A Comparison of Information Technology Curricula

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Abstract

The IT schools movement (Denning 2001) has resulted in several new start-up majors in computing schools. This paper compares and contrasts course content across relatively new undergraduate IT majors offered at eight different schools. Our results indicate that the four-year universities with an IT major offer many of the same types of courses. The courses most commonly offered focus on programming, networks and telecommunications, and a practical capstone experience. The findings of this paper offer curriculum guidance for schools that have started or are planning to start an IT program.

Keywords: information technology degree, information technology major, curriculum development

1. INTRODUCTION

Advancements in information technology have forced universities to rethink their computing curricula. The traditional computer science degree no longer covers the ever-widening range of technology skills needed to be effective IT professional in all areas. The need for four-year universities to focus on the needs of a changing and advancing IT workplace has lead to the development of an IT major (Denning 2001; Spooner 2000). The question addressed by this paper is not whether an IT program should be offered, but how to implement it effectively.

Information technology is a term used in a variety of fields and can have a slightly different meaning in each. IT is a curriculum area where breadth and depth are acquired in technical areas of the discipline (Denning 2001).   There are many universities expressing interest in an information technology track but few have tried to implement one. There is a struggle to understand and provide the needed courses. Questions such as, which courses to offer, the prerequisites required, and staffing qualifications must be dealt with.

The purpose of this paper is to discover common knowledge content among innovative information technology four-year degree programs. A compare-and-contrast analysis of the programs and courses is conducted. The study is to give universities a better understanding of what is being done in the existing IT programs. The information provided is intended to give four-year universities, with an existing IT curriculum and those with a desire to start an IT curriculum, information about the other universities offering IT as a major.

2. BACKGROUND

Several universities have developed curricula that best fit their idea of information technology in terms of meeting the needs of a dynamic IT workplace. One of the ideas of the movement towards an IT degree is that students not only need to complete required courses, but must demonstrate their understanding of their acquired knowledge before they are allowed to graduate (Denning 2001). This demonstration ensures the student and the university that the student is prepared to perform in the corporate world.

The number of industries requesting students have a broader computer education has lead many

universities to create a curriculum that focuses on the modification and usage of existing computer products more than on the creation of new ones (Countermine and Pfeiffer 2000). The supply of properly trained IT professional's must grow to meet the growing needs of the commercial industries. Industry has a desire to hire graduates that can quickly become productive.

3. METHODOLOGY

The curricula of eight four-year degree programs in information technology were studied. The chosen institutions indicate that their school currently offers a degree in IT. Six of the institutions in this report were chosen from a survey of members of the IT Dean's Council (Landry et al.) who reported having an IT program currently in place. The survey was part of a separate study of IT knowledge areas (Landry et al.). Two additional universities were obtained from a review of published articles on IT programs (Countermine and Pfeiffer 2000; Spooner 2000). All of the programs included in the study had curricula information published and accessible on the World Wide Web. See Table 1 for a complete list of programs included in this study.

Table 1 - IT Programs

Institution	IT Program Name
East Tennessee State University	Computer and Information Science
Georgia Southern University	Bachelor of Science Major in Information Technology
Indiana University	School of Informatics
Penn State University	Information Sciences and Technology
Rensselaer Polytechnic Institute	B. S. Information Technology
Rochester Institute of Technology	Information Technology
University of South Alabama	B. S. Computer Science (Information Technology)
University of West Florida	Interdisciplinary Information Technology

Our goal was to compare and contrast the various IT programs in order to find common knowledge content and areas where the programs differed. To accomplish this goal, we looked at the published curricula for each program. We decided to look at the content contained in course titles and descriptions.

Selection of Courses
Our first step was to determine which courses to analyze. If a course was included in what that institution defined as an IT core, then it was included in this study. If the institution did not explicitly define a core set of courses, then we selected all of the required major courses, as well as some elective courses that made up a major elective track. Almost all of these courses fit into an area of computer science, information science, information systems, information technology, or informatics. Some programs included mathematics and statistics courses in the core.

Grouping Courses Around Common Themes
The co-authors analyzed the courses as to knowledge content. The co-authors have experience with information technology, as one is a faculty member in a school of computing while the other is a student in an IT program. Each co-author is believed to possess a sufficient amount of knowledge to understand each university's course titles and descriptions.

The coders placed the courses into groups using the following process. One of the coders divided the courses into individual strips of paper, each strip containing a single course title, description and the name of the institution. Using the verbiage contained within the published course titles and descriptions, the authors, working together, placed the strips of paper into stacks based on a common theme per group. Each course was placed into one and only one group. After all the courses were grouped, a name was agreed upon for the theme that united each group.

The courses in each category were divided into course levels based on the course number. If a course began with a one (1), it was placed in the freshman level. Sophomore level courses began with the number two (2), junior level courses began with the number three (3) and senior level courses began with the number four (4) and above. A total of 13 themed course groups emerged. These common course themes include those listed alphabetically in Table 2.

4. DISCUSSION OF IT COURSE THEMES

Each of the themes is now discussed in detail.

Database
The most common course titles include the phrase "database systems" or "data management." Other course titles include "Information Organization and Retrieval" and "Knowledge Discovery and Data Mining." These courses also include a long list of topics. A common theme consists of analysis, design, and development using database models to store, retrieve, and manage information. Relational database concepts were commonly mentioned in many of the courses.

Human Computer Interaction
The common theme is interface design. All but one of the five courses explicitly mentions the emphasis on design issues for human computer interfaces. The titles of these courses vary, including "Introduction to Human Computer Interaction", "Human Computer Interface", "Interface Design", "Human Factors", and "Introduction

to Informatics." The latter course is the one that emphasizes HCI concepts but does not explicitly mention interface design, and the course also includes societal impacts topics, and could almost be cross-listed as a social impacts course.

Introductory Courses
These courses emphasized the fundamentals and overview of IT at an introductory level. A breadth of topics is mentioned and most are covered in little depth.

IT Project Management
A total of four courses, all taught at the junior or senior level, are in this category. One course is a management principles course, called "Management Fundamentals", whose description seemed to fit an introductory business school management course. The other three courses blended the concepts of project management with IT development issues and new technology issues. Two of the courses, "IT Project Management" and "Project Management and Development", explicitly recognized the need to place systems development in a project management context and a business/organizational context. The other course, named "IT Issues and Management", emphasized case studies of successful and unsuccessful IT development projects.

Management of Technology and Needs Assessment
These nine junior and senior level courses focus on organizational context, needs assessment, planning, integration issues, technology transfer, innovation, managerial dimensions of IT, and the needs, uses, and consequences of information in an organizational context. To sum it up, the themes center around the organizations, needs, uses, impacts, and management of information and information technology.

Mathematics and Statistics
Mathematically-related concepts, including statistics, finite math, probability theory, forecasting, prediction, and logic were mentioned in the course descriptions. Some of the courses focused on specific areas of math such as two calculus courses, "Survey of Calculus" and "Calculus I", and three statistic courses, "Experimental Methods and Statistics", "Statistical Methods" and Introduction to Statistics I". One course required a report from data that is designed, collected and analyzed.

Multimedia
The common focus is the development of multimedia products using audio, video, text, images and software such as Macromedia's Director. Concepts such as copywriting, radio, television and electronic media issues are discussed. Presentations are required to demonstrate the use of multimedia techniques.

Networks and Telecommunications
This area, along with programming, is one of the largest categories with 17 courses in the group. Ten of the 17

course titles use a form of the word "network." Some courses emphasize computer organization and architecture. Other courses are more applied in that they focus on network administration as a specialized job function. These courses include an emphasis on computer, network, and communications hardware components, architecture, and operating system software.

Practical Capstone
The common topic discussed in these course descriptions was a team project where IT students use their previously acquired knowledge to solve a software problem. The skills needed include project development and implementation, report writing, analysis, plan implementation, requirement definitions and presentations. Most of the courses used teams but two required students to have real world, internship or research experiences where reports on what they learned were due at the end of the course.

Programming
Object oriented programming ranging from introductory to advance programming levels were described in the course descriptions. Programming concepts mentioned included:

- Logic syntax
- Algorithms
- Data types
- Input/output
- Data structures
- Arrays
- Design

The programming languages named in the descriptions included: Java, Visual Basic, SQL, open database connectivity (ODBC), and Java Database Connectivity (JBDC).

Social Impacts
IT from a philosophical and social science perspective dominates this set of courses. These courses focus on the impacts of information technology on society, the economic and political ramifications of IT, the psychological and sociological dimensions of information technology, theories about information and information representation, the history of information technology, and ethical issues. No specific managerial or organizational context is stated, however.

Systems Analysis and Design
This set of courses was most varied. One school offers a two-course sequence in software engineering, which is an applied, computer science offshoot. Another school offers the traditional Systems Analysis and Design course usually found in an MIS program. Still another course, entitled "Information Infrastructure", emphasizes software architecture and basic concepts of applications development and programming. One course, entitled "Creative Design for IT", focuses on developing creative thought processes through hands-on

exercises and projects. Another course relates to use and usability issues in designing information systems, and perhaps could be cross-listed with the HCI courses. The latter two courses are interdisciplinary in nature.

Web Application Development
The common topic was web page development using web software tools. The topics discussed in the courses were design, implementation, and support issues. The tools used were animation, graphic and web authoring tools using HTML, multi-media and plug-ins.

5. CONCLUSIONS

The need for an IT curriculum is clear, but the structure of the curriculum is not. Which topics and the amount of emphasis placed on computer topics is not always clear. Each university has its own idea of what an IT program should offer and what the students should leave knowing. The areas most universities agree on are the need for programming (18 total courses), networks and telecommunication (17), and practical capstone (11) courses. Each university offers a broad array of courses in addition to theses courses. The descriptions of some of the courses show that social or psychological issues are also important.

Programming

Sophomore Year
Programming
Mathematics and statistics
Networks and telecommunications

Junior Year
Networks and telecommunications
Systems analysis and design
Multimedia

Senior Year
Practical capstone
Databases
Management of technology, needs assessment, analysis, and problem solving

To produce the basic model, we selected the two or three most popular themes for each year of the curriculum (see Table 2). This model is a reflection of the status quo of current IT programs and represents a kind of "average," model, looking across all of the programs. This model does not reflect any one model of an IT program. It is simply a reflection of the most popular themes across each year of the curriculum. Clearly, schools desiring to start an IT major may

Table 2 – IT Themes

Common Course Theme	Courses per Theme	Schools per Theme	Course Levels			
			Freshman	Sophomore	Junior	Senior
Database	9	6	0	0	3	6
Human computer interaction	5	4	1	1	0	3
Introductory courses	6	2	4	2	0	0
IT project management	3	2	0	0	1	2
Management of technology, needs assessment, analysis and problem solving	9	6	0	0	3	6
Mathematics and Statistics	8	3	2	6	0	0
Multimedia	5	3	0	0	4	1
Networks and Telecommunications	17	6	0	4	9	4
Practical capstone	11	5	0	0	0	11
Programming	18	7	6	7	3	2
Social impacts	5	3	2	2	0	1
Systems analysis and design	6	5	0	1	4	1
Web application development	6	3	2	1	2	1
Totals	--	--	**17**	**24**	**29**	**38**

Looking at these eight degree programs over the four-year model, we produced a basic IT curriculum model from the data. This model suggests that major themes occur during each year as follows.

Freshman Year
Introductory courses

choose to concentrate on the course types common to existing IT universities, or use this four-year curriculum as a frame of reference. The addition of supplemental courses should be added to assist IT curriculum designers in shaping an IT track they desire for their university.

6. REFERENCES

Countermine, Terry and Pfeiffer, Phil, 2000, "Implementing an IT Concentration in a CS Department: Content, Rationale, and Initial Impact." Proceedings, 31st SIGCSE Technical Symposium on Computer Science Education, March 8-12, pp. 275-279.

Denning, Peter, 2001, "The profession of IT - the IT schools movement" (column). *Communications of the ACM*, 44:8, pp. 19-22.

Landry, Jeffrey. P., Pardue, J. Harold., Longenecker, Herbert. E. Jr., and Feinstein, David. L., (forthcoming), "A Common Theme for IT Degree Programs." Communications of the ACM.

Owen, William, 2001, "An Information Technology Capstone Course: An Assessment Implementation." Proceedings of ISECON 2001, Nov. 1-4.

Spooner, D., "A Bachelor of Science in Information Technology: An Interdisciplinary Approach." Proceedings of the ACM SIGCSE Symposium on Computer Science Education, ACM Press, March 8-12, pp. 285-289.

Indiana University, School of Informatics, <http://www.iub.edu>.

Penn State, School of Information Sciences and Technology, <http://ist.psu.edu/>.

Rochester Institute of Technology, Information Technology, <http://www.it.rit.edu/>.

Georgia Southern University, School of Information Technology, <http://www.gasou.edu/>.

University of South Alabama, School of Computer and Information Science (Information Technology), <http://www.cis.usouthal.edu/courses/>.

East Tennessee State University, Computer and Information Sciences, <http://www-cs.etsu.edu/>.

Rensselaer Polytechnic Institute, Information Technology, <http://www.rpi.edu/dept/IT/undergrad/degree_requirements.html>.

University of West Florida, <http://cops.uwf.edu/copsweb/trd/programs.cfm>.