IS Curriculum Recommendations for Web Courses in higher education

Juyun Cho, Ph.D.
Assistant Professor of Computer Information Systems
Colorado State University–Pueblo
Hasan School of Business
Pueblo, Colorado

Jason Couraud, Ph.D Candidate
Management Information Systems
Utah State University
Jon M. Huntsman School of Business
Logan, Utah

ABSTRACT

A wide variety of software tools is currently available to businesses when building e-commerce solutions. Businesses are in need of employees with the appropriate skills to support and implement their e-commerce solutions. Students transitioning from school into the workforce need a well-designed curriculum that can prepare them with the skills needed in the competitive today's job market. The challenge for designing an adequate curriculum for IS programs is the wide array of available tools. This research has taken a survey of the web technologies used by the Fortune 500 companies and compared it to a sample of job postings from businesses. This paper addresses the question of what web tools should be incorporated into the IS curriculum that will make its graduates competitive in the job market.

INTRODUCTION

Technology and business change very rapidly (Goldweber et al. 1997, Lee et al. 1995), creating a gap between current IS curriculum and business needs. Trauth et al. (1993) attribute this gap to a lack of relevance of IS curricula and a shared vision of the requisite knowledge and skill set for IS professionals. It is very difficult to create new curriculum at the speed with which business and technology evolve. According to Mandt (1982) the rate that technology changes is such that no school could possibly keep up. Add to this the slow rate of change in academia coupled with resistance to change and keeping the curriculum up-to-date becomes more daunting (Johnson and Jones, 2006). However, if education is to remain a vital cog in the development of students into a viable workforce, schools must seek to create relevant curricula (Little et al. 1977). If not, students may opt for an alternative to a college education. Further, professional support could be withdrawn from schools as a result of failure to produce an acceptable workforce (Lee et al. 1995). The inability to provide an adequate education could also affect the reputation of a school which could result in decreased enrollment, decreased revenue from tuition, and decreased funding (Bhattacharya et al. 2006). Providing relevant curricula and the falling enrollment rates have been of major concern to both academics and industry (Lee et al. 1995). Additionally, IS education has come under criticism as being unable to produce viable IS professionals (Archer 1983, Cardinali 1988).

There are many different types of technologies in IS Business such as computer networking, databases systems, and web-based systems. Among those technologies, we chose web-based tools for several reasons. First, despite the boom-and-bust cycle recently experienced, e-commerce has experienced steady growth (Ho et al. 2005). Second, this growth is expected to continue as more and more people accept the web as a means for commerce (Bolin 1998, Yang and Miao 2005). Third, growth of the web has created a need for professionals to increase their knowledge of web-based tools to keep pace with e-commerce

growth (Cache et al. 2004). So, it is worthwhile to conduct a survey to discover the most widely used web tools in IS business to shape our web course curricula to help prepare students for the competitive job market.

We are not advocating that IS programs should take students and create technicians. Creating technicians might be more suited to the Computer Science program. However, MIS graduates should have a solid knowledge of web-based tools to be able to complete a systems analysis or to consult effectively.

The paper is organized into the following sections. Background will provide more information on the gap between academia and IS business. Research methodology will detail the steps taken to gather our data. Data analysis discusses the results of the analyses run against the data. Discussion elaborates on the meaning we perceive in the data. Finally, conclusion sums up our research and provides possible directions to pursue for future research.

BACKGROUND

According to Andriole (2006) this gap between academia and IS business is widening, and the gap between theory and practice will greatly affect the ability of graduates to find employment. Employers want potential employees who can pick up the tasks assigned to them with a minimum of instruction and training. Nunamaker et al. (1982) assert that the purpose of an undergraduate IS education is to equip the student to serve in an entry level position and provide the student with a base for career growth. An employer will hire an individual who can do the job, not the individual with the most promise of being able to do the job after training (Mandt, 1982) to decrease the amount of time and money needed to train the employee and maximize business value.

For IS curriculum to be effective it must be based on the needs of the industry and should facilitate the greater contribution of the IS student to the organization (Nunamaker et al. 1982). Many scholars refute the idea that an IS curriculum is valid if based on the requirements of some accreditation board or based on the requirements of academicians (Andriole 2006, Trauth et al. 1993, Mandt 1982, Goldweber et al. 1997, Daniels and Feather-Gannon 2003, and Lee et al. 1995). Since business needs are constantly changing the curriculum must be periodically updated or the students will not learn the skills that employers require (Johnson and Jones, 2006). Nunamaker et al. (1982) put forward that the curriculum changes should reflect the changes in IS, advances in technology, and various other business needs. Indeed, education may become an obstacle rather than a tool to help students gain employment. Should this happen, students may go to another institution of higher education that offers the courses that meet industry requirements or they will find other arrangements such as a technical school or on-the-job training (Bhattacharya et al., 2006). Trauth et al (1993) pointed out three problems with updating IS curricula. First, advice coming from industry sources is often contradictory. Second, accreditation standards often dictate how flexible the curriculum can be. Third, there is a delay before curriculum changes can be implemented. Little et al. (1977) found that the changes to curricula came too slowly and the extent of the change was too limited, meaning that the curricula still did not meet the desired expectations.

Methods for updating IS curricula involve surveying academic institutions, business leaders, and IS graduates. Surveying other academic institutions that have had success in placing graduates can provide valuable insight into what skills and knowledge are currently being sought by businesses. This will also provide information into what students are looking for in an IS education. Business leaders, especially those involved in IS, can provide the most important information for redesigning curricula. Business leaders are the ones hiring IS graduates and they are much closer to the business process than the typical academician (Gruba et al. 2004). They know the needs of their own companies and possibly the needs of their general area (Goslar and Deans 1994) as they are required to keep themselves up-to-date regarding IS developments (Lee et al. 1995). Most of the sources reviewed for this paper advocate using industry as the main reference when designing a new IS curriculum or updating the current curriculum. Graduates who are now working can also prove an invaluable source of information. They can provide information on what they wish they had been taught while in school and what they had to learn once they were hired. They can also supply information on which classes were of most value and which

classes should be either eliminated or redesigned to provide the best education for future students.

Professors may not be comfortable with teaching new technologies. Yet this is exactly what industry requires (Patterson 2006). Many professors learned programming languages such as COBOL or FORTRAN. However, current research has determined that business leaders are putting less and less emphasis on such languages and are putting more emphasis on fourth generation languages (Trauth et al. 1993). Additionally, many professors did not learn web technologies as a part of their formal education, the web being a fairly recent development. However, many businesses depend on the web and web technologies to compete in the world market.

The web is becoming a much more integrated part of businesses, and web skills and knowledge are in much greater demand. However, the number of available web technologies can be daunting when trying to choose which ones will make up the technological part of the IS curriculum. In addition, not all of these technologies can be used together because of incompatibilities and other limitations. So which methods should be used to determine the best fit for the IS curriculum? Which of the available web technologies would be of most value to the students' future employment? Should a variety of technologies be taught or should the curriculum have a certain focus such as opensource or maybe a specific proprietary web scripting language?

RESEARCH METHODOLOGY

We surveyed the top 500 companies listed in the Fortune 500 index (http://money.cnn.com), and, we compiled a list of the web technologies used. Some of these companies own and operate multiple web sites. We recorded whether a certain web technology was present on any of the sites owned by a particular company without distinction between the multiple web sites. Preliminary results show that some companies make use of one web scripting language exclusively while others make use of any and all available technologies.

We pulled up the chosen company's home page using the Mozilla Firefox 2.0.0.14 browser. We pulled up source code for the company web pages by using the View/Page Source option, and then searched for known web tools by looking at file extensions and code comments using the search function built into Firefox. Afterward, we visually searched through the code for any web tools that the search function may have missed. If sites had their own search functionality, it was also utilized to search the site for the various web technologies. In addition, some files, such as the annual report in PDF format, were routinely found in the Investor section of each web site. We would also determine the technologies used by running the mouse pointer over the various links on the web site and examining the URL that appeared in the status bar at the bottom of the screen. Subsidiary web sites belonging to a parent company were also examined and the data recorded for the parent company. Links to subsidiary web sites were usually found on the main corporate web site to indicate which companies the parent company owned.

Upon completion of the survey of Fortune 500 index, another similar survey was conducted targeting job announcements for jobs relating to the internet in single western state. These jobs were identified by checking statewide newspapers as well as several statewide and nationwide websites. When searching statewide websites no effort was made to limit the search to a particular city or region of the state. In searching nationwide job search websites all searches were limited to jobs that were local to the state. Jobs outside of the state were excluded from the search.

A total of five websites were searched. Upon searching the fifth site it became apparent that we were not going to find any more unique listings. Terms used to search for internet related jobs were web and internet. The listings that were returned were then examined and the technologies listed in the job announcement were recorded in a similar manner to the first survey. The technologies listed were recorded as present or absent from the job announcement. Certain technologies were grouped together. For instance, there are several technologies in the family of XML such as XSL and XSLT. These were grouped together under the XML category.

Limitations

We tried to make the procedure for reviewing the web sites as methodical as possible. Each site was reviewed as detailed above. Some data could have been overlooked due to human error. In instances where some data was thought to be missing, a review of the site was undertaken to determine

if the data was indeed missing. In the case where we came across a new web tool, we would go back over the previous web sites to make sure that we did not miss it on previous sites. However, after a short time we documented the majority of web tools and came across fewer and fewer new web tools. In addition, out of the 500 companies on the list, 4 companies either did not have websites or the sites were down when the survey was being conducted.

There is also the possibility that in performing the job search that we have recorded some of the jobs more than once. This is a distinct possibility since each of the websites that were used in the study listed information in a slightly different manner than each of the others. In addition, we did leave out some information such as whether the job posting listed a skill or desired familiarity with a certain program that was not a web technology. It could be that we have left out some information that would have been beneficial to the study. We could also have included some jobs in our search that were telecommuting jobs that were not based in the state in the study which could put a bias on our results.

Another limitation in our study is the assumption that the most widely used web tools reflect the skills that employers are looking for. This might be an inappropriate assumption and can be verified by further study. However, it makes sense to assume that employers are looking for potential employees who have some level of knowledge of the web-based tools that the employer is currently using.

DATA ANALYSIS

We can break the technologies used in web sites into two categories. The first category is technologies the web programmer must know to program a web page. The second category is technologies that the web programmer must know to incorporate graphics, audio, video, and other documents into the web site. The first category consists mainly of scripting languages and markup languages. The second category is made up of everything else, such as image formats, audio and video formats, and document formats. We also performed the data analysis in two parts. First we analyzed all 500 companies together, then we took the top 100 companies and ran the same analyses to check for differences in correlation between technologies and frequency of use. Finally we ran the same analyses on the data taken from the 125 job announcements. Each of the categories and the analyses will be explained in further detail in its own section. The impact and recommendations will be reported in the discussion section.

First Category

The items in the first category (see Table 1 and Figure 1) with the highest usage by count are JavaScript (495, 99.8%) associated with Document Object Model (DOM) (495, 99.8%), CSS (492, 99.2%), Flash (280, 56.5%), and zhtml (260, 52.4%). All other items were found to be used by less than half of the companies in the study. However, the companies investigated seemed to favor Microsoft when more advanced web programming was needed. ASP (232, 46.8%) was found most often, ASPX (162, 32.7%) came next followed by JSP (151, 30.4%), ColdFusion (96, 19.4%), PHP (45, 9.1%), shtml (26, 5.2%), jhtml (14, 2.8%), phtml (3, 0.6%), GSP (1, 0.2%), jsf (1, 0.2%), and jspx (1, 0.2%). XML does not seem to have a very heavy influence in the web yet. XHTML (140, 28.2%), the XML version of html, is used most frequently followed by RSS (114, 23.0%) and XML (11, 2.2%). SiteCatalyst, a web analytics package, was used by 28 (5.6%) companies. Finally, member accounts are used by 194 (39.1%) companies and all of 88 (17.7%) companies using shopping carts are part of those 194 companies.

In an analysis of the top 100 companies (see Table 1 and Figure 2), JavaScript and DOM (99, 99.0%), CSS (98, 98.0%), Flash (62, 62.0 %), and zhtml (59, 59.0 %) are the most commonly used. ASP (53, 53.0%) was still the most used of the more robust scripting languages, followed by JSP (46, 46.0%), ASPX (40, 40.0%), ColdFusion (16, 16.0%), PHP (7, 7.0%), JHTML (6, 6.0 %), phtml (2, 2.0%) and shtml (2, 2.0%), and GSP (1, 1.0%). In the second analysis, JHTML moved up while jsf and jspx were not used at all. RSS (43, 43.0%) moved ahead of XHMTL (30, 30.0%) followed by XML (2, 2.0%). SiteCatalyst (5, 5.0%) usage number declined, but the percentage of use stayed the same. Slightly less than half of the companies with member accounts (62, 62.0%) also had shopping carts (28, 28.0%) as in the previous analysis.

Figure 1
Frequency Use for 500 Companies

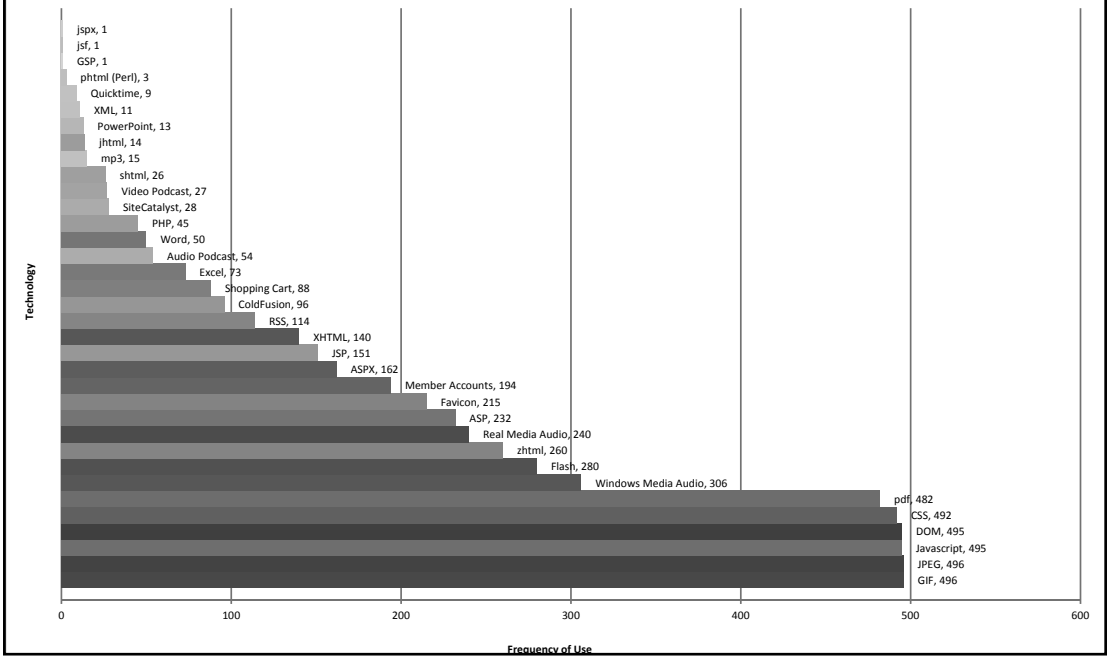


Table 1
First Category
Frequency Counts and Percentages

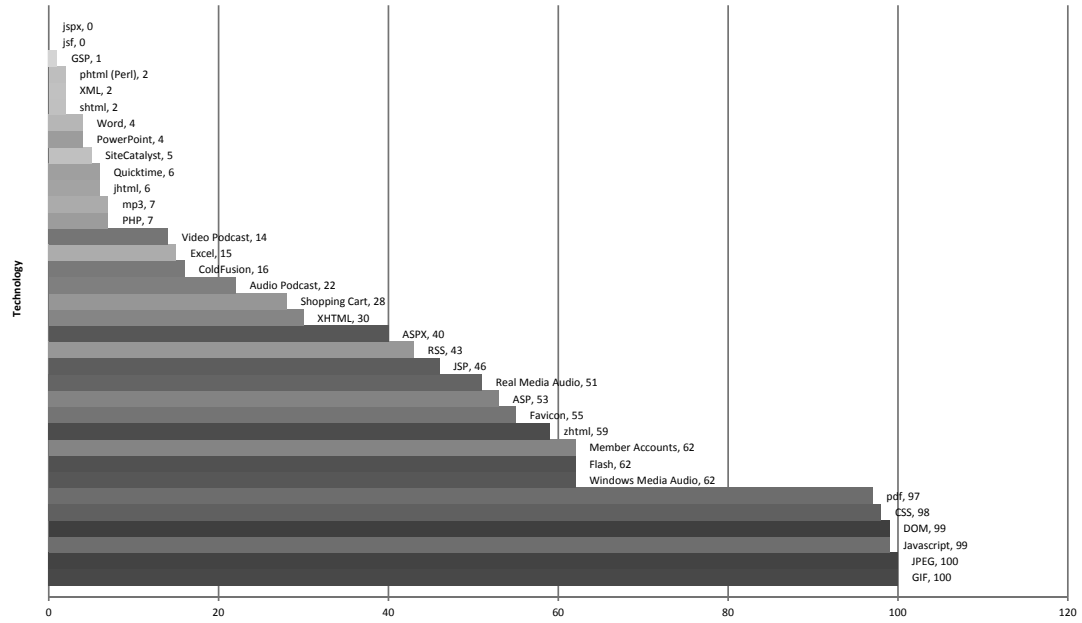
Web Tool	500 Companies		100 Companies	
	Freq.	%	Freq.	%
Javascript	495	99.8	99	99.0
DOM	495	99.8	99	99.0
CSS	492	99.2	98	98.0
Flash	280	56.5	62	62.0
zhtml	260	52.4	59	59.0
ASP	232	46.8	53	53.0
ASPX	162	32.7	40	40.0
JSP	151	30.4	46	46.0
ColdFusion	96	19.4	16	16.0
PHP	45	9.1	7	7.0
shtml	26	5.2	2	2.0
jhtml	14	2.8	6	6.0
phtml	3	0.6	2	2.0
GSP	1	0.2	1	1.0
jsf	1	0.2	0	0
jspx	1	0.2	0	0
XHTML	140	28.2	30	30.0
RSS	114	23.0	43	43.0
XML	11	2.2	2	2.0
SiteCatalyst	28	5.6	5	5.0
Member Accounts	194	39.1	62	62.0
Shopping Carts	88	17.7	28	28.0

Second Category

The items in the second category (see Table 2 and Figure 1) with the highest usage by count are GIF (496, 100%), JPEG (496, 100%), PDF (482, 97.2 %) and Windows Media Audio (WMA) (306, 61.7 %). The most popular audio formats were WMA, Real Media Audio (RMA) (240, 48.4%), Audio Podcasts (54, 10.9%), and Mp3 (15, 3.0%). The most used video formats were Video Podcasts (27, 5.4%) and QuickTime (9, 1.8%). The GIF and JPEG image formats were used by every company in the study. However, less than half made use of Favicons (215, 43.3%), the icons that can sometimes be found next to the URL in the web browser address bar. The document formats with the highest usage are PDF, Excel (73, 14.7%), MS Word (50, 10.1%), and PowerPoint (13, 2.6%).

In analyzing the data of the top 100 companies (see Table 2 and Figure 2), we found that GIF and JPEG (100, 100%) remained on top, followed by PDF (97, 97.0%), and WMA (62, 62.0%). WMA once again topped the list of audio media followed by RMA (51, 51.0%), Audio Podcasts (22, 22.0%), and Mp3 (7, 7.0%). Video Podcasts (14, 14.0%) were still used more often than QuickTime (6, 6.0%). Favicons (55, 55.0%) were used by more than half of the top 100 companies.

Figure 2
Frequency Use for Top 100 Companies



Document format preferences did not change much. PDF had the highest usage followed by Excel (15, 15.0%) and then PowerPoint (4, 4.0%) and MS Word (4, 4.0%).

First Category:Jobs

Examining the data from the job postings we uncover one of the weaknesses in examining the code from a posted website. The job postings most often requested proficiency in SQL (64, 51.2%). By examining the code we only guess that the programmers had to be proficient with SQL especially in the cases where the website allowed access to user accounts and shopping carts. Java (50, 40.0%) was the most frequently required programming language follows by JavaScript and ASP (41, 32.8% each), PHP (35, 28.0%), JSP and AJAX (22, 17.6% each), Perl (13, 10.4%), ColdFusion (7, 5.6%), JSF (5, 4.0%), TCL (3, 2.4%), and Ruby (2, 1.6%). For the development of webpages HTML (49, 39.2%) topped the list, then CSS, (47, 37.6%), XML (30, 24.0%), XHTML (11, 8.8%), and DHTML (10, 8.0%). A few miscellaneous skills were also required, Flash (27, 21.6%), UNIX/Linux (22, 17.6%), Access, RSS, and EDI (1, 0.8% each).

Second Category: Jobs

Skills in the second category were absent from the job announcements. Job announcements made reference to good visual skills, good communica-

Table 2
Second Category
Frequency Counts and Percentages

Web Tool	500 Companies		100 Companies	
	Freq.	%	Freq.	%
GIF	496	100.0	100	100.0
JPEG	496	100.0	100	100.0
PDF	482	97.2	97	97.0
WMA	306	61.7	62	62.0
RMA	240	48.4	51	51.0
Audio Podcasts	54	10.9	22	22.0
Mp3	15	3.0	7	7.0
Video Podcasts	27	5.4	14	14.0
QuickTime	9	1.8	6	6.0
Favicons	215	43.3	55	55.0
Excel	73	14.7	15	15.0
MS Word	50	10.1	4	4.0
PowerPoint	13	2.6	4	4.0

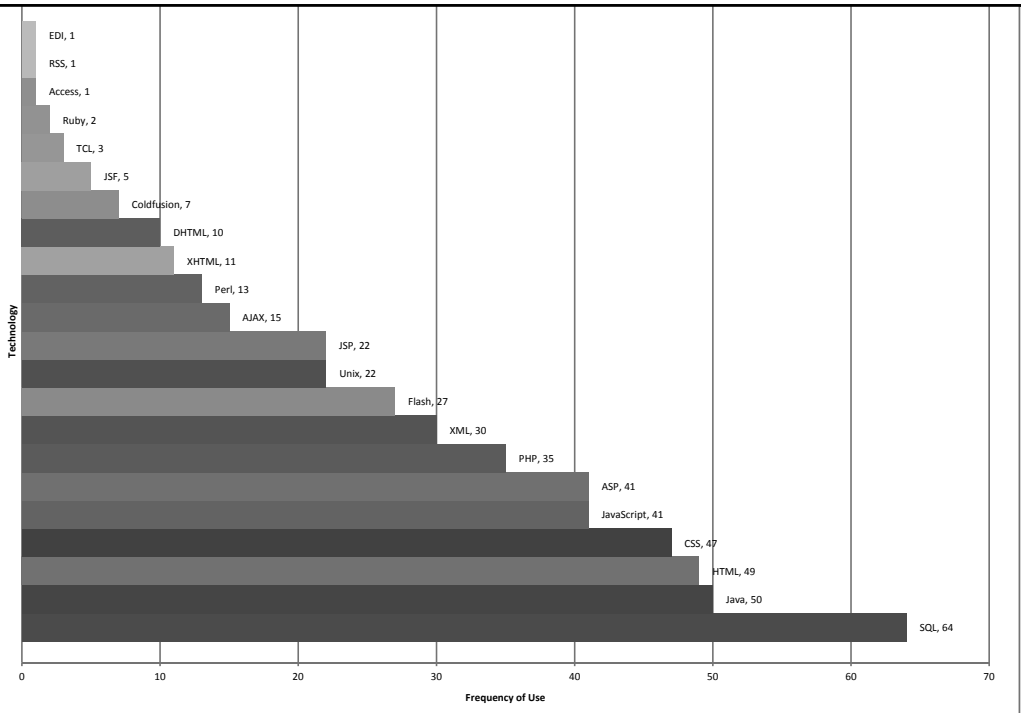
tion skills, etc. and so we feel that understanding how to use and create documents, images, and videos are skills that are either understood or are not required at this level. As part of the standard curriculum students should be exposed to word processing, spreadsheets, and presentations. The creation of images and video may be the responsibility of another department that delivers the finished product to the web programmer. The web programmer may not need to understand how to put the images and video together, but it may be expected that he should know how to incorporate the image or video into a webpage.

Correlation Analysis

Upon running a correlation analysis of the data collected from the 500 companies, we found very few strong relationships. Most of the correlations, in both the positive and negative directions, were less than 0.5. JavaScript and DOM were perfectly correlated as per expectations. The correlation between member accounts and shopping carts was .582 showing that shopping carts were used by roughly half the companies when member accounts were also used. WMA and RMA had a correlation of .746. WMA was the most widely used but if it was used the probability was high that RMA was also used. This relationship is expected. In striving to accommodate the many different users' preferences, it is advisable to use multiple formats. Although WMA may be sufficient as many people use Microsoft operating systems, many people do not like using Microsoft products. The correlation between Audio Podcasts and Video Podcasts was .458. We can expect this correlation to strengthen as Podcasts become more popular. A correlation between JavaScript and CSS of .498 appeared, but this is most likely a coincidence caused by frequency. See Table 3.

We expected to find a stronger correlation between Microsoft products as they are often used together. However, the strongest correlation we found was .711 between Excel and Word with a very low correlation with PowerPoint. The same correlation was run using data from the top 100 companies with similar results. JavaScript and DOM were perfectly correlated in this data set. The correlation between shopping carts and member accounts went down to .488 probably because most of the top 100 are not retail outlets and use their sites for promotion, advertisement, and notifying investors. The correlation between WMA and RMA increased to .799. The increase could be attributed to the larger size of these

Figure 3
Frequency for Job Postings



companies. Larger companies have the available resources to create both file types and might need to do so to reach a wider customer base. The correlation between Audio and Video Podcasts decreased slightly to .481. A few strong correlations between XML and Word (.700), PowerPoint and shtml (.700), and PHP and Word (.544) were discovered, however, this is probably the result of chance. The correlation between CSS and JavaScript increased to .704, but as in the earlier case, is doubtless due to coincidence. See Table 4.

The strength of the relationship between Microsoft products increased slightly for the top 100 companies in some instances. The correlation between PowerPoint and Word increased to .479 from .385, and the correlation between Excel and Word increased to .343 from .270. We feel that this increase signifies that the top 100 companies value the ability to reach more customers by including more file types for download.

In examining the correlations among the data taken from the job postings several interesting correlations were made. Most of the correlations are below .5. However, the correlation between JSF and AJAX is .553. This is most-likely caused by the similar dependence of both technologies on XML. There is a .395 correlation between SQL and PHP. PHP is highly dependent on SQL for database functionality. Java and JSP (.395) and JSP and JSF (.442) have higher correlations than most, which is most-likely attributed to the fact that JSP and JSF are both derived from Java. HTML and JavaScript (.347), HTML and CSS (.324), and CSS and JavaScript (.372) correlate higher as well since these three technologies are highly interdependent. We expected to find a much higher correlation among these three for

Table 3
Significant Correlations for 500 Companies

	Javascript	DOM	CSS	Windows Media Audio	Real Media Audio	Member Accounts	Shopping Cart	Excel	Audio Podcast	Word	Video Podcast	PowerPoint
Javascript	1.000											
DOM	1.000	1.000										
CSS	0.498	0.498	1.000									
Windows Media Audio	0.057	0.057	0.022	1.000								
Real Media Audio	0.044	0.044	0.042	0.746	1.000							
Member Accounts	0.036	0.036	-0.020	-0.045	-0.063	1.000						
Shopping Cart	0.021	0.021	-0.017	-0.004	-0.018	0.582	1.000					
Excel	0.019	0.019	0.038	0.174	0.201	0.030	0.000	1.000				
Audio Podcast	0.016	0.016	0.032	0.035	0.050	0.145	0.176	0.001	1.000			
Word	0.015	0.015	0.030	0.167	0.158	-0.034	-0.051	0.711	-0.010	1.000		
Video Podcast	0.011	0.011	0.022	0.024	0.052	0.136	0.214	0.000	0.458	0.008	1.000	
PowerPoint	0.007	0.007	0.015	0.051	0.043	0.024	0.023	0.110	0.105	0.113	0.127	1.000

Table 4
Significant Correlations for Top 100 Companies

	Javascript	DOM	CSS	Windows Media Audio	Member Accounts	Real Media Audio	Shopping Cart	Audio Podcast	Excel	Video Podcast	PHP	PowerPoint	Word	XML
Javascript	1.000													
DOM	1.000	1.000												
CSS	0.704	0.704	1.000											
Windows Media Audio	0.128	0.128	0.035	1.000										
Member Accounts	0.128	0.128	0.035	-0.061	1.000									
Real Media Audio	0.103	0.103	0.146	0.799	-0.108	1.000								
Shopping Cart	0.063	0.063	0.089	0.029	0.488	0.121	1.000							
Audio Podcast	0.053	0.053	0.076	0.068	0.068	0.086	0.099	1.000						
Excel	0.042	0.042	0.060	0.040	0.156	0.076	0.175	0.047	1.000					
Video Podcast	0.041	0.041	0.058	0.138	0.078	0.165	0.198	0.481	-0.008	1.000				
PHP	0.028	0.028	0.039	0.053	-0.108	0.112	0.003	-0.051	0.214	0.115	1.000			
Power Point	0.021	0.021	0.029	0.055	0.055	-0.004	-0.014	0.138	0.200	0.212	0.144	1.000		
Word	0.021	0.021	0.029	0.055	-0.050	-0.004	-0.127	0.015	0.343	0.065	0.544	0.479	1.000	
XML	0.014	0.014	0.020	0.112	0.112	-0.003	-0.089	0.097	0.148	0.241	0.335	0.700	-0.020	1.000

the same reason. The correlation between XML and JSP (.331) and XML and JSF (.363) are presumably correlated because they are partially derived from XML.

DISCUSSION

What this means for IS students is that, as explained in the introduction, the curriculum needs to contain the components that will be most valuable to them in obtaining and maintaining employment. The largest companies in the U.S. drive industry in many ways, both through direct means, such as demanding a certain skill set in employees, and indirect means, such as when smaller businesses seek to emulate the larger businesses. In either case, employers will be looking for potential employees with skills that match the data we have obtained. The IS curriculum needs to close the gap between industry and academia if it is to accomplish the task of preparing students for future careers.

The way that curricula can continue to prepare students for the future is through periodic evaluation and redesign. Closing the gap will always be an iterative process since technological progress will only continue to speed up. Schools should evaluate the IS program on a yearly basis to make sure that the material is meeting the needs of the students and industry.

A "one size fits all" solution is very difficult to find if the curriculum is going to be industry driven, which it needs to be. Obviously each school will have to decide which mixture will be the best fit

Table 5
Significant Correlations for Job Posting Data

	SQL	Java	HTML	CSS	Java Script	ASP	PHP	XML	JSP	AJAX	JSF
SQL	1.000										
Java	0.013	1.000									
HTML	0.095	-0.054	1.000								
CSS	0.031	-0.229	0.324	1.000							
JavaScript	0.068	-0.049	0.347	0.372	1.000						
ASP	-0.102	-0.292	-0.107	-0.085	-0.053	1.000					
PHP	0.395	-0.218	-0.099	0.068	0.209	-0.208	1.000				
XML	0.211	0.229	0.009	-0.011	0.086	-0.073	-0.058	1.000			
JSP	0.241	0.395	0.059	-0.055	-0.054	-0.099	-0.054	0.331	1.000		
AJAX	-0.033	0.151	-0.044	0.272	0.109	0.057	-0.175	0.254	0.217	1.000	
JSF	0.118	0.250	-0.164	0.094	-0.143	-0.143	-0.127	0.363	0.442	0.553	1.000

for its students. Whether to teach one scripting language or to teach multiple scripting languages will have to be addressed, along with document types, audio and video, animation, graphics, etc. In addition to learning scripting languages, the students should be familiar with using the various file types in web sites and maybe even a little bit of editing for each of the desired file types. It may be desirable to teach a variety of scripting languages. In the top 100 companies, 73 companies chose to use more than one programming language, sometimes on the same site. Out of the 500 companies, 328 companies used more than one programming language. And out of the 125 job announcements 68 required proficiency in more than one programming language.

Technologies with a high usage rate are probably mainstream which is why these large companies are using them. The support for these technologies is in place and familiarity is high. These large companies can get maximum value by using these products as opposed to a more obscure product. For students, this translates into more in-demand skills for the workplace.

We recommend that JavaScript and the associated DOM should be made part of the IS curriculum. The high usage rate indicates that IS graduates will encounter JavaScript and DOM sometime during their employment, most-likely in the early stages of employment. For a more robust scripting language we recommend ASPX, the new version of ASP, due to the prevalence of Microsoft products. However, if an opensource solution is desired JSP is the recommended language. Flash is also highly recommended. Over half of the sites surveyed made use of Flash, indicating a need for knowledgeable employees. Finally, knowledge of how best to implement member accounts should be part of the IS curriculum. Many of the sites employed member accounts, signifying that graduates should have a solid understanding of the best practices for modeling member accounts.

As far as the recommended media is concerned, image manipulation and utilization should be a component of IS education. Every web site surveyed made use of images, either JPEG or GIF images. PDF seems to be the most important document format on the web and students should learn how to create and use PDFs. Web sites appear to favor WMA as the audio file of choice. Video, while not a large part of the Fortune 400, seems to be an emerging technology on the web and could be a major part of the web in the future.

If you are more interested in serving a local, rather than a nationwide, job market, Java is in demand. We expected to see higher rates of opensource or at the very least non-proprietary solutions. However, Microsoft's .Net environment was requested by more employers behind Java. The lower cost solutions such as PHP and JSP were required by fewer than expected. Flash, was not as popular with the local job market as it was with the Fortune 500 companies. It seems that local companies are more interested making their website interactive using technologies that do not require as high a cost, such as AJAX.

CONCLUSION

Closing the gap completely may be impossible. However, we do not want to be part of the problem. We have the burden of presenting relevant content to the students at our universities. We must periodically evaluate the IS program to make sure that the skills being taught match those sought by businesses. We have discussed some of the skills that 500 of the largest companies in the U.S. use in their web sites in an attempt to discover what can be done to keep the curricula relevant to both students and industry. We have also investigated job postings from local businesses to determine if the local businesses require different skills than the larger, nationwide companies. From the looking at the data we have gathered it would seem that the local industries require a slightly different mix, but that it still follows the larger businesses to a degree.

In the future it would be advantageous to determine the other interpersonal and business skills that these employers require and try to match them up with the skills listed in this paper in an attempt to determine what can be done to better prepare students for rewarding careers in either large, nationwide businesses or in small, local businesses.

REFERENCES

Andriole, S. J. "Business Technology Education in the Early 21st Century: The Ongoing Quest for Relevance," Journal of Information Technology Education (5), 2006, pp. 1-12.

Archer, C.B. "What Does Business and Industry Expect from Computer Science GraduatesToday?," ACM SIGCSE Bulletin (15:1), February 1983, pp. 82-84.

Bhattacharya, T. K., DiRenzo, J., Merrit, K., and Smith, K. D. "Updating the Information Systems Curriculum: The Cameron Experience," Issues in Information Systems (7:1), pp. 204-207.

Bolin, S. 1998. E-commerce: a market analysis and prognostication. StandardView 6, 3 (Sep. 1998), 97-105. DOI= http://doi.acm.org/10.1145/324042.324044

Cardinali, R. "Business School Graduates—Do They Meet the Needs of MIS Professionals?," Words (16:5), May 1988, pp. 33-35.

Cash, E., Yoong, P., and Huff, S. 2004. The impact of e-commerce on the role of IS professionals. SIGMIS Database 35, 3 (Aug. 2004), 50-63. DOI= http://doi.acm.org/10.1145/1017114.1017120

Daniels, K., and Feather-Gannon, S. "The Development and Revision of a Model Curriculum in Organizational and End-User Information Systems," Proc ISECON, 2003, pp. 1-13.

Goldweber, M., Impagliazzo, J., Bogoiavlenski, I. A., Clear, A. G., Davies, G., Flack, H., Myers, J. P., and Rasala, R. "Historical Perspectives on the Computing Curriculum," Innovation and Technology in Computer Science Education, 1997, pp. 94-111.

Goslar, M. D., and Deans, P. C. "A Comparative Study of Information System Curriculum in U.S. and Foreign Universities," Data Base, February 1994, pp. 7-20.

Gruba, P., Moffat, A., Søndergaard, H., and Zobel, J. "What Drives Curriculum Change?," Sixth Austrailasian Computing Education Conference, 2004, pp. 109-117.

Johnson, D. W., and Jones, C. G. "IS Education: The Changing Complexity of Relevance," Issues in Information Systems (7:1), 2006, pp. 188-192.

Lee, D. M., Trauth, E. M., and Farwell, D. "Critical Skills and Knowledge Requirements of IS Professionals: A Joint Academic/Industry Investigation," MIS Quarterly, September 1995, pp. 313-340.

Little, J. C., Austing, R. H., Seeds, H., Maniotes, J., and Engel, G. L. "Curriculum Recommendations and Guidelines for the Community and Junior College Career Program in Computer Programming," ACM SIGCSE Bulletin (9:2), June 1977, pp. 17-36.

Mandt, E. J. "The Failure of Business Education — and What to Do About It," Management Review, August 1982. pp. 47-52.

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

Patterson, D. A. "Computer Science Education in the 21st Century," Communications of the ACM (49:3), March 2006, pp. 27- 30.

Trauth, E. M., Farwell, D. W., and Lee, D. "The IS Expectation Gap: Industry Expectations versus Academic Preparation," MIS Quarterly, September 1993, pp. 293-307.

Yang, J. and Miao, G. 2005. The estimates and forecasts of worldwide e-commerce. In Proceedings of the 7th international Conference on Electronic Commerce (Xi'an, China, August 15 - 17, 2005). ICEC '05, vol. 113. ACM Press, New York, NY, 52-56. DOI= http://doi.acm.org/10.1145/1089551.1089564