University Responses to the IS 2010 Model Curriculum: A Pre and Post Comparison

Leidig, Jonathan
jonathan.leidig@gvsu.edu

Leidig, Paul
paul.leidig@gvsu.edu

Ferguson, Roger
roger.ferguson@gvsu.edu

School of Computing and Information Systems
Grand Valley State University
Allendale, MI 49401 USA

Abstract

This study analyzes undergraduate Information Systems (IS) program requirements prior to the release of the AIS/ACM IS 2010 Model Curriculum in comparison with the current requirements. This effort analyzes undergraduate IS programs in a random selection of AACSB accredited institutions. The degree to which institutions modified their program requirements in response to the model curriculum were classified according to the amount of required programming courses. Results indicate that IS 2010 has not been explicitly followed by a majority of programs. Specifically, while IS 2010 dropped the requirement of programming/software development; a significant majority of institutions did not adopt that particular change. At the same time, there has been a lack of a common set of expectations and consistency among programs with similar names.

Keywords: Curriculum, programming competencies, adoption.

1. INTRODUCTION

Background

In 2010, the Association for Information Systems (AIS) and the Association for Computing Machinery (ACM) published the *IS 2010 Curriculum Guidelines for Undergraduate Degree Programs in Information Systems* (IS 2010) (Topi, Valacich, Wright, Kaiser, Nunamaker, Jay Sipior, and de Vreede, 2010). In this study, the implementation of IS 2010 among undergraduate IS programs of a random selection of universities were analyzed; to investigate the extent these programs have modified their programs in response to IS 2010.

Contrary to studies (Babb, Longenecker, Baugh, and Feinstein, 2014) that document the demand for IS graduates with technical skills in programming and software development and the inclusion of required programming courses in a majority of IS programs (Bell, Mills, and Fadel, 2013), IS 2010 removed the requirement of a programming course. This paper examines information systems curricula to determine any significant changes in programming requirements. A missing component of previous research on the affect of IS 2010 on IS programs is a comparison of IS requirements prior to its adoption and current requirements.

The AIS/ACM IS 2010 Model Curriculum

IS 2010 is the latest model curriculum for academic programs in information systems (IS). Efforts to define a standard curriculum for IS began in the early 1970s and has continued for the four decades. The Association for Computing Machinery (ACM) has been a major sponsor of most of these efforts. Other organizations, including the Association of Information Technology Professionals (AITP), formerly the Data Processing Management Association (DPMA), and the Association for Information Systems (AIS) contributed to the development of model curriculums.

In 1981, a report was presented at the First National Conference on Information Systems Education, and the final report (DPMA, 1981) was published later that year. Over the years, the 1981 model curriculum evolved with several revisions. In 1983, ACM published "Information Systems Curriculum Recommendations for the 80's". The DPMA Model Curriculum was twice updated (1985, 1991) to account for both ongoing technological advancement and the changing computing environment. A comprehensive revision of the IS model curriculum resulted in IS'97 (Couger Davis, Feinstein, Gorgone, and Longenecker, 1997) which gained significant support, providing widely adopted curriculum guidelines. IS 2002 (Gorgone, Valacich, Topi, Feinstein, and Longenecker, 2003) updated IS'97 to include new material related to the growth of the Internet.

IS 2010 is the latest in this series of model curricula for undergraduate IS programs. This revision has four broad key characteristics that significantly shaped the suggested curriculum. First, the curriculum attempted to extend beyond schools of business, guided by the belief that while business schools will likely continue to offer Information Systems, the discipline includes expertise that is critically important and supported in an increasing number of domains. Second, the outcome expectations of the curriculum have been articulated first as high-level IS capabilities and also in three knowledge and skills categories: IS specific knowledge and skills, foundational knowledge and skills, and domain fundamentals. Third, the curriculum separates the core curriculum from electives with the intent of supporting optional career tracks. Finally, the design of this curriculum includes enough flexibility to allow its adoption in a variety of educational system contexts.

The high-level IS capabilities that the curriculum specifies as the highest level outcome expectations are as follows:

- Improving organizational processes
- Exploiting opportunities created by technology innovations
- Understanding and addressing information requirements
- Designing and managing enterprise architecture
- Identifying and evaluating solution and sourcing alternatives
- Securing data and infrastructure, and
- Understanding, managing and controlling IT risks.

These high-level capabilities are translated into knowledge and skills in three categories:

1. IS specific knowledge and skills
   - Identifying and designing opportunities for IT-enabled organizational improvement
   - Analyzing trade-offs
   - Designing and implementing information systems solutions, and
   - Managing ongoing information technology operations

2. Foundational knowledge and skills
   - Leadership and collaboration
   - Communication
   - Negotiation
   - Analytical and critical thinking, including creativity and ethical analysis, and
   - Mathematical foundations

3. Domain fundamentals
   - General models of a domain
   - Key specializations within a domain and
   - Evaluation of performance within a domain.

The IS 2010 curriculum is designed to educate graduates prepared to enter the workforce equipped with the knowledge and skills specified in these three categories. As discussed above, it separates the core courses from career track electives and includes seven core courses. For some institutions, it was difficult to follow the curriculum guidelines because they were limited to fewer courses in their program than the 10 specified in IS 2002. To create more flexibility than provided in IS 2002, the task force identified a set of seven required core courses

 ISSN: 2167-1435
v31 n3084

common to all Information Systems programs. The seven courses in the model could be implemented as independent courses or as components within fewer courses.
IS 2010 Core Courses (required):

- IS 2010.1 Foundations of IS
- IS 2010.2 Data and Information Mgmt
- IS 2010.3 Enterprise Architecture
- IS 2010.4 IS Project Management
- IS 2010.5 IT Infrastructure
- IS 2010.6 Systems Analysis & Design
- IS 2010.7 IS Strategy, Mgmt, and Acquisition

Previously required course content is noticeably absent in the core courses:

- application development / programming
- data networking and computer architecture (covered at a higher level of abstraction in an IT Infrastructure course), and
- personal productivity tools

This study focuses on the absence of a programming course requirement and any focus on application development. The demand for these skills in information systems domains has received much attention in both academia and industry. Therefore, this demand is at odds with changes in the requirements of core IS content.

Definition of Programming Skills
To help clarify what programming means as it relates to the IS profession, the following term: "basic coding competency" can be defined as an individual having met two conditions:

- Understand and implement programming structures (e.g., if statements, loops, functions, basic objects, and I/O statements) for a general purpose programming language (Java, C++, COBOL, etc.)
- Understand how a program is designed, created and executed within a computer system.

Basic coding competency does not mean that an individual has the desire or skill set to be a software developer or software designer/analyst. Instead, a person that passes one or two courses that are programming intensive would satisfy condition 1 and 2 of the definition.

Programming Competencies
For the past several years there have been much attention on the demand for software developers (Babb et. al., 2014). Combined with the bureau of Labor statistics this convincingly shows that jobs in the IT, IS, and software development fields will grow at a fast rate and is expected to continue for years to come. This is a well-known trend and good news for IS and IT professionals. The question that this section addresses is not whether there are jobs for programmers in the future, but "Is basic coding competency (i.e., programming) a skill needed for all IS/CIS/MIS professionals?" This is a very broad question and there is no agreed upon answer to this question within the IS profession. In fact, different accrediting organizations have a different answer to this question. In other words, some IS programs (i.e., ABET accredited programs) require coding courses and other IS programs do not require coding courses. Hence, the population of IS students graduating from colleges and universities with fully accredited programs will be inconsistent as it relates to a student's basic coding competency.

The areas where IS professionals are needed has grown significantly. IS professionals work in a variety of sectors in our economy, such as health care, manufacturing, retail trade, academic and scientific institutions, transportation, arts and entertainments, public services, just to name a few. The question stated above, is programming a skill needed for all IS/CIS/MIS professionals, is too broad and therefore not useful. A more appropriate question is: "Does an IS professional need basic coding competency as they work in these different sectors within our economy." The answer seems to be YES for some sectors and not for others, and the following sections shows just a few examples of research that has been done within these different sectors as it relates to an IS professional.

In the field of Criminal Justice, the U.S. postal inspection service report indicates that identity theft is the fastest growing crime in America. Cyber crime, a broader term, has become a very familiar term to the general public due to the over 40 million credit cards stolen from the Target stores. Criminals use computer programs, such as key-loggers, to steal information (e.g., passwords, credit card numbers, social security numbers, and other private data). Here, an IS professional working with Criminal Justice professionals on computer malware programs (e.g., Trojan horse, viruses, and worms) would be at a significant disadvantage if the IS professional does not have basic coding competency.

In the field of health care, a publication in the Perspectives in Health Information Management

ISSN: 2167-1435
v31 n3084

(Garvin, 2004) compared coding competency to project competency. This paper's definition of coding competency was more consistent with an expectation of a software developer. Never the less, as is stated in the paper "Coding competency is extremely important to the health information management profession and health-care in general." The paper goes further and examines the weaknesses of the coders versus non-coders; and offers suggestions on how non-coders could improve their coding skills.

As reported in a paper (Babb, et al, 2014), the skills for an IS professional have not changed despite current trends. Their paper shows an IS professional to remain current in the IS field needs coding skills in the past, present, and future. In other words, they report market experts demand that IS graduates possess technical skills in the computer programming. They go on to argue that "IS educators to remain grounded in the fundamentals of computing by holding fast in our commitment to instruction in computer programming…"

There are many more examples of where an IS professional will need basic coding competency as they interact with other professionals in the workplace. IS professionals without basic code competency will be at a disadvantage to IS professionals that has basic coding competency. Further, the numbers of sectors in our economy that utilize computer systems will only grow in the future. Gregg Pollack, founder of Code School, states the following: "Learn the Basics of Programming: From 'if' conditionals to 'for' loops, knowing the basics of programming will help you recognize some of the lingo and logic used by programmers. You'll also understand why things go wrong and bugs occur. And perhaps best of all--the programmers you communicate with will respect you all the more" (Pollack, 2014).

2. PROBLEM

Apigian and Gambill (2010) reviewed the catalog copy of 240 IS programs in schools of business and found considerable support for programming courses. While only 54% of those schools required a data communications or networking course, a surprising 99% required at least one programming or applications development course. It would appear that almost all institutions regard industry demand for programming skills more relevant than simply satisfying a model curriculum. This is not the case for networking skills. Therefore, it appears the decision of the IS 2010 task force to leave out a programming requirement was not shared by almost all institutions. Instead these programs apparently choose to acknowledge the strong demand for programming skills of IS graduates.

In a similar study, (Bell, Mills, and Fadel, 2013) a majority (81%) of information systems programs still included a required programming/application development course. This paper's finding suggest the disparity between IS 2010 and required coverage of programming was a conscious decision not to comply with the removal of this requirement. Implied is that most IS programs still value programming as an essential IS skill, and therefore are reluctant to reduce that requirement to allow additional "high-level capabilities."

One study (Babb, et al, 2013) suggests difficulty in successfully helping students survive in a programming course as a reason for a decrease in the number of students in IS programs. The study found as many as 70% of students fail to complete programming coursework. Yet, the high demand for computer programmers is getting the attention of legislators: "These are some of the highest-paying jobs, but there are not enough graduates to fill these opportunities." (Marco Rubio, Senator, Florida, http://www.code.org). A recent recommendation for a model CIS curricula (Longenecker, Feinstein, Babb, 2013) calls for requiring a three-course programming sequence.

The problem is an inconsistency between the implication that programming is no longer a necessary part of an IS curriculum, and the documented need for skilled programmers in the IS industry (and difficulties IS students have learning to code).

This study aims to address this problem by analyzing the level of adoption of the IS 2010 curriculum. Specifically, further analyses are needed to better understand the overall affect IS 2010 had on curriculum requirements. More directly, the effort here attempts to determine whether the changes were accepted and adopted by institutions.

ISSN: 2167-1435
v31 n3084

3. PRELIMINARY RESULTS

Study Design

Current and previous academic catalogs were analyzed to determine the affect of IS 2010 on Information Systems curricula. Academic catalogs from the 2008-2009 and the 2013-2014 academic years were gathered for a sampling of universities. These catalogs document the program modifications made to IS programs in the years following IS 2010. 40 programs related to Information Systems were randomly selected from the set of AACSB accredited schools that do not also hold ABET accreditation. These are the programs most likely to have adopted the updated standards. ABET accredited programs were not expected to be modified as a result of IS 2010 changes due to continued ABET accreditation requirements regarding programming. Thus, ABET accredited programs were removed from the set of potential programs. Multiple programs were reviewed, e.g., MIS, IS, and CIS.

An initial hypothesis was proposed to determine if schools generally 1) adopted changes based on the weakened programming requirements (i.e., by eliminating or making programing courses optional) or 2) rejected the IS 2010 changes (i.e., unmodified program curriculum). However, the current landscape and recent modification of Information Systems programs is more complex than this simple hypothesis would indicate. As a result, a diverse and complex set of program modifications followed the IS 2010 changes. Determining which changes were implemented due to IS 2010 and which changes (e.g., new tracks) were not affected by IS 2010 was not straightforward. Subsequently, the provided analyses represent the complex reality of the dynamic modifications taking place in Information Systems curricula.

This complexity is compounded by a myriad of ill defined program names. As detailed in the following analyses, program names and tracks included Business Information Systems (BIS), Business Information Technology (BIT), Business Technology (BT), Information Management (IM), Information Systems (IS), Information Systems and Supply Chain Management (ISSCM), Information Systems and Technology (IST), and Management of Information Systems (MIS). Each of these programs was housed in the Business School of the respective university.

The following sections describe the current landscape of IS-related programs, recent modifications, and identified trends.

Programming Intensiveness

The current 2014 academic catalogs were reviewed to determine the current state of IS-related programs. The numbers of required and elective programing courses intended at increasing basic coding competencies were gathered. Course names included "Business Application Programming", "Introduction to Computer Programming", "Web Programming", etc. As shown in Table 1, the majority of the selected programs currently require multiple programming-intensive courses. These results align with the previously cited papers' claims that the majority of programs include programming.

	Program/Track Name
Required 4 Courses	BIS
Required 3 Courses	None observed
Required 2 Courses	BIS, IS, MIS
Required 1 Course	IS
Optional 3 Courses	IS
Optional 2 Courses	IS
Optional 1 Course	None observed
No Optional Courses	MIS

Table 1. Number of required or elective courses based on program names.

Program Naming

Disambiguation of program and track names based on programming requirements is shown as a problem in Tables 2 and 3. Programs with the same title have a diverse set of programming requirements. For simplicity, the programs in these tables that contain less than two required programming courses are labeled as Limited Programming programs. Programs with two to four required programming courses are labeled Extensive Programming. Due to the small sample size of program names outside of MIS or IS, Table 2 bins several related program names. Programs that have separate programming and non-programming routes in the same containing program or track name may appear in both categories.

Program Name	Limited Programing	Extensive Programming
BIS, MIS, IM	7	7
CIS, CSIS, IS, IST	5	11
BIT, BT, IST, IT	0	4

Table 2. Extent of programming requirements in grouped program names.

Program Name	Limited Programing	Extensive Programming
MIS	7	5
IS	4	6

Table 3. Extent of programming requirements in MIS and IS programs.

Program and Track Name by Strength

Programming in the Curriculum	Program and Track Name
None	MIS
Limited	4 MIS 3 IS 1 IM 1 ISSCM
Limited and Extensive Paths	1 MIS 2 IS 1 CIS
Extensive	1 BIT 1 BT 1 BIS 1 CIS 1 CS/IS (joint program) 4 MIS 5 IS 1 IST 1 ISSCM 1 IT

Table 4. Number of programs/tracks assigned with each respective label.

The programming requirements associated with each of these program names can further be divided to provide insights into the confusing nature of program names present in the 2014 landscape. In Table 4, "None" indicates 0 required courses, "Limited" indicates 1 required course, and "Extensive" indicates 2-4 required courses. "Limited and Extensive Paths" represents an emerging situation (noticeable after IS 2010) wherein programs have moved the set of previously required programming courses into a new set of courses designed as electives. Thus, the onus is left to students decided if they prefer or would benefit from a programming intensive or programming free path through the same program and track without an official label or distinction for this choice.

Programming Requirement Modifications

	Program and Track Name
De-emphasized	3 MIS: programming reduced
Same	7 MIS programs 5 IS programs 2 BIS program 1 BT programs 1 CIS program
Increased Emphasis	1 IS program added a required course 1 ISSCM added both a required and an elective course 2 IS programs added an elective 1 MIS program dropped a previously available no programming option 1 IS and 1 IM programs changed one elective to a required course 1 IS program added an intensive software design track 1 MIS program replaced one required course with a set of 3 new, highly recommended elective courses

Table 5. Program modifications based on the net effect of all changes within programs that were not structurally reorganized (comparing 2009 to 2014 catalogs).

Several trends can be observed by comparing the current set of catalogs with catalogs prior to the publication of IS 2010. Programs may weaken their programming requirements by eliminating required courses, eliminating elective options, or shifting required courses to elective options. Programs may strengthen their programming requirements by adding elective options, required courses, and eliminating non-programming routes. Programs may have remained at the existing level of programming emphasis (regardless of the nature of the program's prior limited or extensive requirements). Programs may also have remained at the existing level of emphasis by adopted new, updated programming courses to take the place of previous courses (while keeping the total number of courses constant).

As an example, one CIS program swapped three programming courses (COBOL, Business Application Software, and Advanced C/C++) for an alternative set (Visual C#, Java, Systems Development). Table 5 displays the direction programs have taken in regards to programming emphasis after the release of IS 2010. This table demonstrates that most programs have rejected adoption of IS 2010's programming guideline, with a third of programs actually increasing their programming requirements.

Structural Changes

Several structural changes resulted in 6 of the 40 programs. Three programs/tracks were eliminated between 2009 and 2014 (MIS, IS, and a no programming track within MIS). One new College of Information Systems was formed. One new Business Technology track was formed in a School of Business. One new programming intensive Software Design track was added. One new MIS program was formed. One program was renamed from IS to BIS. One new CS/IS degree was created and offered jointly by the unit containing Computer Science. Following the release of IS 2010, four programs added a 'choose your own intensiveness' route. Students in these programs had the official track designations removed and had freedom to select courses with either a limited or extensive programming set of electives. This resulted in what might be considered two separate but unofficial tracks within each program under the same program name.

4. CONCLUSIONS

This research analyzed 40 undergraduate IS programs, comparing their program requirements prior to the adoption of IS 2010 and current requirements. Preliminary results indicate that there were numerous changes observed in IS programs, track names, and organization structures after IS 2010 was adopted. Interestingly, these changes do not reflect the dropping of the required computing competencies. An additional finding is that multiple programs increased programming requirements, while only one institution decreased the amount of programming coverage. This finding is not surprising given the current demand for software developers and the desire on the part of universities to meet that demand. While the IS 2010 task force decided to leave out programming to allow for additional new topics, such as enterprise architecture, institutions apparently did not share that concern and have continued requiring programming courses.

Results indicate that IS 2010 has not been explicitly followed by a majority of programs. At the same time, there is a lack of a common set of expectations and consistency among programs with similar names leading to confusion and inconsistency in the essence of what an IS degree should contain. For example, programs named MIS/BIS are split on requiring programming courses and provide a limited computing experience, while the majority of IS/CIS named programs require a much more extensive programming experience. This inconsistency calls for a standardization of program names, content, and requirements.

This study shows that IS 2010 did not have an effect on IS programs for the vast majority of institutions. This is consistent with the recognized need for skilled programmers in the IS community. This further contradicts the decision to remove the requirement of programming in the core curriculum. In other words, this calls into question whether the programming requirement change proposed a solution for a nonexistent problem.

5. REFERENCES

Apigian, C. H. and Gambill, S. E. (2010) Are We Teaching the IS 2010 Model Curriculum? Journal of Information Systems Education, Volume 21, Number 4, Winter 2010, pp. 411-42.

Babb, J., Longenecker, H., Baugh, J. and Feinstein, D., Confronting the Issues of Programming in Information Systems, Curricula: The Goal is Success", *Information Systems Education Journal*. Vol. 12 (1), January 2014.

Bell, C.; Mills, R.; and Fadel, K. (2013) "An Analysis of Undergraduate Information Systems Curricula: Adoption of the IS 2010 Curriculum Guidelines," Communications of the Association for Information Systems: Vol. 32, Article 2. Available at: http://aisel.aisnet.org/cais/vol32/iss1/2

Couger, J. D., Davis, G. B., Feinstein, D. L., Gorgone, J. T., and Longenecker, H.E. "IS'.97: Model Curriculum and Guidelines for Undergraduate Degree Programs in Information Systems," The DATA BASE for

Advances in Information Systems, SIG-MIS Association for Computing Machinery, (26:1) 1997, pp 1--94.

DPMA. DPMA Model Curriculum, 1981. Park Ridge, Illinois: Data Processing Management Association, 1981.

DPMA. DPMA Model Curriculum, 1986. Park Ridge, Illinois: Data Processing Management Association, 1986.

Garvin, J. H., and Watziaf, V., Current Coding Competency Compared to Projected Competency, *Perspectives in Health Information Management, Online Research Journal*, April 22, 2004.

Gorgone, J., Davis, G., Valacich, J. S., Topi, H., Feinstein, D., and Longenecker, H. E. "IS 2002 Model Curriculum and Guidelines for Undergraduate Degree Programs in Information Systems," The DATA BASE for Advances in Information Systems, SIG-MIS Association for Computing Machinery, (34:1), 2003.

Longenecker, H. E., Jr., and Feinstein D. L. (Eds.). IS'90: The DPMA Model Curriculum for Information Systems for 4 Year Undergraduates. Park Ridge, Illinois: Data Processing Management Association 1991.

Longenecker, H. E., Jr., Feinstein, D. L., and Babb, J. S., Is There a Need For a Computer Information Systems Model Curriculum?, Proceedings of the Information Systems Educators Conference, San Antonio, TX, November 2013.

Nunamaker, J. F., Couger, J. D., and Davis, G. B. "Information Systems Curriculum Recommendations for the 80s: Undergraduate and Graduate Programs," Communications of the ACM, (25: 11), November 1982, pp. 781--805.

Pollack, Gregg, No, Not Everyone Needs to Learn to Code - But Here's What They Should Know, Posted: 04/16/2014 11:00 am EDT, available at: http://www.huffingtonpost.com/gregg-pollack/no-not-everyone-needs-to-_b_5155549.html?utm_hp_ref=email_share

Topi, H., Valacich, J.S., Wright, R.T., Kaiser, K., Nunamaker, J., Jay F., Sipior, J.C., and de Vreede, G.J. 2010. "Is 2010: Curriculum Guidelines for Undergraduate Degree Programs in Information Systems," Communications of the Association for Information Systems (26:1), 2010, p. 18.