What's In and What's Out: Defining an Industry-Aligned IS Curriculum Using Job Advertisements

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Information Systems (IS) curricula need to provide students with skills that match industry requirements. This study examined online Information Technology (IT) job advertisements, compared them to the IS 2010 Model Curriculum, and recommended nine courses for an IS curriculum. The study found that programmer, network administrator, and database administrator were the top three jobs and that programming, database, and design were the top three qualification types. The data does not support 41% of the career tracks, nor 28% of the courses, in the IS 2010 Model Curriculum. The nine recommended courses deliver 76% of the qualifications suggested by the data.

INTRODUCTION

As technology evolves, the skills needed by organizations change. For example, the intrusion of enterprise systems such as Enterprise Resource Planning (ERP), Customer Relationship Management (CRM), and Geographic Information Systems (GIS) has been reshaping the Information Technology (IT) workforce (Litecky, Igou, & Aken, 2012). Other skills such as business analytics, business intelligence and privacy management have become pervasive in today's data-intensive lexicon. Organizations rely on their Information Systems (IS) teams to manage changing infrastructure, emerging technologies, and evolving organizational processes (Eom & Lim, 2012). Therefore, providing organizations with graduates that can demonstrate currently required industry skill sets is of high importance (Bell, Mills, & Fadel, 2013; Bullen, Abraham, Gallagher, Simon, & Zwieg, 2009).

Since the late 1980s, IS researchers have examined requisite skills (e.g., Albin & Otto, 1987). Skill examinations have used a variety of methods including: content analysis of job advertisements (Arnett & Litecky, 1994; Gallivan, Truex III, & Kvasny, 2004), surveys (Leitheiser, 1992; Noll & Wilkins, 2002), surveys combined with focus groups (Lee, Trauth, & Farwell, 1995), and more recently, data mining approaches (Litecky, Aken, Ahmad, & Nelson, 2010; Litecky, et al., 2012). These studies as well as others identify a "mismatch" between industry requirements and IS curriculum (Kim, Hsu, & Stern, 2006). This long recognized "expectation gap" has been attributed to the slow process of IS curriculum change (Trauth, Farwell, & Lee, 1993), which suggests a need for a systematic and continuous examination of the alignment between the skills acquired by IS graduates and industry requirements.

This study performs a content analysis of online job advertisements as part of this continuous examination of curriculum and job requirements alignment. The main objective of this study is to aid the

refinement of an undergraduate IS curriculum for a metropolitan university in the southeastern United States. The goal for the curriculum refinement is to ensure that the resulting curriculum changes are focused on preparing students for IS industry demands through alignment with the skills and competencies required by industry. Therefore, the research questions for this study are:

- What IT jobs predominate?
- How are IS courses aligned with the predominate qualifications required by those jobs?

This article proceeds as follows. The next section reviews prior studies on the evolution of IS skills since the 1970s, as well as, the history of IS curricula development. The literature review is followed by a discussion of the four phase research methodology used to identify and analyze the required skills. Then, the data analysis and results are described. Discussion of the findings follow the data analysis. Finally, the limitations and future research are discussed, which are followed by the study's conclusion.

LITERATURE REVIEW

A number of studies have been conducted over the last four decades to examine the IS skills required by industry. A limited number of studies were conducted in the 1970s that were primarily focused on discussing the importance of technical skills (White, 1970) and in-house training for programmers (Anderson, 1969). In the late 1980s, researchers studied job advertisements to determine the required IS skills and found an increased interest in business communication skills in addition to technical skill (Albin & Otto, 1987). In the 1990s, researchers identified an "expectation gap" between the needs of the IS profession and graduates' abilities that appears to result from the slow process of IS curriculum change (Trauth, et al., 1993). In the beginning of the 21st century, the employment rate for IT skills mirrored the economic slowdown and the post "dotcom" mania, but the positions that were available post-dotcom required an increase in number of skills (Gallivan, et al., 2004). Researchers continue to identify "skills gaps" between academic curriculum and industry needs (Eom & Lim, 2012; Kim, et al., 2006). While curricula efforts are also undertaken at the graduate level (Gorgone, Gray, Stohr, Valacich, & Wigand, 2005), this study focuses on undergraduate curricula efforts. Some of the most current studies identifying required IS skills for industry along with their research methods are summarized in **Table 1**.

TABLE 2
SUMMARY OF RESEARCH ABOUT IS SKILLS

Reference	Methodology	Sources of Data	Relevant IS Skills
(Litecky, et al., 2012)	Data Mining (crawler)	Online job advertisements sites	Business skills, soft skills, general technical skills
(Eom & Lim, 2012)	Survey	IT personnel	Personal traits, communication and problem-understanding, collaboration and project management, IT facilitation and promotion
(Litecky, et al., 2010)	Data mining	Online Job advertisements	20 Clusters
(Huang, Kvasny, Joshi, Trauth, & Mahar, 2009)	Literature Review Online search	Proquest Database and Online job Ads	Technical, humanistic, and business skills
(Gallivan, et al., 2004)	Content Analysis	IT publication Newspaper Job Ads	Technical skills and non-technical skills

(Noll & Wilkins, 2002)	Survey	IS practitioners	Business knowledge, advanced IS applications, user support, programming, systems planning.
(Lee, et al., 1995)	Focus Groups Survey	IS and Business managers	Technical knowledge, technology management, business functional knowledge, interpersonal and management skills
(Todd, McKeen, & Gallupe, 1995)	Content Analysis	Newspapers	Programmers, systems analysts, IS managers
(Trauth, et al., 1993)	Interviews Surveys	IS practitioners	Combination of human, technical and business abilities. Gap in skills between IS degree programs and industry requirements

This ongoing identification of required skills suggests a reason for ongoing revisions to IS curriculums (summarized in **Table 2**). Curriculum development in information systems started in the early 1970s with the Association of Computing Machinery (ACM) curriculum committee for computer education for management (Ashenhurst, 1972; Couger, 1973; McKenney & Tonge, 1971; Teichroew, 1971). This was followed by other reports in the 1980s (Nunamaker, Couger, & Davis, 1982) that proposed several curriculum changes to the 1972 and 1973 reports including the structure and definition of courses as well as the inclusion of the Association to Advance Collegiate Schools of Business (AACSB) common body of knowledge (Nunamaker, et al., 1982). Data Processing Management Association (DPMA) was a major curriculum model developed in the 1990s (Longenecker Jr, Feinstein, Fournier, Doran, & Reaugh, 1991). The IS 1997 Curriculum (Davis, Gorgone, Couger, Feinstein, & Longenecker Jr, 1997) was the result of the joint efforts of ACM, Association of Information Systems (AIS), and Association of Information Technology Professionals (AITP) and was the basis for IS accreditation. This was followed by IS 2002 Curriculum which provided guidelines for undergraduate programs of information systems. The IS 2010 Curriculum (Topi et al., 2010) is the latest standardized IS curriculum developed for the purpose of educating students and preparing them to enter the IS/IT job market. While the standardized model provides a framework to develop curriculum, it is important to enhance the model with wisdom from the practitioner community (Huber & Watson, 2013). This study provides practitioner community data to validate, refine, and focus the standardized curriculum model.

TABLE 3
SUMMARY OF IS CURRICULUM EFFORTS

Curriculum Model	Curriculum Efforts by	Reference
'70s Reports	ACM Curriculum Committee	(Ashenhurst, 1972; Couger, 1973; McKenney & Tonge, 1971; Teichroew, 1971)
'80s Reports	ACM Curriculum Committee on Information Systems (C^2IS)	(Nunamaker, et al., 1982)
DMPA'90	Data Processing Management Association (DPMA)	(Longenecker Jr, et al., 1991)
IS'97	ACM, AIS and DPMA/AITP	(Davis, et al., 1997)
IS 2002	ACM, AIS and DPMA/AITP	(Gorgone et al., 2003)
IS 2010	ACM and AIS	(Topi, et al., 2010)

METHODOLOGY

A four phase study was conducted to investigate online job advertisements and compare it to IS curriculum. Phase one involved a content analysis of online job advertisements to identify predominate job types and qualification types. In phase two, focus group and discussion with industry executives and academics was performed to obtain some validity to the content analysis. In the third phase, the findings were compared to the IS 2010 Curriculum to identify discrepancies between online job advertisements and the currently recommended curriculum. Lastly, the job advertisement and IS curriculum comparison was used to create a prioritized job list and a prioritized course list in phase four.

Phase 1

This study employed a content analysis of online job advertisements. The data collection and analysis of this phase was carried out with four steps. In the four steps, the online job advertisements were pulled, filtered, refined, and coded. These steps are discussed in the following paragraphs.

Online advertised jobs were pulled from four major job posting websites (Careerbuilder.com, Helpwanted.com, Indeed.com, and Monster.com). The websites were chosen based on being in the top Google search results for "technical job postings". The jobs were pulled using "Information Technology" as a category and as keyword searches. The jobs were pulled in October of 2012 for the state of Arkansas in the United States.

The initial job pull resulted over a thousand IT jobs. Many of these jobs were not relevant to the study due to job miscategorization and non-IT jobs having technology qualification requirements. Correcting the issues from the initial job pull required that the pulled jobs be filtered. Some examples of the jobs removed from the study's dataset included: sales opportunities, entrepreneurial opportunities, tower climbing, etc. After removing the erroneous search results, the search resulted in 206 information technology jobs for the state that were loaded into a Microsoft Access database.

Once loaded into the database, the qualifications were refined. Several iterations were performed to identify and remove duplicated qualifications from the list. This duplicate removal process included the identification and removal based on synonyms in the qualifications (e.g., issue and problem were found to be synonyms in the qualifications). A representative single qualification from each set of duplicates was selected. The representative qualification was related to all the jobs related to the set of duplicates and all other duplicated qualifications in the set were removed from the database.

Content analysis was performed on the refined data by coding Jobs and Qualifications into categories (i.e., Job Types and Qualification Types). Content analysis is a method of making replicable and valid inferences from text to the text's context (Krippendorff, 2004, p. 18). Content analysis has as its goal a numerically based summary of a chosen message set (Neuendorf, 2002, p. 14) and is appropriate for the summary of any message pool (Neuendorf, 2002).

The categories used in the content analysis were derived inductively from the data using a grounded theory approach (Strauss & Corbin, 1997). The first fifty jobs that were entered into the database were analyzed to identify the Job Type and Qualification Type categories by a member of the research team who has over twenty-years of practical experience in the information systems field in both technical and managerial roles. Those initial categories with their membership were presented and discussed in meetings with information systems and management researchers to establish some initial validity. Those initial categories were utilized by a second member of the research team to code the remainder of the jobs. The category memberships provided guidance in this coding process. Any questions, issues, or instances that did not fit the established categories were discussed and refinements were made to the categories and to the guidance used in the coding process. Upon completion of the coding process, the data analysis was reviewed for errors and omissions by the initial member of the research team.

Every Job and every Qualification was manually coded and recorded in the database to facilitate querying and reporting. This coding reduced a large set of job titles and an even larger set of qualification descriptions from the advertisements into a set of more general categories. This coding generalized job sub-specialties such as Java developer, web developer, and .NET software engineer among others into a

single programmer category. The job description and qualifications were used to confirm job type. As examples, the job description and qualifications were used to determine whether or not Systems Analyst / Programmer belonged in the Programmer category or the Business Analyst category and to determine that Customer Replenishment Analyst should be categorized as a Data Analyst. Each job was categorized to one and only one Job Type. The coding of Qualifications also generalized sub-specialties, particularly tool and technology related qualifications, such as Hibernate, JSTL, Tiles, and JBuilder into a Programming Qualification Type. In some cases, the tools and technologies that were unfamiliar were researched to facilitate categorization and the job title often provided a context for the qualification. Each Qualification was categorized to one and only one Qualification Type. Issues in coding were discussed by the coder and other team members and the agreed resolutions drove the coding efforts. The results of this data coding are presented in the Analysis section of this article.

Phase 2

Phase two performed an initial validation of the data coding. The Phase 1 round of data coding was performed for Job Type and Qualification Type. This initial coding of the data was presented to the College of Business (COB) IS Advisory Board, a focus group of industry managers and executives. Issues, such as a lack of security and mobile development categories, identified by the focus group led to additional rounds of Job Type and Qualification Type data analysis.

The process resulted in the dataset for which record counts are presented in **Table 3**. The relationship counts in the dataset were reviewed and utilized to identify data errors. Data errors such as records not utilized in relationships (e.g., a duplicated qualification that was erroneously not deleted from the tables) were identified. The final descriptive relationship statistics are presented in **Table 4**.

TABLE 4
DATA COUNTS

Item	Record Count
Company	113
Location	22
Source	4
Job Type	13
Job	206
Job Qualification	4254
Qualification Type	26
Total Qualifications	1184

TABLE 5
RELATIONSHIP STATISTICS

Relationship	Average	Maximum	Minimum	Standard Deviation
Jobs per Company	1.82	20	1	2.21
Jobs per Location	9.36	82	1	19.14
Jobs per Source	51.50	107	7	42.12
Jobs per Job Type	15.85	87	2	22.50
Job Qualifications per Job	20.65	63	2	11.00
Job Qualifications per Qualification	3.60	86	1	6.91
Qualifications per Qualification Type	47.36	223	1	51.98

Phase 3

The coded results from the first two phases were compared to IS 2010 Model Curriculum. Job Types from the dataset were compared to Career Tracks in the IS 2010 Model Curriculum. In some cases a Job Type was listed more than once when it could be identified that the Job Type encompassed more than one Career Track. Also, Qualification Types from the dataset were compared to IS Courses in the IS 2010 Model Curriculum. In some cases a Qualification Type was listed more than once when it could be identified that the Qualification Type encompassed more than one IS Course. The objective to the comparison was to identify overlaps and gaps between the IS job market and the recommended IS curriculum. The results of this comparison are described in the Analysis section of this article.

Phase 4

The comparison results were used to define a prioritized job focus and a prioritized course list. The prioritized job focus was based on the number of jobs for a Job Type. The larger the number of jobs for a job type caused a higher job priority. The prioritized course list was based on the number of qualifications for a Qualification Type. The larger the number of qualifications caused a higher course priority.

DATA ANALYSIS AND RESULTS

The results of data coding can be summarized in two tables. Two-hundred and six jobs were categorized into thirteen categories, which are summarized in order of Job Count in **Table 5**. Eleven-hundred and eighty-four qualifications were categorized into twenty-six qualification types. The Qualification Type coding is summarized in order of Qualification count in **Table 6**.

TABLE 6
JOB TYPES

Job Type	Job Count	Job Percent
Programmer	87	42%
Network Administrator	27	13%
Database Administrator	19	9%
Architect / Designer	14	7%
Business Analyst	13	6%
Application Support	10	5%
Data Analyst	8	4%
Project Manager	8	4%
Security Administrator	5	2%
Trainer	5	2%
Database Developer	4	2%
Other	4	2%
Tester	2	1%
Total	206	100%

TABLE 7
QUALIFICATION TYPES

Qualification Type	Qualification Count	Qualification Percent
Programming	223	18.83%
Database	138	11.66%
Design	106	8.95%
Project Management	97	8.19%
Networking	96	8.11%
Requirements	80	6.76%
Communication	59	4.98%
Problem Solving	56	4.73%
Security	42	3.55%
Education	35	2.96%
Business	33	2.79%
Reporting	32	2.70%
Testing	31	2.62%
Data Analysis	31	2.62%
Package	29	2.45%
Performance	20	1.69%
Personal	19	1.60%
Experience	18	1.52%
Industry	11	0.93%
Training	11	0.93%
Research	7	0.59%
Team	5	0.42%
Mobile	3	0.25%
e-Commerce	1	0.08%
Content Management	1	0.08%
Total	1184	100%

Job Type to Career Track Comparison

This coded dataset was analyzed by comparing it to the IS 2010 Curriculum (Topi, et al., 2010). The first analysis compared Job Types to the Career Tracks provided by the IS 2010 Model Curriculum. The Job Type to Career Track comparison shows an incomplete match. There are some Job Types that do not readily map to Career Tracks and Career Tracks that do not readily map to Job Types. Overall, 86% of jobs fit into a Career Track. An overview of the mapping can be found in **Table 7**.

Additional analysis and adjustment was performed since the Job Type coding occurred in a content analysis approach with no reference to Career Tracks. Two of the eighty-seven programming jobs are reclassified to the web content manager career track though those jobs appear to be more concerned with development of digital content than the management of content. In addition, two of the thirteen business analyst jobs are reclassified to business process analyst career track.

There are five Job Types with no matching Career Track, which include: application support (10 jobs), data analyst (8 jobs), trainer (5 jobs), other (4 jobs), and tester (2 jobs). The application support jobs cover a range from help desk support to administration of purchased packages. The data analyst jobs cover a variety of industries and functions, but in general terms they are about reporting and decision making with data. The trainer jobs deliver technical training and develop technical course content. The other jobs are for Computer Aided Design (CAD) specialist and sales support. The tester jobs are for quality assurance jobs.

TABLE 8
JOB TYPE TO CAREER TRACK MAPPING

Career Track	Job Count	Job Type
Application Developer	85	Programmer*
Business Analyst	11	Business Analyst**
Business Process Analyst	2	Business Analyst**
Database Administrator	19	Database Administrator
Database Analyst	4	Database Developer
Architect	14	Architect / Designer
Security and Risk Manager	5	Security Administrator
Network Administrator	27	Network Administrator
Project Manager	8	Project Manager
Web Content Manager	2	Programmer*
	10	Application Support
	8	Data Analyst
	5	Trainer
	4	Other
	2	Tester
e-Business Manager		
ERP Specialist		
Auditing and Compliance Specialist		
Asset Manager		
Consultant		
Operations Manager		
User Interface Designer		
Total	206	

38% (5 of 13) of Job Types and 14% (29 of 206) of Jobs are not readily apparent as a Career Track

41% (7 of 17) of Career Tracks are not readily apparent in Job Types

(symbols * and ** mark duplicates)

There are seven Career Tracks with no matching Job Types, which include: e-business manager, ERP specialist, auditing and compliance specialist, asset manager, consultant, operations manager, and user interface designer. While an inspection of job qualifications implies e-business across job types, there were no specific jobs of e-business manager. An inspection of jobs and job qualifications implies ERP applications in jobs, but there were no jobs that could be clearly categorized as ERP specialist. While "audit" and "compliance" are mentioned in some qualifications, none of the jobs can be categorized as audit and compliance specialists. The term "asset" was mentioned only once in a qualification, which was in the context of auditing existing assets, so no jobs appeared for asset manager. There were two jobs that mentioned "consulting" in the names. One was categorized as application support and the other was categorized as other (technology sales support). Several of the companies in the data are consulting companies, but their jobs are best categorized with a different Job Type. The term "consult", or a variation of it, appeared in a variety of qualifications and seemed to refer to a skill of interpersonal interaction more than as a specific job. None of the jobs can be categorized as operations manager. User interface design is not directly mentioned in any job or job qualification, though the skill is implied in some qualifications.

Overall there is about a 60% overlap between Career Tracks and Job Types. That overlap accounts for 86% of the jobs in the data set. Another 5% of the jobs, or 91% of the jobs, are accounted for using the assumption that someone trained as an application developer has the basic skills needed to perform an application support job. This assumption is supported by the qualification data.

Qualification Type to IS Course Comparison

The second level of analysis compared the Qualification Types to the IS Courses provided by the IS 2010 Model Curriculum. The Qualification Type to IS Course comparison shows an incomplete match. There are Qualification Types that do not readily map to IS Courses and IS Courses that do not readily map to Qualification Types. Overall, 76% of Qualifications by count fit into an IS Course based on Qualification Type categorizations. An overview of the mapping can be found in **Table 8**.

TABLE 9
IS COURSE TO QUALIFICATION TYPE MAPPING

IS Courses	Qualification Count	Qualification Type
Application Development	223	Programming
Data and Information Management+	138	Database
Enterprise Architecture+	102	Design**
Project Management+	97	Project Management
Infrastructure+	96	Networking
Systems Analysis and Design+	70	Requirements*
Security and Risk Management	42	Security
Information Search and Retrieval	32	Reporting
Audit and Controls	31	Testing
Data Mining / Business Intelligence	31	Data Analysis
Enterprise Systems	29	Package
Business Process Management	10	Requirements*
Human-Computer Interaction	4	Design**
	59	Communication
	56	Problem Solving
	35	Education
	33	Business
	20	Performance
	19	Personal
	18	Experience
	11	Industry
	11	Training
	7	Research
	5	Team
	3	Mobile
	1	e-Commerce
	1	Content Management
Foundations of IS+		
Strategy, Management, and Acquisition+		
Collaborative Computing		
Social Informatics		
Knowledge Management		
Total	1184	

(#1) 56% (14 of 25) of Qualification Types and 24% (279 of 1184) of Qualifications are not readily apparent in IS Courses

(#2) 28% (5 of 18) of IS Courses are not readily apparent in Qualification Types

(symbol + marks Core IS Courses) (symbols * and ** mark duplicates)

Additional analysis and adjustment was performed since the Qualification Type coding occurred in a content analysis approach with no reference to IS Courses. Ten of the eighty requirements qualifications are reclassified to the business process management IS Course as they describe competency in business processes. In addition, four of the one-hundred and six design qualifications are reclassified to the human computer interaction IS Course as they describe user-computer interaction competencies.

There are fourteen Qualification Types with no matching IS Course (See #1 in **Table 8** for summary view). Education and experience Qualification Types should be removed from the analysis since they are concerned with levels of education (e.g., Bachelor degree required) and years of experience (e.g., three or more years of experience) as those are not curriculum related items. Business and industry Qualification Types should also be removed from the analysis since business functions (e.g., makes recommendations for improving merchandising operations) and industry expertise (e.g., demonstrates an understanding of the financial services industry) are contexts that are typically taught outside of a strictly IS curriculum. Content management and e-commerce Qualification Types may not be gaps since there are Career Tracks for e-business and web-content manager, so it is assumed that those topics are covered within one or more of the IS Courses even though there are not specific IS Courses for the topics. Communication (e.g., excellent written and verbal communication skills), problem solving (e.g., troubleshoot, identifies, & resolves issues to root cause), performance (e.g., ensures system performance), personal (e.g., adaptable, self-motivated, can work under pressure), research (e.g., strong research skills), and team (e.g., team player) Qualification Types need to be considered in the analysis but there should not be an expectation that there would be a specific course for each of these required competencies. The training Qualification Type (e.g., delivers technical training to end-users on new/established programs) is not considered a gap since it is assumed that training course development and delivery skills would be considered outside the scope of a typical IS curriculum. The mobile Qualification Type (e.g., experience in developing cross-browser compatible mobile applications) should be considered a gap, but is probably explainable by recognizing that mobile computing is a relatively new trend.

There are five IS Courses with no matching Qualification Types (See #2 in **Table 8** for summary view), which include: foundations of IS, strategy, management and acquisition, collaborative computing, social informatics, and knowledge management. The foundations of IS course does not provide specific qualifications to the IS graduates, but it is a course taught across the College of Business to all business majors. The strategy, management, and acquisition course is a core IS 2010 Curriculum course, but based on this data, it contributes little to qualifications identified with technology jobs. Also, the data provides little evidence that collaborative computing, social informatics, and knowledge management courses contribute to qualifications identified with technology jobs.

Overall there is about a 44% match of IS Courses to Qualification Types. That overlap accounts for 76% of the qualifications in the data set. Another 15% of the qualifications, or 91% of the qualifications, are accounted for using the assumption that the six qualification types identified as not expected to be found in individual courses (i.e., communication, problem-solving, performance, personal, research, and team) are taught throughout, or within, the other courses.

DISCUSSION

Based on the data, there are ten basic job types (excluding the Job Type – Other). Those ten Job Types assume that an education as a Programmer will also prepare the candidate for Application Support jobs and it assumes that an education as a Database Administrator will prepare candidates for a job as Database Developer. Data Analyst was excluded from the Database Administrator job since it focuses more on reporting and business decision making than on the specifics of database development and operation. The job types are listed in **Table 9**.

TABLE 10
TARGET JOB TYPES

Job Type	Job Count	Job Percent
Programmer (includes ten Application Support jobs)*	97	47%
Network Administrator*	27	13%
Database Administrator (includes four Database Developer jobs)*	23	11%
Architect / Designer*	14	7%
Business Analyst*	13	6%
Project Manager	8	4%
Data Analyst	8	4%
Security Administrator	5	2%
Trainer	5	2%
Tester	2	1%
Other (not included in job focus)	4	2%
Total	206	100%

Of those ten Job Types, there are five Job Types that account for about 85%, or 174 of 206, of the jobs found in the data. These five jobs therefore become the focus for the local curriculum and those jobs are highlighted with an "*" in **Table 9**. This focus establishes that goal that students will be qualified for those jobs as graduation. If there is a need to further focus the job types, then the top three jobs account for 71% of the jobs.

While the goal is for students to get jobs and the job focus helps ensure that goal for students, the mission of a university business school is to provide career education not simply job training (Trauth, et al., 1993). For this reason, the curriculum should focus on the predominance of qualifications for all IT jobs and not just those for the jobs in focus. For this reason, nine courses are suggested for the curriculum, based on Qualification Type, as shown in **Table 10**. **Table 10** is derived from **Table 8** where thirteen IS 2010 Curriculum courses are suggested by the data. Since Qualification Types were duplicated (listed twice or more in the table) to provide IS Course coverage, only eleven Qualification Types that identify courses are required to provide adequate coverage. The merging of testing with security and the merging of reporting with data analysis further reduces the necessary course number down to nine courses. Note that the IS Foundations course, which is taught to all business majors, is not part of the IS curriculum, but all IS majors will take that course as part of their business degree.

The below nine course curriculum provides an overview of what the data suggests should be provided in an IS curriculum, but it includes some assumptions. One assumption is that to improve the effectiveness of the curriculum the six qualification types not identified by individual courses (i.e., communication, problem-solving, performance, personal, research, and team) must be integrated across all of the courses in the curriculum. Another assumption is that a single course is sufficient to deliver adequate competency, but that might not always be true (e.g., can a single programming course deliver adequate competency?). Given those assumptions, the above curriculum provides a recommended priority of courses based on the highest level of coverage from both a job data point of view and from the recommended curriculum point of view.

TABLE 11
LIMITED CURRICULUM COURSES

Qualification Types	IS Courses	Count	Percent
Programming	Application Development	223	19%
Database	Data and Information Management	138	12%
Design	Enterprise Architecture	106	9%
	Human-Computer Interaction		
Project Management	Project Management	97	8%
Networking	Infrastructure	96	8%
Requirements	Systems Analysis and Design	80	7%
	Business Process Management		
Security and	Security and Risk Management	42	4%
Testing	Audit and Controls	31	3%
Reporting and	Information Search and Retrieval	32	3%
Data Analysis	Data Mining / Business Intelligence	31	3%
Package	Enterprise Systems	29	2%
Total		905 of 1184	76%

LIMITATIONS AND FUTURE RESEARCH

The study was initiated as a part the curriculum revision process within a university in the southeast of the U.S. The data collection was limited to the state of Arkansas where the university is located. While the findings are appropriate for the university in the IS department's curriculum decision, it limits the generalizability of the findings across the fifty U.S. states. A valuable area for future research would be to replicate the study for more, or larger, geographic regions.

The study utilized a grounded approach to data coding. The job types and qualification types emerged from the data and are biased to the researcher's experience. While this approach is appropriate to exploratory studies such as this one, future research should measure the validity of job types and qualification types by utilizing methods that address this bias, by utilizing multiple researchers, or study participants, to code the data, and by measuring inter-rater reliability.

The study is based on data acquired for a single point in time. The small dataset allowed manageable manual manipulations and coding that would not have been possible with a larger dataset without an automated process. Future research should encompass a longitudinal study to monitor changes in required skills over time within the state and the implementation of web crawlers and text mining tools to facilitate the study of larger datasets.

This study is based on job postings written in a language that communicates job requirements to applicants. That style of writing is not highly structured beyond a tendency to include a job requirement as a sentence in a description or a bullet in a bulleted list. Those sentences and bulleted items were used as the items of data in this study. Some of those data items contained compound qualifications (i.e., multiple qualifications in a single item). Each compound data item was assigned to one and only one qualification type. In some cases the compounding was irrelevant to the coding (e.g., "excellent written and oral communication skills" was categorized as Communication), yet other cases the item could have fit into several qualification types at the same time (e.g., "can design, analyze, construct, & support quality web applications" was categorized as Programming). When an item could have simultaneously fit into multiple qualifications types, a single qualification type was chosen based on the coders perceived emphasis of the qualification and validated through discussions of the research team. While this approach

is sufficient for this exploratory study, it identifies a need for future research to use much more rigorous methods that breakdown the qualifications (e.g., "excellent written and oral communication skills" was categorized as Communication and "can design, analyze, construct, & support quality web applications" was categorized as Programming)

The study uses online job advertisements as its data source. Focus group discussions suggest that companies do not post all of their jobs on the job posting websites because of cost. The focus group discussion suggested that the jobs found online tend to be those that companies cannot fill internally, on their intranet, or by posting on their extranet. This suggests a biased sample where some Jobs Types and Qualifications Types may be under-represented, or over-represented. While this issue provides an opportunity for future research, it was decided that this limitation was not severe enough to invalidate this study. Future research should acquire job postings from individual company websites, as well as commercial online job search sites, to improve the validity of the results and to explore the differences in company posted and commercially posted job advertisements.

CONCLUSIONS

This study is part of an ongoing review, analysis, and revision of IS curriculum at colleges and universities. This study provides a detailed evaluation process and empirical evidence on the skills required by the IT job market. A content analysis approach was used to code and analyze the data that was then compared to the IS 2010 Curriculum (Topi, et al., 2010). The data identified a list of five job types, representing 85% of the available jobs in the studied region, on which to focus the curriculum. The data analysis and comparison to the standardized curriculum identified a prioritized list of nine courses that represent 76% of the qualifications. These courses provide the basis for an industry-aligned IS undergraduate curriculum refinement at a metropolitan university in the southeastern United States.

This study is useful for students. While university brand, location, and many other factors effect student's university choices, the alignment of curriculum to job market requirements should also be a factor. This list of courses provides a basic checklist of courses that should be in a curriculum when students are concerned about how well their IS degree prepares them for the job market.

This study is useful to academics. While keeping in mind the previously described limitations of this study, weaknesses were found in the IS 2010 Model Curriculum. The data does not support 41% of the career tracks, nor 28% of the courses, in the IS 2010 Model Curriculum, which demonstrates the importance of a systematic and continuous examination of the alignment between IS curriculum and industry requirements.

In conclusion, the study provides insight into available jobs, required skills, and course priorities. The findings suggest that today's IT job market is still predominately technical with 71% of the jobs being programmer, network administrator, and database administrator. The findings suggest that while softer skills (e.g., communication, problem solving, personal, research, and team) are important elements in a curriculum and account for 12% of the qualifications, technical skills account for 76% of the qualifications. Therefore, assuming a goal of undergraduate programs is student placement and accounting for other competencies that are required of graduates, the nine prioritized courses in an IS curriculum ensure IS graduates are competent in fundamental technical skills that match the IT job market.

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