Are We Teaching the IS 2009* Model Curriculum?

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ABSTRACT

This article presents the results of research that gathered data about undergraduate information systems curricula and compared it to previous studies and the IS 2009 working model curriculum which is now named IS 2010 Model Curriculum after final approval. Data was collected from the websites of 240 colleges and universities identified as having information systems programs in colleges of business. The results indicate that although a core set of courses continues to be offered at schools, IS curricula continues to evolve but does not always match current curriculum models.

Keywords: Curriculum, Curricula, Information Systems, IS, Teaching

1. INTRODUCTION

Technology continues to change and evolve at a rapid pace (Topi et al., 2009), which has led to a need to review and maintain up-to-date IS curriculum (Kung et al., 2006). However, has the Information Systems (IS) curriculum kept up with this evolution? In September of 2009, a task force from the Association of Computing Machinery (ACM) and the Association of Information Systems (AIS) released an updated working model curriculum, titled IS 2009: Curriculum Guidelines for Undergraduate Degree Programs for Information Systems. The task force assessed that it was time for a change in the structure of the IS curriculum and by posting the draft in a wiki-style website, it offered the opportunity to critique and comment on the alignment and appropriateness of the guideline. Since the release of IS 2009 (Topi et al., 2009), it has been approved and renamed IS 2010 (Topi et al., 2010).

This study reviews the aims and intentions of the IS 2009: Curriculum Guidelines for Undergraduate Degree Programs for Information Systems (Topi et al., 2009) and reviews the literature to establish a basis for its rationale. The second aim of this study is to identify whether information systems degree programs within business colleges are teaching the proposed curriculum and if the current offerings have evolved in recent years compared to other studies. This was completed by compiling course offerings from 240 colleges and universities in the United States that offer four-year undergraduate degrees and comparing it to previous studies (Maier and Gambill, 1996; Porter and Gambill, 2003) and the IS 2009 (Topi et al., 2009) model curriculum.

2. THE NEED FOR EVALUATION OF IS CURRICULUM

Prior to gathering information about current course offerings, literature was review to establish the validity of a new model curriculum. The IS 2009: Curriculum Guidelines for Undergraduate Degree Programs in Information Systems (Topi et al., 2009) established several reasons for updating the IS 2002 guidelines, which are well supported in the literature. The most obvious reason is the length of time since the last curriculum model update. The last comprehensive revision was IS 1997 (Davis et al., 1997) with IS 2002 (Gorgone et al., 2002) considered an editorial update to include e-commerce issues (Topi et al., 2009). IS 2009 includes several key changes from the IS 2002 model curriculum (Gorgone et al., 2002), based on current technology and industrial practices. These changes include globalization, web technologies, a new architectural paradigm, large-scale ERP systems, the availability of mobile applications, and the use of IT control frameworks (Topi et al., 2009). Another factor is a significant decline in the number of individuals interested in majoring in information systems (Kung et al., 2006). All of these changes support the need to reevaluate the core principles of the IS curriculum and ensure alignment with business needs (Granger et al., 2007). There was also a change in how the curriculum model was created. More Web 2.0 technologies were used to include the IS community through a wiki environment. The following includes a review of the literature that pertains to the need for a model curriculum and the motivation for the revision and culmination of IS 2009.

* Now named IS2010 Model Curriculum after final approval.

2.1 Changing Technology and Required Skill-Set

Technology and its required skill set continue to change and innovate, which further encourages the need to review IS curricula. In addition, the difference between industry needs and academic perception of those needs has been a known issue for some time (Trauth et al., 1993). IS 2009 (Topi et al., 2009) attempts to address this need by identifying four guiding assumptions about the IS profession. First, it indicates that IS is expanding into a broader domain that includes other fields such as health care, business, government, etc. This blurring of disiplines may faciltate the need to encourage more students to minor in IS, the creation of joint programs or certificate programs, hands-on experience for students and faculty, and better alignment of curriculum with local industry (Granger et al., 2007).

Second, IS professionals must have good analytical and critical thinking skills to become problem solvers. Many CIOs claim that graduates lack the business thinking and communication skills that are now required for corporate IS jobs (Hoffman, 2003). This deficiency continues to be an issue and is critical to the success of the IT industry especially since the vast majority of the IT workforce initially receive their training from academia (Ehrie, 2002; Lippert and Anandarajan, 2004).

Third, IS professionals must have good interpersonal communication and team skills in order to understand system requirements and have the ability to collaborate with other business professionals. Employers still desire technical skills, such as programming, systems testing, desktop support, database design and management, and data communications, but they also emphasize soft skills that include problem/opportunity solving skills, relationship/conflict resolution skills, as well as project management skills (Bannerjee and Lin, 2006).

Lastly, IS professionals must be able to design and implement solutions to improve the organization's performance and not just to adhere to specified rules without consideration of business processes. This shift in the IT mission from delivering technology based solutions to managing the process of delivering business solutions (Zweig, 2006) forces academics to shift their focus from a technology based curriculum to a business integrated approach. IS graduates are expecting to move into jobs that require managerial skills (Plice and Reinig, 2007), but the inadequate coverage of areas such as security and project management (Kim et al., 2006) and too much emphasis on traditional systems development has led some to believe that there is not sufficient emphasis on integrating technologies, applications, and business functions (Surendra and Denton, 2009).

2.2 The Decline in Majors

As stated in IS 2009 (Topi et al., 2009), the interest in IS has dramatically declined, with many calling it a recession in majors (Becker et al., 2006). This decline in IS majors has been a significant trend since 2000 (McGann et al., 2007), with many departments experiencing a drop in majors of 30% to 50% (Plice and Reinig, 2007). IS 2009 (Topi et al., 2009) also mentions that the problem is not just a curriulum issue. Researchers have developed theories on why this has happened, including outsourcing, the Internet bust, etc. (Zweig, 2006). Therefore, although curriculum is not the only reason for declining majors, it obviously is a contributing factor if courses are not well-aligned to today's IT environment (Bullen et al., 2007).

2.3 IS Model Curriculums

The evolution of model curriculums dates back to 1972, with the ACM Graduate and Undergraduate Programs in IS (Gorgone et al., 2002). Revisions and newer models were published in 1983 and 1990 (in cooperation with IEEE). In 1981, DPMA published their first model curriculum, with updated versions published in 1985, 1991, and one for two-year institutions published in 1994 (Topi et al., 2009). This culminated in a joint partnership between ACM, AIS and DPMA and the development of IS 1997 Model Curriculum and Guidelines for Programs of Informations Systems (Davis et al., 1997). Minor updates of IS 1997 occurred in 2002 (Gorgone et al., 2002) and the most recent version is IS 2009 (Topi et al., 2009) produced by AIS and ACM, with the final version being renamed to IS 2010 (Topi et al., 2010).

With each new model curriculum, there have been papers that address the alignment with the current state of IS curricula in colleges and universities (Maier and Gambill, 1996; Porter and Gambill, 2003; Kung et al., 2006). In each case, we do see similarities and differences between models and existing curricula, as well as a trend toward newer technologies and an evolving set of IT related skills. This has been propelled by the continuing changes in technology and a need for IS programs to mitigate the effects of a drastic reduction in enrollments.

2.4 Studies on IS Curriculum

Several studies have analyzed IS curriculum, with some offering their own proposed IS model structures (Maier and Gambill, 1996), as well as an analysis of the alignment to the current IS model curriculum (Porter and Gambill, 2003; Kung et al., 2006). Maier and Gambill (1996) collected a sample of 108 AACSB-accredited colleges and universities in CIS/MIS to identify the most common courses taught. Their analysis proposed an information systems curriculum model based on what was being taught at the time. Courses in the model included COBOL I and II, database management systems, data communications, data/file structure, decision support systems, IS project and IS concepts, as well as management of IS, micro-applications, and systems analysis, and design. Although this is not an all-inclusive list, it does indicate the relevant courses of the time.

Porter and Gambill (2003) conducted a follow-up study that relied on the Internet for data collection. This study not only analyzed the most consistently offered required and elective courses, but they also compared their results to the IS 2002 Model Curriculum (Gorgone et al., 2002) for alignment. Their analysis indicated a high level of alignment between programming, database, and systems analysis and design courses. However, there was less than a majority of alignment between data communications, computer concepts, fundamentals, Internet, and micro-applications courses. A final study compared a comprehensive study of current curricula to the IS 2002 Model Curriculum (Gorgone et al., 2002). Their results compared 232 institutions to each standard to indicate alignment. They further divided the sample into public vs. private and AACSB accredited vs. non-accredited institutions. Their analysis found several similarities and a few deviations from the standards, but also found no significant differences based on differences within the sample.

The gap between practitioners and academia continues to be magnified as requirements have changed from technical to business skills. Although there have been several studies that have compared previous IS model curriculums to a current state within institutions, there are no studies for the most recent publication; IS 2009 Model Curriculum (Topi et al., 2009). Therefore, this study not only looks at the current curricula within academia and compares with previous studies, but it also compares current course offerings to IS 2009 (Topi et al., 2009).

3. METHODOLOGY

3.1 Data Collection

The intention of this study is the have a current data set of courses that is comparable to previous studies and IS 2009. Although any type of classification would be subjective, it was concluded that methodologies from previous studies would first be analyzed for its ability to categorize current and past courses and ensure a level of comprehensiveness. Therefore, Porter and Gambill's (2003) method and classification of schools and courses were used as a starting point. It was then cross referenced to subjects and courses that were listed in other research, as well as inclusion of all topics from IS 2009. After careful analysis by two separate reviewers, the Porter and Gambill (2003) methodology was closely simulated, with a few additional courses based on newer subjects and technologies. To collect data for this study, colleges and universities were identified that offered a four year undergraduate degree in the area of information systems from a business school. Although the IS field continues to change and broaden its reach, limiting the research to business schools was based on the business emphasis in IS 2009 (Topi et al., 2009) and their exclusive use in previous studies (Maier and Gambill, 1996; Porter and Gambill, 2003; Kung et al., 2006). A total of 240 universities and colleges were identified as having a program in information systems, with a total of 324 total degrees or concentrations (some of the schools offered more than one IS specific degree). All schools were included regardless of accreditation to better represent the expected targeted sample that is indicated in IS 2009 (Topi et al., 2009). Previous research has shown no difference between accredited versus non-accredited colleges and universities (Gambill and Maier, 1998). Consistent with past IS curriculum research, there is still a wide variety of program names with 24 different names identified. Management Information Systems (36.1%) is the most common followed by Information Systems (20.4%), Computer Information Systems (16.7%), Business Information Systems (7.4%), and Accounting Information Systems (7.1%) (See Table 1). This is similar to a study quoted by IS 2009 (Topi et al., 2009), which indicated MIS in 40.5% of programs, 20.6% in IS/IT, and 18.0% in CIS (Pierson et al., 2008). Other studies have also shown no significant difference between IS/IT programs based on program name (Gambill et al., 1999).

The websites for each of these institutions were carefully reviewed and used for identifying the names of programs as well as required and elective courses. Course information was compiled into a database that was then organized based on school, course name, course description, and its classification as an elective or required course. If information was not available, the university and its professors were contacted for clarification. For example, many of the programming courses did not list the prominent language used for the course. If a language was not apparent by the title or description, contact was made to identify the programming language used for the course. Overall, a total of 6,494 course titles were compiled from the 240 academic institutions.

Program	Number	Percent
Management Information Systems	117	36.1%
Information Systems	60	18.5%
Computer Information Systems	54	16.7%
Business Information Systems	24	7.4%
Accounting Information Systems	23	7.1%
IS & Operations Management / IS Decision Sciences	13	4.0%
Information Security & Assurance	7	2.2%
E-Business	5	1.5%
International Business	2	0.1%
OTHER	19	5.8%

Table 1: Distribution of Names for College Programs

3.2 Coding of Course Titles for Comparisons

The 6,494 course titles were coded into titles that were easier for comparison to previous studies. (Maier and Gambill, 1996; Porter and Gambill, 2003). Porter and Gambill (2003) characterized their titles into 227 possible titles. After careful review, it was determined that the titles were still relevant for the data collected for this study and were also a good starting point for comparison with IS 2009 (Topi et al., 2009). The courses were then analyzed to ensure they were true IS courses. Of the 6,494 courses identified, 897 course titles were non-IS courses and 885 courses were operations/statistics. This left a total of 4,712 IS courses that were categorized into 227 different course titles.

Utilizing the same classification scheme as previous research with minor adjustments (Maier and Gambill, 1996; Porter and Gambill, 2003), the courses were reviewed and categorized based on the course title and description by two different researchers. The separate results were then compared for accuracy and any discrepancies were reviewed and classified based on a consensus. For example, 494 of the 4,712 IS courses were initially classified into the broad category of database courses. The courses were then assigned to one of the ten database sub-categories originally

Rank	Course	Number	Percent
1	Systems Design	203	84.58%
2	MIS	183	76.25%
3	Data Communications [a]	130	54.17%
4	Database Concepts [b]	107	44.58%
5	Business Programming [c]	72	30.00%
6	Project Management	64	26.67%
7	Database Administration/Management [b]	63	26.25%
8	Business Systems & Information Systems	60	25.00%
9	Web Management/E-business	54	22.50%
10	System Development	53	22.08%
11	Programming Concepts [c]	52	21.67%
12	Web Design and Programming [c]	42	17.50%
13	Database Design & Implementation [b]	41	17.08%
14	Audit & Security Management	40	16.67%
15	Micro Applications	39	16.25%
16	Object Oriented Programming [c]	36	15.00%
17	Visual Basic [c]	36	15.00%
18	Network Design and Admin [a]	35	14.58%
19	IS Concepts	28	11.67%
20	Intro to IS	27	11.25%
21	Computer Simulation	25	10.42%
22	ERP	22	9.17%
23	Database Applications and/or Programming [b]	21	8.75%
24	Data / File Structure	20	8.33%
25	Application Development	19	7.92%
Note:	[a] *All courses pertaining to network and data communications total 68.75%* [b] *All courses pertaining to database total 96.66%* [c] *All courses pertaining to programming total 99.17%*		

Table 2: Top Required Courses

utilized in the Porter and Gambill (2003) study, which included database concepts, database administration/management, database design & implementation, etc. The same approach was used to categorize all remaining courses.

Once all of the courses were categorized correctly by the corresponding title, the data was further analyzed to ensure that each university was only represented once within each course sub-category. To match previous studies, the frequencies indicate whether a school offered at least one course within a sub-category. Therefore, if a particular school offered more than one course title in the same sub-category, it was only listed once in our percentages. Since there were 240 institutions, the data had to reflect the number of institutions that offered a course, not the total number of courses within a sub-category.

A final step in the coding of the course titles was to carefully categorize each course into one of the categories represented in IS 2009 (Topi et al., 2009). A total of 7 categories for required and 7 categories for elective courses are listed within the model curriculum (see Table 7 for a list of categories), and in order to compare actual results to their proposed model curriculum each of the 227 course titles were carefully placed within one of the categories. If the course did not fit one of the IS 2009 categories, it was placed in an Other category. A total of 13 course titles were categorized as Other.

4. RESULTS

4.1 Courses

The 240 schools offered an average of 9 required courses with a range of 4 – 16. Out of the required courses, Systems Design was the single most offered required course at 84.58%, MIS second at 76.25%, and Data Communications third at 54.17% (Table 2). However, if you combine similar courses into a single course category each for Data Communications, Database Concepts, and Programming a different top 3 is identified. Programming then becomes the single most offered required course at 99.17%, Database second at 96.66% and Systems Design third at 84.58%. It is interesting to note that the percentages drop off dramatically after the top 5 courses. Project Management, ranked at number 6, was required at 26.7% of schools and the percentages continue to drop from there. Audit and Security Management at number 14 was required at only 16.67% and offered as an elective at 32.65% of schools. With all the publicity around security breaches and stolen data this low number of security offerings was somewhat surprising.

The average number of elective courses per school was 7.9 with a range of 1 – 26. The top 25 most offered elective courses are listed in Table 3. With the top elective course electives are most important. E-business/E-commerce is the single most offered elective course at 33.16%. Audit and Security Management at 32.65% and Project Management at 31.63% are a close second and third respectively.

Rank	Course	Number	Percentage
1	E-business / E-commerce	65	33.16%
2	Audit and Security Management	64	32.65%
3	Project Management	62	31.63%
4	Network Design and Applications	55	28.06%
5	Management of IS	53	27.04%
6	Programming Concepts	48	24.49%
7	Internet Programming	47	23.98%
8	Database Design & Implementation	42	21.43%
9	Systems Design and Development	41	20.92%
10	Database Applications	40	20.41%
11	Systems Development	38	19.39%
12	Web Design & Development	38	19.39%
13	Data/Telecommunications & Networking	33	16.84%
14	Java	33	16.84%
15	Object Oriented Programming	32	16.33%
16	Data Communications	30	15.31%
17	Visual Basic	30	15.31%
18	Accounting Information Systems	28	14.29%
19	Business Applications--Programming	27	13.78%
20	Systems Simulation	27	13.78%
21	COBOL	25	12.76%
22	Artificial Intelligence	24	12.24%
23	C / C++ / C#	24	12.24%
24	Enterprise Systems	23	11.73%
25	Operating Systems	23	11.73%

Table 3: Top Elective Courses

4.2 Historical Comparison of Courses

Table 4 provides a view of required course offerings by comparing results of this research with data collected in 1996 and 2003. Eleven of the top 18 required courses for 2010 are not listed in the top 25 in the 1996 research. Eight of the top 18 required courses for 2010 are not listed in the top 25 in the 2003 research. One area of consistency over time among the top required courses is that some type of database, systems analysis/design, data communications, and programming course appears among the most often required courses. This indicates that a core set of courses are offered at most schools with the remainder of courses determined more by constituent needs than a generic curriculum model.

A number of expected changes were noticed, including the drastic drop in COBOL offerings. In 1996, COBOL was the top required course at 86%. However, it dropped to 20% in 2003 and completely out of the Top 25 in 2010 with less than 8%. Also interesting to note is the change in what is normally considered a first course for students. In 1996, 55% of programs required an Introduction to IS course, with 41% offering a course in the Management of Information Systems (MIS), which tends to be a more business integrated style of introducing IS. By 2010, Introduction to IS dropped to 11% and MIS increased to 76%, which is a good indication that academia understands the need to emphasize the business integrated approach to IS. Other emerging required courses include Web Management/E-Business (23%), Web Programming and Concepts (18%), Audit and Security Management (17%), and Object Oriented Programming (15%), which were not identified as top 25 courses in the two previous studies. This indicates that academics understand the growing need for newer technologies, such as web enabled concepts and object oriented programming, as well as areas that have been neglected by IT education for some time (IS security).

Table 5 offers a view of elective course offerings. Twelve of the top 18 elective courses for 2010 are not listed in the 1996 research and a different set of 12 are not listed in the 2003 research. This indicates that electives continue to change as technology evolves within the marketplace. The two top electives in 1996, Decision Support Systems (46.5%) and Data Communication (39.5%), have dropped dramatically, with Decision Support Systems being offered by 1% and Data Communications being offered as elective by 15% of the programs in 2010. It should be mentioned that Data Communication has become more specialized with the use of the Internet, and many of the programs are now offering a Network Design and Applications course (28%).

Newer technologies like E-business/E-commerce (33%) at number 1 and Audit and Security Management (33%) at number 2 top the electives list. Most of the remaining elective courses are more traditional with Project Management (32%), Network Design and Applications (28%), and Management of IS (27%) rounding out the top 5 elective courses.

Required Courses	% in 2010	% in 2003[a]	% in 1996[b]
Systems Design	85%	62%	77%
MIS	76%	30%	42%
Data Communications	54%	15%	42%
Database Concepts	45%	48%	81%
Business Programming	30%	*	*
Project Management	27%	22%	33%
Database Administration/Management	26%	12%	*
Business Systems & Information Systems	25%	*	*
Web Management/E-business	23%	*	*
System Development	22%	14%	*
Programming Concepts	22%	*	*
Web Design and Programming	18%	*	*
Database Design& Implementation	17%	14%	26%
Audit & Security Management	17%	*	*
Micro Applications	16%	*	35%
Object Oriented Programming	15%	*	*
Visual Basic	15%	14%	*
Network Design and Admin	15%	36%	*
Note: ** category was not among the top courses* *[a] data is from Porter and Gambill (2003)* *[b] data is from Maier and Gambill (1996)*			

Table 4: Top Required Courses – Comparison of Studies

Elective Courses	% in 2010	% in 2003[a]	% in 1996[b]
E-business/E-commerce	33%	23%	*
Audit and Security Management	33%	*	9%
Project Management	32%	*	19%
Network Design and Applications	28%	*	*
Management of IS	27%	26%	16%
Programming Concepts	24%	*	*
Internet Programming	24%	*	*
Database Design & Implementation	21%	*	9%
Systems Design and Development	21%	*	*
Database Applications	20%	*	*
Systems Development	19%	*	*
Web Site Design & Development	19%	*	*
Data/Telecommunications and Networking	17%	18%	*
Java	17%	*	*
Object Oriented Programming and Development	16%	17%	*
Data Communications	15%	15%	40%
Visual Basic	15%	*	*
Note: ** category was not among the top courses* *[a] data is from Porter and Gambill (2003)* *[b] data is from Maier and Gambill (1996)*			

Table 5: Top Elective Courses – Comparison of Studies

Programming Language	Count	Percentage
Java	71	33.5%
Visual Basic	49	23.1%
C++	46	21.7%
COBOL	28	13.2%
ASP.NET	3	1.4%
C#.Net	3	1.4%
BASIC	2	0.9%
Python	2	0.9%
C	1	.05%

Table 6: Top Programming Courses

4.3 Programming Courses

Many have debated the need to teach programming courses in a business school, but as the data shows over 99% of all schools are requiring at least one programming course. Therefore, it seemed appropriate to delve deeper to identify the actual programming languages that are being taught. Information was specifically gathered on programming languages, and as stated in the methodology section, the programs that did not specify a programming language for a particular course were contacted directly to determine which programming language was taught. Table 6 lists the top ten offered programming languages. Based on the percentages, there is not an overwhelming favorite among business schools. Regardless of required or elective offerings, Java is the most popular course with 33.5%, followed by Visual Basic (23.1%), and C++ (21.7%). COBOL is a surprising fourth at 13.2% with the remaining offerings in the single digits.

Maier and Gambill (1996) did not provide specific programming courses in their study, but Porter and Gambill (2003) did produce results that identified the programming language used in course offerings. COBOL was used at 64.0% of the academic institutions, followed by C/C++ (25.7%), and Visual Basic (25.7%). From 2003 to 2010, COBOL shows a drastic decline, with C/C++ and Visual Basic stayed relatively the same. Java made the largest gain, going from 6th most popular in 2003 (13.5%) to the most popular in 2010 (33.5%). Therefore, it is not surprising to see that object oriented programming gained the most ground in schools. It is also interesting to note the reemergence of programming concepts as a course. Table 5 shows that 24% of schools are offering a Programming Concepts course. Many of these courses do not specifically cover a particular language but they cover the basics of programming that are synonymous with all languages. It is also apparent that application software is no longer limited to the traditional PC, mini or mainframe computer and associated peripherals. There is a growing market for software to run newer devices, such as smart phones, and different types of open software and operating systems, such as Android/Chrome OS from Google. With the expanding market for non-traditional applications, it seems likely that the number and type of programming languages will continue to expand.

4.4 IS 2009 and Current Course Offerings

A comparison between IS 2002 (Gorgone et al., 2002) and IS 2009 (Topi et al., 2009) is shown in Table 7. Both required and elective courses were compared based on their descriptions. Between the IS 2009 model core and elective courses, Fundamentals of Information Systems is the only course to retain the same name from IS 2002 to IS 2009, with three of the courses similarly based on course descriptions. The pairs that matched well from IS 2002

IS 2009 Courses	IS 2002 Core Courses
Fundamentals of Information Systems	Fundamentals of Information Systems
Data and Information Management	Physical Design and Implementation with DBMS
Enterprise Architecture	Electronic Business Strategy, Architecture & Design*
IS Project Management	Project Management and Practice
IT Infrastructure	Information Technology Hardware and System Software*
Systems Analysis and Design	Analysis and Logical Design
IS Strategy, Management and Acquisition	Information Systems Theory and Practice*
IS 2009 Courses	**IS 2002 Elective Courses**
Application Development	Programming, Data, File and Object Structures*
Business Process Management	Personal Productivity with IS Technology**
Enterprise Systems	Networks and Telecommunication**
Fundamentals of Human-Computer Interaction	Physical Design & Implementation Emerging Environments**
IT Audit and Controls	*No comparable category*
IT Innovation	*No comparable category*
IT Security and Risk Management	*No comparable category*
Note: ** some similarity between courses* *** no similarity between courses*	

Table 7: Comparison of IS 2002 and IS 2009 Model Curriculum

Core Courses (required)	Percent Offered
IS 2009.1 Fundamentals of Information Systems	87.4%
IS 2009.2 Data and Information Management	87.0%
IS 2009.3 Enterprise Architecture	20.6%
IS 2009.4 IS Project Management	53.8%
IS 2009.5 IT Infrastructure	83.0%
IS 2009.6 Systems Analysis and Design	93.7%
IS 2009.7 IS Strategy, Management and Acquisition	35.4%
Elective Courses	
IS 2009.E01 Application Development	92.4%
IS 2009.E02 Business Process Management	37.7%
IS 2009.E03 Enterprise Systems	64.1%
IS 2009.E04 Fundamentals of Human-Computer Interaction	14.3%
IS 2009.E05 IT Audit and Controls	7.6%
IS 2009.E06 IT Innovation	18.4%
IS 2009.E07 IT Security and Risk Management	33.2%

Table 8: Comparison of Data and IS 2009 Curriculum Model

(Gorgone et al., 2002) to IS 2009 (Topi et al., 2009) were all core courses: 1) Physical Design and Implementation with Database Management Systems / Data and Information
only one course was similar from IS 2002 (Gorgone et al., 2002) to IS 2009 (Topi et al., 2009); Application Development / Programming, Data, File and Object All of the remaining 6 elective courses from IS 2009 (Topi et al., 2009) were new and had no similar counterpart from IS 2002.

Table 8 lists the IS 2009 (Topi et al., 2009) curriculum model courses and the percent of schools offering a similar course. While the course names from IS 2009 (Topi et al., 2009) do not match up perfectly with course names offered at reviewed colleges and universities, they do match up fairly well when course descriptions are taken into consideration. None of the model required courses or elective courses are offered at every school. Systems Analysis and Design tops the list of required courses with 93.7% followed by Fundamentals of Information Systems at 87.4%, Data and Information Architecture at 87%, and IT Infrastructure at 83%. The percentages then drop off significantly, with IS Project Management at 53.8%, IS Strategy, Management and Acquisition at 35.4%, and Enterprise Architecture at 20.6%.

Application Development is the most offered elective course with 92.4% offering a similar course. The percentages drop even more dramatically than required courses with Enterprise Systems a distant second at 64.1%. Business Process Management is third at 37.7%, followed by IT Security and Risk Management at 33.2%, IT Innovation at 18.4%, Fundamentals of Human-Computer Interaction at 14.3%, and IT Audit and Controls at 7.6%.

One of the key changes in IS 2009 is the move away from sequencing of courses and the "one size fits all" philosophy of IS 2002 (Topi et al., 2009). IS 2002 (Gorgone et al., 2002) created a schema that indicated 10 core courses, which in essence were required. This model did not allow for much flexibility to add or change courses based on local innovation or demographics. IS 2009 introduced greater flexibility by identifying 7 required courses and 7 elective courses (Table 7) that may be offered at the discretion of a university. Similar to previous research, the percentages listed in Table 8 support the idea that most schools offer a similar core set of courses with considerable variety beyond that core. Most schools offer the following courses:

- Fundamentals of IS
- Data and Information Management (database)
- Systems Analysis and Design
- IT Infrastructure (network communications)
- Application Development (programming)

The remaining course offerings vary greatly in terms of subjects and courses. For example, a school may have an emphasis in security and controls and may offer several courses in that subject while other schools might focus on the strategy of IT. Therefore, is it more important for a university to offer all of the courses in IS 2009 (Topi et al., 2009), or offer the core courses that are indicated and then tailor their curriculum to their market? Apparently, most schools like the freedom to offer courses specific to their environment, but based on the courses they offer, the majority seem to agree that schools should be teaching certain skills, such as database, network communications, programming, etc.

5. LIMITATIONS

There are certainly limitations to this research. First and probably most obvious is that categorization of course offerings is a subjective process. With almost 6,500 courses reviewed, it was necessary to collapse those courses into a relatively small number of manageable categories. For example, with 492 database courses, it was somewhat difficult to clearly define and categorize each course into one of the 10 database course titles utilized in this study. A total of 148 courses were identified as some type of database concepts course, but the titles varied, such as Database Systems, Database Concepts, Database Management Systems, Business Database Concepts, and Database Theory and Practice. Most of the time, the categorization process was relatively simple, and it was obvious where a course should be categorized, but at other times it was not so obvious.

Another limitation was in relying on course information posted on websites. There was no practical way to determine if the information was current. Many of the websites simply posted the latest catalog while others provided major and course information separately from the catalog. It is possible that course offerings had changed since publication of the catalog or website. It is also possible that a course listed in the catalog or website was not active and may not have been taught recently.

The decision to include only programs housed in colleges of business could be considered a limitation but was outside the scope of what this research was trying to accomplish. In addition, previous research used for comparison in this study only included programs housed in colleges of business (Maier and Gambill, 1996; Porter and Gambill, 2003).

Finally, since initiating this research the IS 2009 working model curriculum has now been approved by ACM and AIS. The results presented in this paper are still valid since the scope of the paper is limited to IS programs in business schools and since there are no significant changes in both the core and elective courses. The main change in the IS 2010 model curriculum is to enable the application of IS in areas beyond business.

6. CONCLUSION

It is clearly important to maintain an up-to-date curriculum and the data presented here indicates this is happening with many of the most common courses from previous studies not appearing in the current research. The makeup of model curriculums as well as course offerings also continues to evolve. However, courses do not necessarily always match with proposed models. When comparing current courses with the IS 2009 (Topi et al., 2009) curriculum model the percentages of courses offered matching up with the model ranged from 20% – 94% for required courses and 8% – 92% for elective courses. There continues to be a basic core of courses that most schools have been teaching for the past 15 years which includes some type of IS fundamentals, database, systems analysis and design, network communications, and programming course. Beyond these five courses there is a wide variety of courses offered at colleges and universities reviewed in this and previous research. This variation could be due to schools modeling their curriculum based on the demands of their local market, instead of published IS model curriculums. It is also possible that the field has become so broad and diverse that no single model can meet the needs of every market, and the wide variety of course offerings beyond a small core of courses are simply a reflection of that diversity. Another explanation of the diversity of courses may lie within the decline of majors. A common reaction to a decline in majors is to try to attract students through course offerings. The courses that may be added would also be indicative of the local business environment, which may be different in varying regions. All of these conclusions of course variation and diversity are speculative and would be interesting for future directions of research.

Further research in this area is certainly warranted and may add insight into the diversity of IS curriculums. A logical next step would be to divide the sample of schools to indicate if diversity is based on specific criteria. For example, the schools could be divided based on AACSB accreditation, business vs. non-business programs, based on the names of the programs, or based on geographic location. Comparisons with U.S. and non-U.S. schools would also be of interest, as well as a comparison between the top rated IS programs and the IS 2009 Curriculum Model (Topi et al., 2009) to see if the elite schools are merely keeping pace with industry or leading the way. Requests for access to the data may be forwarded to the authors. These comparisons as well as other iterations of curriculum will continue to be necessary, as the rate of change in technology does not seem to be slowing down. As technology continues to change, the IS curriculum will continue to be reviewed and revised.

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