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Information System Curriculum versus Employer Needs: A Gap Analysis

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Abstract

Information systems (IS) curriculum review is a continuous process. Universities seek to offer content that they believe will be most beneficial to students as they begin their career. However, that content may or may not satisfy employer needs. This paper, which is part of a larger study, seeks to determine if required course content matches the desired skills from employers. Course descriptions from 221 IS curricula in AACSB accredited schools were content analyzed to determine knowledge areas and technical skills covered. The study finds that there are gaps between the current IS curriculum and the employer's desired skills. Among others, security and project management should be more prominent in the IS curriculum. A full discussion of findings is provided.

Keywords: IS curriculum, knowledge area, technical skills

1. INTRODUCTION

Information system (IS) curricula seems relatively standard to most; however, the specific courses that each institution requires can vary. This means a required course at one university is not required at another. The course may be an elective or not covered at all. Therefore, the result can be a more diverse curriculum than one might anticipate. Added to this diversity is the wants and needs of industry. Some employers may desire the curriculum that is being offered in universities for IS professionals or they may desire curriculum that will specifically help their new hires to hit the job at full speed.

Programming, system methodologies and development, database design, and telecommunications come to mind when thinking of "standard" offerings; however, project management could be an unmet need at some universities as well as more specific application development.

In order to understand if IS curriculum is matching employer needs, this study is a continuation of two previous works – the first identified IS skill categories and the second identified of those skill categories which are desired most by employers. This study takes these previous findings and determines what

courses are being required by universities and how the previously identified desired skills match required course content. Ultimately, this paper identifies if there is a gap between required course content and desired employer needs. More specifically, this paper will assess whether certain "employer desired" IS topics are being neglected in the curriculum.

2. LITERATURE REVIEW

IS curriculum review has been done for many reasons. Veltri, et al. (2011) developed a framework for curriculum mapping to be used as a tool to help undergraduate IS programs determine if they are offering courses in the proper order to achieve the desired learning outcomes. The authors provide instruction on how to use the framework for continuous improvement of the program. In addition, the researchers discuss how mapping the IS curriculum can serve as an assessment tool for accreditation purposes.

Mills, et al. (2012) developed four types of IS curriculum profiles: independent, focused, adoptive, and flexible. These were developed by reviewing IS programs in AACSB schools and using the IS 2010 Model Curriculum Guidelines as a framework for their analysis. The independent profile represented programs that did not closely adhere to the 2010 model guidelines. The focused profile had programs with 30% to 70% adherence to the 2010 model guidelines. The adoptive profile had between 40% and 80% adherence. Finally, the flexible profile showed a 20% to 60% adherence to the 2010 model guidelines. The authors provided sample curriculum for each of the different profiles. Understanding the different types of profiles can help programs to see where they fit into the overall IS curriculum picture.

In addition to these reasons for studying and reviewing curriculum, researchers have also been studying the ability of IS programs to satisfy the needs of industry for quite some time. Researchers have used many methods. Some researchers have surveyed students to bring in their perspective, while others have worked with industry professionals. Each has added to the knowledge in this area. Here are just a few of those studies.

Plice and Reinig (2007) surveyed alumni of an IS program to determine what needed to be done to the program to better align it with their careers by balancing the technical vs. the business content. They found that the participants felt that bringing in heavier business content over

technical content would only help them in the short-term. This type of change would actually hinder their advancement into managerial roles, they reported. The need for an emphasis in communication and teamwork skills was the result.

Aasheim, Shropshire, Li, & Kadlec surveyed Information technology (IT) managers nationwide in a longitudinal study about the skills and traits needed for entry-level IT workers (2012). The first survey was administered in 2006 and then a second in 2010. In the 2010 survey, the top 12 skills found were the soft skills - personal and interpersonal skills. While some of the soft skills were different, the top skills were also the soft skills in 2006. The top technical skills were very close as well. In 2010, they were operating systems, security, hardware, networking, and database.

Mardis, et al. (2017) surveyed course syllabi, job postings, and certifications from information technology prep programs at a state college and two universities. They were trying to understand to what extent students were prepared for technical careers. The researchers used text analysis to review these artifacts. They found that they were able to determine that the programs provided the students with the technical skills. However, the soft skills, such as critical thinking and teamwork, were a bit more difficult to determine from the learning outcomes of the syllabus.

Longenecker, Babb, Waguespack, Janicki, and Feinstein (2015) used CC2005 as a base for creating the model curricula for CIS programs. This included the knowledge areas and sub-areas for each. The authors combined knowledge areas from the Bodies of Knowledge recognized by computing professional societies. Next, they organized a group of experts with backgrounds in computing education. They surveyed this group in regards to the knowledge areas list. They found that the experts indicated Database, Information Systems Development, Systems Design, Software Requirements/Programming (including web), and Project Management based on Leadership, Team, and Interpersonal Skills were the most important to curriculum.

These previous studies illustrate that there is room to continue improving IS curriculum as well as the studies being used to assess said curriculum. The next section will provide explanation for how this study hopes to examine the employer needs versus the IS curriculum content.

3. METHODOLOGY

This study is part three of a larger, ongoing research project which intention is to determine current employer needs and align IS curriculum to better satisfy those needs. In the first part of the study, the authors conducted 10 telephone interviews with IS/IT professionals and identified a starting place for development of a questionnaire (Lang, Jones, & Leonard, 2015). They identified several skill categories using inductive category development: soft skills, consisting of intrapersonal skills and interpersonal skills; and hard skills, consisting of domain knowledge and technical skills. In the second part of the study, the authors surveyed IS professionals regarding desired entry-level skills (Jones, Leonard, & Lang, 2018). Appendix A shows the demographics information of participants. They found that employers deemed soft skills as significantly more important than hard skills for entry-level IS positions. Among the soft skills were critical thinking and willingness to learn. The most important hard skills were Microsoft Office, Security, and database.

The current study adopted a methodology used in a prior study to directly survey universities IS program curriculum as described on their websites (Yang & Wen, 2017). Starting with a list of AACSB-accredited schools, the schools reviewed were ones with programs that had computer information system (CIS)/management information system (MIS)/IS programs listed. Not assessed were schools with a focus of computer science or business or data analytics for their program.

This was a two-stage process: data collection and data mapping. Data collection took place from September of 2016 to May 2017. Data collected included: course name, number, description, credits, and required/elective. General information about each university was also collected.

Once all of the data was collected, the data mapping could begin. The authors determined only to review the required courses, as each student in the program would take these. Knowledge Areas and Technical Skills were the framework used for mapping the data (Jones et al., 2018). Each author individually went through the courses and coded them based on the framework item that best described that course. Table 1 and Table 2 provide a list of the Knowledge Areas and Technical Skills. The Rank column is the rank they had from the second part of the larger study (Jones et al., 2018). It was

determined that it would be too difficult to identify if the Interpersonal/Intrapersonal Skills were being captured in the courses based on the course descriptions. Mardis, et al. (2017) had a similar issue found in their study. Therefore, only the Knowledge Areas and Technical Skills are in this study. Course descriptions for many courses identified more than one area or skill. In these cases, the authors selected the main area or skill. There were additional columns in the spreadsheet for secondary areas and skills, but those were minimal and are not a part of this paper. After each author went through the list individually, the lists were reconciled against each other.

Rank	Code	Area
1	K1	Security
2	K2	Programming
3	K3	Systems Development Methodologies
4	K4	Database Design
5	K5	Project Management
6	K6	Web Development
7	K7	IS Trends
8	K8	Enterprise Architecture
9	K9	Disaster Recovery
10	K10	Development Estimation Techniques
11	K11	Networking/Telecommunications
12	K12	E-Commerce
13	K13	Management
14	K14	Finance
15	K15	Accounting
16	K16	Marketing

Table 1: Knowledge Areas

Rank	Code	Skill
1	T1	Microsoft Office (Word, Excel, PowerPoint)
2	T2	Database/Data Warehouse/ Structured Query Language (SQL)
3	T3	Programming Languages
4	T4	Enterprise System Software
5	T5	Web Development Software
6	T6	Project Management Software
7	T7	Decision Support Systems
8	T8	Statistical Packages

Table 2: Technical Skills

4. RESULTS

At the time the research study began, there were 517 schools/colleges with an AACSB accreditation. Of these, 356 schools had some type of computing education program. After removing specialized programs and programs such as computer science, the number of schools was 249. Of these, 15% were private universities and 85% were public. Among these schools, 221 had clear designations of required versus elective courses on their websites.

Table 3 provides a list of the knowledge areas used as a main topic for the required courses sorted by frequency found in the courses across the schools. The table lists both the number of courses and the associated percentage. The main topic of 18% of the courses reviewed was programming. Database Design and Systems Development Methodologies were the main topics of 14% of the required courses. Management and Networking/Telecommunications was the main topic of 10% of the required courses. Table 4 provides a list of the knowledge areas and their frequencies of appearing as the main topic of at least one course in a program at the university. Database Design was the main topic of at least one course in 87.78% of the programs reviewed. Systems Development Methodologies was the main topic of at least one course in 85.97% of the programs reviewed. Programming was the main topic of at least one course in 75.57% of the programs reviewed. However, security was only the main topic of at least one course in 14.03% of the programs reviewed.

Code	Knowledge Area	Frequency	Percentage
K2	Programming	288	18%
K3	Systems Development Methodologies	228	14%
K4	Database Design	226	14%
K13	Management	166	10%
K11	Networking/Telecommunications	161	10%
K5	Project Management	114	7%
K6	Web Development	59	4%
K8	Enterprise Architecture	53	3%
K7	IS Trends	41	3%
K1	Security	34	2%
K12	E-Commerce	21	1%

Table 3: Frequency of Knowledge Area as Main Topic of Required Course

Code	Knowledge Area	Frequency	Percentage
K4	Database Design	194	87.78%
K3	Systems Development Methodologies	190	85.97%
K2	Programming	167	75.57%
K11	Networking/Telecommunications	137	61.99%
K13	Management	107	48.42%
K5	Project Management	101	45.70%
K6	Web Development	51	23.08%
K8	Enterprise Architecture	48	21.72%
K7	IS Trends	33	14.93%
K1	Security	31	14.03%
K12	E-Commerce	20	9.05%

Table 4: Frequency of Knowledge Areas Found in Programs

Table 5 provides a list of the technical skills emphasized for the required courses sorted by frequency found in the courses across the schools. This table also provides both the number of the courses and the associated percentage. Programming languages was the emphasis of 18% of the required courses reviewed. Database/Data Warehouse/SQL was the emphasis of 14% of the required courses. These mirror what was in the knowledge area. Many courses had both aspects of theory and hands on learning. Table 6 provides a list of the technical skills area and their frequencies of appearing as the emphasis of at least one course in a program at the university. At least one course in 87.78% of the programs emphasized Database/Data Warehouse/SQL. At least one course in 75.57% of the programs emphasized programming languages. Less than half of the programs, 47.51%, had at least one course emphasizing Project Management Software. Towards the bottom of the list was Microsoft Office (Word Excel, PowerPoint). Only 8.14% of the programs had this in at least one course.

Code	Technical Skills	Frequency	Percentage
T3	Programming Languages	289	18%
T2	Database/Data Warehouse/SQL	227	14%
T6	Project Management Software	116	7%
T5	Web Development Software	59	4%
T4	Enterprise Systems Software	47	3%
T1	Microsoft Office (Word, Excel, PowerPoint)	19	1%
T7	Decision Support Systems	14	1%
T8	Statistical Packages	12	1%

Table 5: Frequency of Technical Area Emphasized in Required Course

Code	Skill	Frequency	Percentage
T2	Database/Data Warehouse/SQL	194	87.78%
T3	Programming Languages	167	75.57%
T6	Project Management Software	105	47.51%
T5	Web Development Software	51	23.08%
T4	Enterprise System Software	43	19.46%
T1	Microsoft Office (Word, Excel, PowerPoint)	18	8.14%
T7	Decision Support Systems	13	5.88%
T8	Statistical Packages	11	4.98%

Table 6: Frequency of Technical Skills Found in Programs

5. DISCUSSION

In reviewing the results of the study, it is clear that there are gaps between what industry professionals rank as important entry level skills (Jones et al., 2018) and where the current IS

curriculum stands. This discussion will begin by addressing areas where there seem to be gaps, and follow with areas that seem not to have gaps.

In the knowledge area, the industry professionals ranked Security as the top desired skill for entry-level employees in the information systems field (Jones et al., 2018). However, this study shows that only 14.03% of the programs have a required course in security. Many of the programs did have a course in security listed as an elective. However, this would not ensure that every student graduating from that program would acquire the skill seen as important by the industry professionals. Universities will want to add or alter their curriculum to incorporate security as a required course.

Project Management is another knowledge area that was in the top five desired skills of entry level IS employees. However, this study found that only 45.70% of the programs had at least one course with project management as the main topic. For the technical skills area of Project Management Software, only 47.51% of the programs had emphasized project management in at least one course. As the importance of project managers in IS projects continues to be shown (Venkatesh, Rai, & Maruping, 2017), project management knowledge will continue to be seen as an asset to graduates.

Microsoft Office (Word, Excel, and PowerPoint) was the number one ranked technical skill that the industry professionals desired in entry level IS employees. However, this study showed that only 8.14% of programs had a required course that emphasized the use of the programs. Most courses would utilize this software in some way throughout the course. However, most did not have set objectives to teach the software. Most likely, universities are making assumptions that students are coming in with certain skill sets and are no longer offering these basic computer literacy courses. However, perhaps this is not an assumption to make. Many high schools may not be using these specific software packages, even though they are utilizing something similar. Programs may find it worth at least some portion of a course dedicated to ensuring their students master these skills.

Networking/Telecommunications appears in 61.99% of the programs reviewed as a required course. Yet, it was listed as ranking 11th in the desired skills for entry level IS employees by industry professionals (Jones et al., 2018). While this is clearly on the radar of the industry professionals, it appears less important than

some of the topics that are not appearing in many of the programs are. Perhaps if universities are looking for ways in which they can move courses around in order to accommodate courses such as Security and/or Project Management, moving the Networking/Telecommunications course to an elective and one of these to a required may be the answer.

Web Development and Enterprise Architecture are two other areas that receive little attention in the required curriculum but employers indicated a desire for these skills. While these areas are not in the top five for knowledge areas, they are in the top five for technical skills desired. However, the percentage of current IS curriculum that offers these as required courses is small (technical skills: 19.46% Enterprise System Software and 23.08% Web Development Software). Web development is a skill that is not going away and employers will continue to need it. Enterprise system software development can vary by industry but is definitely a desired technical skill as it ranked number four in the previous study.

Other desired knowledge and technical skills were heavily emphasized in the IS curriculum as expected such as programming, system development methodologies, and database design. These are standard and expected skill sets offered in the curriculum and desired for new hires in industry. It was a positive to see no gap in these areas between offerings and desires.

The intrapersonal/interpersonal skills, also indicated as important skills for entry level IS employees, still needs researching (Jones et al., 2018). These were difficult to determine if they were taught by reviewing the course descriptions, which were shown on the websites of the programs. Future researchers will want to survey programs to determine if these skills are in the programs. That will provide a guide for universities to know where their gaps are in regards to what the industry professionals rank as important.

Consider the limitations of this study when reviewing the recommendations. First, this study focused solely on AACSB-accredited schools. It is possible that IS curricula at non-AACSB accredited schools offer a different set of Knowledge Areas and Technical Skills. Second, the study focused solely on required courses. As a result, this analysis disregarded the content provided in elective courses. Given the strong emphasis on flexible curricula coupled with academic advising, it is likely that students at

many AACSB-accredited universities learn additional Knowledge Areas and Technical Skills not identified in this study of required courses. Third, this study relied solely on course descriptions when determining the coverage of Knowledge Areas and Technical Skills. While course descriptions should be a good indicator of course content, it is possible that certain minor content is not captured in the course descriptions and thus not in our study. Lastly, this study used a framework of Knowledge Areas and Technical Skills that were previously developed (Jones et al., 2018). As a result, this study did not address other potential content areas, including interpersonal skills.

6. CONCLUSION

IS curriculum and employer desires may not always meet eye-to-eye. This study has identified knowledge and technical areas where there are gaps in what universities are teaching, and what IS Professionals identified as skills that new hires need. More specifically, this study finds that universities offer programming, systems development methodologies, and database design in the curriculum and these are desired by employers. However, there are several areas that receive less attention in the required IS curriculum, such as security, project management, web development, and enterprise architecture, yet, employers desire them. IS curriculum must constantly evolve in order to produce students that meet the needs of industry. This study is part of a larger study which seeks to examine these gaps in the curriculum and offer recommendations to Universities seeking to improve their IS course offerings.

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Appendix A

Demographic Information of IS Professionals (Jones et al., 2018)

Demographic Variable		% of Respondents
Industry	IT	40%
	Healthcare	8%
	Financial Services	9%
	Consulting	10%
	Manufacturing	3%
	Chemical	1%
	Utilities	3%
	Education	3%
	Other	24%
Company Size (Number of Employees)	Less than 100	13%
	100 – 500	4%
	501 – 1000	1%
	1001 – 2500	4%
	2501 – 5000	13%
	5001 – 10,000	9%
	Over 10, 000	57%
Size of IT Staff	Less than 5	9%
	5 – 9	1%
	10 – 50	8%
	51 – 100	9%
	101 – 150	4%
	More than 150	70%
New IS Positions Per Year	Less than 5	26%
	5 – 9	9%
	10 – 19	8%
	20 – 29	13%
	30 – 49	3%
	50 or more	41%
Company Location	CA	1%
	CO	1%
	CT	37%
	IL	1%
	KS	1%
	MA	4%
	MN	1%
	NJ	5%
	NY	4%
	NC	3%
	OK	24%
	PA	4%
	SC	3%
TX	11%	
Job Title (Respondent)	CIO/VP, IS Director	10%
	IS Manager/Consulting Manager	11%
	Project Manager/Leader	10%
	Systems Analyst/Programmer, IS Consultant	29%
	Human Resources/Recruiter	3%
	Other	37%
Years of Experience (Respondent)	Less than 5	33%
	5 – 9	35%
	10 – 15	14%
	16 – 20	1%
	20 or More	17%