on artificial intelligence. The focus of this subject is symbolic AI. The objectives of the subject Neural Computing are to introduce students to the major neural network types and their applications in business and industry, to enable students to understand the tasks and techniques involved in the development of neural network applications, and to acquire the skills necessary to develop neural network applications. The subject syllabus includes:

- The history, architecture, and biological motivations of neural computing.
- Learning in neural networks: supervised and unsupervised learning, the perceptron and its limitations, the multilayer perceptron, backpropagation, Kohonen self-organising map, counterpropagation, Hopfield network, bidirectional associative memories (BAM) network.
- Fuzzy logic, neuro-fuzzy systems.
- Neural network implementations and applications of neural networks: neural network expert systems, neural networks as decision support tools, engineering applications.
- Development of neural network applications using interactive environments, data preprocessing, building heuristic and techniques, training, testing, evaluating neural network performance.

This subject is seen as complementary to the core AI subject, exposing students to alternative approaches to computation.

Postgraduate course subjects

Two elective subjects covering soft computing approaches were offered to students in the department's Masters course. These were Intelligent Decision Aids, available to students in the first year of the course, and Applied Neural Networks, available to students in the second year of their course. The department believes that it is important to give its students at the postgraduate level the opportunity to study the latest approaches and technologies that are being applied within the context of information systems in organizations. Soft computing was seen to have many applications to business information systems and decision support systems.

Intelligent Decision Aids

This subject addresses the application of soft computing to intelligent decision support. The objective of the subject is to introduce students to cutting edge decision support technologies such as neural networks, fuzzy logic, and genetic algorithms. The subject includes the basic theory and applications of these computation methods and gives students the opportunity to acquire skills in building decision support aids using neural networks. The syllabus includes:

- key features of intelligent systems, uncertain knowledge and reasoning,
- fuzzy logic, decision making in fuzzy environments, building applications using fuzzy software,
- neural networks, applications to decision support, developing applications using neural network simulators,
- genetic algorithms, application of genetic algorithms to optimisation problems, and
- hybrid systems: combining neural networks fuzzy logic and genetic algorithms for better performance.

The students acquire practical skills and enhance their understanding of the application of soft computing methods by developing prototype applications using packaged software incorporating some of these techniques.

Applied Neural Networks

The objective of this subject is to enable students who have already completed some studies in soft computing methods to investigate in considerable depth various neural network paradigms and their application to real world problems. The subject takes the form of lectures and research seminars which are presented by the students. Seminar topics are selected from advanced areas of neural network research and applications. The focus of the subject is on applications of neural networks to problems in business and industry, including economic forecasting, financial risk analysis, marketing, and manufacturing. Expert systems and data mining are discussed. Students enhance their understanding of the area and acquire practical skills by developing real life neural network applications using commercial neural network software packages. The applications are generally in the area of business or finance.

4. GUIDELINES FOR THE TEACHING OF SOFT COMPUTING METHODS

Soft computing is a new and emerging discipline that has been recognised as one of the key technologies in the development of effective, efficient and flexible computer systems with more human-like and adaptive user interfaces and decision support facilities. The status of soft computing within the academic community as a valid area for research and the increasing and considerable attention its methods have received have led to the establishment of courses and subjects in soft computing at a number of universities. However, there has been very little discussion of appropriate curriculum structures, course content and subject syllabi for the teaching of soft computing. The panel session held at ICONIP97 provided a rare opportunity for members of the academic community undertaking research and teaching within the area to debate these issues.

There was general agreement at the panel discussion on the need to include soft computing/ computational intelligence in the curricula of computing education courses so that students are aware of and have some understanding of soft computing methods as well as traditional approaches to computation and artificial intelligence problems. All students majoring in information technology studies should have a basic knowledge of the principles of computational intelligence and the operations of systems that use computational intelligence methods (Wu 1994; Jagielski 1994). This can be achieved by including material covering this basic knowledge within introductory courses on computing.

The importance of the complementary relationship between soft computing and symbolic AI was stressed by many participants. It is strongly recommended that the curricula of soft computing courses should be designed in conjunction with those of symbolic artificial intelligence courses to help ensure that students are able to understand and fully appreciate the relationship between the two areas, their complementarity, and the strengths and weaknesses of each area. It is essential to teach traditional AI, including such important areas as search and search techniques, machine learning, knowledge representation, natural language processing, and expert systems (Wu 1994). Soft computing is complementary to traditional artificial intelligence: its essence is qualitative, approximate reasoning, and inexact and approximate computing (Jagielski 1994).

There was a general consensus concerning the advantages of combining both types of approaches in order to achieve more flexible and effective information processing. The benefits identified in recent research of integrating connectionist approaches, which are flexible but lack the ability to represent structural knowledge directly, with symbolic AI techniques were commented on by a number of panel members and other participants. Neural networks have the capability of learning from noisy data, however they lack the explanatory capabilities of traditional AI methods. Recent studies investigating the integration of soft computing and symbolic AI approaches have been motivated by the complementary characteristics of their methods. More powerful computational systems should be possible, incorporating the advantages of both types of information processing. This integration sounds reasonable from the viewpoint of cognitive science, because humans seem to use both types of information processing. Students need to understand both approaches if they are to appreciate the latest developments and cutting edge technologies in this area.

The design of courses and curricula in soft computing must also take into account the nature of their intended audience in terms of both the academic level of the students (undergraduate or postgraduate) and the orientation of the particular courses (computer science or information systems). The objectives and learning outcomes relating to the teaching of soft computing were generally seen to be different at the undergraduate level, where the focus should be on understanding only the basic principles and operations of computational intelligence methods, from those at the postgraduate level, where more indepth knowledge and understanding of the mathematical foundations of the methods are appropriate. It was generally agreed at the panel session at ICONIP97 that, regardless of the orientation of the course, undergraduate courses should include only minimal coverage of the mathematical foundations of the various soft computing methods. For example, syllabi of undergraduate neural network subjects should only include as much theory as is necessary for students to understand the basic operations of the networks. At the postgraduate level, however, soft computing education should provide students undertaking computer science, electrical engineering and similar technically-oriented courses with an indepth understanding of the theoretical foundations of the various soft computing paradigms and the opportunity to use and develop more complex and advanced applications of the technologies. The importance of getting students at all levels to actually use the technologies to develop practical applications as a means of enhancing their understanding of the core concepts should also be stressed.

Although information systems courses have a different orientation from that of computer science courses, information systems students should have the opportunity to study soft computing because of its many applications within the areas of decision support and expert systems and to many problems in business and finance. Information systems encompasses the acquisition, deployment and management of information technology resources and services, and the development of infrastructure and systems for information use (Couger et al. 1995). Information systems students need to understand computer and information technologies and their use within organizations. The authors' experience in teaching soft computing subjects to information systems students has been that they are keen to have exposure to some of the latest approaches and leading edge technologies that are being applied in information systems within organizations. The focus of soft computing education within information systems courses should be on the practical applications of the technologies to problems in business and industry and in the areas of decision support and expert systems. Generally, information systems students require knowledge of only the basic theory and foundations of soft computing methods.

5. CONCLUSION

Soft computing is a new and emerging discipline which does not yet have the status of fields such as artificial intelligence or software engineering. It is subject to the problems usually associated with an area that is still developing and maturing. Although the need for soft computing education has been recognised, there has been very little discussion of appropriate curricula, course structures and subject syllabi for the teaching of soft computing. This paper has contributed to the debate concerning the role of soft computing education in computing courses. The paper first discussed the fundamental nature and core methods of soft computing and its relationship to other areas within the field of computing. The next section of the paper presented a discussion of the design of the curricula, course structures, and subject syllabi at the various universities of the panel members at the panel session at ICONPI97 on teaching soft computing methods. The key problems, issues and points of agreement concerning the teaching of soft computing raised during the discussion at the panel session were identified and summarised. A number of recommendations for the teaching of soft computing in computer courses were proposed drawn from the discussion at the panel session at ICONPI97, from the authors' practical experiences in teaching soft computing methods, and from the soft computing and AI education literature in particular.

Further debate and review of soft computing courses and sharing of experiences in teaching soft computing is necessary to promote continued development of teaching in the area. Curriculum models for soft computing education need to be developed in order to further clarify its role in computing education in general and in terms of specific levels and orientations of courses. This will assist in identifying the scope, nature and level of the knowledge and skills that the various courses should provide. The nature and objectives of practical work for soft computing courses, and the appropriate teaching methods, are areas requiring further attention.

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Managing Telecommunications: The Marketing Managers' Viewpoint

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Abstract

This article reports the results of a survey of marketing managers in order to obtain information from an end user about the management structure of the telecommunications function and its importance and role in the organization. While the information systems (IS) manager was the most common form of management of the telecommunication function, the organizations with a separate and distinct telecommunications manager reported a more formalized telecommunications planning and implementation process. These organizations also indicated strong agreement with the importance of telecommunications to the organization. Marketing managers from organizations with an advisory steering committee were not as aware of the importance of various telecommunications applications and issues as the respondents from other organizations. More favorable responses were received from organizations when the steering committee had the authority to create and implement policy.

Keywords: Telecommunications, management structure, marketing managers, planning

1. INTRODUCTION

Telecommunication technology is revolutionizing the manner in which business is conducted. Organizations are feeling the urgency to adopt innovative ideas in order to gain a competitive advantage. No business function is feeling this impact more than the marketing area. Unprecedented technological change is revolutionizing the marketing profession (Sheridan, 1996).

With the proliferation of fiber optics and user friendly software, more emphasis is being placed on obtaining a competitive edge by developing a tight bond to customers and suppliers. Through technological and marketing innovations, such as the universal product code (UPC), additional information about customers and buying behavior can be efficiently collected, which ultimately will assist the organization in meeting the customer needs (Amaravadi, et.al., 1995; McKenna, 1991),

Organizations are looking to interactive marketing to strengthen customer loyalty and satisfaction. BMW is utilizing interactive kiosks to improve communication between the organization and its customers. The U. S. Postal Service is experimenting with a "virtual post office", which will allow consumers to buy stamps and supplies through their television sets. Their mail carriers would deliver the supplies the next day with their regular mail. Lipton is testing supermarket kiosks to help shoppers plan dinner by suggesting recipes featuring Lipton products (Davids, 1994).

The internet is a means of increasing the customer base and improving customer service. First Union National Bank in Charlotte, N. C. is migrating from mass mailings for potential credit card customers, to the internet. Within one year of development, more applications for credit cards were received on the web than with a typical branch bank (Lord, 1995).

The remainder of this paper reports the results of a nationwide survey of marketing managers about their perceptions and use of telecommunications. A literature review of telecommunications managerial issues is included in the next section. The methodology, including questionnaire construction and sampling design, is discussed in the third section. The results of the survey, subdivided by objective, are presented in the fourth section. In the final section of the paper is a discussion of the results.

2. LITERATURE REVIEW

Organizations are rapidly implementing new telecommunications technology and applications. In a survey of 400 senior information technology and telecommunications managers reported by Kennedy (1998), 22% of the respondents were utilizing electronic commerce. An additional 32% indicated that they will add electronic commerce applications in 1998. Sixty-seven percent were hesitant to join the group due to security concerns. Lusa (1998) reported that 93 of 118 respondents are planning on expanding their Intranet into an Extranet.

Applications for the outside access include product inquiries, customer service, company news and order placement.

Grover, et.al (1998) reported that managing a rapidly changing resource like information technology requires applying methods from change management. IS functional expertise is not sufficient to manage all the rapidly changing technologies in the area. In the face of the rapid changes in technologies, IS investments must be prioritized using a holistic organizational perspective. Although these statements were made about prioritizing investments in information systems, they are without a doubt equally true and applicable to the even more rapidly changing telecommunications area.

Telecommunications is now embedded in the infrastructure of many organizations. It is increasingly being seen as a critical part of the organization. Most organizations make considerable investments in telecommunications resources. These resources must be judiciously spent by establishing effective management structure for allocating funds for the development and use of telecommunications technologies. It is important to consider how to best manage telecommunications.

Traditionally, telecommunications was managed within the information systems area. Although this is still a dominant management method for telecommunications, there are alternatives. One such alternative is managing telecommunications by steering committee. Another alternative would be to have distinct telecommunications managers.

Although steering committees are often used to form information technology strategies, there is little research to date on the use of steering committees to manage telecommunications. Adams, et. al. (1990) conducted an extensive literature review of MIS research and found that most of the telecommunications research focused on lower level management issues like installing a network and not on strategic telecommunications issues. One exception to this trend is a statistical analysis of the responses to a survey instrument by Kunnathur and Raghunathan (1993) which concluded that having a separate steering committee to manage telecommunication technology has a positive impact on various factors affecting telecommunications usage and management.

In contrast, much research has been done on the use of steering committees in managing the information systems area. A 1997 survey of 301 CIOs by *CIO* magazine and ICEX Inc. found that 64% used steering committees to review IT strategy (Pearson, 1998). In addition, there is much research which suggests that successful systems development projects usually report to steering committees headed by the executive who is most affected by the success or failure of the project (Ong, 1997). While there are similarities between MIS and telecommunications steering committees, there are very important differences in the focuses.

A 1992 study of 137 telecommunications managers found that 1) large firms are more likely to have telecommunications steering committees, 2) firms with telecommunications steering committees are more likely to have formalized planning practices for their telecommunications functions, and 3) firms with telecommunications steering committees are more likely to provide organizational support and recognition for the telecommunications function (Torkzadeh and Xia, 1992).

The exploratory study reported in this article was undertaken in order to gain insight into 1) the management structure of the telecommunications function, 2) the impact of the management structure on the perceptions of the marketing manager on the importance of telecommunications to the organization, 3) the impact of the management structure on the planning process, and 4) the impact of the management structure on the importance of 30 telecommunications issues as reported by an end user, the marketing manager.

3. METHODOLOGY

Questionnaire

A questionnaire was developed and pilot tested. It consisted of two parts. The first part requested information about the respondents and their organizations. Information about the respondent included his/her position and management level. Organizational information included the type of business, size of the organization in employees, the amount of assets and annual revenue, the number and types of computer systems, and the size of the capital budget for telecommunications and information systems.

Marketing managers were asked to indicate the management structure of the telecommunications. Four options were given. These were: 1) telecommunications manager, 2) information systems manager, 3) authoritarian steering committee, or 4) an advisory steering committee reporting to a CIO, functional manager or similar executive.

The respondents were also asked to indicate on a five-point Likert scale their degree of agreement or disagreement with the statements that 1) telecommunications were vital to their organization and 2) top management understands the importance of telecommunications. In addition, respondents were asked to indicate whether or not their organization had a telecommunications plan. For the organizations with such a plan, information about the percent of implementation of the plan was also sought.

In order to complete the final objective of the study, the marketing managers were asked to rate the importance of thirty different telecommunications issues. A five-point Likert scale, ranging from a value of "1" indicating not important to "5" indicating extremely important, was utilized.

Subjects

The Disclosure Database was used to obtain the sample. The Disclosure Database contains financial and management information on more than 12,000 public companies. Company data is extracted from annual and periodic reports filed with the U. S. Securities and Exchange Commission (SEC). The Disclosure Database includes records for companies that provide goods and services to the public. Approximately two thousand small organizations were sought for the sample. The researchers randomly selected several of the smaller organizations from the database only to discover that they were no longer in business or had moved and left no forwarding information. In order to minimize this problem, the researchers selected 1870 organizations with sales between 10 million and 40 million dollars. From this list, 43 were eliminated due to duplicate addresses, such as holding companies. Seventy-four questionnaires were returned as undeliverable; twenty-three responded with a letter indicating a policy of not completing surveys or an apology for lack of time to complete it. Of remaining 1753 surveys, 118 usable forms (6.7% rate of return) were received.

TABLE 1
Response Rate

Questionnaires Mailed	1827
Forms Returned	215
Usable	118
Unusable	97

There were several reasons for the low rate of return. First, the survey was mailed to "Marketing Director" as opposed to an individual by name. Although the Disclosure Database listed the officers in the organizations, many of the organizations were so small, there were only two or three officers. It was difficult for the researchers to ascertain which officer was in charge of the marketing function.

Another reason for the low rate of return was the technical nature of the questionnaire. A few respondents indicated ignorance about several of the telecommunications issues. Finally, some subjects expressed hesitation about rating their organization as below average. This was a more significant concern in this survey since many of the results indicate an inadequate emphasis on the importance and use of telecommunications in the marketing function.

4. ANALYSIS OF THE RESULTS

Demographic Data

Although the response rate was low, the questionnaire was completed by a relatively high level of management. Fifty-two percent were senior managers, forty-one percent were middle managers and six percent were supervisory or professional personnel. Most titles varied from Vice-President in charge of Marketing to Purchasing Manager.

Table 2 shows the organizational characteristics as reported by the respondents. It was interesting to note the average number of employees in the organization as 483 while the average number of employees in the telecommunications area was approximately 8. The ratio of one telecommunications employee to sixty organizational employees appeared quite adequate. However, the exact nature and abilities of the telecommunication employees are not known. Their classifications varied from clerical to technical to managerial.
Finally, the average number of personal computers in the organizations responding to the survey was approximately 260, while the number of mini-computers averaged 13. And lastly, the average number of mainframe computers in the organizations was approximately 3.

Telecommunications Results

The Management Structure of the Telecommunications Function: The marketing managers were asked to indicate the management structure of the telecommunications function in the organization. Only seven respondents indicated that their organizations utilized a Telecommunications Manager. Sixty-one respondents indicated that the telecommunications function reported to the Information Systems Manager. Another twenty-seven respondents indicated that their organization utilized an advisory steering committee reporting to either a CIO or another executive. Finally, twenty-one marketing managers indicated that the telecommunications function in their organizations was managed by a steering committee with decision making authority. This information is presented in Table 3. The twenty-seven respondents indicating an advisory committee are not included in the managerial totals.

The Impact of Management Structure on the Importance of the Telecommunications Function: The marketing managers were asked to indicate their degree of agreement or disagreement with the statements: 1) "Telecommunications is vital to the organization" and 2) "Top management understands the importance of telecommunications". A five-point Likert scale, ranging from "1" for strong disagreement to "5" for strong agreement was utilized.

TABLE 2
Organizational Characteristics

Measure	Category	Percent
Industry Classification	Manufacturing and Processing	41.4
	Finance, Banking and Insurance	27.6
	Wholesale and/or Retail	3.4
	Transportation, Utilities	8.6
	Health Service and Hospitals	5.2
	Other	13.8
Annual Gross Revenues (in millions)	< 1	1.1
	1 – 5	2.1
	6 – 10	13.8
	11 - 50	7.4
	51 - 100	54.3
	101 - 250	10.6
	251 - 1000	8.5
	1000 - 1500	2.1
Number of Employees - Entire Organization	1 - 100	27.7
	101 - 500	60.4
	501 - 1000	5.0
	1001 - 5000	5.0
	5001 - 10000	1.0
	10001 - 20000	0.0
	20001 - 30000	1.0
Number of Employees - Telecommunications Department	0 - 5	85.1
	6 - 10	5.0
	11 - 20	2.0
	21 - 50	3.0
	51 - 100	5.0

TABLE 3
Management Structure of the Telecommunications Function

Management Structure	*Number Respondin g*	*Percent*
Solitary Manager		
Telecommunications	7	6.0%
Information Systems	61	52.6%
Steering Committee		
Advisory Only	27	23.3%
Authoritarian	21	18.1%

Respondents from organizations with telecommunications managers indicated greater agreement with these statements than the other respondents. Similarly, respondents from organizations utilizing "advisory" steering committees indicated less agreement with both statements than the other respondents. These results were obtained with the use of the General Linear Model (F-statistic) and a Duncan *post-hoc* test. The results from these statistical tests are included in Table 4.

Thus, the telecommunications manager appears to be an excellent messenger throughout the organization about the significance and the role of the telecommunications function. The information systems manager did not convey the message as clearly as the telecommunications manager. Perhaps, this is due to the wide range of activities which the information systems manager must oversee. The telecommunications function is just one of many competing demands on his/her time.

Table 4
Importance of Telecommunications by Management Structure

Statement/Subgroup	F-statistic	P-value	Mean
Telecommunications is vital to the organization	2.37	.0740	
Telecommunications Manager			5.00
Authoritarian Steering Committee			4.29
Information Systems Manager			4.41
Advisory Steering Committee			4.00
Top management understands the importance of telecommunications	5.35	.0018	
Telecommunications Manager			4.71
Authoritarian Steering Committee			4.00
Information Systems Manager			3.68
Advisory Steering Committee			3.11

Table 5
Telecommunications Planning by Management Structure

Formalized Planning by Subgroup	F-statistic	P-value	Mean
Development and Implementation of an Organizational Telecommunications Plan:	4.31	.0065	
Percent Implemented by Management Structure			
Telecommunications Manager			60.70%
Authoritarian Steering Committee			50.58%
Information Systems Manager			34.83%
Advisory Steering Committee			00.00%

Likewise, organizations with "authoritarian" steering committees appear to value the telecommunications function more than organizations with "advisory" steering committees. Several respondents indicated that their "advisory" committees were generally ineffectual and unproductive. However, respondents had a higher opinion of the telecommunications function when the steering committee had the authority to create and implement policies.

The Impact of Management Structure on the Planning Process: In order to determine the impact of the management structure on the formalized planning process, the marketing managers were asked to indicate whether or not their organizations had a telecommunications plan. Respondents from organizations with a telecommunications plan were asked to indicate the percent of implementation on a five-point Likert scale ranging from 0 to 100 percent in 25% intervals. The researchers found a strong association between the management structure and the formalized planning process for telecommunications as measured by the percent implemented of the telecommunications plan ($F=4.31$, $p=.0065$). The results of a *post-hoc* Duncan test indicated that the telecommunications function guided by a specialized manager had a more formalized planning processing than the steering committee approach, including both the advisory and authoritarian steering committee. These results are presented in Table 5.

Of the twenty-seven organizations where the telecommunications function was guided by an advisory steering committee, fifteen had a telecommunications plan. But, none of these organizations had implemented any part of the plan. This was a very surprising result, considering that organizations with the telecommunications functions guided by a telecommunications manager or an authoritarian steering committee had on average more than 50% of their telecommunications plans implemented.

Thus, organizations with telecommunications managers were more likely to have developed and/or implemented a telecommunications plan than organizations which utilized steering committees to guide their telecommunications function.

he Impact of Management Structure on the Importance of Telecommunications Issues: The final objective was to determine the impact of the management structure on the importance of thirty telecommunications issues as perceived by an end user, the marketing manager. The results generally indicated that respondents from organizations with the telecommunications function guided by a telecommunications manager valued telecommunications more than respondents from organizations guided by an advisory steering committee. Respondents from organizations with the telecommunications function guided by a telecommunications manager valued the standard telecommunications applications, such as voice mail more than respondents from organizations guided by an advisory steering committee. This same result was also found on managerial issues such as network management and control, end user telecommunications needs, strategic planning of telecommunications, and the information management of telecommunications. In addition, this result was true on one technical issue, telecommunications terminology.

Thus while it appears that the telecommunications managers do a better job than the IS manager or steering committees of relating the importance of telecommunications in the areas of standard applications and managerial issues, there was little difference in the importance of technical issues or advanced applications. Telecommunications terminology was the only issue of these seventeen on which there was a difference of viewpoints of the marketing managers divided by the telecommunications structure. Similarly, it was not true of any of the emerging trends, such as web page development, conducting business on the internet, or local area networks. While it appears that the telecommunications manager does a better job of conveying the importance of telecommunications, for the standard applications and managerial issues, than the IS manager or steering committee, this advantage was not widely noted in the technical issues or advanced application areas. General Linear Model Statistic (F-statistic), probability value, and the means of the four types of management structure for each of the thirty telecommunications issues are contained in table 6.

While there appeared to be little or no impact of management structure on the technical issues or advanced applications issues, there is a cumulative effect. There was significance in the average means for all items in the group by management structure. The Duncan *post-hoc* test provided information which lead the researchers to have confidence in the responses of the marketing managers. The marketing managers from organizations with either telecommunications or IS managers indicated that greater importance was placed on the technical issues that the marketing managers from organizations utilizing steering committees (F=8.65, p=.0001). This appeared to be a logical result. Telecommunications and IS managers are more technically focused than individuals from throughout the organization on a steering committee.
Similarly, respondents from organizations with a telecommunications manager showed a greater appreciation of the importance of standard applications (F=8.08, p=.0001), advanced applications (F=3.37, p=.0182) and managerial issues (F=10.36, p=.0001) than the other organizations. Respondents from organizations with an advisory steering committee valued these areas less than the other organizations.

The marketing managers have spoken. They prefer to see the telecommunications area evolve from an extension of an IS area to a distinct area worthy of separate management. This is not surprising given that during the 21st century, telecommunications will not only be used as a means of rapidly transporting data from one location to another, but will also be used in innovative applications to give the organization a competitive advantage. Telecommunications manager and authoritarian steering committees are the preferred management structure for this evolution.

5. DISCUSSION

The results of the survey of marketing managers about the telecommunication function in their organization had surprising results. From the literature review, the researchers had expected that the steering committee form of management would have been preferred by the marketing manager. Yet, the results indicate that the marketing managers had more agreement with both statements: 1) Telecommunications is vital to the organization, and 2) Top management understands the importance of telecommunications, if their organization was managed by a telecommunications manager versus the other forms of management. In addition, marketing managers indicated that organizations whose telecommunications function was guided by a telecommunications manager, have a more formalized telecommunication planning and implementation process than the other organizations. Finally, the telecommunication manager appears to be an excellent messenger about the importance of many of the telecommunications issues and areas.

These results were unexpected. But it should be noted that only seven of the 118 respondents indicated that the telecommunications function was guided by a telecommunications manager. Yet, there was significance, even when the statistical tests adjusted for the unequal and small sample size. Throughout the analysis, the general linear model from the SAS package was used as opposed to the ANOVA procedure.

The sample size for the other forms of management of telecommunications function ranged from 21 to 61. What was most surprising was the negative statements by the marketing managers from the organizations which utilized an advisory steering committee to manage the telecommunication function. These committees generally reported to the CIO, IS manager or some other top executive.

Table 6
Importance of Telecommunications Standard Applications by Telecommunications Structure

ISSUE	F-statistic	P-value	Means			
			A	B	C	D
Standard Applications						
Voice Mail	**4.55**	**.0048**	5.00	4.33	4.05	3.78
Electronic Mail	**3.87**	**.0113**	4.86	4.52	4.39	3.96
Voice Teleconferencing	**2.38**	**.0738**	4.14	4.10	3.85	3.48
Facsimile Devices	0.54	.6581	4.57	4.57	4.52	4.33
Telephony	**3.20**	**.0264**	4.57	3.90	3.89	3.38
Surfing the Internet	0.04	.9895	3.43	3.33	3.41	3.35
Combined	**8.08**	**.0001**	4.42	4.13	4.02	3.73
Managerial Issues						
Network Management and Control	**3.61**	.0156	4.00	4.19	4.38	3.72
Information Management of Telecommunications	**3.20**	**.0263**	4.43	3.71	4.02	3.50
End User Telecommunications Needs	**2.21**	**.0910**	4.00	4.00	3.77	3.35
Strategic Planning of Telecommunications	**3.71**	**.0138**	4.43	4.30	4.08	3.52
Use of Telecom for Competitive Advantage	1.52	.2125	4.71	4.00	4.26	4.00
Managing Innovation and Technology	1.86	.1300	4.71	3.90	4.13	4.00
Environmental Restrictions	1.24	.2999	3.00	3.20	3.33	2.88
Combined	**10.36**	**.0001**	4.21	3.90	4.00	3.57
Technical Issues						
Data Security	1.76	.1599	4.57	3.90	3.89	3.38
Data Transmission Management	0.83	.4799	3.86	3.71	3.90	3.58
Use of PC for Telecommunications	1.69	.1735	4.43	4.29	4.36	3.96
Vendor Selection	0.79	.5000	3.71	3.52	3.88	3.73
Voice/Data Integration	0.42	.7403	3.71	3.57	3.50	3.31
Data Integrity	0.98	.4058	4.29	4.05	4.32	4.00
Equipment Capability	1.32	.2733	4.29	3.95	4.14	3.76
Telecommunications Software Availability	1.42	.2419	4.29	3.76	3.83	3.52
Telecommunications Terminology	**2.92**	**.0373**	3.29	2.95	3.46	2.84
File Transfer Protocol (FTP)	1.24	.2992	3.57	3.62	3.65	3.20
Combined	**8.65**	**.0001**	4.00	3.79	3.95	3.60
Advanced Applications						
Video Teleconferencing	1.47	.2633	2.86	3.05	2.95	2.44
Telemarketing	0.53	.6600	3.71	3.00	3.13	3.00
Telecommuting	1.55	.2071	4.00	3.30	3.16	2.92
Web Page Development	1.35	.2606	4.43	3.52	3.67	3.56
Conducting Business on the Internet	0.98	.4045	4.29	3.43	3.68	3.58
Electronic Data Interchange	0.82	.4853	3.14	3.81	3.63	3.44
Local Area Networks (LAN)	1.66	.1795	4.43	3.90	4.17	3.84
Combined	**3.37**	**.0182**	3.84	3.43	3.48	3.26

A=telecommunication manager, B=authoritarian steering committee, C=IS manager, D=advisory steering committee
the higher the mean the more important the issue

In addition, organizations utilizing an advisory steering committee had less formalized telecommunications planning. Of the 27 organizations with advisory steering committees, fifteen had a telecommunication plan. But none of these had implemented any part of the plan.

Finally, marketing managers from organizations with an advisory steering committee were not as aware of the importance of various telecommunications applications and issues as the respondents from other organizations. Without the awareness of the potential of telecommunications, it seems unlikely that these concepts would be utilized to the benefit of the organization.

Marketing managers were clearly distinguishing between authoritarian and advisory steering committees. If an organization wishes to achieve the benefits from this form of management, the committee must be given the authority to create and implement policy.

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Conflicting Expectations and Presentations Between the Devil and the Deep Blue Sea

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Abstract

The MIS core course at our university has met many challenges and is currently under a major redesign. Some of the significant problems encountered by our students, but certainly not specific to our university include student backgrounds, lack of reinforcement of concepts through other courses, faculty's dissatisfaction in teaching the course, and course focus. This paper discusses the challenges we have faced, the causes for student and faculty dissatisfaction with the course, and some suggestions to get us back on track.

Keywords: IS curriculum, computer instruction, MIS course, CBA core

1. INTRODUCTION

The Information Age is moving at an alarming rate. Software for children under five is the fastest growing educational software category with sales that quadrupled between 1997 and 1998 to more than $49 million, according to a Virginia-based PC Data Market-research firm (Ojeda-Zapata, 1999). Fourth-grade students at an elementary school in the Southwest led both a workshop and a hands-on lab for 40 teachers about creating computer web sites (Whitney, 1999). Recruiters for IBM, faced with fierce competition to find talented workers for technology jobs in a competitive environment, are heading to locations frequented by students on spring break (Rolwing, 1997).

These examples indicate a strong need for individuals trained in the use of information technology (IT). This strong need for IT skills requires university CIS programs to remain current with industry needs. This is a monumental task, especially for the MIS core course. It is imperative that we prepare our students for the challenges they will face in a future that has already arrived (Trauth et. al., 1993 and Lee et. al., 1995). New textbooks are attempting to get business students excited about MIS by providing an interactive learning environment that includes Web-based projects, self evaluations, focus on electronic commerce, and CDROM multimedia presentations that integrate technology with course content. All of these offerings are an attempt to convince business majors that the knowledge of IT is essential to solve management problems and find new opportunities to improve their organizations regardless of their plan to be a tax accountant, financial analyst, marketing specialist, or computer programmer. The success rate that we have experienced in reaching our students has been disappointing and is similar to that reported by Novitzki

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(1997). Written comments from student course evaluations indicate that they do not see the relevance of this course to their future job success, and had very little desire to take the course. Our CIS majors not only provide these opinions on student evaluations but also inform CIS faculty of their feelings.

In this paper we will discuss the challenges of an upper division MIS core course in an undergraduate business degree program. We identify the problems and suggest possible solutions to provide a more meaningful learning experience.

2. CURRENT PRACTICES

In the College of Business Administration at Northern Arizona University (NAU), we have six major areas of study: marketing, management, accounting, finance, economics, and CIS. As freshman and sophomores our students take foundation courses in English and mathematics along with lower division courses in accounting, business environment, CIS, economics, and statistics. In their second semester as a sophomore they can apply for business major status based on certain criteria. Once the student is accepted to business major status, as juniors, they can start taking the upper-division business courses and major courses of study. A major problem in getting students to understand the relevance of taking CIS courses is that almost all of the lower-division business courses do not require the CIS course as a prerequisite. Also upper-division core courses in management, marketing, finance, and production and operations management do not require the upper-division MIS course as a prerequisite. Since the MIS course is not a prerequisite most faculty teach the content of the courses without requiring the use of IT. It is not difficult to see why the students fail to see the relevance of the MIS course; they learn management, marketing, finance, and production and operations management without having to use a computer.

3. CURRENT CONFLICTS

The MIS core course at our university has meet many challenges. Some common problems that have been identified at other institutions and reported in the literature include: focus on management versus focus on technology, and student's dissatisfaction with the course, Novitzki (1997), keeping course content current with changes in technology, Couger et.al. (1995), closing the gap between the information technology skills required by organizations versus the skills academic institutions are providing their graduates, Trauth et. al., (1993) and Fry (1993), and appreciating the multiple function/diverse audience flavor of the course, Chepaitis, (1991). Some of the significant problems encountered by our students, but certainly not specific to our university include student backgrounds, lack of reinforcement of concepts through other courses, faculty's dissatisfaction in teaching the course, and course focus.

Student Backgrounds

Course and faculty evaluations by students at the completion of the course reveal very similar conclusions as those reported by Novitzki (1997). On our evaluation form students are asked questions on the student's preference in taking the course and the value of the class for their career. By far, given the problems already stated, the most popular response, on a scale of 1 to 5 where 5 is a negative response, is either a 4 or a 5. Non-CIS majors see the course as too technology intensive, while CIS majors see it as not intensive enough. Comments run the gamut between "I know everything already so why should I have to take this course", to "I just need a little more practice before I start my new job", to "I am computer phobic and don't see myself having to use computers on my job". Very often, the last exposure most students have had to information technology is the basic computer literacy course taken during the freshman year. For this reason, student's expectations are that the MIS core class should be a computer literacy "refresher" course.

Lack of Concept Reinforcement

Faculty teaching the non-CIS courses rely heavily on the MIS core class to teach their majors information technology as it pertains to their individual area of study. This is due to fact that many faculty have not kept up with the technology themselves and they do not want to use any of their limited class or preparation time for IT concepts. Since the business core includes the upper-division MIS class they believe it to be the job of CIS to teach IT concepts. Courses in accounting, finance, marketing, and management are taught without a required use of IT. Since travel and development funds are scarce, the faculty in the non-CIS areas choose seminars and conferences that are specific to their content area and receive limited exposure to integrating information technology within their courses. Since many students have already completed the courses in their major without using information technology, it is difficult for them to see the value of information technology to their major course of study.

The CIS area has tried to provide for the integration of business content and information technology by soliciting projects from the other areas; finance, management, accounting, economics, and marketing. Students are separated into teams, based on their major, to complete these semester projects. Unfortunately, we have found that this practice impedes students from getting an overall business perspective but rather obtain a *major* business perspective of the concepts. Also, with each major area submitting their requirements to the MIS core, the course has become almost impossible to teach, as it must be "all things to all people". This puts added qualifying factors on the CIS faculty to know, with more than a basic knowledge, the practice of all business areas in order to teach this course. This greatly increases CIS faculty's dissatisfaction for teaching the course.

Faculty Dissatisfaction in Teaching the MIS Core
Is it any wonder that faculty desire to teach the course is at about the same level as the students' desire to take it? Lack of reinforcement of IT concepts in other courses requires either in-class time for review or a hard-nosed approach requiring students to bring their IT skills up to the prerequisite level on their own. CIS faculty must also attempt to keep current on changes in information technology and must also have and maintain a greater than introductory level in accounting, finance, marketing, and management in order to show the students the relevance of the MIS core course to their majors. Faculty without tenure can not risk the poor student evaluations nor the preparation time required to be proficient at both IT and all the other functional areas of business. Senior tenured faculty, when given their choice of courses, do not put the MIS course at the top of their list.

A temporary solution has actually made the situation worse. Part-time faculty have been used extensively. Part-timers are hired with minimal qualifications in IT, knowledge of the other functional areas of business, and teaching ability. Poor salary provides little motivation to do a good job on preparation and delivery of course concepts.

Course Focus
The focus of the course is not well defined. Most CIS faculty have a technical background and spend a considerable amount of time discussing areas of their expertise. For example, a professor actively publishing in the database area tends to spend up to one third of the course convincing students that database concepts are important because the database is the heart of the information system – if the database design and content are not correct, nothing else will work properly. Part-time faculty without a broad technical background tend to take a managerial approach. Because many students do not take this course until their senior year, some faculty believe that strategy should be the focus. This results in a course that looks like a capstone course, relying heavily on cases and current articles about organizations. As noted in Novitzki, 1997, "it builds on general business knowledge and the functional line manager, but it ties this to strategic IS issues and it's role as a managerial tool".

4. REDUCING AND/OR ELIMINATING CONFLICTS

We are currently in the process of modifying the MIS core course. A committee was established to identify the many challenges stated above. The focus of the change effort is to create a course that is successful for both students and faculty. As a first step we have reduced the use of part-time faculty to teach the course. Full-time CIS faculty have generated ideas for improvement in an electronic meeting. We are also researching the MIS core courses in peer institutions to gather successful experiences. Among the many ideas that have been generated include practice what we preach, technology vs. management focus, pretesting, modularizing course content, and adding a Web-based course.

Practice What We Preach
When teaching the Systems Development Life Cycle, we make the point that to implement a successful system, we must have full cooperation from upper management and take into consideration the role of user participation in the development process. The same concepts apply in this situation. An added difficulty, which seems to plague MIS/CIS programs in many locations, is that IS faculty have trouble explaining the *uniqueness* of CIS/MIS as a business major to faculty in other areas of the Business College. We must have a "buy in" from all areas of the Business College to promote the necessary changes. It is important that we then take back ownership of this course and clearly define learning outcomes, regardless of student's major. This will eliminate the impossible task of "being all things to all people". Part of this process also requires other business areas to reinforce information technology concepts in their major course work and not rely on CIS to supply this knowledge in one course. This in turn will help students understand the importance of MIS in business and better prepare them for their future careers.

Technology vs. Management
The ongoing debate of course focus is a special challenge as each professor brings unique knowledge and experiences to the class environment. Regardless of focus, it is agreed that the lab facilities must be made available, not to teach frequently changing hardware and software components, but rather to use technology as a tool to solve basic business problems. We also must decide on the strategy component of the course. If strategy is to be a major focus, students should be advised to choose the course near the end of their program to ensure that they have the necessary background to understand mature business concepts. If the contrary is true, then students need to be advised to select the course early in their junior year to ensure that they get the benefits of this knowledge. This is especially true of the CIS majors.

Pre-testing

The main argument that students use to attempt to eliminate the MIS core course from their program of study is that they possess current knowledge of the course content. CIS majors who leave the completion of this course until their graduating semester are most notorious in this practice. Currently, there is no procedure to "test out" of this material, therefore, many students dispiritedly drudge their way through the semester. Unfortunately, grades achieved by these students tell a different story. It is not clear however, if the deficient grades are the result of a lack of knowledge, or the result of a lack of interest. A pretest may kill two birds with one stone. It can be used to test knowledge of the student, and if the outcome is negative, can help enforce the value of the course content to the success of future employment.

Modularize Course Content

One suggestion was to divide the MIS core course into one-credit hour (each with a five week duration) modules. Possible topics include: interdisciplinary MIS foundations, MIS and marketing, MIS and controllership (accounting and finance), advanced spreadsheet analysis, advanced database concepts, the MIS function (for CIS majors) and projects. Students would be required to take 3 modules and would be advised by their major area of study as to those most appropriate. The MIS foundations module could be a common starting point taken by all students. All modules could be offered concurrently. The biggest challenge would be coordination and implementation of the modules with faculty in other business areas. Team teaching is another possibility with this structure.

Web Based MIS Core

Another opportunity for the management information systems course is that the College of Business Administration has a mission to "Provide educational opportunities across the state through appropriate technologies." In a prior semester the MIS course was taught statewide using Instructional Interactive Television (IITV). The IITV broadcasts are via satellite and the university has a limited number of time slots available. An expansion of the statewide programs has resulted in more courses competing for the limited air time slots. To guarantee that the MIS course would be available to our statewide students on a regular basis it was decided to present the course over the Web. Web development was started during spring 1999 and the course will be presented for the first time spring 2000.

In the past the course has included group work both in and out of class with discussion and presentation of their solutions. In the Web course the face-to-face work and discussion will be replaced with the Virtual Conference Center (VCC). Discussion groups are possible for the entire class and for each student group. The one major problem area will be the lab component of the course, where the students work with spreadsheet, database and other software tools to solve MIS problems. In the lab students have a lab aid available to assist them in the use of the tools. In the Web course we are looking at having on-line tutorials that the students can use and probably a great deal of e-mails between the students and faculty.

5. CONCLUSIONS

We are currently in the process of modifying the MIS core course. A committee of full-time CIS faculty has been established to identify problems and to introduce possible solutions. These solutions will be communicated to the entire faculty of the college of business for their feedback. Reliance on part-time faculty to teach the course has been reduced. Starting in fall 1999 the course format will change from a lecture only to a combination lecture and lab. The lab will allow the students to use tutorials to bring their IT skills up to the prerequisite level and to use IT tools while under faculty supervision to solve business problems. Additional changes will be forthcoming and reported in time for the conference.

It is clear to the CIS faculty that our position with the current MIS core course is a no-win situation. Something must be changed – if for nothing else, for the nature of our profession. We are embarking on a difficult journey – we must find a solution for our majors as well as all majors in the college. It is important for the other major areas to see that a buy-in is necessary for this change to succeed.

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A Beginner's Course in Computer Graphics and Animation for an IS Program

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Abstract

This paper describes an approach used to teach a computer graphics course for Information Systems, IS, majors. Various concepts are discussed ranging from graphic primitives to 2-D and 3-D transformations and animation. The composition of the student's project notebook, lab exercises assigned, and the student's final project are further described. By effectively bridging the gap between graphics theory and practice, this approach has resulted in increased classroom participation and student motivation.

Keywords: Graphics, fractals, animation, project notebook, music, sound

1. PURPOSE OF THE COURSE

This is a one semester course aimed at IS students, sophomore level and above. The course teaches students how to develop graphical oriented programs using applied basic concepts and techniques together with coded fragments.

Graphics programming is learned by "doing it" in a lecture-lab environment. The authors will share some of their successful teaching techniques used to make the course interesting and fun. Currently, this course is titled CIS 345 Computer Graphics (lecture 2, lab 2, credit 3).

Included are topics regarding:

1) Overview of computer graphics
2) Introduction to workstation and hardware terminology
3) Basic graphic concepts and primitives
4) 2-D and 3-D concepts, algorithms, and transformations
5) Color theory and principles
6) GUI's and windowing concepts
7) Animation
8) Music and sound
9) Fractals
10) A survey of popular graphics packages

2. INSTRUCTIONAL MATERIALS AND RESOURCES

Students who enroll in this class usually have completed a course using the MS Quick Basic programming language. They have become proficient in applying modern programming practices such as the top-down (modular) approach and the structured programming approach to a wide variety of on-line and batch programs as described by (Quasney 1998). Students are also expected to have knowledge of college algebra, matrices, geometry, and trigonometry.

The programming language used to do the graphics and animation is Quick Basic (QB). However, Visual Basic, C, or C++ are allowed for some of the advance students enrolled in the course. All processing is performed on Intel x86 based PC's such as the Pentium.

The instructional materials consist of a textbook (Hill 1998) and an omnibus (Maniotes 1999). The textbook covers the theory and fundamentals of graphics and contains pseudocode for many of the algorithms.

The omnibus serves to supplement the textbook and the lectures. The omnibus also contains coded fragments written in QB for keyboard, mouse, and GIF drivers; icons and fonts; and for many other useful utilities. In addition, handy formulas from physics, algebra, geometry, and trigonometry are in the omnibus to aid the student in animating displays.

The students feel that having access to the formulas and coded fragments allows them to spend their time more productively on the lab exercises and final project.

3. THE LAB EXERCISES

One of the first lab exercises assigned deals with construction of a well known international symbol or logo. All logos are developed from overlapping primitives such as rectangles, circles, ellipses, arcs, wedges, lines, and points. QB has some powerful statements such as LINE, CIRCLE, PSET, and PRESET to draw these primitives. QB also has a DRAW statement which is used to draw complicated logos or objects that can not easily be constructed from the primitives.

Some of the popular logos that students have drawn in the past are the Chevy, Chrysler and Apple logos and the international symbols representing a child, man, women, and a handicapped person. Students are surprised at the simple composition of these logos after they have been decomposed into overlapping primitives.

To navigate and select the appropriate lab exercises, a Master Menu is constructed from the basic primitives. Menu options, descriptions, and icons are placed in a "Toolbar Area" which is similar to those found in Internet browsers. Selection is made by moving the cursor over the appropriate menu description or icon. All this is done using QB.

Another lab exercise deals with drawing flags such as the USA flag, Olympic flag, or flags from various nations, states, or events. Flags are displayed in color and are either rigid or waving. A few bars of music play in the background. QB supports the COLOR and PAINT statements which are used to color, tile, or shade objects with various patterns.

QB also supports the BEEP, SOUND, and PLAY statements which can be used to create various sound effects and music. Using the SOUND statement, students have developed sounds such as the ringing of a phone, the wailing of a siren or fog horn, and the falling of an object or coin. Using the PLAY statement, students have generated a few bars of music for the national anthem or for a symphony by Bach or Beethoven. Students enjoy experimenting and trying various combinations of musical notes and sounds.

After color theory and color models have been discussed, students do a lab exercise that illustrates the additive effects of the primary colors of red, green, and blue (RGB). Initially, three circles are filled respectively with the three aforementioned colors. Via animation, students move and superimpose the three

circles in such a manner as to blend and display the colors of white, cyan, magenta, and yellow (CMY). QB uses the GET and PUT statements to do high quality animation and high speed motion. In the past, students have also animated the subtractive effects of the primary colors of CMY as well as the international
symbols of a child, man, or women to perform various kinds of movements.

After 2-D and 3-D concepts, algorithms, and transformations are discussed, students apply these to an interesting lab exercise. Students construct a 3-D opaque container which is filled partially with some kind of liquid. The container is then lifted and rotated in order to pour the liquid into another container which is transparent. As the liquid is poured, the liquid is seen rising in the receiving container. Students are asked to program the viscosity of the liquid (water vs. thick molasses vs. a cryogenic liquid vs. a molten metal); the sounds made when the liquid is poured (splashing vs. fizzing vs. bubbling); and the shape of the container (cylindrical vs. bottle shape vs. carton shape).

QB provides the WINDOW statement to redefine the coordinates of the screen and allows one to "zoom" and "pan" a figure. QB also has a VIEW statement which defines a viewpoint that figures can be displayed. Students use both of these statements to create icons representing their lab exercises and display them in their Master Menu.

Students are excited when the subject of fractals is discussed. Fractals are mathematical formulas and techniques used to create snowflakes, surfaces, trees, plants, clouds, mountains, landscapes, etc. Over the past few years students have created some of these interesting objects and had fun doing them.

4. THE STUDENT'S FINAL LAB PROJECT

The general specifications for the final lab project are issued about two-thirds through the semester. Students are requested to research and develop a lab project which is of interest to them and which makes use of the many graphical and animation concepts discussed in the course. They are encouraged to be <u>creative</u> with regard to their final project.

Students are required to submit a one or two page proposal and enclose sample sketches of their proposed graphic and animation displays as well as any algorithms expected to be used. Some of the interesting final lab projects developed by students have been the rolling of a bar of steel in a mill, the bio-morphing of cells, the animation of the games of pong and billiards, flying the USS Enterprise in 3-D, developing new fractal landscapes and surfaces, etc.

5. PRESENTATIONS

During the last week of the semester, a one hour appointment is scheduled with each student so they can present all the work accomplished during the semester. The presentations are open to the faculty of our department but not to the other students in the class.

The instructor and the faculty ask the questions. Students are expected to "defend" their graphic and animated designs and demonstrate that they work according to the specifications.

The presentations take place in a large room equipped with PC's. The graphic and animation images appearing on the student's PC are also displayed on a large 6' by 6' screen for viewing.

Prior to the final presentations, two other presentations have taken place during the semester with each student. For example, during the fifth week, a 15 minute presentation takes place on the initial graphic lab exercises assigned. Another presentation of about 30 minutes takes place during the tenth week on the additional animated lab exercises assigned.

During the early presentations, serious design flows and errors can easily be detected by the instructor and later corrected by the student. Also during the presentations, the students discuss their progress and problems.

During each presentation, the student is asked to record any problems, errors or flaws that are discovered during the presentation. These "loose ends" are later written up, and the next day a copy is given to the instructor. A copy is also placed in the student's Project Notebook.

6. THE COMPOSITION OF THE STUDENT'S PROJECT NOTEBOOK

All students are required to keep all their pertinent graphics work in a Project Notebook. Furthermore, they are required to submit their Project Notebook each time they give a presentation to the instructor. After each presentation, the Project Notebook is graded and returned to the student with appropriate suggestions for improvement.

The students are also expected to prepare in a professional manner a formal report and place it in the Project Notebook. All narrative documentation is prepared doubled-spaced using, a word processing system or a desk top publishing system.

The documentation in the formal report contains:

1) A cover page consisting of suitable information identifying the student, course, institution and project. The cover page is usually prepared using a Presentation Graphics Software package.
2) A table of contents
3) An abstract of the project
4) A list of assumptions made pertaining to the project
5) An introduction including purpose, scope, etc
6) A description of the computer system, compiler, interpreter, operating system, and other software used
7) A copy of any algorithms used
8) A general hierarchy chart of the project
9) Procedures for operating the computer
10) A list of any error/warning conditions (both system and program generated) concerning the project
11) A description of any problems encountered such as portability, inconsistencies, hardware, software and people type problems, etc.
12) A description of any innovative/unique solutions
13) Recommendations and conclusions regarding the project
14) Future improvements that can be made to this project
15) Bibliography of references consulted
16) The specifications to all the lab exercises

Students also place in the Project Notebook all directory listings, program listings, printer outputs, menus and I/O screens of the graphical displays, and the diskette containing all their programs.

7. FUTURE DIRECTIONS

Currently, the department does not offer a follow-up course in computer graphics. Many of our students, who have completed this course, have requested additional courses in graphics and animation.

In addition, the department has received numerous requests from students, alumni, and employers requesting us to teach the fundamentals, concepts, and techniques dealing with Web Page design, Web server hosting, MS Front Page, HTML, Dynamic HTML, multimedia, Java applet programming, JavaScript, E-commerce using the Internet, interfacing Web pages and the Internet with legacy base systems, etc. A few of these topics are covered in our lower level IS courses, and others are taught by the Continuing Education Department as an all-day Friday or Saturday offering.

Our department has recently formed a committee to study the aforementioned requests. We are exploring the possibility of creating a new option incorporating computer graphics, animation, multimedia, and Internet courses.

Furthermore, we are exploring the use of additional resources required to support this new option. The issue of using high powered workstations (such as SUN, H/P, COMPAQ/DEC, etc) versus traditional Intel base or Apple MAC base PCs will be examined. The issue of using advance graphics and animation packages from Adobe, Alias/Wavefront, Macromedia, Metacreations, etc will be researched. The issue of training the existing IS staff will also be addressed.

8. CONCLUSIONS

This course is designed to provide students with a firm foundation in the fundamentals of graphics. Furthermore, the course tries to bridge the gap between the theoretical and the applied graphical concepts.

The course also creates a dynamic classroom environment where changes can be made to the graphical programs to give meaningful answers to questions such as "What would happen to the graphical image or animation if...?"

The strength of the course lies in the lab exercises and the final project that the students are expected to complete. With the variety of lab exercises assigned and the number of coded fragments given, students actually "learn" graphics by "doing it" instead of just being "taught" graphics.

Although many of our programming majors massage "bytes" in their traditional programming courses, students in this course massage "pixels." This is the key difference that sets this graphic and animation course apart from the other traditional IS courses.

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Implementing Groupware Courses within an Information Systems Curriculum

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Abstract

Information Systems and Information Technology are areas of study that change rapidly. In order for colleges and universities to continue to produce highly qualified graduates, curricula must be continually updated. One area that curricula must address is groupware. Groupware is also called work group computing or collaborative computing. It allows individuals to communicate and collaborate in a manner not previously possible. It has helped companies increase productivity, increase communication among employees, increase the amount of information available about the company, and increase the sharing of corporate knowledge. This paper is going to discuss how groupware courses can be incorporated within the context of an overall information systems curriculum architecture.

Keywords: Groupware, Collaborative Computing, Work Group Computing, Course Development

1. Introduction

Having gone through corporate downsizing in the early nineties, many companies still had the same amount of work or even more work to accomplish but with fewer people. So how were companies going to do this? Many companies turned to their information technology architectures as the answer. Many companies started to move from a mainframe architecture to a client server architecture. As client server architectures have developed and matured, companies have been provided with a great deal of flexibility, have empowered employees to meet a lot of their own information needs, and have allowed for employees to communicate and collaborate in ways that were not possible before. One new area of computing that grew out of client server computing is groupware. Groupware is a collection of different electronic technologies that supports communication, coordination, and collaboration among two or more people. Groupware can be defined as technologies that allow people to work together to become more productive and increase communication regardless of physical location or time. Commonly used synonyms of groupware are collaborative computing and work group computing. There are five fundamental technologies that groupware builds upon:

- electronic mail
- calendaring and scheduling
- workflow
- synchronous and asynchronous conferencing
- electronic meetings

As educators, why do we need to worry about groupware and do we need to develop courses to teach students about groupware? Figure 1 shows the number of people using the major groupware products and estimates the number to the year 2000. As educators, we can't afford to ignore the number of people using groupware technologies if we want our graduates to have a high quality education, to have an idea of what is currently happening in industry, and to possess the skills required to assure on the job success.

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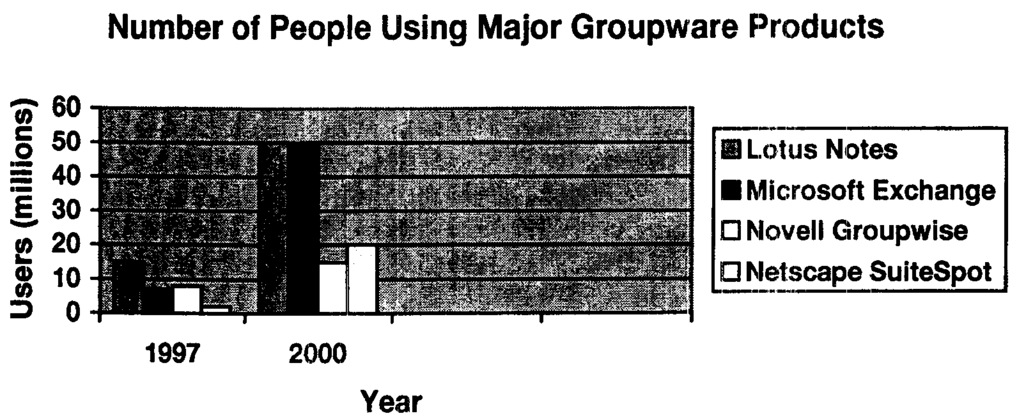

Figure 1 Number of People Using Major Groupware Products

This paper is going to discuss where groupware fits into an overall Information Systems curriculum, as well as how to plan, develop, and implement courses on groupware.

2. Curriculum Overview

The Computer Information Systems Department at Purdue University has two areas of concentration. A student can earn a B.S. with a concentration in Information Systems Development or a B.S. with a concentration in Telecommunications and Networking Technology. As technology and industry needs change we improve our curriculum to meet those needs based on feedback we receive from our industrial advisory boards. Figure 2 shows how groupware fits into a subset of an overall information systems curriculum architecture.

Networking Fundamentals	Groupware	Internet Computing
CPT 330 Local Area Networks	CPT 321 Advanced Groupware	CPT 375 Internet/Intranet App. Development
CPT 230 Data Comm.	CPT 235 Groupware	CPT 275 Internet & WWW (Introductory)
CPT 176 Information Technology & Architecture		

Figure 2 Curriculum Overview

3. Planning a new course

The combination of changing industry needs and the technology to meet those needs makes it difficult for educators to remain current with industry and technology trends. We continually have to update our curriculum with not just new technologies but with new courses and areas of concentration as well. In order to bring some semblance of order to this technology chaos, the author developed a planning matrix to help organize thoughts, ideas, and concepts for new courses. The planning matrix is a great place to start when given a new course to develop or teach. By using the planning matrix, a professor is able to look at what concepts need to be covered, what technology is going to be used, how assessment will be handled, as well as the number and content of lectures and labs. The planning matrix was developed in Microsoft Excel as a template and is shown in Appendix A.

The planning matrix was developed by identifying areas that need to be addressed when teaching a course. The matrix allows a professor to organize their thoughts for the course into an organized framework. A good place to start is with a broad course objective and also list the prerequisite course(s) the students should have in order to assure a consistent knowledge level coming into the class. After making those decisions, fill in the matrix with the concepts, skills, and technology the students should learn. Also, include a column on how students will be assessed in the course. Finally, the matrix allows a professor to break the concepts and technology up into lectures and labs so they can put together a more detailed schedule. Appendix B shows the matrix and an example of how topics in CPT 235 - An Introduction to Groupware will be covered. The planning matrix template can be used again to plan the next course in the groupware sequence.

4. Course Organization

Currently there are two courses that make up our groupware area. They are CPT 235 which provides students with an introduction to groupware and mainly focuses on the front-end. The other course is CPT 321 which provides students with an advanced understanding of groupware and distributed computing architectures focusing on the back-end and integration issues. The introductory course will target end users and focus mainly on how companies collaborate in a LAN environment. The students are introduced to topics such as groupware, collaborating on intranets, workflow, data and audio and video conferencing, electronic mail, and calendaring and scheduling. The students gain hands-on experience with Microsoft Internet Explorer, Microsoft Outlook as the front-end with Microsoft Exchange Server as the back-end, Lotus Notes as another front-end with Domino Server as the back-end, and Microsoft FrontPage 98. Many Microsoft products are used in our curriculum because we have developed a good relationship with them and they donate a lot of their software to our program. Both Exchange Server and Domino Server were selected as the back-ends because industry predictions are showing that they are pretty equal in terms of market share.

As mentioned earlier, the planning matrix is a framework that can be used to organize thoughts about a particular course and can be used as a beginning to more in-depth development of both lectures and labs. Below are more detailed objectives regarding one portion of the class, calendaring and scheduling. Similar objectives were produced for all other portions of the class. Both the knowledge and technology objectives are listed.

Knowledge Objectives

Students should be able to:

1. Understand the history of calendaring and scheduling
2. Distinguish between calendaring and scheduling
3. Identify the three areas of calendaring and scheduling
4. Distinguish between the three areas
5. Understand items to look for when evaluating various products
6. Understand what standards are important in calendaring and scheduling

Technology Objectives

Using Microsoft Outlook 97 and Lotus Notes 4.6 students should be able to:

1. Understand what the calendar is
2. Understand the different views within the calendar
3. Understand the difference between an appointment, meeting, and event
4. Set various calendar options
5. Create appointments
6. Create recurring appointments
7. Create events
8. Create recurring events
9. Schedule meetings with others
10. Mark holidays on their calendars
11. Edit their calendars
12. Print their calendars

The assignments were designed so that the students would learn to collaborate electronically with one another as well as with the instructor. This was accomplished through the use of e-mail, calendaring and scheduling, public folders, and through the development of web pages. It took students some getting used to when submitting assignments electronically since so many of them wanted to turn in a printed copy of their homework. This first course provides students with a solid understanding of the various concepts and technologies that make up groupware. The advanced course, still under development, will focus on integration and administration and enterprise wide collaborative computing in a distributed environment. The students will be introduced to enterprise wide concepts and issues in lecture and will gain hands-on experience with more robust groupware products in the lab portion of the class. The lab portion of the advanced class will have students installing and configuring the following software: Microsoft NT Workstation and Server, Microsoft SQL Server, Microsoft Exchange Server, Novell Groupwise, and Lotus Notes/Domino Server. It will focus on back-end integration such as how to integrate Exchange Server and Domino Server and how to integrate Domino Server as the back-end with a Microsoft Outlook front-end.

5. Conclusion

As educators in a field that is ever changing, what tools do we have to keep on top of developing new courses? By using a planning matrix it provides a good framework for organizing ideas about a new course. The benefits to us as educators are that it provides us with an easy way to organize our high level ideas about concepts, technologies, skills; how we'll assess the students; and finally, allows us to have an idea about the number of lectures and labs we can devote to a particular concept or technology. The benefit to our students is that the first time the new course is taught it is very organized and well planned which provides the students with a high quality learning environment.

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7. Appendix A

PLANNING MATRIX FOR COURSE DEVELOPMENT					
Course:					
Prepared by:		Revision Date:			
Textbook:		11/97			
Course Objective:					
Prerequisite(s):					
Assumptions:					
What should they know?	What should they be able to do?	What will they do it with?	How will we measure what they know and can do?	How many lectures? How many topics?	How many labs? How many topics?
Concepts	**Process (Skills)**	**Technology**	**Assessment**	**Lecture**	**Lab**
Topic					
Topic					
Topic					

8. Appendix B

PLANNING MATRIX FOR COURSE DEVELOPMENT					
Course: CPT 235		Revision Date:			
Prepared by: Julie Mariga		2/16/98			
Textbook: Groupware Collaborative Strategies for Corporate LANs and Intranets	**Course Objective**: Explore work group computing applications in a LAN setting	**Prerequisite(s)**: CPT 135 and CPT 176	**Assumptions**: Students will have successfully completed CPT 135 and CPT 176		
What should they know?	What should they be able to do?	What will they do it with?	How will we measure what they know and can do?	How many lectures? How many topics?	How many labs? How many topics?
Concepts	**Process (Skills)**	**Technology**	**Assessment**	**Lecture**	**Lab**
Email	Students should be able to use an e-mail package and they should demonstrate an understanding of e-mail concepts, standards, and trends.	MS Outlook 97	Exam and Lab Assignment	3	2
Work Group Scheduling	Students should be able to use a calendaring and scheduling package and they should demonstrate an understanding of calendaring and scheduling concepts, standards, and trends.	MS Outlook 97	Exam and Lab Assignment	3	2
Conferencing	Students should demonstrate how to use conferencing technologies and understand the concepts, standards, and trends.	MS NetMeeting	Exam and Lab Assignment	2	2
Internet and Intranets	Students should be able to use web development software and they should demonstrate an understanding of the internet and intranet concepts, standards, and trends.	MS Office MS FrontPage	Exam and Lab Assignment	2	2
Workflow	Students should be able to demonstrate an understanding of workflow concepts, standards, and trends.	None currently	Exam and Article Review	3	0
Electronic Meeting Systems	Students should demonstrate an understand of electronic meeting systems and where and why they are used	None currently	Exam and Article Review	3	0
Major Players (Lotus, Microsoft, Novell, Netscape)	Students should be able to distinguish between the major vendors and understand the trends and where the market is heading.	MS Outlook MS Exchange Server	Exam and Lab Assignment	4	2

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