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An Ethics Whirlwind: A Perspective of the Digital Lifestyle of Digital Natives and Initial Thoughts on Ethics Education in Technology

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Abstract

As digital natives continue rolling onto college campuses around the country, the questions surrounding digital ethics grow. Students do not know life without modern technology, computers, mobile devices, the Internet and their lifestyle has developed around this mass. Unlike their predecessors, they do not recognize a difference between the digital space and the real world. They are one-in-the-same. Yet, the connection between digital actions and real-life consequences is often unrecognized. This is mainly due to the fundamental lack of proper moral code education and application. This paper is a presentation of data collected on students' digital behavior and initial thoughts on the issues surrounding digital ethics education.

Keywords: ethics, digital lifestyle, technology education, behavior, moral framework

1. INTRODUCTION

To lay the foundation for further study on digital ethics education an initial questionnaire was developed and distributed to three same-semester sections of an introductory web class at a teaching college in New England. The rationale behind the class selection was threefold: introductory web classes have a good mix of technology majors, the majority of students would be first-year and such a web class incorporates a large mix of technological issues – networks, the Internet, social networking, security, publication, privacy, programming, media and so on. For a sample non-technologist comparison the questionnaire was also given to a section of criminal justice majors.

There are several goals for the multi-part study. This first component, and paper, provides data on some digital behaviors and ethical viewpoints of students. The derived information will assist in developing a deeper examination and determination as to what incoming students view as ethical digital behavior. Also, it must be determined to what extent behavioral differences exist between the digital space and non-digital aspects of life and decision-making. Another part of future study will be assessing the state of ethics education in technology programs around the country and its emphasis in model curricula.

Eventually, the empirical evidence will be used to help establish a model for properly educating technology students, and retraining them if necessary, on the topic of an ethical digital lifestyle. This should also result in the application of ethical and moral principles to objectives of technologists. The primary challenge with this type of research is keeping pace with the technology (Peslak, 2007, p. 1).

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2. LITERATURE AND QUESTIONS

There have been many studies and thoughts presented in the past on students' software piracy and morals (Kini, Rominger & Vijayaraman, 2000; Ramakrishna, Kini & Vijayaraman, 2001), computer security practices (Teer, S. Kruck & G. Kruck, 2007), attitudes toward computers and software (Anderson & Schwager, 2002), risky computing practices (Aytes & Connolly, 2004), careless views on privacy (Hinde, 2003), how to improve user behavior (Lu & Lin, 1998/1999; Collins, Rawlinson, Manwani & Allen, 2005; Leach, 2003), and even ethical views of students vs. professionals in information systems scenarios (Cappel & Windsor, 1998). There are entire journals in the information and technology field devoted to ethical topics (e.g. *Ethics and Information Technology*).

The common academic approach has been to separate these technology topics and research specific reasons for a specific behavior, and to suggest methods for improving specific outcomes. For example, one can easily find articles on ethics of computer and information security, but few on student behavior and perceptions surrounding a digital *lifestyle*. Though the scientific and philosophical methodology of breaking things into their smallest components may be useful to a certain extent, it may not be the best approach to the subject of digital behavior and ethics.

An alternative approach in the professional world has been to push the "code of ethics" doctrine (ACM, IEEE, AITP, etc.). Unfortunately this strategy has not been extremely influential in education, and is conflicted and volatile (Peslak, 2007). So, even *if* organizations adopt some sort of umbrella ethical code about information and technology, it does little for purposeful education or altering the digital decision-making of those raised with modern technology. Does the world expect students, future technology professionals, to instantly apply a code of ethics that differs from their established beliefs and behaviors?

A current observation is that one way ethics is detached from the classroom is its virtual non-existence in the IS model curriculum (Topi et al., 2009). It is slightly more emphasized in the IT and CS curriculum models, but still lacks a cohesive, unambiguous and fundamental tone (Lunt et al., 2008; Cassel et al., 2008). As already alluded to, a curriculum analysis will be conducted in a future phase of this research. Still, the ongoing challenge is to find the best approach to educating students on this topic.

The main research questions to be approached throughout the study are as follows:

RQ1: What are the digital behaviors and ethical views of students entering college?

RQ2: What do students perceive as acceptable or troublesome digital behavior?

RQ3: What are the implications of these behaviors and perceptions?

RQ4: What is the current state of ethics in the classroom?

RQ5: How should technology educators educate or retrain students about digital ethics?

This paper primarily addresses RQ1, and partially confronts RQ2 and RQ3.

3. METHODOLOGY

Abstraction is extremely important in many areas of computer science, particularly in algorithm design, computer organization/architecture, and complex systems (e.g. biological, neural networks, robotics). Taking an elevated view can be very beneficial when studying highly complex systems and in understanding how something works and why (Schneider, Gersting & Miller, 2009). For example, discussing how computers work in terms of electronic gates does little to educate many, if not most students. Alternatively, it is much more engaging to discuss how a CPU communicates with memory or how multiple information systems work together architecturally.

The fact that current and future students have not been raised alongside computing technology, but every aspect of their life has been intertwined with it makes the issue quite complex. Possibly more complex than it is with digital immigrants, those who were introduced to such things later in life. Therefore, viewing digital behavior at a higher level, as a lifestyle, can be an advantageous approach.

With this high-level abstraction (HLA) methodology in mind, the first-phase questionnaire was developed with the understanding that the natural tendency of digital natives, those raised surrounded by tools of the digital age, is to view technology in terms of *use* rather than what is happening technologically (Prensky, 2001). This had an impact on the questions chosen and their wording. The survey provided the quantitative data discussed in this paper.

The questionnaire was a set of 20 questions to which the students could respond *Yes, No,* and if applicable *Some*. Their year status was also obtained. In total the questionnaire was given to 69 students. The primary group totaled 59 students composed of 45 freshmen, 2 sophomores, 4 juniors and 8 seniors/continuing studies. The smaller comparison group of 10 criminal justice majors was only meant to be a sample (not of high statistical significance) that might give non-technical yet related insight into the topic.

4. RESULTS

Aside from the following discussion, the full survey (Table 1) and results (Table 2) are included in the Appendix. An admonition to readers of this paper is to be mindful that this is one instance of student perspective. It is very possible that results would vary based on location, variations in student year-status and nationality, and the distribution numbers and date.

The results were a mixture of expected, unexpected and telling. When broken out, the questions fall into different categories (Table 3) that may be considered aspects of the digital lifestyle: attention, recipient, actions/behavior, privacy, and belief. Some questions may contribute to more than one category; not all combinations have been declared. There are many other questions that could have been part of this initial questionnaire, but again the goal was to get an overall sense of the digital lifestyle, not to dissect individual categories or questions.

Attention

The goal of the *Attention* category was to get a feel for the level of attention paid to digital detail. Sometimes detail in the digital space can be technological in nature such as a warning prompting the installation of a file. Sometimes it can be legal detail such as in the case of End User License Agreements (EULAs). And sometimes it can be noticing when someone is being emotionally or verbally attacked via a technological medium, which crosses into some of the other categories.

The questions posed in this category netted expected yet somewhat conflicting ideas. Nearly 40% do not give attention to security certificates and likewise nearly 50% to Terms of Service (TOS). As expected EULAs get the least amount of attention with 78% not reading applicable agreements. Yet, 83% do read prompts and warnings before clicking. The only major difference with the sample non-technologist group was they were even less likely to read the warnings and TOS agreements.

Naturally, this progression of likelihood of attention to detail is linked to the length and complexity of the information. As with most people, information is expected in a distilled and quickly digestible format. This is something that composers of the information and its presentation must incessantly remember. However, regardless of length or complexity, educators should dedicate more resources to the importance of attention to detail in the digital space. The belief that technology and systems make our lives easier should not equate to indifference. An EULA may not be a space heater, but reading the warning label may prevent "burning the house to the ground".

Recipient

One of the questions that might apply to both the *Attention* and *Recipient* categories was if the student had witnessed the attempted reputation damage of another person via some form of technology. This would include things such as status updates on social networking sites, email, web postings, digital photos, and is inclusive of the larger topic of cyber-bullying. In the primary group 65% of students claimed to have seen this behavior and 70% in the secondary group.

There were two other questions posed in which the student was a direct recipient. The results of these questions also give cause for concern. First, 30% reported being on the receiving end of what they considered harassing messages through social networking sites. In the comparison group it was 50%. Second, in both groups 60% of students indicated that they had not been exposed to discussions of ethical digital behavior in high school. This may be changing in many places, but obviously it is still an area that needs more attention.

One of the responsibilities of collegiate educators, even in technical fields, is to create well-rounded global citizens. If students are not receiving proper ethics instruction prior to college, when most behaviors are established, then it is critical the subject is delivered with directed intensity. It must be repeatedly expressed that digital behavior is not abstract and it is not virtual. It is real and therefore has real consequences. Technology and systems are catalysts for many things, but the sense of a virtual or digital existence is giving rise to an unwarranted sense of behavioral entitlement that does not expect actual consequences.

Actions

A large portion of the questionnaire was designed to ascertain the *Actions* of incoming students in the digital space. These eight questions varied greatly in focus, again to gain an overall sense of usage of technology and systems. The results of the criminal justice group were similar to the technologist group aside from them being slightly less likely to illegally download media or install pirated software.

In sum: 92% had downloaded pirated media, 66% had taken content from the web and used it without citing credit, 85% had used an Internet connection they were unauthorized to use, 85% had installed pirated software on their computers, and 63% had seen someone doing something they considered "wrong" on a computer and took no action against it. One of the redeeming statistics was that 95% claimed they had not attempted to damage another person's reputation using forms of technology. A couple of the questions that blend into the next category of *Privacy* were that 34% had looked through someone else's computer, files or email, and 70% had tried to find information about someone for personal reasons using technological means.

This group of questions was also one of the drivers for the selection of first-year criminal justice majors as the secondary sample group. Most of these actions could result in legal action, some civil and some criminal, so getting their case was useful. There is definitely a lack of awareness, a feeling of indifference, or a logical detachment between digital actions and tangible outcomes. Digital natives, students and many other people in general do not know of, consider, or in some cases care about the existing laws governing digital behavior.

Take the cases of 85% using an unauthorized network connection and 34% looking through someone else's computer and apply it to the following Vermont Statute (13 VSA, 2011).

> "Title 13: Crimes and Criminal Procedure, Chapter 87: Computer Crimes
>
> § 4102. Unauthorized access
>
> A person who knowingly and intentionally and without lawful authority, accesses any computer, computer system, computer network, computer software, computer program, or data contained in such computer, computer system, computer program, or computer network shall be imprisoned not more than six months or fined not more than $500.00, or both. (Added 1999, No. 35, § 1.)"

Simply put, the education of digital ethics and consequences is not pervasive.

Privacy

Several of the questions were focused on *Privacy* concerns. Like most topics ethics is wrapped in the web of perception, so to help this study it is necessary to determine what the perception is of personal information and its digital availability. 57% of students either had no or only some concern about personal information available via the Internet. 50% are willing to leave computers "logged in" for extended periods of time. However, 90% use some form of privacy granulation and 56% do not use public computers for personal reasons. The non-technical group was even less concerned about information availability, but was more guarded about leaving account sessions active.

These results show another conflict. Though students are mostly unconcerned with their personal information being digitally available, they do care about being able to control it in some way. This suggests they are mildly aware that there is potential danger in the misuse of or unethical actions based on their digital information. On an anecdotal level it could be stated that these numbers would be very different if more of them had been personally or professionally burnt by the misuse of their digital information or if they knew exactly what information *is* available. Particularly with about 50% leaving accounts active or using public computers for personal reasons.

As educators one concern should be raising awareness of ethics and information privacy of a digitized life. For example, if students discussed the availability of their legal records on their respective county clerk web sites, they would begin to consider not only its unrestricted availability, but also their actions leading to its digital existence and the morality of its usage by potential employers when making hiring decisions. The problem is that many are not even aware this does exist. Even more important, such topics should be discussed to inform the moral compasses of the students who will be responsible for building and maintaining such systems.

Belief

The last category, *Belief*, had one main question though some of the previously discussed questions percolate into this area. One example was the question in the *Actions* section that asked if the student had seen someone doing something "wrong" and did not take action against the behavior. Such a question is based on what the student believes to be wrong. Be that as it may, the pivotal question was direct and asked if the student applied the same moral, ethical and legal beliefs digitally that they believe in otherwise. The telling response was that nearly 50% either do not or only partially.

This data highlights the failure or complete lack of digital ethics education for students throughout the evolution of digital technology, the Internet and its applications. Furthermore, what was and is an oversight in education has fostered unethical social norms that incoming students have adopted. An ethical and moral framework was never a *principal* concern and it is still an afterthought in most technology programs.

In most cases there may be one ethics course in a program, sometimes technology ethics, often only included to meet accreditation requirements. At that point hands are wiped clean and it is claimed that moral responsibility has been met. This method is dangerous and only reinforces the mentality that ethics is 'easy' and not fundamental in the digital age (Cassel et al., 2008, p. 92).

At the 2011 TEDx Silicon Valley event, Damon Horowitz stated that technology makers should be considering their "moral operating system" just as much as their mobile operating system and that "we have stronger opinions about our handheld devices than the moral framework we should use to guide our decisions" (Horowitz, 2011). Technology educators must be more proactive in confronting this issue and the earlier the education the better.

5. CONCLUSIONS AND FUTURE RESEARCH

This first step of gaining an understanding of the current state of students entering higher education, particularly in the technology field, was important for the final goal of the multi-part study. That goal is to develop a better method of educating technology students on the subject of digital ethics. Though this is important for all students, it is even more important for those responsible for designing and building the systems and solutions to meet the needs of the digital era.

It must be understood that this will not be an attempt to "tack on" the mere idea of good-faith adherence to a code of ethics or to suggest a "quick fix" course. This developing method will strive to supplement the entire educational experience and fundamentally change how students digitally live. The next phases of behavior examination and exploration of ethics content in IS/IT/CS programs should give a better view of the moral mindset of students and their ethics exposure. This ongoing research will also provide content for ethics extensions to ACM and AIS model curricula and associated wikis.

Technology educators have a heightened responsibility as a result of technology evolution. Technology educators should intently be focusing on developing an appropriate and modern method for building and reinforcing a moral framework for this new type of student, the digital space and the information age.

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Appendix

Table 1: Survey

Question	**Yes**	**No**	**Some**
Do you pay attention to security certificates?			
Do you use privacy granulation or attempt to control who can see particular information about you on the Internet? (eg. friend lists in Facebook)			
Do you read EULAs (End User License Agreements, when Installing software)?			
Have you ever received a harassing message through a social networking site?			n/a
Do you read warnings, prompts, before clicking Yes/No?			
Have you ever downloaded music/movies/media without paying for it?			n/a
Have you used text/code/images from the internet without citing credit?			n/a
Have you attempted to find information on an individual for personal reasons?			n/a
Have you used someone else's unsecured wireless connection?			n/a
Have you looked through someone else's email/account/files/computer?			n/a
Are you concerned about the amount of information about you available on the Internet?			
Have you ever installed software you didn't purchase (excluding Freeware, Open Source, etc)?			n/a
Have you ever tried to damage someone's reputation using some form of technology (status updates, web page, mass email, posting pictures)?			n/a
Have you ever seen the above done to someone, but weren't involved?			n/a
Do you read the Terms of Service when you sign-up online for a service (like google sites, web hosting, email account, online banking)?			
Do you apply the same moral, ethical, and legal beliefs digitally that you believe in otherwise?			
Did any teachers in high school discuss questions like those addressed in this survey?			n/a
Have you ever seen someone else doing something "wrong" on a computer and said nothing to them or a teacher/supervisor/manager?			n/a
Do you use public computers for personal reasons?			
Do you set your email or other accounts to stay "signed in" for extended periods of time?			

Circle your year in College: Freshman Sophomore Junior Senior Grad/CP

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Table 2: Results

	Primary Group (n=59)			Secondary Group (non-technologist, n=10)		
Question	Yes %	No %	Some %	Yes %	No %	Some %
Do you pay attention to security certificates?	15.25%	37.29%	47.46%	30%	50%	20%
Do you use privacy granulation or attempt to control who can see particular information about you on the Internet? (e.g. friend lists in Facebook)	81.36%	10.17%	8.47%	80%	0%	20%
Do you read EULAs (End User License Agreements) when installing software?	3.39%	77.79%	18.64%	0%	80%	20%
Have you ever received a harassing message through a social networking site?	30.51%	69.48%	n/a	50%	50%	n/a
Do you read warnings, prompts, before clicking Yes/No?	83.05%	6.78%	10.17%	50%	10%	40%
Have you ever downloaded music/movies/media without paying for it?	91.53%	8.47%	n/a	80%	20%	n/a
Have you used text/code/images from the Internet without citing credit?	66.10%	33.90%	n/a	70%	30%	n/a
Have you attempted to find information on an individual for personal reasons, using the Internet?	69.49%	30.51%	n/a	70%	30%	n/a
Have you used someone else's unsecured wireless connection?	84.75%	15.25%	n/a	70%	30%	n/a
Have you looked through someone else's email/account/files/computer?	33.90%	66.10%	n/a	40%	60%	n/a
Are you concerned about the amount of information about you available on the Internet?	42.37%	45.76%	11.86%	10%	60%	30%
Have you ever installed software you didn't purchase (excluding Freeware, Open Source, etc.)?	84.75%	15.25%	n/a	50%	50%	n/a
Have you ever tried to damage someone's reputation using some form of technology (status updates, web page, mass email, posting pictures)?	5.08%	94.92%	n/a	10%	90%	n/a
Have you ever seen the above done to someone, but weren't involved?	64.41%	35.59%	n/a	70%	30%	n/a
Do you read the Terms of Service when you sign up online for a service (like Google Sites, web hosting, email account, online banking)?	18.64%	47.46%	33.90%	0%	70%	30%
Do you apply the same moral, ethical and legal beliefs digitally that you believe in otherwise?	52.54%	27.12%	20.34%	60%	20%	20%
Did any teachers in high school discuss questions like those addressed in this survey?	40.68%	59.32%	n/a	40%	60%	n/a
Have you ever seen someone else doing something "wrong" on a computer and said nothing to them or a teacher/supervisor/manager?	62.71%	37.29%	n/a	50%	50%	n/a
Do you use public computers for personal reasons?	33.90%	55.93%	10.17%	40%	60%	0%
Do you set your email or other accounts to stay "signed in" for extended periods of time?	42.37%	50.85%	6.78%	20%	70%	10%

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Table 3: Categories

Question	Category
Do you pay attention to security certificates?	Attention
Do you use privacy granulation or attempt to control who can see particular information about you on the Internet? (e.g. friend lists in Facebook)	Privacy
Do you read EULAs (End User License Agreements) when installing software?	Attention
Have you ever received a harassing message through a social networking site?	Recipient
Do you read warnings, prompts, before clicking Yes/No?	Attention
Have you ever downloaded music/movies/media without paying for it?	Actions
Have you used text/code/images from the Internet without citing credit?	Actions
Have you attempted to find information on an individual for personal reasons, using the Internet?	Actions/Privacy
Have you used someone else’s unsecured wireless connection?	Actions/Privacy
Have you looked through someone else’s email/account/files/computer?	Actions/Privacy
Are you concerned about the amount of information about you available on the Internet?	Privacy
Have you ever installed software you didn’t purchase (excluding Freeware, Open Source, etc.)?	Actions
Have you ever tried to damage someone’s reputation using some form of technology (status updates, web page, mass email, posting pictures)?	Actions
Have you ever seen the above done to someone, but weren’t involved?	Attention/Recipient
Do you read the Terms of Service when you sign up online for a service (like Google Sites, web hosting, email account, online banking)?	Attention
Do you apply the same moral, ethical and legal beliefs digitally that you believe in otherwise?	Belief
Did any teachers in high school discuss questions like those addressed in this survey?	Recipient
Have you ever seen someone else doing something “wrong” on a computer and said nothing to them or a teacher/supervisor/manager?	Actions/Belief
Do you use public computers for personal reasons?	Privacy/Actions
Do you set your email or other accounts to stay “signed in” for extended periods of time?	Privacy/Actions

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Abstract

A network engineer is an Information Technology (IT) professional who designs, implements, maintains, and troubleshoots computer networks. While the United States is still experiencing relatively high unemployment, demand for network engineers remains strong. To determine what skills employers are looking for, data was collected and analyzed from 1,199 nationwide job advertisements listed on Dice.com. Requested skills were then grouped into related categories and summarized. The most frequently requested skills were identified and discussed. The authors also collected data regarding the education level and certifications requested. The results can be used to modify networking courses/curriculum to better prepare students to obtain positions and be successful as network engineers.

Keywords: education, network engineer, job, skills, requirements

1. NETWORKING FIELD

Role of Networks

Networking has become a highly technical, widespread, and necessary technology. It is a part of everyday life: we are using it at workplaces, as well as for education, recreation, and entertainment. The basic understanding is that the network and access to it is there, and the default expectation is that "it just works".
National and local governments worldwide – even countries with huge economic problems – realize the necessity and value of connections and invest in local-, metropolitan-, and wide-area networks.

Networks enable the creation of online learning communities, digital cities, e-government support, virtual organizations, and telecommuting (Tapia et. al., 2011).

The Role of a Network Engineer

A network engineer is an IT professional that manages, and services the network infrastructure of an organization. The duties and responsibilities include a wide range of different technologies that are integrated into local-, wide-area network, and Internet access solutions. The engineers deal with the setup and configuration of devices and equipment that make up the functional parts of the network, such as servers, switches, routers, firewalls, user computers, and several other devices. The network engineers work with hardware, user and network operating systems, security software, configuration, filtering and monitoring tools, and have to master different networking protocols and standards. They do not get recognition for the network being up and operational, but they always get the grief when it goes down (Norton, 2011). Further, the role of the network engineer is changing rapidly. Besides delivering availability and connections they also have to be adaptable to new technologies and provide a mandated level of reliable networking services. They have to manage costs, and ensure security and application delivery (Metzler, 2011). Based on a survey conducted by Cisco among Cisco Certified Internetwork Expert (CCIE) certificate holders in 2010 the most important skills are related to virtualization and green IT, support of increased collaboration in the workforce through unified communications (UC), and (probably the most in-demand networking skills) security and risk management (Pickett, 2011).

Job Demand

The U.S. Department of Labor in the Occupational Outlook Handbook, 2010-11 Edition predicts that employment of network engineers and computer systems administrators will increase by 23 percent from 2008 to 2018, much faster than the average for all occupations. Computer networks are an integral part of business, and demand for these workers will increase as firms continue to invest in new technologies. Even more, the increasing adoption of mobile technologies means that more establishments will use the Internet to conduct business online. This growth translates into a need for professionals who can help organizations use technology to communicate with employees, clients, and consumers. Growth will also be driven by the increasing need for information security. As cyber attacks become more frequent and increasingly sophisticated, demand will mount for workers with security skills. The predicted skill set includes critical thinking, reading comprehension, systems analysis, active listening, complex problem solving, judgment and decision-making, monitoring, systems evaluation, operation monitoring, and programming (US DoL, 2009).

2. EDUCATION

Education for Network Engineers

Most college or university programs don't offer a degree specifically in Computer Networking. Four-year academic programs that might be suitable for the computer or IT networking field include: Computer Information Systems, Computer Science, Electrical and/or Computer Engineering, Information Technology, Communications Science, Telecommunications, and/or Telecommunications Management.

Different professional organizations have published recommendations regarding how much coverage of networking related issues should be in the body of knowledge in model curricula. The "*Information Technology 2008 Curriculum Guidelines for Undergraduate Degree Programs in Information Technology*" which is the joint work of Association for Computing Machinery (ACM) and Institute of Electrical and Electronics Engineers (IEEE) Computer Society suggests that the following topics should be covered: networking (22 core hours – including foundations of networking, routing and switching, network management etc.), platform technologies (14 core hours – including computing infrastructures, enterprise deployment software, firmware etc.), information assurance and security (23 core hours – including forensics, information states, security services etc.), and web systems and technologies (22 core hours - including web technologies, information architecture, vulnerabilities etc.). All together they represent 81 hours out of the recommended 314 hours (ACM, 2008).

The *"IS 2010 Curriculum Guidelines for Undergraduate Degree Programs in Information Systems"* is the joint work of the Association for Computing Machinery (ACM) and the Association for Information Systems (AIS). The curriculum guidelines include topics from IS 2010.3 Enterprise Architecture (including audit and compliance, system administration, IT control and management frameworks, emerging technologies etc.), and IS 2010.4 IT Infrastructure (including core computing system architecture concepts, virtualization of computing services, networking, network security and security devices, etc.). The document does not specify the number of credits, contact hours, or even courses, but the two references are part of seven recommended areas (ACM, 2010).

Accreditation organizations such as the *Accreditation Board for Engineering and Technology* (ABET), do not define specific hours or curriculum guidelines for accredited programs but they require that students be exposed to networking as part of their required studies (ABET, 2010).

Different programs focus on different technologies including Microsoft, UNIX, Cisco, and Novell. Post-secondary education offers certifications at different levels related to all of these systems. But researchers mostly agree that it probably matters little which networking technology one learns. More importantly, students should recognize that technology changes rapidly, and it is highly unusual that studying just one field would be sufficient for a lifetime career (Yuan & Zhong, 2010; Uzunboylu, Bicen, & Cavus, 2011).

Computer networking involves a number of fundamental technologies including switching, Transmission Control Protocol/ Internet Protocol (TCP/IP), the Open Systems Interconnection (OSI) model, Ethernet, internetworking, and others. Their combinations in real-life cases and business situations assume complexity and involve a wide range of different solutions coming from various vendors.

On the job market many companies view college degrees as a sign of commitment to the professional field. Network technology changes very quickly, so in addition to proof of a person's current knowledge, they also look for employees with the ability to learn new technologies in the future. Up-to-date certifications can effectively demonstrate contemporary knowledge, but college degrees best demonstrate one's general learning ability.

Salaries

Salary.com reports the national salary average of 80 IT networking-related positions, which can then be fine-tuned based on education, years of experience, position in the organization (direct reports versus reports to), job performance, location, company size, and industry. For example, with 5-10 years experience security experts can expect a salary of around $102,000, client technology managers - $98,000, Local Area Networks (LAN)/Wide Area Networks (WAN) administrators - $70,000, and network technology technicians around $54,000. With the importance of these IT jobs and increased demand in the field, salaries are increasing by 2-5% on an annual basis and are further supported by additional benefits. This trend has been reported not only in the United States but also worldwide (Culpepper, 2011). The numbers correspond with the statistical data provided by Bureau of Labor Statistics (BLS, 2010). Unemployment rates remain at half of the national average.

What Employers Want

Forester conducted a survey of 1,500 individuals responsible for managing, evaluating, or hiring network professionals. The survey was conducted in 10 countries to gather data about the various job roles within the network and to understand how skills requirements would change over a five-year time horizon. The results clearly showed that "… managing talent in the network environment is becoming increasingly challenging for CIOs, IT managers, and HR decision-makers." Some of the major findings of the study indicate that organizations seek more network certifications; skills like security, risk, and performance management are emerging as important, regardless of the role of the individual in the IT organization; IT (including networking) is an increasingly global industry, requirements are consistent across geographies (Forester, 2008).

Dice.com, the highly rated technology job board, published a special report on May 1, 2011 with the title "*America's tech talent crunch*." The job market numbers and the number of academic degrees conferred in related subject areas describe well the challenge facing American businesses in need of tech-skilled new hires in 2011 and beyond (Dice, 2011). They also report that there is an increasing number of states where organizations have a difficult time filling positions, and/or that the pace of education and training cannot keep up with the creation of new positions.

3. RESEARCH RESULTS

Methodology

A national search for jobs with "Network Engineer" in the title was performed at

Dice.com. Dice.com is one of the major job boards for technical positions. A total of 1,199 sequential job positions were downloaded from April through May 2011. Obvious duplicate jobs were eliminated. Only positions where it was clear that Network Engineer was the primary job assignment were used. For example, Network Security Engineer and Network Sales Engineer were not included. Both entry/junior level and senior network engineer positions were included.

Job requirements for the 1,199 jobs were examined. The tables below categorize the requested skills by types of protocols, standards, operating systems, etc.

Protocols and services associated with Wide Area Networks (WANs) are presented in the first three tables. Table 1 indicates the number of jobs that listed specific routing protocols. Border Gateway Protocol (BGP) was the most frequently requested protocol. It is an exterior gateway protocol (EGP) that is used to link autonomous systems. This would explain the high demand for this protocol. The other items listed are interior gateway protocols (IGP). The general term "Router" in the job ads just adds emphasis to the importance of this area in general. Cisco's IOS was requested by 13.2% of companies.

Table 1. Routing Protocols

Protocol	*N*	*%*
Border Gateway Protocol (BGP)	409	34.1%
Open Shortest Path First (OSPF)	355	29.6%
Enhanced Interior Gateway Routing Protocol (EIGRP)	234	19.5%
Cisco Internetwork Operating System (IOS)	158	13.2%
Router	144	12.0%
Routing Information Protocol (RIP)	74	6.2%
Intermediate System To Intermediate System (IS-IS)	34	2.9%
Interior Gateway Routing Protocol (IGRP)	22	1.8%
Routing Information Protocol – version 2 (RIP-2)	1	0.1%

Table 2 lists the other protocols requested. One would expect IP to have the largest percentage of requests, due to the vast body of knowledge it covers such as subnetting and understanding addressing in terms of route aggregation. Subnetting itself was specifically mentioned in 1.4% of the positions. When a specific version of IP was mentioned, it is interesting to see the higher percentage for IPv6, indicating the move to IPv6. However, the numbers for IPv4 reflect the current coexistent need for the two protocols. Voice over IP (VoIP) is the third most requested item. TCP is used more than User Datagram Protocol (UDP). Internetwork Control Message Protocol (ICMP) is the protocol in the TCP/IP suite that is used for router-to-router communication of problem conditions in the internetwork.

Table 2. Other Protocols

Other Protocols	*N*	*%*
Internet Protocol (IP)	561	46.8%
Transmission Control Protocol (TCP)	387	32.3%
Voice over Internet Protocol (VoIP)	253	21.1%
User Datagram Protocol (UDP)	42	3.5%
IPv6	26	2.2%
IPv4	19	1.6%
Subnetting	17	1.4%
Internetwork Control Message Protocol (ICMP)	11	0.9%

Table 3. WAN Services

WAN Services	*N*	*%*
WAN	534	44.5%
Integrated Services Digital Network (ISDN)	103	8.6%
Asynchronous Transfer Mode (ATM)	84	7.0%
Frame Relay	77	6.4%
T3/ DS-3	62	5.2%
T1	60	5.0%
SONET	45	3.8%
OC-3	31	2.6%
OC-12	17	1.4%
OC-48/OC-192/OC-768	12	1.0%

Table 3 summarizes WAN Services. General wide area network experience was requested in 44.5% of the positions. Asynchronous Transfer Mode (ATM) and Frame Relay appear to be popular services, as one would expect. The relatively high number for Integrated Services Digital Network (ISDN) is somewhat surprising. ISDN showed up as ISDN in general as well as Basic Rate Interface (BRI) and Primary Rate Interface (PRI) specifically.

Most of the ISDN requested was the PRI variety (66 of the 103 requests). This has the same bandwidth as a T1. Knowledge of T1s was requested almost as much as T3s. This is somewhat of a surprise as the T1 bandwidth is so low given the availability of services such as

Synchronous Optical Network (SONET) today. SONET was requested in table 3 and will probably increase in frequency over the years. The very high speeds for SONET, OC-48 (2.488 Gbps), OC-192 (10 Gbps), and OC-768 (40 Gbps) were only requested in one percent of positions but only a few companies would be using these speeds regularly today.

Tables 4 – 8 cover concepts and standards relating to LANs and network components. Switches, LANs, and VLANs were the most requested topics in Table 4.

Table 4. LAN Topics

LAN Topics	*N*	*%*
LAN	490	40.9%
Switch	127	10.6%
Virtual Local Area Network (VLAN)	94	7.8%
Spanning Tree Protocol - 802.1d	58	4.8%
Wireless LAN (WLAN)	44	3.7%
VLAN Tagging - 802.1q	26	2.2%
Storage Area Network (SAN)	15	1.3%
802.11a/b/n	13	1.1%
WiMax - 802.16	13	1.1%
802.3	6	0.5%
Token Ring	6	0.5%
40/100 Gigabit Ethernet	2	0.2%

WLANs were requested in general and as specific 802.11 standards. WiMAX, the fixed broadband wireless access standard, was requested as often as the 802.11 (WiFi) standards. It is very surprising to see Token Ring requested at all as it has not been upgraded since the 16 Mbps version in the 1980s.

Conspicuously absent are requests for specific Ethernet standards such as 802.3ab (1000Base-T), 802.3z (1000Base-SX and 1000Base-LX). As Ethernet is the predominant wired standard, maybe the companies were thinking of it when they requested LANs in general. Knowledge of the Spanning Tree Protocol, which is used to prevent topological loops in networks, and VLAN Tagging, were also requested quite frequently.

Table 5 shows the operating systems requested. If we combine Active Directory with the various versions of Windows Server (17.5%), one can see that both Linux and Unix almost match this number. Of the Microsoft client operating systems Windows XP was the most requested. A surprising entry is Novell NetWare, a skill one would have expected to be no longer needed.

Table 5. Operating Systems

Operating Systems	*N*	*%*
Linux	203	16.9%
Unix	180	15.0%
Active Directory	158	13.2%
Windows XP	57	4.8%
Windows Server NT/2000/2003/2008/2008R2	51	4.3%
Solaris	41	3.4%
Novell NetWare	34	2.8%
Vista	20	1.7%
Windows 7	19	1.6%
RedHat	14	1.2%
CentOS	7	0.6%
OpenBSD	1	0.1%

Requests for knowledge of Database Management Systems (DBMS) are shown in Table 6. Microsoft SQL Server and Oracle are the two main DBMSs as would be expected.

Table 6. Database Servers

Database Servers	*N*	*%*
Microsoft SQL Server	54	4.5%
Oracle	29	2.4%
MySQL	10	0.8%
PostgreSQL	5	0.4%
IBM DB2	3	0.3%

Table 7. Web Servers

Web Servers	*N*	*%*
Microsoft IIS Server	54	4.5%
Apache	23	1.9%
IBM Http Server	7	0.6%
Apache Tomcat	4	0.3%

Table 7 shows the requested web servers. In this sample of companies, the most requested is Microsoft's IIS Server. There were far fewer requests for DBMSs and Web Servers compared to requests for network/server operating systems, which makes sense given the job title searched was "Network Engineer".

Of the other servers requested in the ads, Microsoft Exchange was the clear leader – see Table 8.

Table 8. Other Servers

Other Servers	*N*	*%*
Microsoft Exchange	140	11.7%
Sharepoint	29	2.4%
Citrix Server	4	0.3%
Lotus Domino	1	0.1%

Table 9 shows that a reasonable percentage of companies requested knowledge of virtualization technologies with VMware being by far the most common solution. Blade technology was also requested.

Table 9. Server Technology and Virtualization

Server Technologies	*N*	*%*
VMware	146	12.2%
ESX	45	3.8%
Blade/Blade Servers	27	2.3%
Hyper-V	33	2.8%
Zen	2	0.2%

While some positions requested specific monitoring software (see Table 10), the most requested item was SNMP itself. Most monitoring tools support SNMP.

Table 10. Monitoring Tools

Monitoring Tools	*N*	*%*
Simple Network Management Protocol (SNMP)	115	9.6%
Nagios	17	1.4%
Orion	13	1.1%
Zenoss	2	0.2%
Freenats	1	0.1%
Opsview	1	0.1%
Tclmon	1	0.1%
Zabbix	1	0.1%

Table 11. Protocol Analyzers

Protocol Analyzers	*N*	*%*
Wireshark	42	3.5%
Sniffer	32	2.7%
Netflow	25	2.1%
Ethereal	15	1.3%
Omnipeek	7	0.6%

Protocol analyzers were also requested by several companies, with Wireshark being the most requested. – see Table 11.

The next set of tables relates to degrees and certificates requested in the position listings by companies. Table 12 shows the degrees requested. Combining the degree in Computer Science and Computer Information Systems totals, we see that 34.2% of companies requested a degree in one of the two most common computer related degrees.

Table 12. Degree Requirements

Degree Requirements	*N*	*%*
Degree In Computer Science	313	26.1%
Bachelors Degree	123	10.3%
Degree In Information Systems	97	8.1%
Masters Degree	13	1.1%

Table 13. Certificate Requirements

Certificate Requirements	*N*	*%*
Cisco		
Cisco Certified Network Professional (CCNP)	371	30.9%
Cisco Certified Network Associate (CCNA)	283	23.6%
Cisco Certified Internetwork Expert (CCIE)	226	18.8%
Cisco Certified Design Professional (CCDP)	50	4.2%
Cisco Certified Network Professional CCNP Voice CCNP Voice (Previously CCVP)	41	3.4%
Microsoft		
Microsoft Certified Systems Engineer (MCSE)	84	7.0%
Microsoft Certified Systems Administrator (MCSA)	21	1.8%
Microsoft Certified IT Professional (MCITP)	19	1.6%
CompTIA		
A+	8	0.7%
Network +	1	0.1%
Security		
CISSP	43	3.6%
TS/SCI	33	2.8%
DoDD 8570 Compliant	9	0.8%
GIAC	4	0.3%
CISM	3	0.3%

Different types of certificates were also listed as requirements in many positions – see Table 13. As expected, Cisco and Microsoft certificates were the most requested. The fact that 23.6% of companies requested the entry-level Cisco certificate (CCNA) shows how high the bar is for our students. Security certificates were also requested as shown in Table 13, demonstrating the importance for network engineers to have proven knowledge in this ever more important area of networking.

Table 14. Vendors

Vendors	*N*	*%*
Cisco	870	72.6%
Juniper	199	16.6%
HP	102	8.5%
Dell	28	2.3%
Ericsson	4	0.3%
Siemens	2	0.2%
Alcatel-Lucent	1	0.1%
Netgear	1	0.1%

Table 14 lists vendors in the networking field that were requested in the positions. Care needs to be taken with the interpretation of this data as, in the case of Cisco for example, a company could be listed for a variety of reasons (for a certificate, a specific router/switch, etc.). Nevertheless, it points to the practical nature of the requirements of these employers.

The final table provides a general summary of the relative importance employers appear to place on the different areas. As shown in Table 15, various routing protocols were the most requested skill with a total of 1,431 in the job listings. This represented 22.6% of the 6,339 total tabulated skill requests in tables 1-11. This was followed by items from the Other Protocols category 1,316 (22.6%) and by WAN services 1,025 (16.2%).

Table 15. Summary

Skill area	*N*	*%*
Routing Protocols	1431	22.6%
Other Protocols	1316	20.8%
WAN Services	1025	16.2%
LAN Topics	894	14.1%
Operating Systems	785	12.4%
Server Tech & Virtualization	252	4%
Other Servers	174	2.7%
Monitoring Tools	151	2.4%
Protocol Analyzers	121	1.9%
Database Servers	101	1.6%
Web Servers	88	1.4%

4. CONCLUSIONS

The tables above contain a wealth of information for faculty teaching in the networking area. One example is the significance of coverage of certain networking topics. In the internetworking area, we can see the importance of covering TCP/IP, BGP, OSPF, and EIGRP. In the LAN area the coverage of the Spanning Tree Protocol is not the most requested, yet it was requested much more than e.g. the 802.11 protocols. Sometimes students do not see the value of what may appear to them as just a theoretical topic, yet it clearly has practical applications.

In the operating systems area, Linux and Unix show up very strong, a message to faculty that this material should be offered in the curriculum. Virtualization is another area that needs to be in a curriculum, albeit in a more minor role.

In positions seeking network engineers, it is interesting to note that database and web server technologies were also requested. The requests for these other servers demonstrate that one of our students, a future employee of one of these companies, will typically have to have multiple areas of expertise. Another interesting point is that employer expectations can be quite high in terms of practical skills. For example, Cisco's IOS was requested by 13.2% of the companies.

Information systems students can take heart from the data in Table 12, which shows that a degree is important to employers. They may not be as happy to see the number of companies requesting certificates and many of these are requests for the higher-level certificates!

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An Expanded Study of Net Generation Perceptions on Privacy and Security on Social Networking Sites (SNS)

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Abstract

Social networking on the Internet continues to be a frequent avenue of communication, especially among Net Generation consumers, giving benefits both personal and professional. The benefits may be eventually hindered by issues in information gathering and sharing on social networking sites. This study evaluates the perceptions of students taking a required university-core computing course in an expanded and new survey at a leading northeast institution on facets of privacy of marketplace social networking sites, relative to internal information gathering and sharing on the sites. Findings from the survey continue to demonstratively indicate less knowledge of personal information gathering and sharing techniques on the sites, notably in privacy and security statements, than of the popular sociality of the sites. These findings furnish impetus into the continued improvement of curricula in the disciplines of information systems and non-information systems, in order to educate students on often overlooked dimensions of social networking on the Internet.

Keywords: Communication Technology, Curriculum Design, Cyber-Bullying, Cyber-Stalking, Net Generation (Net Geners), Privacy, Security, Social Contract Theory, Social Networking, Social Networking Sites (SNS)

1. INTRODUCTION

Social networking on the Internet, the concern of this study, has several definitions. A social network is defined as a location at which consumers create a home page or personal space, on which they blog on Web logs, post files, and share files, ideas and information with other individuals and other networks and sites on the Internet (Turban, King, McKay, Marshall, Lee and Viehland, 2007). Files may be music, photographs and video with numerous other

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utilities (Delehanty, 2009). Salaway (Salaway, Caruso and Nelson, 2008, p. 20) essentially defines a social network site as an extended, functionally improved and larger managed network of other individuals and sites – "all my people right here, right now" (Lampinen, Tamminen and Oulasvirta, 2009). Snyder (Snyder, Carpenter and Slauson, 2006) defines a social networking site (SNS) as a fundamental social network that may be a frequent and further initiator medium of informal networking relationship (Dickerson, 2004) or a medium of possibility of networking relationship as a social network (Boyd and Ellison, 2007).

The Educause Center for Applied Research (ECAR) Study of Undergraduate Students and Information Technology in 2008 indicates Bebo, Facebook, Friendster, LinkedIn, MySpace, Other, Sconex, Windows Live Space, and Yahoo! 360 as the choices of sites among Net Generation (Echo Boomers, Millennials or Net Geners) consumers aged 12-32 years (Salaway, Caruso and Nelson, 2008, p. 84), as indicated in Figure 1 in Appendix A. Facebook (www.facebook.com) and MySpace (www.myspace.com) are the top choices among the consumers at 110 million active users monthly; Facebook is the largest social networking site (Hempel, 2009, p. 37) in the country, with user base almost equivalent to the population of Brazil (Hempel, 2009, p. 35). Facebook is now the second most popular site on the Internet after Google (The Economist, 2010). More than half of teens aged 12–17 years on the Internet are consumers (Digital Communities, 2007), and most students aged 18–19 years are consumers of these sites (Salaway, Caruso and Nelson, 2008, p. 15). More than half of students at academic institutions are on the sites 1 to 5 hours weekly, and a quarter of students are on them 6-10 hours weekly (Salaway, Caruso and Nelson, 2008, p. 15), but 90% are on the sites daily (Sausner, 2009). Students are clearly active consumers of social networking sites, as further indicated in Figure 2 in Appendix A, and the sites are considered to be changing the fabric of institutions (Salaway, Caruso and Nelson, 2008, p. 9) in enabling formation of multiple relationships.

Through social networking sites, students contact family and friends (Lenhart and Madden, 2007), and especially male students in meeting new friends (Salaway, Caruso and Nelson, 2008, p. 15). They learn about other individuals they may not meet in person. They share ideas, information and files with other friends, individuals and especially fellow students (Salaway, Caruso and Nelson, 2008, p. 15). Throughout political seasons, they invite if not mobilize other people and students to programs (McGirt, 2009). They mourn and support themselves in tragedies, such as at Virginia Tech. These sites are definitely facilitating social relationships and resources and are considered a fixture for students.

Social networking sites are enabled through personal profiles (Lehnert and Kopec, 2008) that link to other profiles through protocols on the system. Profiles, exceeding 100 million on MySpace (Solove, 2008, p. 102), consist generally of information on 'about me', ages (including birthdays), ethnicity, habits (drinking and smoking) or interests (holiday or spring break plans), marital statuses (in a relationship), locations (cell numbers, e-mail addresses or instant messaging names), names (pseudonyms), orientations (heterosexual or homosexual), photographs, and religions of the students. Though more than half of the students have personal profiles, most students, especially female teenagers, have profiles that are private or semi-private or have other restrictions on the sites (Digital Communities, 2007). Students appear not to be cavalier about disclosing information.

The concern of the authors of this study is that Net Generation students may lack knowledge of the fact, or impact of the fact, that characteristics of social networking sites are inherently public on the World Wide Web**.** In addition, because of the nomenclature (e.g. "MySpace"), students may be induced into a false impression of privacy and security (Mooradian, 2009). Literature indicates Net Generation students lack knowledge of personal privacy and security on social networking sites (Wilson, 2008), if not knowledge of the privacy and security statements on the sites (Pollach, 2007), more than older generations (Zukowski and Brown, 2007), as privacy may be perceived to be obsolete in an open society (Brin, 1998). Profiles may be inadvertently divulging intimate information (Solove, 2008, p. 101) on the public sites (Acquisti and Gross, 2005). Students interact and share instant but intimate information on social networking sites (Tapscott, 2008), including information disseminated by friends (Ho, Maiga and Aimeur, 2009) and by friends of adversaries (Nagle and Singh, 2009). These data may be disseminated to audiences on Web or non-Web forums in an unexpected (Kluth, 2009) if not harmful (Brenner, 2009) manner. Such audiences may include advertisers (Claburn, 2007, p. 72), criminals (Kirchheimer, 2009), future employers, governmental investigators, marketing firms (The Economist, 2007), third party organizations that are partners of the sites (Claburn, 2007, p. 69), predators (Consumer Affairs, 2006), strangers, or stalkers (Paullet, Rota, Turchek and Swan, 2009) or almost any audiences (Rosenblum, 2007), all of whom might have accounts on the site (Romano, 2006). This further invades privacy on sites that intersect personal and professional information (Snyder, Carpenter and Slauson, 2006). Privacy risk is significant (Whitcomb and Fiedler, 2010). In short, the authors contend that students and teens may not be fully knowledgeable of privacy risk and security on social networking sites.

2. BACKGROUND

This study attempts to clarify the knowledge of students on issues of privacy and security on public social networking sites. Knowledge of privacy begins with definitions of accessibility privacy, decisional privacy, and informational privacy. Accessibility privacy is defined as freedom from intrusion; decisional privacy is freedom from interference in personal choices; and informational privacy is freedom to limit access to the collection and control the flow of personal information (Tavani, 2004). On-line privacy "is the continuous process of negotiating with relevant third parties, an optimum or acceptable level of disclosure of personal information" on the Web (Moloney and Bannister, 2009). Privacy is essentially the right to determine the distribution of private information (Westin, 1967) "grounded on the more general principle of respect for persons" (Benn, 1971). Inasmuch as protection of privacy is not included as a right in the Constitution of the United States, but is in legal precedents and regulations that have limited protection (Solove, 2008, p. 104) that has to be further safeguarded in society (Lawler, Molluzzo and Vandepeutte, 2008), students have to be dependent inevitably on privacy policies of social networking sites.

Social networking sites' privacy policies are effectively social contracts cited in social contract theory (Snyder, Carpenter and Slauson, 2006). Students are dependent on the rules (terms of usage) defined in the policies on the sites, though such rules may be artifacts of the 1990s (Lohr, 2010). Policies may be designed in favor of the social networking sites, not in favor of the students. Difficulty in interpretability of collection and distribution of information policies in privacy and security statements is clear in practitioner and scholarly literature (Rapoza, 2008 & Showalter, 2008). Importantly, the impact of improvement in personal information gathering techniques, information mining technologies, and increased interest in SNS and third-party gathering of private information (Henderson and Snyder, 1999) is not evident in the privacy statements of the sites. Finally, it is not evident in the feasibility of intrusion into the right to privacy and security of the students (Milberg, Smith and Burke, 2000).

Issues of privacy and security statements relative to social networking sites are evident further in the literature. Firms managing the sites are engaged in fruitful interactions (Vijayan, 2009), but are focused less on privacy (McCreary, 2008) and more on marketing opportunities (MacMillian, 2009) – a $1.4 billion (Aguiar, 2008) monetization machine at Facebook, MySpace and other social networking sites (Hempel, 2009, p. 37). In the past, Facebook has gathered presumed private information without permission of students and informed "friends of a friend" of students on sites, in order to market products of organizations partnered with Facebook (Gohring, 2008). Facebook is piloting "digital calling cards" that identify subjects as they surf the Web (MacMillian, 2010). eGuardian has introduced age clarification methods that may be marketing products to teens with presumed private profiles on MySpace sites without permission of the teenagers (Stone, 2008). Google is introducing monitoring "friends of a friend" of students that may be influencing the marketing of products on social networking sites (Green, 2008) and is noted for "Web bugs" that share information with others (Rapoza, 2009). Literature indicates students and teenagers may not be fully knowledgeable of marketplace non-privacy on Web sites (Turow, Hennessy and Bleakley, 2008) if not SNS (Havenstein, 2008), even assuming knowledge of privacy and security. Privacy loss may be a loss of security (Dyson, 2008). Moreover, regulations and statements may not be protective of privacy and security (Feretic, 2008), as they may not be current with mining techniques (Markoff, 2008) or technologies (Landau, 2008 & Schneider, 2009).

Such issues are evident in the aforementioned Educause Center for Applied Research (ECAR) Study of Undergraduate Students and Information Technology, in which leaving a history that may cause problems, misusing information of students, security and stalking of students were identified to be problems of social networking sites (Salaway, Caruso and Nelson, 2008, p.16), as indicated in Figure 3 in Appendix A. The extent of the issues in the minds of the students may be a problem, as barely half of the students indicated the issues to be problematical or risky to them (Salaway, Caruso and Nelson, 2008, p. 16). Further surveys indicated that more than half of the students are satisfied with privacy and security statements (Harris Poll, 2008). Students may not be fully knowledgeable in information gathering and sharing techniques that may not be furnished in non-interpretable privacy and security statements (McGrath, 2008). They may be generally insensitive to issues of privacy and security (Brown, 2008). This prompts the study of student perceptions of the privacy protection in SNS privacy and security statements.

Therefore, the authors attempt to document student knowledge in privacy and security on social networking sites in an expanded survey that began in 2009 (Lawler and Molluzzo, 2009). This new survey enables a foundation for educators that may enhance curricula for dimensions of exposure on social networking on the Internet (Dhillon and Blackhouse, 2001). This is important as firms in industry invest more in relationships (Baker, 2009) and services (Sausner, 2009) on social networking sites (Greengard, 2008). They invest more and more in snooping of students when they recruit them (Lamm and Phile, 2009). They may not have invested in sufficient privacy training of their staff (Cline, 2010). Students may learn improved methods of personal profiling that might protect privacy and security on the sites (Rennie, 2008). They may learn methods for evaluating elements of fair practices protective of privacy and security (Anton, Bertino, Li and Yu, 2007) evident or not evident in the privacy and security statements of SNS (McGrath, 2008), and for learning which sites furnish the optimum in protection of personal privacy and security. The results of the new survey in the present study furnish input on the perceptions of privacy and security that can be integrated into curricula that might be more cognizant of the impact of social networking on the Web.

3. FOCUS OF STUDY

The focus of this study is to further evaluate the extent of knowledge of Net Generation students in dimensions of information gathering, profiling and sharing in social networking on the Internet. As in the preliminary published study of 2009 (Lawler and Molluzzo, 2009), this study explores knowledge of SNS privacy practices among students taking a required core introductory computing course, particularly as furnished in privacy and security statements on the sites. This study explores the personal practices of the students as they pertain to privacy and security on the sites. Updated input into the knowledge of privacy and security will help instructors to integrate pedagogical methods reflective of frequently perceived issues of privacy (Clifford, 2009), issues of public sharing (Solove, 2008), and mechanisms needed on privacy and security on the sites (Strater and Lipford, 2008). Learning the problems and risks of invasive technologies (Baase, 2008) will help to protect the privacy of students. The study in this new survey is timely as pundits not infrequently perceive the problems and risks of social networking technology (Prince, 2010).

4. RESEARCH METHODOLOGY

The survey was conducted during spring and fall 2009, and the findings were evaluated in the spring and summer 2010. It was administered online to undergraduate students who were taking the introductory university-core required computing course. Of approximately 500 students asked to participate in the study (most by email, some in several classes), 384 valid responses were obtained.

Survey Instrument

The survey consisted of several demographic data questions These were followed by questions to discover what kind of data students post on their social networking sites (SNS), and questions that asked about student knowledge of how their social networking sites handle their personal information. Many questions from the survey will be discussed in the following section. There were five demographic questions, one question asking which SNS the respondent belongs to, and one question that asked how many hours the respondent spends each week on their SNS. Question 8, henceforth referred to as the “Data Question”**,** listed fifteen types of data a respondent might place on their SNS. Questions 9 through 20, henceforth referred to as the "Knowledge Questions", asked about the respondent's knowledge about their SNS privacy policy, and if they had read that policy. The complete survey instrument is available from the authors. For reference in the following, the Data and Knowledge Questions are included in Appendix B.

Demographic Data

During the fall and spring semesters of 2009 384 students were surveyed. The average age of the respondents was 19.9. The ethnicity was distributed as follows: African American (8.6%), Asian (14.6%), Caucasian (53.1%), Hispanic (13.7%), Middle Eastern (2.2%), and other (7.7%). Most of the respondents were female (60.9%).

Respondents were asked to choose which among a list of 10 popular social networking sites they were members. The three sites that achieved at least 10% were Facebook (95.1% were members), MySpace (30.7% were members), and Twitter (22.4% were members.) Respondents were asked how many hours they spend each week on their SNS. Our data tend to confirm the results of Salaway (Salaway, Caruso and Nelson, 2008, p. 15) in that about half of students (47.9% in the current survey) spend 1 to 5 hours each week on SNS, and about one-quarter (32.8% in the current survey) spend between 5 and 10 hours each week on SNS. Of those surveyed, 8.9% reported that they spend more than 16 hours on their SNS.

Data Stored on Social Networking Sites

Respondents were asked to select from a list the types of data they store on their social networking sites. The results are shown in Table 1 in Appendix C, which shows the percent of the respondents who indicate they store that type of data.

Note that nearly everyone stores their name (96.2%) and gender (92.2%). Many store the names of friends (88.4%), photos (86.0%), and age (75.2%). A surprising number store what can be considered highly personal data, such as their telephone number (14.3%), but not many store their address (4.9%).

It is of some interest to consider some of the intersections of these attributes. For example, 50.7% of respondents include in their profile all of the following: name, age, gender, school attending, names of friends, relationship status, and photos. Adding sexual preferences changes the percentage to 30.7%, and then adding religion changes the percent to 16.9%. This would give enough information to a hacker to construct an accurate profile on 1 of every 6 SNS users!

The survey asked whether the respondent's profile was public (i.e. available to anyone who is a member of the SNS and in some instances, for example MySpace, to anyone on the Internet), or private (available only to those SNS members "friended" or invited by the respondent.) Among the respondents, 15.6% indicated that it was public. This indicates that the well-publicized concerns over one's privacy SNS profile are having a positive effect on first-year university students.

5. ANALYSIS AND DISCUSSION

Background

The survey contained questions that asked about the respondent's knowledge of how their personal information is gathered, used, and shared. The survey also asked questions about choices SNS users have about the accuracy and security of personal information gathered by their SNS. See Appendix B for a list of the questions used in the survey. In these questions, respondents were asked to respond "yes", "don't know", or "no." Because our sample size was relatively small (n = 384), having three categories did not yield statistically valid results. It was felt that the "don't know" and the "no" responses basically meant the same thing – the respondent could not answer in the affirmative. Therefore, these answers were combined, which enabled a chi-squared test of significance on 2x2 cross-tabs. Following is an analysis of some of the statistically significant results organized along some of the categories of the respondents.

Academic Differences

Pace University consists of five undergraduate schools, including a school of computing. Because computing students *should* be more attune to the privacy dangers inherent in surfing the Web as well as the privacy dangers of SNS, the respondents were separated into computing and non-computing majors to see if there were indeed any differences between the groups in how they perceive privacy issues on SNS.

Interestingly, there were no significant differences between the groups on any of the Knowledge Questions. Thus, even non-computer majors seem to know as much about their SNS privacy policy as their computing major counterparts.

The only significant differences between these groups were in how much time the students spent online, with the computing students spending more time online (p = 0.016), placing on their SNS which school they attend (P = 0.024) and their identifying their friends (p = 0.055).

Age Differences

The respondents were separated into first-year and non-first-year students. Table 2 in Appendix C shows the significant differences between these groups. The Question numbers in the table refer to the list of survey questions in Appendix B. Question 8 is a list of things a person might store on a SNS site. There are significant differences in storing age, school attending and place of employment. There are significant differences between age groups on questions 10, 14 and 16. Question 10 asks if their SNS tells them how their data will be used, and question 14 asks if they have a choice in the amount of data gathered about them. Question 16 refers to ways of correcting errors on a SNS.

Gender Differences

There were several significant differences in male and female responses. Table 3 in Appendix C summarizes the results. In the Data Question (question 8), which asks what the respondent has stored on their SNS, males were more likely to store their telephone number (8c) and to list their sexual preferences (8l), while females were more likely to list friends (8h) and their relationship status (8k).

On question 10, which asks if the respondent knows how their SNS uses their personal data, and question 16, which asks if the respondent knows how to correct information gathered by their SNS, males are more likely to answer yes. On question 11, which asks if the respondent knows if their information will be shared internally, and question 12, which asks if the respondent knows how their information is shared external to the SNS, females are more likely to answer yes.

Ethnicity Differences

Pace University is ethnically very diverse. Among those surveyed, 51% were Caucasian, 15% Hispanic, 13 % Asian, 8% African American, and the remaining 13% divided among other ethnicities. For purposes of analysis, the respondents were divided between Caucasian and Minorities. The significant differences between these groups are summarized in Table 4 in Appendix C.

There were two significant differences at the p = 0.05 level in the Data Question. Minorities stored their addresses (8b) significantly more than Caucasians, but Caucasians listed their sexual preferences (8l) significantly more than Minorities. This is perhaps a reflection of more liberal sexual attitudes in the West.

There were also significant differences at the p = 0.05 level in three of the Knowledge Questions. Minorities were more likely to respond that they knew what data their SNS gathered (question 9), and that they believed their SNS explicitly tells them how their data is used (question 10). However, Caucasians are more likely to respond that their SNS tells them if their information will be shared internally (question 11).

Hours of Use Differences

Respondents were asked how many hours they spend each week on their SNS. For purposes of comparison, we divided the respondents into two groups: users who spend less than 6 hours per week (light users) and users who spend 6 or more hours each week (heavy users) (Salaway, Caruso and Nelson, 2008, p. 15.) The results are shown in Table 5 in Appendix C.

Most of the differences are in the Data Question – question 8. Heavy users are more likely to store their telephone number (8c), school attending (8f), place of employment 8(g), and social activities (8i), than are light users. However, light users are more likely to believe that they know how their data will be shared externally by their SNS.

Privacy Policy Reader Differences

The respondents were separated into those who claim that they have read and those who admit that they have not read their SNS privacy policy. As might be expected, there were no significant differences between these groups in any of the parts of the Data Question. However, there were highly significant differences in five of the Knowledge Questions. These results are summarized in Table 6 in Appendix C.

In all cases listed in Table 6, the respondents who did not read their SNS privacy policy were *more* likely to believe that they know what personal information is collected by their SNS (question 9), that their SNS explicitly tells them how their data will be used (question 10), that their SNS tells them if their information will be shared with internal departments (question 11), that they have a choice about how their data is used (question 14), and that they know how their information will be safeguarded (question 17).

It is a bit paradoxical that those who claim they have not read their SNS privacy policy are more willing to believe their SNS will behave regarding their personal data. Perhaps this is because those who have read the privacy policy know better!

6. IMPLICATIONS OF STUDY

Referring to Table 1 in Appendix C, note that the most popular items students place on their SNS concern their personal data and preferences. Data such as name, gender, school attending, friends, and photos are routinely stored by them. However, it is noteworthy that there seems to be some concern among respondents about privacy. For example, only 4.9% store their address and 14.3% their telephone number. Also, it seems that respondents are somewhat reluctant to store data that one might consider too personal to make public. For example, only 28.6% store their political views, 27% store their place of employment, 35.3% store their tastes and preferences, and 36.7% store their religion. The implication is that SNS users appear to have three levels of privacy concern. Privacy Level 1, or high privacy, consists of items such as address, telephone number and political views that users tend not to divulge on their SNS. Privacy Level 2, or medium privacy, consists of items to which users seem to be indifferent, such as age, place of employment, relationship status and social activities. Finally, Privacy Level 3, or low privacy, consists of those items that users freely share with other users of their SNS, such as name, friends, school attending, and photos.

The majority of respondents (60%) did not read the privacy policies of their SNS. This could be the result of several factors. A user might not care about privacy and, therefore, not seek out the privacy policy. A user might assume their data will be kept private and, therefore, not seek out the privacy policy. The link to the SNS privacy policy might not be easy to find. Even if the user seeks out the policy, it could be too long or written in terms that are difficult to understand, thereby encouraging the user not to bother reading it. Whatever the reason, it is clear that SNS should make their privacy policies easily accessible and easy to read. SNS might also consider trying to make new users read their privacy policy as part of the sign-up process.

The results obtained on the Knowledge Questions show a range of knowledge of SNS privacy policies. Table 7 in Appendix C shows how people responded to the Knowledge Questions. Note the very large percentage of respondents (except for question 19) who did not know the answers! This means that these people either did not read their SNS privacy policy, read it and did not remember, or read it and did not understand it. Again, this confirms the authors' belief that more has to be done by SNS to make their privacy policy statements more accessible to their members. Further study needs to be done to see if there is a correlation between not reading the SNS privacy policy and not knowing the answers to the questions.

Note also that questions 11, 12, 13, 17, 18 and 19 have less than one-third "Yes" responses. Question 10 (does the SNS tell how personal data will be used) elicited only a 37% "Yes" response. Thus 63% of respondents do not know how their personal data might be used by their SNS. Question 14 (do you have a choice in how your data is used) received only a 35% "Yes" response rate, while Question 15 (Do you have an easy way to correct your SNS data) received only a 47% response rate.

Questions 17and 18 concern security of the respondent's SNS. These questions received the lowest "Yes" response rate. Only 22% know how their information will be safeguarded (question 17) and 10% know what their site will do if there is a security breach (question 18.)These results imply that users do not know their rights as users of their SNS, thus basically relinquishing control of their personal data. Also implied in this study is the need for better online privacy education. Surprisingly, 14% of the respondents, about one in 7, leave their SNS site public (question 19). Nearly all teenagers and college-age people in the U.S. are members of at least one SNS. See Figure 2 in Appendix A. The present study shows that a large part of this population is unaware of the data practices of their SNS. This population needs to be educated on how their SNS, indeed nearly all Internet sites, collect and use their surfing and personal data. Most colleges and universities have introductory computing courses. These courses should include modules on privacy and the Web. Our nation's high schools should also educate their students, who all too frequently are very open about what they store on their SNS, on who might see their personal data, how permanent that data is on the Internet, and how their SNS might use their personal data.

At Pace University, the required core introductory computing course contains a significant module on online privacy and security.

7. LIMITATIONS AND OPPORTUNITIES

The present study has several limitations. The answers to the knowledge questions in the survey (for example question 9 asks, "Do you know what personal information your Social Network site gathers?"), must be interpreted with caution. If a respondent answered that they read their SNS privacy policy (in responding to question 20, 44% claimed they did), then what does it mean if they answered "Yes" to question 9? Does their SNS privacy statement actually state what personal information it will gather, or does the student merely think that the SNS privacy policy makes this statement? In the spring 2012, the authors will study whether what survey respondents think is stated in their SNS privacy policy is in fact actually stated in that policy.

Another limitation is the restriction of the study population to one university. A broader study involving students from across the country would validate the results of the present study.

An opportunity for further research is to verify the three levels of privacy mentioned in Section 6. A study involving many more respondents could verify or refine this. Moreover, research needs to be done to verify the conclusion that not knowing the answers to the Knowledge Questions is related to not reading the SNS policy statements.

8. CONCLUSION

Results of this new study show that many respondents have not read their SNS privacy policy statement. It also shows that many do not know how their personal information will be gathered, used, and shared. Finally it also shows respondents are not familiar with their rights regarding their own personal data stored on SNS. Clearly, SNS need to make privacy more of a priority than it is now. Users need to be informed in easily accessible privacy statements that are easy to understand – especially by teenagers who make up a substantial proportion of their users.

SNS frequently point out that a user can customize their privacy settings very easily. However, what is easy to one may not be to another. For example, to control what certain groups of people can see on a page, Facebook allows a user to create lists of friends. Using lists, a user can restrict sharing of content to certain lists. This sounds like an effective way to control who sees what content on a user's page. Actually creating the restricted lists, however, is not so easy. Described as a "little known feature", here is how it is done.

> "To create a list, click on the *Friends* link, and under "Lists" on the left, click *Create*. To restrict sharing info in certain lists, go to *Settings/Privacy Settings* and click *Profile*. Open a profile item's drop-down menu and choose *Customize*. Select *Some Friends* in the resulting pop-up, and then enter the name of the friends list you want to choose. (Larkin, 2009)

Thus, Facebook does not make it as easy as it could to create and manage restricted lists of friends. Why does this have to be so difficult to do?

SNS, and most other Websites, are in business to make money. One way to do so is to use the data gathered, personal data in the case of SNS, for profit. The amount of personal data contained on a SNS is enormous. This data has great value to marketers. Facebook's Beacon is an example of how such data can be used. First offered as an opt-out service, Beacon shared Facebook users' purchases from affiliated companies with their Facebook friends. So, for example, if you bought a book from an affiliate online bookstore, that purchase would be known to one's Facebook friends. The existence of this service caused uproar among Facebook users, spurred on by an online petition against Beacon by the civil action group MoveOn.org. As a result, Facebook made the service opt-in (Blodget, 2007). While this story has a more or less "happy ending", it does emphasize that user data on SNS is basically for sale. This fact needs to be made know to SNS users.

Perhaps the best way to ensure that the public is made aware of SNS privacy concerns is through proper education. This education needs to take place at all levels. Although many SNS require that their members be at least 13 years of age to join, many pre-teens use SNS, such as MySpace, to keep in touch with friends. Thus educating pre-teens and their parents on the importance of what data is stored on their SNS, how it might be used, and who is likely to have access to it is very important. Once in high school where there is usually a great increase in social activity, students should again be educated about their personal data stored on SNS. Finally, as students prepare for their entrance into the workforce, they should be educated on the consequences of posting inappropriate personal data on their SNS.

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Editor's Note:

This paper was selected for inclusion in the journal as a ISECON 2012 Meritorious Paper. The acceptance rate is typically 15% for this category of paper based on blind reviews from six or more peers including three or more former best papers authors who did not submit a paper in 2012.

APPENDICES

Appendix A: Figures on Social Networking Sites

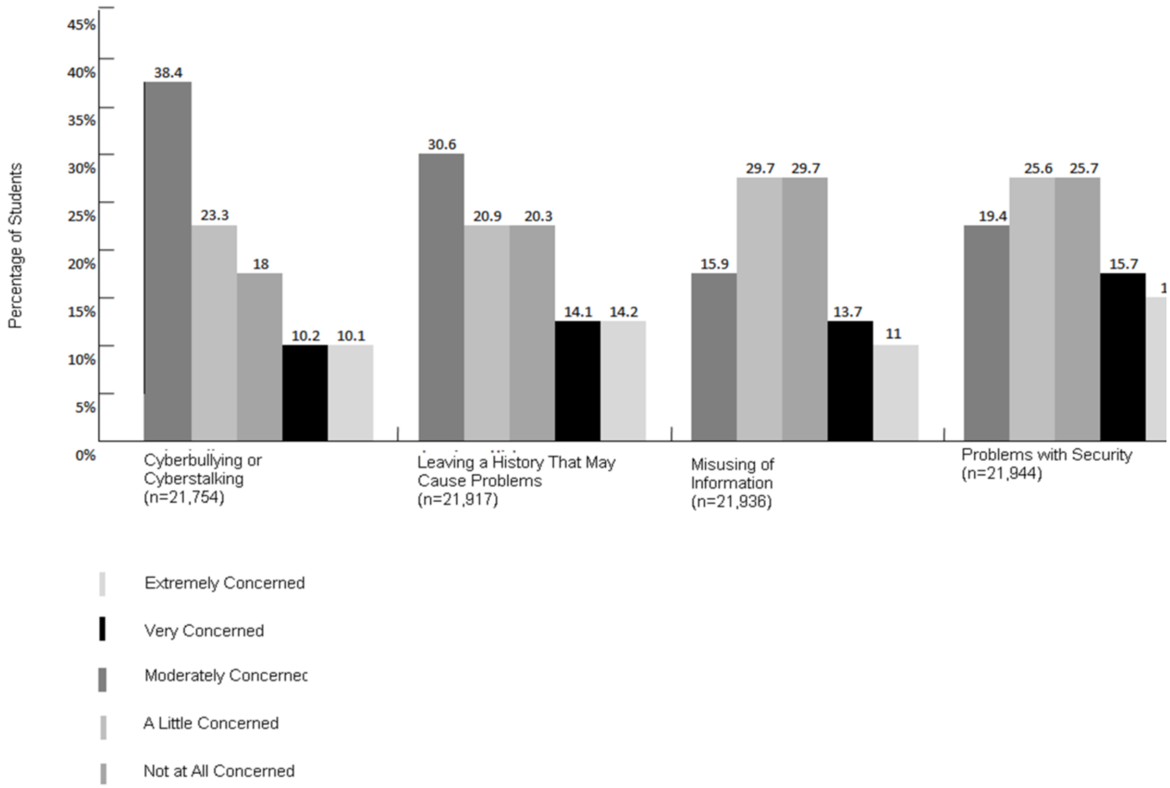

Figure 2: Social Networking Sites – Issues on Privacy and Security

Source: Salaway, G., Caruso, J.B. and Nelson, M.R. (2008), The ECAR Study of Undergraduate Students and Information Technology, 2008. Research Study from Educause Center for Applied Research, 8, p. 93 [Adapted].

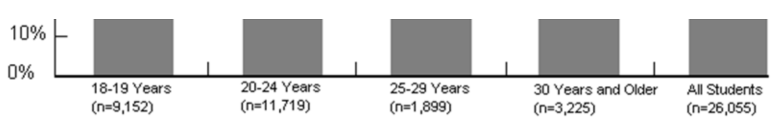

Figure 3: Social Networking Sites – Generation of Consumers (Students)

Source: Salaway, G., Caruso, J.B. and Nelson, M.R. (2008), The ECAR Study of Undergraduate Students and Information Technology, 2008. Research Study from Educause Center for Applied Research, 8, p. 83.

Appendix B: Instrument of Survey

Following are the non-demographic survey questions only.

8. What information do you have on your Social Networking site? Check all that apply.

   a. Name
   b. Address
   c. Telephone Number
   d. Age
   e. Gender
   f. School Attending
   g. Place of Employment
   h. Friends
   i. Social Activities
   j. Tastes and preferences
   k. Relationship Status
   l. Sexual Preferences
   m. Photos
   n. Political Views
   o. Religion

9. Do you know what personal information your Social Network site gathers?

10. Does your Social network site tell you explicitly how the site will use your data?

11. Does your Social Network site tell you if your information will be shared with other internal departments and personnel of the business of this site?

12. Does your Social Network site tell you if your information will be shared with other external firms or organizations partnered with the business of this site?

13. Do you have a choice about the amount of information your Social Networking site gathers about you?

14. Do you have a choice about how the information gathered about you will be used?

15. Do you have a convenient and easy method to contact the site to correct information gathered about you?

16. Do you have the ability to review and correct information gathered about you?

17. Do you know how your information will be safeguarded?

18. Do you know what the site will do if there is a breach in the security of the site?

19. Is your profile public? That is, can any other site user access your profile, friend or not?

20. Have you read the privacy policy of your Social Networking site?

Appendix C: Statistical Tables

Table 1 - Data Stored on SNS

Data Stored	Percent Choosing
Name	96.2
Gender	92.2
Friends	88.4
School Attending	86.5
Photos	86.0
Age	75.2
Relationship Status	72.5
Sexual Preferences	47.4
Social Activities	43.4
Religion	36.7
Tastes and Preferences	35.3
Political Views	28.6
Place of Employment	27.0
Telephone Number	14.3
Address	4.9

Table 2 – Significant Differences Between Under and Upperclassmen

Question	p ≤ .001	p < .01	p < .05
8d		.	0.041
8f			0.050
8g	0.001		
10			0.021
14		0.005	.019
16		0.005	

Table 3 – Significant Gender Differences

Question	p < 0.01	p < 0.05	% Male	% Female
8c		0.017	19	11
8h		0.037	88	94
8k		0.034	70	79
8l		0.040	57	47
10		0.040	55	32
11		0.030	59	72
12		0.040	64	76
16	0.006		49	35

Table 4 - Significant Differences in Ethnicity

Question	p ≤ 0.050	% Caucasian	% Minority
8b	0.021	1.9	6.7
8l	0.054	55	46
9	0.029	32	46
10	0.035	60	66
11	0.023	71	63

Table 5 – Significant Differences Between Hours < 6 (Light Users) and Hours ≥ 6 (Heavy Users) Spent on SNS

Question	p ≤ .001	p < .01	p < .05	% Light	% Heavy
8c			0.050	12	21
8f			0.013	88	97
8g	0.001			23	42
8i	0.000			41	66
12		0.004		74	58

Table 6 – Significant Differences Between Readers and non-Readers of SNS Privacy Policy

Question	p ≤ .001	p < .01	% Read PP	% Not Read PP
9		0.009	30	44
10	0.000		48	73
11		0.002	57	74
14		0.003	56	76
17		0.010	69	82

Table 7 – Percent Responses to the Knowledge Questions

Question	Yes	Don't Know	No
9	61	33	6
10	37	40	23
11	31	47	23
12	27	49	24
13	27	49	24
14	35	41	24
15	47	35	17
16	61	27	12
17	22	51	27
18	10	50	41
19	14	10	76

Does the Instructor's Experience as a Practitioner Affect the Purpose and Content of the Undergraduate Systems Analysis and Design Course?

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Abstract

This paper reports the results of a survey and follow up interviews that were administered to instructors of the undergraduate systems analysis and design course, a core course of the Information Systems curriculum. The goal of this research was to learn if the background of the instructor, in terms of industry experience, affects the purpose and content of the course. The survey results indicate that there are significant differences between instructors with no practitioner background and those with prior industry experience.

Keywords: IS research toward educators, pedagogy, IS undergraduate curriculum, Teaching Systems Analysis and Design

1. INTRODUCTION

In 2005, Burns and Klashner researched and wrote a short anecdotal conference article that compared and contrasted the content of the system development courses in the Information Systems programs of sixty colleges and universities (Burns & Klashner 2005). In that article, course materials were examined to determine what textbooks and system development methodologies were being covered in system development courses (Burns & Klashner 2005).

As a follow up, in 2010, Burns conducted a study that delved much deeper into this research area (Burns 2011). Significant data was collected from instructors teaching systems analysis and design in colleges and universities around the world. An initial paper reporting the findings from that study was presented at the ISECON 2010 conference, published in the proceedings, and later published in the Information Systems Educator Journal (ISEDJ) in 2011 (Burns 2011).

The purpose of this paper is to further that research. This time, the research question is: "Does the background of the instructor (in terms of industry experience) affect the purpose and course content of the systems analysis and design course?"

2. BACKGROUND

Peter Keen, at the first International conference on Information Systems (ICIS) in 1980, defined IS as an "applied" discipline (Keen 1980). Applied disciplines have two primary objectives; to increase knowledge (theory) and to improve practice (Phillips 1998). Furthermore, applied disciplines use theory from other "reference" disciplines and apply it to solve practical problems rather than having any distinct theoretical base of their own (Baskerville and Myers 2002, Moody and Buist 1999).

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In the three decades since that first ICIS, there have been those who have embraced the argument that IS is an applied discipline and those who have not. Those who embrace it, argue that IS should continue to stay rooted as an applied discipline and, as such, should emulate other applied fields such as medicine, engineering, and architecture (Moody and Buist 1999). Others argue that the time has come for IS to become a reference discipline of its own (Baskerville and Myers 2002). As such, its research should embrace its theoretical underpinnings and serve as a foundation for other disciplines, including those who once served as reference disciplines for IS. However, even those in the latter camp would have to agree that there is a measure of applied practice that will always exist in the IS field.

The debate of theory versus practice extends beyond the arena of research and into the arena of IS education as well. Prior research has shown that IS instructors are divided in their opinions as to whether the focus of IS education should be on theory or practice (Burns 2011). However, it appears that there is little debate as to the importance of practical experience for the instructors themselves. The IS 2010 Curriculum Guidelines state that "The program is enhanced significantly when faculty acquire practical experience in the profession" (Topi, Valacich, Wright, Kaiser, Nunamaker, Sipior, and de Vreede 2010). Looney et al. determined that IS faculty need both academic training and practical experience in order to be effective IS teachers (Looney and Akbulut 2007).

A point of distinction can be made between IS and other applied disciplines. While the 2010 IS Curriculum Guidelines strongly suggest that faculty acquire practitioner experience, they do not mandate it. In other fields of applied discipline, instructors are *required* to have practical experience. Medical academics must do a minimum amount of clinical practice to retain accreditation and get promoted (Moody and Buist 1999). The ABET accreditation criteria for university construction programs stipulate that they must include at least one faculty member who has had full-time experience and decision-making responsibilities in the construction industry. The American Council for Construction Education Document 103 states, "Evaluation of faculty competence must recognize appropriate professional experience as being equally as important as formal educational background" (McCuen 2007).

Clinebell and Clinebell discuss the tension between academic rigor and real world relevance in business education (Clinebell and Clinebell 2008). This is pertinent because most IS programs are housed in the school of business in colleges and universities and IS is generally considered to be a business discipline. Clinebell et al., discuss how the pendulum in business education has swung from an emphasis on practice to academic rigor and now back to practice again. A shortage of business PhD's to teach business courses and criticism of inadequate real world preparation of students has encouraged business schools to hire more practitioners to teach in their programs (Clinebell and Clinebell 2008). There are some who feel that this practice may not be in the best interest of business programs and their students (Fowler 2005).

The crux of the discussion, for this research, is in determining the differences between instructors with extensive practitioner backgrounds and those who do not. Prior research has shown that faculty with industrial experience spend a greater percentage of their time on teaching above and beyond their work assignment, are more likely to teach undergraduates, are less likely to think about changing jobs to spend more time on research, and are less likely to believe that publishing should be the primary criterion in promotion and tenure decisions (Fairweather and Paulson 1996).

The purpose of this paper is to further this research. This time, the research question is: "Does the background of the instructor (in terms of industry experience) affect the purpose and course content of the systems analysis and design course?

3. RESEARCH METHODOLOGY

This research was conducted using a "grounded theory" approach. Grounded theory was developed by the sociologists Barney Glaser and Anselm Strauss in the 1960's. In the grounded theory approach, conclusions are drawn and theories are produced by analyzing a body of data. In essence, the theories that are produced are "grounded" in the data (Glaser & Strauss 1967).

For this study, the process began by analyzing the current body of literature on teaching the SA&D course. This allowed the researchers to create a survey instrument that would be used to ask questions about the delivery of the SA&D course and the demographical background of the instructors and institutions that delivered those courses. The survey included mostly closed end questions (which are listed in the results section below) and a few open ended questions.

A list that contained approximately 1500 names of IS instructors was compiled and an email was then sent to every person on the list. The email explained the purpose of the study and provided a link that the subject could click on to complete the questionnaire. Approximately 172 people chose to participate in the study. Once the initial results had been tabulated, a follow up email was sent to all of the participants in order to gain a deeper understanding of their responses.

For this paper, "practitioners" are defined as those respondents who have had significant practitioner experience. Respondents were asked to indicate whether they had no, less than five years, five to ten years, or greater than ten years of practitioner experience. Significant practitioner experience was defined as having more than five years. Therefore the respondents were split into two categories; those with less than five years of practitioner experience and those with five or more. The data collected showed that the respondent pool was almost evenly divided between the two categories.

3. RESULTS

In this section, the data that was collected is summarized and presented as a series of tables. The survey questions are included to provide additional clarity. Each table has four columns or categories. The "P" column shows the practitioner responses, the "NP" column shows the non-practitioner responses and the "All" column shows the aggregated responses of both categories. The lowercase "p" column shows the probability calculated from a two tailed z-test. A "p" of less than .05 is considered statistically significant.

Question 1: How do you determine what subjects and material to cover in your Systems Analysis & Design course? (Multiple Answers Allowed)

Most often chosen combination:

Based on industry experience, feedback, or trends, the textbook, and academic literature

Table 1 How Instructors Choose their SA&D Course Content

	All	P	NP	*p*
Based on industry experience, feedback, trends	83%	97%	68%	*.01*
Based on the textbook	70%	67%	76%	*.33*
Based on academic literature	52%	57%	48%	*.45*
Based on academic suggested course outline	24%	38%	18%	*.23*
Mandated by college or department	12%	6%	18%	*.56*
Other	13%	12%	13%	*.95*

Question 2: What textbook(s) do you use in your course?

Table 2 Textbooks Used in SA&D Courses by Percentage of Respondents

Textbook Used	All	P	NP	*p*
Whitten & Bentley, "Systems Analysis and Design Methods"	18 %	18%	20%	*NA*
Dennis, Wixom, & Roth "Systems Analysis & Design"	12 %	7%	15%	*NA*
Shelly, Cashman, & Rosenblatt, "Systems Design & Analysis"	11 %	14%	9%	*NA*
Satzinger, Jackson, & Burd: "Systems Analysis and Design in a Changing World"	6%	9%	2%	*NA*
Dennis, Wixom, & Tegarden: "Systems Analysis and Design with UML"	6%	6%	5%	*NA*
Hofer, George, & Valcich: "Modern Systems Analysis and Design"	6%	4%	7%	NA

Valacich, George, & Hoffer: "Essentials of Systems Analysis and Design"	6%	4%	9%	NA
Own Material	5%	7%	2%	NA
Whitten & Bentley: "Introduction to Systems Analysis and Design"	4%	5%	2%	NA
Kendall & Kendall: "Systems Analysis and Design"	4%	9%	0%	NA
George, Batra, Valacich, & Hoffer: "Object-Oriented Systems Analysis and Design"	4%	0%	7%	NA
Shelly & Rosenblatt: "Systems Analysis & Design"	3%	5%	0%	NA
Marakas: "Systems Analysis & Design: An Active Approach"	3%	0%	4%	NA
DeWitz: "Systems Analysis and Design and the Transition to Objects**"**	2%	4%	0%	NA
Harris, "Systems Analysis and Design for the Small Enterprise"	2%	2%	2%	NA
Larman: "Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design and Iterative Development"	2%	0%	4%	NA
Other	4%	12%	14%	NA

Question 3: How did you determine what textbook(s) to use in your Systems Analysis & Design course? (Multiple Answers Allowed)

Table 3 How Respondents Determined What Textbook to Use

	All	P	NP	*p*
Based on what I feel the course should cover	73%	70%	76%	*.51*
Based on industry experience, feedback, or trends	39%	52%	26%	*.05*
Suggested by a colleague	18%	16%	19%	*.85*
Based on an academic suggested textbook	12%	13%	10%	*.86*
Mandated by college or department	4%	6%	2%	*.86*
Use my own materials	2%	0%	3%	*.71*
None of the above	2%	0%	3%	*.71*
Authored the book	2%	3%	0%	*.71*
Other	14%	12%	16%	*.81*

Most often chosen combination:

Based on industry experience, feedback, or trends and on what I feel the course should cover

Question 4: How is your Systems Analysis & Design Course delivered?

Table 4 How SA&D Course is Delivered

	All	P	NP	*p*
Traditional classroom	78%	73%	80%	*.41*
Hybrid (part classroom/part online)	11%	14%	6%	*.68*
Online	7%	3%	11%	*.73*
Some sections online and some in traditional classroom	2%	7%	0%	*.64*
Other	2%	3%	3%	*0*

Question 5: What phases of the systems development life cycle are covered in your Systems Analysis & Design course?

(Multiple Answers Allowed)

Table 5 Phases Covered in SA&D Course

	All	P	NP	*p*
Initiation	85%	91%	77%	*.04*
Planning	92%	93%	92%	*.83*
Analysis	98%	100%	98%	*.24*
Design	93%	97%	89%	*.07*
Implementation	75%	78%	73%	*.56*
Maintenance	52%	61%	45%	*.18*
None of the above	0%	0%	0%	*0*
Other (testing, project management, non-traditional)	7%	9%	5%	*.83*

Most often chosen combination:

Initiation, Planning, Analysis, Design, Implementation, and Maintenance

Question 6: What system development approaches do you cover in your Systems Analysis & Design Course?

Table 6 Approaches Covered in SA&D Course

	All	P	NP	*p*
Both traditional and object oriented	53%	66%	39%	*.03*
Traditional	25%	20%	31%	*.47*
Object Oriented	15%	5%	25%	*.41*
Traditional, object oriented, and other (Agile, RAD, JAD, etc.)	5%	6%	3%	*.88*
Other (Method Engineering, Short life cycle, prototyping)	2%	3%	2%	*.96*

Question 7: What system development methodologies or models do you cover in your Systems Analysis & Design Course? (Multiple Answers Allowed)

Table 7 Methodologies Covered in SA&D Course

	All	P	NP	*p*
Waterfall	80%	77%	81%	*.61*
Boehm's Spiral	22%	22%	21%	*.95*
Prototyping	75%	74%	75%	*.91*
Object Oriented	64%	64%	63%	*.92*
Rapid Application Development	75%	84%	63%	*.02*
Extreme Programming	35%	32%	37%	*.72*
Scrum	12%	12%	13%	*.95*
None of the above	0%	0%	0%	*1*
Other	10%	10%	10%	*1*

Most often chosen combination:

Waterfall, Prototyping, Object Oriented, and Rapid Application Development

Question 8: What project feasibility measurement concepts and techniques do you cover in your Systems Analysis & Design Course? (Multiple Answers Allowed)

Table 8 Feasibility Concepts Covered

	All	P	NP	*P*
Economic	84%	86%	84%	*.77*
Technical	89%	90%	87%	*.61*
Organizational/ Cultural Feasibility	71%	74%	69%	*.59*
Resource	56%	65%	46%	*.11*
Scheduling	63%	64%	61%	*.78*
Cost/Benefit Analysis	74%	71%	75%	*.66*
Return on Investment	62%	68%	56%	*.26*
None of the above	7%	4%	11%	*.73*
Other	5%	6%	2%	*.86*

Most often chosen combination:

Economic Feasibility, Technical Feasibility, Organizational/Cultural Feasibility, Resource Feasibility, Scheduling Feasibility, Cost/Benefit Analysis, Return on Investment

Question 9: What project management tools/techniques do you cover in your Systems Analysis & Design Course? (Multiple Answers Allowed)

Table 9 Project Management Tools/Techniques Covered

	All	P	NP	*p*
Microsoft Project	44%	49%	42%	*.59*
Work Breakdown Structures	30%	30%	32%	*.89*
GANTT Charts	66%	76%	58%	*.07*
PERT Charts	56%	70%	43%	*.02*
Critical Path	51%	61%	42%	*.12*
None of the above	19%	9%	30%	*.29*
Other	5%	4%	5%	*.95*

Most often chosen combination:

Microsoft Project, GANTT Charts, PERT Charts, Critical Path

Question 10: What information gathering techniques do you cover in your Systems Analysis & Design Course? (Multiple Answers Allowed)

Table 10 Information Gathering Techniques Covered

	All	P	NP	*p*
Interviews	93%	91%	94%	*.53*
Questionnaires	84%	86%	81%	*.48*
Observation	77%	74%	79%	*.55*
Heuristic Analysis	17%	22%	13%	*.59*
Protocol Analysis	14%	20%	6%	*.52*
Document Review	77%	84%	67%	*.04*
JAD	58%	62%	52%	*.38*
None of the above	3%	3%	3%	*1*
Other	7%	6%	7%	*.95*

Most often chosen combination:

Interviews, Questionnaires, Observation, Document Review, JAD

Question 11: What diagramming techniques do you cover in your Systems Analysis & Design Course? (Multiple Answers Allowed)

Table 11 Diagramming Techniques Covered in SA&D Course

	All	P	NP	*p*
E-R Diagrams	82%	90%	73%	*.02*
Data Flow Diagrams	83%	74%	91%	*.02*
Flowcharts	30%	44%	16%	*.11*
Structure Charts	39%	50%	28%	*.13*
Database Diagrams	33%	40%	25%	*.32*
UML Class Diagrams	52%	54%	50%	*.74*
UML Use Case Diagrams	54%	54%	53%	*.93*
UML Activity Diagrams	34%	34%	34%	*1*
UML Communication/Collaboration Diagrams	23%	18%	28%	*.53*
UML State Machine Diagrams	21%	22%	20%	*.90*
Package Diagrams	9%	7%	11%	*.82*
None of the above	2%	3%	2%	*.96*
Other	5%	3%	6%	*.87*

Most often chosen combination:

E-R Diagrams, Data Flow Diagrams

Question 12: What other system development concepts and techniques do you cover in your Systems Analysis & Design Course?

(Multiple Answers Allowed)

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Table 12 Other System Development Concepts and Techniques Covered

	All	P	NP	*p*
Systems Development Life Cycle	91%	91%	90%	*.85*
Interface Design	68%	72%	65%	*.47*
Forms Design	55%	59%	51%	*.49*
Database Design	58%	69%	47%	*.05*
Network Design	21%	24%	18%	*.70*
Buy vs. Build	63%	67%	59%	*.45*
Object and Class Design	42%	42%	42%	*1*
Use Case Descriptions	62%	65%	60%	*.64*
UML	39%	42%	36%	*.66*
Modular Concepts (cohesion and coupling)	33%	36%	30%	*.68*
People and Resistance Issues	54%	52%	56%	*.73*
Scope Creep	58%	58%	58%	*1*
Pseudo code Techniques	20%	35%	5%	*.28*
Structured English	28%	26%	30%	*.79*
None of the above	1%	1%	0%	*1*
Other	7%	6%	8%%	*.91*

Most often chosen combination:

Systems Development Life Cycle, Interface Design, Forms Design, Database Design, Network Design, Buy vs. Build, Object and Class Design, Use Case Descriptions, UML Modular Concepts (cohesion and coupling), People and Resistance Issues, Scope Creep, Pseudo code Techniques

These next tables represent the answers given to a series of follow up questions that were administered to the survey respondents.

Question 13: Is your course delivered in one course or two**?**

Table 13 Number of Courses

	All	P	NP	*p*
One	76%	89%	67%	*.01*
Two	24%	11%	33%	*.24*

Question 14: Do you have a course project?

Table 14 Respondents with Course Project

	All	P	NP	*p*
Yes	96%	94%	96%	*.61*
No	4%	6%	4%	*.91*

Question 15: Do you use a real world or simulated project?

Table 15 Real or Simulated Project

	All	P	NP	*p*
Real	58%	39%	70%	*.01*
Simulated	42%	61%	30%	*.02*

Question 16: If real world, how do you find the projects?

Table 16 How Projects Are Found

	All	P	NP	*p*
Instructor finds projects	46%	60%	35%	.06
Students find projects	54%	40%	65%	.04

Question 17: Do you split students into groups or do all students work on one project

Table 17 How Students Collaborate On Project?

	All	P	NP	*p*
Split into groups	88%	80%	90%	*.14*
Students work individually or together	11%	20%	10%	*.57*

Question 18: Does the course project extend beyond the course and one semester

Table 18 Does Course Extend Beyond One Semester?

	All	P	NP	*p*
Yes	21%	0%	30%	*.01*
No	79%	100%	70%	*.01*

Question 19: In your SA&D course, do you use more lecture or hands-on activities?

Table 19 Lectures or Hands On

	All	P	NP	*p*
Lecture	24%	28%	22%	*.69*
Hands on	13%	0%	22%	*.01*
About Equal	62%	72%	56%	*.13*

Question 20: Do you feel that the purpose of a SA&D course should be to give students practical experience or theoretical foundation?

Table 20 Instructors Perception of the Purpose of the SA&D Course

	All	P	NP	*p*
Practical experience	4%	0%	7%	*.69*
Theoretical Foundation	2%	6%	0%	*.62*
Mostly Practical	29%	33%	26%	*.64*
Mostly Theory	24%	28%	22%	*.69*
Even Split	41%	33%	44%	*.42*

4. CONCLUSION

The results of this research seem to indicate that there are significant differences between practitioners and non-practitioners. The answer to the question of, "Does the background of the instructor (in terms of industry experience) determine the course content of the systems analysis and design course?" appears to be yes.

Question one asked instructors how they chose their SA&D course content. Not surprisingly, 97% of practitioners said that they did so based on industry experience. Non-practitioners were more likely to determine the course content based upon the textbook (although a significant number also use industry feedback and trends).

There appears to be little difference between practitioners and non-practitioners as to what textbook they use (question two) as both groups use many different textbooks, however, there are significant differences as to how they go about choosing the textbook (question three). Again, not surprisingly, practitioners are much more likely (52% to 26%) to use industry experience.

Non-practitioners are more likely to deliver their course in a traditional classroom or fully online setting. Practitioners are more likely to deliver their course in a hybrid format or to split their course sections between the classroom and online. While both practitioners and non-practitioners are likely to cover all phases of the systems development life cycle, practitioners are more likely (by a 14% margin) to cover the initiation phase. Perhaps industry experience has shown these instructors the importance of this phase.

Question six asked instructors what system development approaches they covered in their SA&D course. There are some significant differences between practitioners and non-practitioners here. Practitioners are much more likely to cover both the traditional and object-oriented approaches in their classes. Non-practitioners are much more likely to cover only the object-oriented approach and slightly more likely to cover only the traditional approach. Perhaps instructors with industry experience are more likely to have been exposed to both approaches and thus feel that it is important to cover them both in their class.

In regard to methodologies and models covered in the course, there is much similarity between practitioners and non-practitioners. The one area where there appears to be a significant difference is in the covering of rapid application development (RAD). Practitioners are much more likely to cover RAD. This stands to reason given the fact that RAD, for many, is about circumventing the bureaucracy of theory and implementing a purely practical approach (Howard 2002).

Practitioners are more likely to cover resource feasibility when covering feasibility concepts and non-practitioners are slightly more likely to not cover any of the popular feasibility concepts. Under the category of project management tools/techniques (table 9), practitioners are much more likely to cover GANTT charts, PERT charts, and critical path concepts. Perhaps this is because practitioners have used these "hands on" tools in industry. Non-practitioners are much more likely to not cover any of the popular project management tools/techniques.

Question ten asked the instructors what information gathering techniques they covered. Instructors from both groups are equally likely to cover the popular techniques (interviews, questionnaires, observation, etc.); however practitioners were much more likely to cover document review and Joint Application Development (JAD). Again, these techniques were probably more likely to be encountered in industry.

When it came to diagramming techniques, practitioners were much more likely to cover the techniques associated with the traditional approach to systems development (E-R, flowcharts, structure charts, and database) with the exception of dataflow diagrams, which were much more likely to be covered by non-practitioners. Both practitioners and non-practitioners covered object oriented diagramming techniques about equally.

Other system development concepts and techniques are also covered equally by both practitioners and non-practitioners with the exception of "buy vs. build" and pseudocode techniques which are much more likely to be covered by practitioners.

Non-practitioners were much more likely to deliver their SA&D course as two courses and over multiple semesters (tables 13 and 18). However, this may be more a function of the program than the instructor. Non-practitioners were also much more likely to use a real world project in the course as opposed to a simulated project. Perhaps the practitioners are able to simulate a real world project they have worked on in the past. Not surprisingly, when using a real world project, practitioners were more likely to find the projects for the students as opposed to non-practitioners who let the students find the projects themselves.

Interestingly, non-practitioners were much more likely to use hands-on activities only in their courses when asked if they used lectures or hands-on. Practitioners were more likely to use about equal amounts of lecture and hands-on. A substantial number of both practitioners and non-practitioners use only lectures.

Finally, when asked if the purpose of the SA&D course should be theory or practice, approximately two-thirds of both practitioners and non-practitioners felt that there should be an even split between theory and practice or that the focus should be more practical than theory. Practitioners were slightly more likely to say that the focus should be more practical.

This research has shown that there is, indeed, a difference in perception and course content of the SA&D course when instructors have significant industry experience. Future research will focus on the content of the typical undergraduate SA&D course and its consistency with the skills, tools, and knowledge required in industry.

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Behind the Final Grade in Hybrid v. Traditional Courses: Comparing Student Performance by Assessment Type, Core Competency, and Course Objective

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Abstract

There are many different delivery methods used by institutions of higher education. These include traditional, hybrid, and online course offerings. The comparisons of these typically use final grade as the measure of student performance. This research study looks behind the final grade and compares student performance by assessment type, core competency, and course objective. The statistical conclusions showed that hybrid course delivery could produce similar if not better results than traditional delivery. In addition, students performed significantly higher in assignments, critical thinking, written communications, and the advanced course objectives. Surprisingly, there appeared to be little if any impact on group projects and teamwork skills in the hybrid sections. Therefore, this study supports the hybrid delivery method for courses with similar course components.

Keywords: assessment, core competency, course objectives, delivery method, hybrid, traditional

1. INTRODUCTION

Institutions of higher education are in the business of educating students, offering a variety of degree programs and providing it through many different delivery methods. These delivery methods primarily include the traditional face-to-face course conducted in a classroom, online courses using some type of web-based technology, and the more contemporary hybrid courses that employ a combination of the previous two. Traditional, or face-to-face, instruction brings the instructor and the students together in the same location at the same time each week for class meetings. The content and structure of the class vary, but at a minimum include some type of lecture and class discussions. Whereas online course delivery uses technology to deliver the course content and assess the students without the need of a physical classroom or any face-to-face time. Hybrid courses consist of both the traditional class meetings, although typically less sessions, and an online component. This type of delivery method is also referred to as blended and started more recently around 2001 (Martin, 2003). With the exception of fully online universities, the traditional delivery method is still the most widely used method among instructors. However, online course and hybrid course offerings are increasing (Allen, Seaman, & Garrett, 2007; NCES, 2008; NEA, 2000). Many attribute this growth to the changing needs of the new generation of students (Kraft & Kakish, 2009). Others suggest technology allows hard-to-reach students to attend courses that otherwise could not because of geography, time restraints, or disabilities (USDLA, 2001).

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Some instructors point out the ability to improve their teaching with new tools and techniques (Toth, Amrein-Beardsley & Foulger, 2010). Regardless of the reasons, the important questions are whether these new delivery methods work at least as well as traditional methods and are they the right fit for all courses.
There are many research studies comparing course delivery methods using final grades as the measure of student performance, but few studies that focus specifically on comparing student performance by course components. These components being the different types of assessments, core competencies or skills, and course objectives. Individual assignments, group projects, and exams are a few examples of the more common assessment types. Students may perform well on one of these but not well on others for a variety of reasons. For example, students may find group projects more challenging in a hybrid course since there is less face-to-face interaction among the group members. The skills required to complete each of the assessments are also different. Some assessments require critical thinking skills while others require teamwork skills. For the course objectives, again these vary as well in content and difficulty. The beginning of the course may focus on basic theory and concepts while the latter part of the course delves into more advanced topics. The more advanced objectives may require more classroom discussion based on student feedback. The grade for each of these assessments has a direct impact the final grade. Therefore, it is important to compare student performance at a more detailed level to identify whether the course delivery method has an impact on specific course components that result in the final grade of the student in the course. This may also impact which courses are well suited or not to particular delivery methods.

The purpose of this study was to compare student performance between the hybrid and traditional course delivery methods by looking behind the final grade at specific course components. The study compared student performance by assessment type, core competency (skill), and course objective. This was done in a junior-level information systems course over two semesters where each semester one section was taught using traditional course delivery and one section was taught using hybrid course delivery. This would hopefully provide valuable information as to the effectiveness of the hybrid model for this particular set of students and this type of institution, where the majority of students have not been exposed to hybrid or online delivery methods. Instructors have the option as to whether they offer their courses in the hybrid format but must first obtained approval. Only a few sections of a few courses (less than 1% or about 3/120 sections) were offered in the hybrid format during the Spring 2011 semester. Fully online courses are not being offered at this time in the business school. A very small number of fully online courses are being offered at the college in other areas. The results may also be useful to other institutions with similar students and institutions exploring the benefits of distance education, particularly the hybrid model.

2. LITERATURE REVIEW

Research studies comparing course delivery methods commonly use final or exam grades as the measurement of student performance. This includes a meta-analysis conducted by the Department of Education of over a thousand empirical studies of online learning from 1996 through July 2008 (USDOE, 2010). Final grades, along with a few other learning outcomes, show evidence that students performed better in courses using both online and blended delivery than courses using traditional delivery methods. However, this analysis also showed that the difference between online and traditional course delivery was larger than between blended and traditional course delivery (USDOE, 2010). Regardless of the results of this study, the important item to note is the use of overall grades in a course as a measurement of student performance.

Other research studies that were not part of the Department of Education study also used final grades for measuring student outcomes and performance. One study, based on final course grades, showed a significant difference between traditional, internet-based, and hybrid delivery methods with the internet-based method outperforming the other two (Reasons, Valadares, & Slavkin, 2005). The results of this study differ from the Department of Education study, but the authors did note that they expected the differences to be stronger than they were. They predicted that the students in the hybrid sections would outperform the students in the traditional and internet-based sections. Their study also showed no difference between the hybrid and traditional courses. In complete contrast, another study comparing online versus traditional courses showed the traditional courses producing higher final course grades (Ury, 2005). This study did show the online delivery method as effective but the mean score for the online sections was significantly lower than the mean scores of the traditional sections. Two other studies also used final grades as their comparison measure but showed the percentage or number of letter grades (As, Bs, Cs,) achieved in a hybrid versus a traditional course (Scida & Saury, 2006; Hensley, 2005). Interestingly, the first study showed students performing significantly higher in the hybrid course and the second study showing the opposite.

Other research studies comparing course delivery methods tend to focus on exams (pre, post, midterm, final) instead of final course grade. One such study used the combined score of two midterms and one final exam to compare the blended versus the traditional approach and showed no significant difference between the two (Xu, Meyer, & Morgan, 2008). Similarly, another study examined three different exams and the overall exam average between students in traditional, hybrid, and web-based classes. This study also showed no significant difference among either the exam or the overall exam average (Rivera & Rice, 2002). Utts, Sommer, Acredolo, Maher, & Matthews (2003) used pre- and post-tests and also showed no difference between student performance in classes using traditional and hybrid instruction. As a side note, this study did show a difference in the evaluation of the two delivery methods. Students reported a slightly more positive view of tradition delivery. In complete contrast, another study showed online course delivery producing lower scores on final exams then both the traditional or hybrid delivery methods with hybrid outperforming traditional (Abdullat & Terry, 2005).

These previous studies comparing student performance by course delivery method vary in the results, with some showing each type of delivery method producing significantly higher results. The main type of measurement used for this comparison is final course grades or various exams grades. Some of the studies reviewed by the Department of Education did use other learning outcomes besides grades and exams but none are specifically discussed in the meta-analysis. This research study breaks down the final grade into different course components in order to identify any possible underlying issues with hybrid courses.

3. METHODOLOGY

The methodology used for this study consisted of combining the grades for two hybrid and two traditional courses and calculating an average score for each type of delivery method, one for the hybrid model and one for the traditional model. The grades were broken down into the three different course components of assessments types, core competencies, and course objective.

Information Systems Course Description

The particular course used for this study was a junior-level information systems course in the School of Management at a medium-sized, four-year, public college in southern New England. The goal of this course is to present a core of information systems principles with which every business student should be familiar and to offer a survey of the information systems discipline that will enable all business students to understand the relationship of advanced courses to the curriculum as a whole. The main course objectives include Information Systems Concepts, Management, and Security, Information Technology Fundamentals, and Business Structure and Processes. This course is required for Accounting, CIS, Management, and Marketing majors. The college offers at least three sections of the course each semester with a maximum class size of 32 students. A typical section consists of about 30% Accounting majors, 10% CIS majors, 30% Management majors, 10% Marketing majors, and 10% other majors. The other majors can include Finance, Economics, Computer Science and Communications majors. The sample for this study was 125 students, 62 in the two hybrid sections and 63 in the two traditional sections. The same instructor taught all four sections.

Traditional Sections

The traditional courses met twice per week for lecture, discussion, and group projects. The lectures used slides provided, but modified, by the textbook and posted on Blackboard. The course work for the traditional sections consisted of individual assignments, group projects, and exams. The individual assignments were discussed in class but the students completed on their own outside of class. The group projects were also discussed in class and the last 15-20 minutes of each class session was set aside for group meetings. The exams were conducted in class and consisted of multiple choice and short essay questions.

Hybrid Sections

The hybrid courses met once per week for lecture, discussion, and group projects. Again, the lectures consisted of the same set of slides as the traditional course but with less discussion time available during the class sessions. The course work for the hybrid sections consisted of the same individual assignments, group projects, and exams. The only difference was that the group project meetings were once a week versus twice a week in the traditional course. The hybrid course also required the students to read a case study from the textbook and post a comment to an online discussion board created in Blackboard. This was part of the participation grade for the course and not one of the assignments.

Assessment Types

The course consisted of three types of assessments. These included individual assignments, group projects, and exams. Since the course was divided into three modules, there was one of each type of assessment for each module. Therefore, there were three individual assignments, three group projects, and three exams throughout the course. The individual assignments consisted of various discussion and comprehension questions based on each chapter of the textbook covered in class. The group projects required the groups to create a written report for module 1, a diagram for module 2, and a presentation for module 3. Again, the exams consisted of multiple choice and short essay questions.

Core Competencies

In order to compare student performance by core competency, the core competencies needed to be associated with each assessment type. Each assessment type was examined for the required core competency as defined by the School of Management. For the purposes of this study, the core competencies were organized for simplicity and applicability to the course. Each core competency was renamed using a single word or phase. For example, *Prepare written communications such as proposals that are correct, clear, concise, and appropriate* was simplified to *Written Communication*. Three separate core competencies related to Teamwork and four related to Critical Thinking were combined into one each, respectively. Two of the thirteen core competencies were not applicable to the course and therefore were not used. This process created the five core competencies of Ethics, Critical Thinking, Oral Communications, Teamwork, and Written Communications (Appendix: Table 1).

Course Objectives

The course consists of ten course objectives that were combined into three major objectives for simplicity, allowing for the three modules of the course. The three major course objectives were Concepts, Information Technology, and Information Systems. Finally, the assessment types, core competencies, and course objectives were combined into a table for readability and organization (Appendix: Table 2).

Research Questions

The research questions for this study are based on the assessments types, core competencies, and course objectives. Although the previous research studies show mixed results on the performance of different delivery methods, this study based its hypotheses on the results of the Department of Education (DOE) meta-analysis. Again, the DOE study showed hybrid courses outperformed traditional courses. Each hypothesis in this study will predict that the hybrid sections will outperform the traditional sections on each of the three assessments.

The research questions for the assessment types include the three types of assessments (assignments, group projects, and exams). This created three hypotheses (H_1, H_2, and H_3).

H_1: Students in the hybrid sections will have significantly higher <u>Assignment Grades</u> than students in the traditional sections.
H_2: Students in the hybrid sections will have significantly higher <u>Group Project Grades</u> than students in the traditional sections.
H_3: Students in the hybrid sections will have significantly higher <u>Exam Grades</u> than students in the traditional sections.

The research questions based on the core competency include the five core competencies of Ethics, Critical Thinking, Oral Communications, Teamwork, and Written Communications. Therefore, there are the five hypotheses (H_4, H_5, H_6, H_7, and H_8).

H_4: Students in the hybrid sections will have significantly higher Ethics Grades than the students in the traditional sections.
H_5: Students in the hybrid sections will have significantly higher Critical Thinking Grades than students in the traditional sections.
H_6: Students in the hybrid sections will have significantly higher Oral Communications Grades than students in the traditional sections.
H_7: Students in the hybrid sections will have significantly higher Teamwork Grades than students in the traditional sections.
H_8: Students in the hybrid sections will have significantly higher Written Communications Grades than students in the traditional sections.

The research questions based on course objective include the three major objectives of the course (Concepts, Information Technology and Information Systems). This created three hypotheses (H_9, H_{10}, H_{11}).

H_9: Students in the hybrid sections will have significantly higher Concept Grades than students in the traditional sections.
H_{10}: Students in the hybrid sections will have significantly higher Information Technology Grades than students in the traditional sections.
H_{11}: Students in the hybrid sections will have significantly higher Information Systems Grades than students in the traditional sections.

A final hypothesis was added to compare the final grades of both delivery methods.

H_{12}: Students in the hybrid sections will have significantly higher Final Grades than students in the traditional sections.

4. RESULTS

The results for each course component are discussed below and summarized for all areas in Table 8 (see Appendix). Each of the eleven hypotheses is a directional hypothesis. The t-test was used to compare the grades because there is one independent variable, two factors in the independent variable, one dependent variable, and quantitative data. The independent variable has two levels, one for the average grade in the hybrid sections and one for the average grade in the traditional sections. The dependent variable is performance measured by grades. The quantitative data consisted of numerical scores to two decimal places. The independent t-test was used because the grades for the students were not related. There was no connection between the students in the hybrid and traditional sections. The sample size included 62 students in the hybrid sections and 63 students in the traditional sections with a total of 558 and 567 individual grades respectively. This sample is representative of the population of the School of Management at this institution.

Assessment Types

The assessment types included assignments, group projects and exams. There were three assignments, three group projects, and three exams required for each section of the course. An assignment average, group project average, and exam average was calculated for each type of course, one for the two hybrid sections and one for the two traditional sections. A total of 186 and 189 individual grades, respectively, were used in the calculations. The hypotheses were that the students in the hybrid sections will have significantly higher grades than the students in the traditional sections. The results supported this only for the assignments (Appendix: Table 5). The group projects and the exams did not show a statistically significant difference.

H_1 was supported.
The students in the hybrid sections did have significantly higher Assignment grades that the students in the traditional sections.

H_2 was rejected.
The students in the hybrid sections did not have significantly higher Group Project grades that the students in the traditional sections.

H_3 was rejected.
The students in the hybrid sections did not have significantly higher Exam grades that the students in the traditional sections.

Core Competencies

The core competencies included Critical Thinking, Ethics, Oral Communications, Teamwork, and Written Communications. Again, an average grade was calculated for each type of course, one for the two hybrid sections and one for the two traditional sections for each core competency. Unlike the assessment types, each core competency included one or a combination of assessment types used for the average grade (Appendix: Table 3). Critical Thinking used the three assignment grades, the three group project grades, and the three exam grades. This included 558 individual grades for the hybrid sections and 567 individual grades for the traditional sections. Ethics only used Assignment 1 and Exam 1. This included 124 individual grades for the hybrid sections and 126 individual grades for the traditional sections. Oral Communications used only Group Project 3. This included 62 individual grades for the hybrid sections and 63 individual grades for the traditional sections. Teamwork used all three of the group projects. This included 186 individual grades for the hybrid sections and 189 individual grades for the traditional sections. Written Communications used all three assignments and the first two group projects. This included 310 individual grades for the hybrid sections and 315 individual grades for the traditional sections. The hypotheses were that the students in the hybrid sections would have significantly higher grades than the students in the traditional sections. The results supported this only for two (Critical Thinking and Written Communications) of the five core competencies (Appendix: Table 6). Again, the average scores for all five competencies

H_4 was supported.
The students in the hybrid sections did have significantly higher Critical Thinking grades that the students in the traditional sections.

H_5 was rejected.
The students in the hybrid sections did not have significantly higher Ethic grades that the students in the traditional sections.

H_6 was rejected.
The students in the hybrid sections did not have significantly higher Oral Communications grades that the students in the traditional sections.

H_7 was rejected.
The students in the hybrid sections did not have significantly higher Teamwork grades that the students in the traditional sections.

H_8 was supported.
The students in the hybrid sections did have significantly higher Written Communication grades that the students in the traditional sections.

Course Objectives

The course objectives included the three major items of Concepts, Information Technology, and Information Systems. Again, the course was organized into three modules corresponding to the course objectives (Appendix: Table 4). The Concepts included Assignment 1, Group Project 1, and Exam 1. Information Technology included Assignment 2, Group Project 2, and Exam 2. Information Systems included Assignment 3, Group Project 3, and Exam 3. Just like the assessment types and the core competencies, an average grade was calculated for each type of course, one for the two hybrid sections and one for the two traditional sections. All three of the course objective items included 186 individual grades for the hybrid sections and 189 grades for the traditional sections. The hypotheses were that the students in the hybrid sections would have significantly higher grades than the students in the traditional sections. The results supported this both Information Technology and Information Systems but not for Concepts (Appendix: Table 7).

H_9 was rejected.
The students in the hybrid sections did not have significantly higher Concept grades that the students in the traditional sections.

H_{10} was supported.
The students in the hybrid sections did have significantly higher Information Technology grades that the students in the traditional sections.

H_{11} was supported.
The students in the hybrid sections did have significantly higher Information Systems grades that the students in the traditional sections.

5. CONCLUSIONS

This research study looked behind the final grade in hybrid and traditional courses by comparing student grades in assignments, core competencies, and course content. Although the results were not consistent between these items, they did provide some evidence that hybrid course delivery can produce similar if not better results than traditional delivery. In addition, there were several surprises in the areas related to group projects, teamwork, and the advanced course objectives.

Assessments

For the three assessment types, assignments grades were significantly higher in the hybrid courses. The assignments were exactly the same for the both types of courses. The thinking would be that the traditional grades would be higher because the additional class time allowed for longer class discussions and clarification of course content. Therefore, there is some unknown agent impacting the grades in the hybrid sections allowing for the higher grades. As for the group projects, common sense would say that group projects grades would be higher since the traditional sections had two class meetings per week for group meetings, where the hybrid sections only had one class meeting per week. Again, the same thinking would be that that the extra time meeting as a group would help the group members complete the group projects. Although the statistics did not show a significant difference, students in the hybrid courses (90.65) did complete the group projects just as well as the students in the traditional course (89.01). They have obviously figured out methods for working together with less face time and were able to collaborate virtually. There is also the possibility that students divided the work more efficiently, knowing that they have less time to work together in class. Another possibility could be that students work better with less group meetings due to the fact that not all students like group projects or working with other students. Less group meeting time reduces the chances for issues, conflicts or free loading. Further study would be needed in this area. However, the good news for hybrid delivery methods is that this study showed that hybrid courses could produce as good, if not better grades, than traditional courses in various types of assessments. In addition, the hybrid delivery method did not have a negative impact on group projects.

Core Competencies

Of the five core competencies of the course, students had significantly higher grades in Critical Thinking and Written Communication. For Critical Thinking, there is support that the self-paced learning in a hybrid course increases content retention (Rainer & Cegielski, 2011). This could attribute to the higher grades in this area. There may be some students that assume the extra lecture time in traditional courses will in and of itself help them learn and retain this information, where students in hybrid courses know they must read and learn the material on their own. For Written Communication, the requirement of posting to an online discussion in the hybrid sections may have contributed to the higher grades. In addition, students interact with other students and the instructor more by Written than Oral Communications in a hybrid course. This also could improve this skill area. For Ethics and Oral Communications, the course material was covered the same way in both delivery methods and both types of courses required one oral presentation. In both skill areas, the average student grade was higher in the hybrid sections just not at a significant level. So again, the hybrid sections had a positive impact. Lastly, the Teamwork skills did not show a significant difference in student grades but again, the average grade in the hybrid sections (90.65) was higher than the higher grade in the traditional sections (89.01). Thus showing no major impact on this skill set for hybrid courses.

Course Objectives

The results of student grades by course objective showed significant differences in two of the three modules. The Concepts module did not show a significant difference and was the only area out of the Assessments, Core Competencies, and Course Objectives that produced a higher average for the traditional sections (86.71) than the hybrid sections (86.21). Both the Information Technology and Information Systems modules did produce significantly higher results in the hybrid sections. These modules contain more difficult material than the Concepts module. Again, this supports the research that hybrid delivery methods can produce higher grades.

For the last part, it was important to look at and compare Final Grades between the two delivery methods as was done in other research studies. In this case, Final Grades were not significantly higher in the hybrid sections but the average grade (84.86) was very similar to the average grade of the traditional sections (84.49). And although the Critical Thinking skill in the Core Competencies included all the grades for the course, it was not the weighted average used to calculate the Final Grade.

6. IMPLICATIONS

Overall, the results of this research study showed that student performance in hybrid courses does vary by course component. More importantly, it also showed that students in hybrid course could perform as well as students in traditional courses and in some cases better. This includes students that have not been exposed to hybrid delivery methods. As for the course components, group projects may be used in hybrid courses without having a negative impact on grades. This study also showed that in the area of core competencies (skills), hybrid courses could produce similar student performance, and they may even improve performance in critical thinking and written communications. Lastly, the results showed significant differences in the more advanced course objectives. This again is a positive indication that courses with advanced topics may be suitable to the hybrid delivery method. Of course, more research is needed to examine other types of course components than the assessment types, core competencies, and course objectives of this study. However, this provides some insight behind the final grades in hybrid versus traditional courses.

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Appendix

Table 1

Core Competency	Core Competencies of the School of Management
Written Communications	1. Prepare written communications such as reports and proposals that are correct, clear, concise, and appropriate.
Oral Communications	2. Present oral communications that are correct, clear, concise, and appropriate to small or large groups, in planned or extemporaneous formats, and in response to formal or informal requests.
Teamwork	3. Work effectively with individuals, and in groups with diverse members.
	4. Influence others.
	5. Manage and resolve conflicts.
Critical Thinking	6. Identify, analyze, and solve both structured and unstructured problems in a logical and/or creative manner.
	8. Manage restricted resources such as time, capital, human resources, and materials.
	10. Draw inferences, reach conclusions, and apply knowledge to new situations.
	11. Use efficient learning techniques to acquire and apply new knowledge and skills.
Ethics	7. Use value-based reasoning to develop appropriate responses to ethical situations.
Not applicable to course	12. Reason mathematically and apply quantitative analysis methods; including interpreting charts, tables, and graphs; and applying concepts to word situations.
	13. Use computers to process information for communications, mathematical applications, problem solving, and decision-making.

Table 2

Assessment Type	Core Competency	Course Objective
Assignments		
Module 1	Written Communication, Critical Thinking, Ethics	Concepts
Module 2	Written Communication, Critical Thinking	Information Technology
Module 3	Written Communication, Critical Thinking	Information Systems
Group Projects		
Module 1	Written Communication, Critical Thinking, Teamwork	Concepts
Module 2	Critical Thinking, Teamwork	Information Technology
Module 3	Oral Communication, Critical Thinking, Teamwork	Information Systems
Exams		
Module 1	Critical Thinking, Ethics	Concepts
Module 2	Critical Thinking	Information Technology
Module 3	Critical Thinking	Information Systems

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Table 3

Core Competency	Assessment Type
Critical Thinking	Assignments 1-3, Group Projects 1-3, Exams 1-3
Ethics	Assignment 1, Exam 1
Oral Communications	Group Project 3
Teamwork	Group Projects 1-3
Written Communications	Assignments 1-3, Group Project 1-2

Table 4

Course Objective	Assessment Type
Concepts	Assignment 1, Group Project 1, Exam 1
Information Technology	Assignment 2, Group Project 2, Exam 2
Information Systems	Assignment 3, Group Project 3, Exam 3

Table 5

Assessments	Count	Mean	Std Dev	ANOVA p-value	t test p-value
Assignments (H_1)					
Grades - Hybrid Sections	186	88.31	12.16		
Grades - Traditional Sections	189	85.48	17.28		
Reject Null - 0.03 < alpha (0.05) ***Hybrid grades significantly higher***				0.06785**	0.03392
Group Projects (H_2)					
Grades - Hybrid Sections	186	90.65	9.17		
Grades - Traditional Sections	189	89.01	14.33		
Fail to Reject Null - 0.19 > alpha (0.05) *Hybrid grades not significantly higher*				0.18995**	0.1886
Exams (H_3)					
Grades - Hybrid Sections	186	79.21	10.56		
Grades - Traditional Sections	189	77.90	13.18		
Reject Null - 0.14 > alpha (0.05) *Hybrid grades not significantly higher*				0.28915**	0.14417
* ANOVA *p-value* < 0.05 Equal Variance Not Assumed ** ANOVA *p-value* >= 0.05 Equal Variance Assumed					

Table 6

Core Competency	Count	Mean	Std Dev	ANOVA p-value	t test p-value
Critical Thinking (H_4)					
Grades - Hybrid Sections	558	86.06	11.77		
Grades - Traditional Sections	567	84.13	15.70		
Reject Null - 0.01 < alpha (0.05) ***Hybrid grades significantly higher***				0.02031*	0.01002
Ethics (H_5)					
Grades - Hybrid Sections	124	85.55	11.81		
Grades - Traditional Sections	126	85.21	12.46		
Fail to Reject Null - 0.054 > alpha (0.05) *Hybrid grades not significantly higher*				0.10853**	0.05427
Oral Communications (H_6)					
Grades - Hybrid Sections	62	91.81	13.05		
Grades - Traditional Sections	63	88.00	20.62		
Fail to Reject Null - 0.11 > alpha (0.05) *Hybrid grades not significantly higher*				0.22070**	0.11035
Teamwork (H_7)					
Grades - Hybrid Sections	186	90.65	9.17		
Grades - Traditional Sections	189	89.01	14.33		
Fail to Reject Null - 0.09 > alpha (0.05) *Hybrid grades not significantly higher*				0.18995**	0.09498
Written Communications (H_8)					
Grades - Hybrid Sections	310	89.00	10.28		
Grades - Traditional Sections	315	87.09	14.88		
Fail to Reject Null - 0.03 < alpha (0.05) ***Hybrid grades significantly higher***				0.06173**	0.03087
* ANOVA *p-value* < 0.05 Equal Variance Not Assumed ** ANOVA *p-value* >= 0.05 Equal Variance Assumed					

Table 7

Course Content	**Count**	**Mean**	**Std Dev**	**ANOVA p-value**	**t test p-value**
Concepts (H_9)					
Grades - Hybrid Sections	186	86.21	10.37		
Grades - Traditional Sections	189	86.71	10.91		
Fail to Reject Null - 0.33 > alpha (0.05) *Hybrid grades not significantly higher*				0.65001**	0.32501
Information Technology (H_{10})					
Grades - Hybrid Sections	186	86.04	9.15		
Grades - Traditional Sections	189	83.86	13.70		
Reject Null - 0.04 < alpha (0.05) ***Hybrid grades significantly higher***				0.07184**	0.03592
Information Systems (H_{11})					
Grades - Hybrid Sections	186	85.91	15.02		
Grades - Traditional Sections	189	81.81	20.58		
Fail to Reject Null - 0.01 < alpha (0.05) ***Hybrid grades significantly higher***				0.02841*	0.01404
Final Grade					
Grades - Hybrid Sections	62	84.86	5.11		
Grades - Traditional Sections	63	84.49	6.04		
Fail to Reject Null - 0.35 > alpha (0.05) *Hybrid grades not significantly higher*				0.70896**	0.35448
* ANOVA *p-value* < 0.05 Equal Variance Not Assumed ** ANOVA *p-value* >= 0.05 Equal Variance Assumed					

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Table 8

Item	Hybrid Ave Grade	Trad Ave Grade	Statistical Conclusion
Assessments			
Assignments	88.31	85.48	***Hybrid grades significantly higher***
Group Projects	90.65	89.01	*Hybrid grades not significantly higher*
Exams	79.21	77.90	*Hybrid grades not significantly higher*
Core Competency			
Critical Thinking	86.06	84.13	***Hybrid grades significantly higher***
Ethics	85.55	85.21	*Hybrid grades not significantly higher*
Oral Communications	91.81	88.00	*Hybrid grades not significantly higher*
Teamwork	90.65	89.01	*Hybrid grades not significantly higher*
Written Communications	89.00	87.09	***Hybrid grades significantly higher***
Course Content			
Concepts	86.21	86.71	*Hybrid grades not significantly higher*
Information Technology	86.04	83.86	***Hybrid grades significantly higher***
Information Systems	85.91	81.81	***Hybrid grades significantly higher***
Final Grades	84.86	84.49	*Hybrid grades not significantly higher*

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The Need for Mobile Application Development in IS Curricula: An Innovation and Disruptive Technologies Perspective

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Abstract

Disruptive technologies, such as mobile applications development, will always present a dilemma for Information Systems educators as dominant paradigms in our environment will tend to favor the existing sustaining technologies that we have become known for in our discipline. In light of this friction, we share our approach in investigating and designing a mobile application development which centers on student-faculty partnerships. We discuss a mobile application prototyping strategy and process which has allowed first-hand exploration of the current generation of mobile devices, and associated operating systems (*Android* and *iOS*). The nature of application development for these current-generation devices is discussed. A strategy for investigating and incorporating disruptive technologies, such as mobile applications, is offered for curriculum development. These strategies and the thinking surrounding them are influenced by theories on disruptive technologies and innovation. Of particular interest is the need to keep abreast of innovative technologies without, at the same time, chasing down every "fad" that appears.

Keywords: mobile applications, disruptive technology, curriculum development, innovation

1. INTRODUCTION

To paraphrase Bower and Christensen (1995), a failure to stay on top of technology and market changes remains a persistent problem facing Information Systems (IS) educators in their task of curriculum design in the face of rapid Information Technology (IT) changes. In the case of this change, a primary challenge remains an ability to recognize and separate fad from fundamentals (Noll & Wilkins, 2002; Lightfoot, 1999). As IS educators have witnessed successive "waves" of technological innovation and trends in practice – the micro-computer, end-user computing, object-orientation, the world wide web, etc. – IS educators have been faced with a conundrum: whether an innovation is a "game-changing" development or something more ephemeral? Moreover, the perspectives of the various stakeholders for a given program – students, employers, educators, the public, and the discipline at large – will each exert, at times, contradicting and countermanding demands on the IS curriculum for the sake of relevance. This dilemma is certainly a wicked problem and, arguably, is part and parcel to the very nature our discipline (Denning, et al., 1989). Thus, we assert that what is "core" to our discipline is not always stable; new and disruptive technologies will continually shape the curriculum as it does the discipline. As we seek to develop over-arching models for our curricula – as we think in terms such as theory, abstractions, and design – we must be willing to introduce the new into the tapestry of the old.

There are two principal aims for this paper: first, we consider the inclusion of mobile application development into the IS curriculum; and, second, this paper takes a disruptive technologies theory perspective on how IS educators can recognize important disruptive technologies and incorporate these technologies into the IS curriculum (Bower & Christensen, 1995), and also from an innovation theory perspective (Drucker, 1998). Specifically, we consider the incorporation of the latest generation of mobile devices, and software applications ("apps"), into the IS undergraduate curriculum.

For IS educators and researchers, the latest generation of mobile device presents new horizons for inquiry concerning portability, security, privacy, computing resource management, human-computer interaction, and the social impacts of computing. While these phenomena are not new, the latest generation of mobile devices has newly synthesized these concerns in light of the convergence of technologies manifest in the devices. In this sense, while mobile computing is not new, its impact on cultures and societies has been acute in this latest generation of mobile devices. In fact, mobile computing has further eroded the digital divide as people from various backgrounds and socio-economic persuasions all seem to have embraced mobile computing (Varshney & Vetter, 2000; Lyytinen & Yoo, 2002). For these reasons, we are certain that mobile computing will continue to impact the IS discipline pedagogically, professionally, and intellectually.

In this paper, we take the position that currency gained from embracing innovations will require risk-taking. To this end, we will share our experiences in investigating mobile application development for inclusion into our curriculum. Furthermore, we discuss a process by which IS departments can manage this risk, based on our experience. As such, this paper proceeds as follows. First, we discuss how disruptive technologies influence curriculum design. Next, we discuss the latest generation of mobile devices and characterize what is distinctive, new, and disruptive about these devices. Next, we focus on how and why IS curricula should plan on incorporating mobile computing in accordance with the theory of disruptive technologies. We then propose a course in mobile application development influenced by our experiences and strategies for adopting the technology. Finally, we conclude and discuss how our experiences have reinforced the lessons of both disruptive technology theory and innovation theory, and what implications these hold for curriculum design.

2. A DILEMMA FOR CURRICULUM DESIGN

The challenge for IS educators always has been how to decide when to include a specific new topic or technology into the curriculum, and how to facilitate such implementation without undermining the existing curriculum. Developing a plan and strategy for incorporating mobile application development into IS curricula is not a new or isolated change management problem. It has always been imperative that IS educators remain cognizant of new developments and be vigilant in developing strategies for the research and development of new innovations so as to anticipate demand. In doing so, IS educators may develop a "vision" for which new technologies are suitable for their circumstances (Johannessen, Olsen, & Olaisen, 1999). One utility of this vision is as a means to assess risk tolerance in adopting new technology innovation: is this new technology a right fit and how quickly can we capitalize on this new technology when demand arises? In this sense, we recall a paradox for research and development efforts in the areas of promising technologies: we must develop both the temerity and instinct to act outside of stakeholder demand by investing energy and resources into areas not yet in demand (Bower and Christensen, 1995). Part and parcel to this concept is to develop an "incubator" within our departments for exploring new topics and technology.

In the context of mobile computing in the Information Systems curricula, only recently, in the IS2010 model curriculum, does ubiquitous mobile computing command serious mention (Topi, et al., 2010). Moreover, the IS2010 model curriculum mentions ubiquitous mobile computing in the context of an extant concern, that of the Human Computer Interaction concentration (Topi, et al., 2010). Evidently, a natural tendency exists such that we classify new phenomenon in the context of extant phenomenon (Christansen, 1997). When new areas of concern arise, such as mobile applications, social network computing, and even games and "gamification," it is not likely that our peers, our stakeholders, or our constituents will "green light" the need for these innovations early enough such that an IS program is ready to "hit the ground running" when demand quickly thrusts the relevance of the innovation into our concern. In many cases, it will rest on IS faculty to provide the insight and leadership to recognize and assume these risks. Moreover, we could argue that this is exactly the role faculty are meant to take – to develop new ideas, new knowledge, and strategies for incorporating innovation into the curriculum. In fact, championship of the research and design of new curriculum areas is no different than the championship required for new information systems implementations and other change-management concerns in industry (Bower & Christensen, 1995, p. 44). Thus, change management for the nurture of a disruptive technology requires a unique approach.

Imperative to adopting a disruptive technologies perspective is an understanding of what Bower and Christensen (1995) call *sustaining technologies* and *disruptive technologies*. From a curriculum-development perspective, there are certain *sustaining technologies*, or subjects, that we rely upon to deliver the indisputable core of the information systems curriculum. These are the skills, knowledge, and techniques that the majority of our stakeholders and constituents expect of our programs. Typically, these will be: applications development in a modern programming language, databases and data management, systems analysis and design, data communications and networks, and grounding in the role of IT in organizations. As our going concerns, these sustaining technologies define our discipline and frame how we engage our processes of curriculum assessment and continuous improvement. To borrow from Kuhn (1962), our pedagogical, basic, and applied research and development efforts in this area constitute our *normal science*. As with Kuhn's *paradigms*, we are often careful to structure a curriculum, and models for curricula, in close alignment with the current paradigm; our understanding of and expectations of our programs hinges on this paradigmatic activity. Granted, our curricula, and models thereon, certainly allow for tailoring programs through free electives; however, it is less clear that we are willing (or able) to fundamentally change the paradigm.

We contend that thinking of curriculum development from a paradigmatic perspective supports Bower and Christensen's (1995) assertion that reconciling between the demands of a *sustaining technology* and the uncertain promise of a *disruptive technology* requires finesse and determination. A *disruptive technology* introduces a distinct set of qualities and capabilities which are not readily and apparently relevant to the demands of the existing paradigm. For instance, it has taken time to develop frameworks and infrastructure such that web application development has merged with aspects of traditional systems and software development practices. In fact, one could argue that the advent and maturation of agile software development methods may be somewhat related to the push to incorporate web development methods into the body of knowledge and practice of "conventional" modes of systems development (Abrahamsson et al., 2003). Thus, as with web application development, markets, employers, and educators may not adopt a disruptive technology at the same rate and at the same time. The challenge for IS educators is to develop strategies for exploring new curriculum areas without negatively affecting extant and sustaining technologies, in the short term; in the long term, given the eventual relevance of the innovation, the IS educator must then incorporate the innovation.

Fundamental to the dilemma of adopting a disruptive technology is that the new innovation may not make full "sense" in the existing market as the need for the improvements of the disruptive technology are not yet apparent. As Bower and Christensen (1995) put it, the apparent performance advantages, particularly in light of the prevailing paradigm, often present a small advantage as the market often doesn't "see" the value. For instance, for a previous generation of mobile devices, Research in Motion's *BlackBerry* smart-phone was considered the "gold standard" for enterprise and corporate users such that earlier generations of Nokia and Windows smart-phone devices were not considered serious corporate-use contenders. Now, as the latest generation of mobile devices (Apple's *iPhone* and *iOS*, Google's *Android OS*, and Microsoft's *Windows 7 Mobile OS*) proliferate, the conventional paradigm that the *BlackBerry* is the only serious enterprise device has been challenged (Cozza, 2011). This is not due to the inferiority of the *BlackBerry* so much as the expectations of the market had changed, driven largely by a collection of new capabilities intrinsic to the new devices. In other words, the market was now ready for the disruptive innovation.

According to Bower and Christensen (1995), we can assess the potential of a disruptive technology by understanding the performance trajectory offered by both the extant sustaining technologies and the new and disruptive technology (see Figure 1).

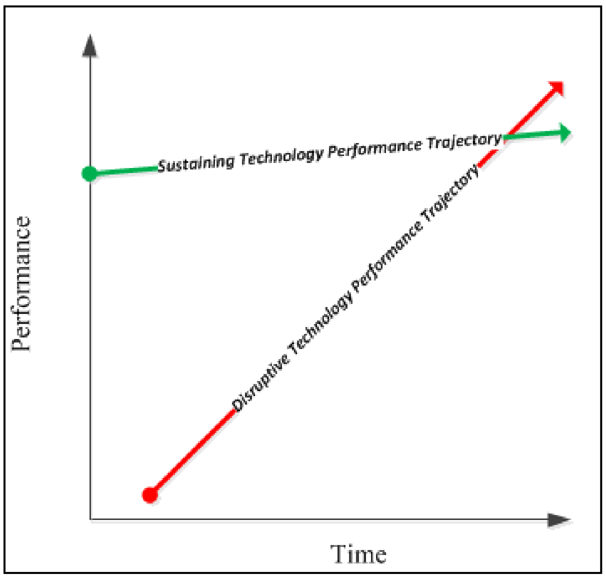

Figure 1 Assessing Disruptive Technologies (Bower and Christensen, 1995)

Whereas the performance trajectory for a sustaining technology is fairly predictable in support of dominant paradigms, the disruptive technology performance trajectory is initially estimated, but not guaranteed. However, if and when the trajectory intersects with, and then surpasses, the sustaining technology trajectory, it can be assumed that the implications for the dominant paradigm will be fairly certain: the disruptive technology is incorporated. Few expected that *Android*, *Windows Mobile*, and *iPhone* devices would threaten *BlackBerry*, but this has been the case and is expected to continue (see Table 1).

In the case of mobile devices, a convergence of technologies and capabilities has impacted the dominant paradigm. The incorporation of several previously-independent features – a PDA, a phone, a GPS, an audio player, a camera, etc. – into the latest generation of mobile devices has challenged the wired paradigm in a compelling way. We see other parallels in the advent of multi-core processors, in the increase in Internet subscribers brought about by the World Wide Web, and in the rediscovery of cloud computing. With these examples, we see that the potential of some technologies is not fully reached until other environmental conditions allow for the benefits of the technology to impact the marketplace. This convergence of device and software capabilities have created new user empowerment and has positioned mobile computing, and accordingly, mobile application development, as among the key strategic technologies for 2011 and beyond (Pettey, 2010).

To punctuate the influence of Bower and Christensen (1995) on our own mobile application development strategy for our curriculum, we reiterate that simply accommodating the curricular needs of the existing and dominant paradigm will likely stifle efforts to explore disruptive technologies. However, programs likely have very little room for experimentation as both the core curriculum and electives are suited to the dominant paradigm and any other concomitant institutional imperatives, such as AACSB accreditation, etc. Therefore, while we must continue to explore new technologies in order to sustain and broaden the appeal and viability of our IS programs, traditional methods may not yield the desired results. Typically, the exploration of new topics for incorporation into the curriculum transpires thusly: we carve out elective space (perhaps even within an existing course), we select a textbook, and we then "guinea pig" a group of students in order to ascertain suitability. As it is often the case that even electives are delivered and received within the auspices of the dominant paradigm of sustaining technologies, the normative approaches may not yield results. Rather, the research & development and "vision" necessary to fully explore the potential of the disruptive technology may be best realized when these efforts are sequestered away from the normal curriculum.

It is important that we do not underestimate the potential that a disruptive technology holds for reinvigorating and revitalizing our IS programs. Historically, as we have continued to explore and incorporate new technologies, we have also broadened the appeal of the major. For instance, the World Wide Web likely brought in an entirely new crowd to IS who may not have been attracted by our previous concerns. Furthermore, whereas our traditional concerns, perhaps from earlier technology waves, were programming, and analysis and design, a focus on new concerns may bring other interests, such communications, marketing, security, etc., as newer technology "waves" move through our discipline.

3. MOBILE COMPUTING BACKGROUND

As exemplary of a disruptive technology, the current generation of mobile applications and devices has not arisen in a void; rather there exist precursors to present mobile computing which goes back for nearly 20 years. Particularly in the 1990s, both the marketplace for mobile devices (particularly mobile phones and Personal Data Assistants) and research on mobile computing phenomena, quickly rose to prominence (Satyanarayanan, Fundamental Challenges in Mobile Computing, 1996; Forman & Zahorjan, 1994; Satyanarayanan, Kistler, Mummert, Elbling, Kumar, & Lu, 1996; Spreitzer & Theimer, 1993; Chess, Grosof, Harrison, Levine, Parris, & Tsudik, 1995).

An ongoing aspect of each generation of mobile device remains the fact that the device can connect wirelessly to the network and that the device offers open-ended computing capabilities (Forman & Zahorjan, 1994, p. 38). That these devices increasingly also incorporate aspects of mobile telephony constituted an early theme that has not only persisted, but has also come to acutely characterize the current generation of mobile devices: that characteristic is feature convergence.

The Current Generation of Mobile Computing Devices

For the purposes of this article, a mobile computing device primarily connects to the network via IEEE 802.11 Wireless LAN networks and/or the International Mobile Communications 2000 (IMT-2000) mobile telecommunications networks. Accordingly, it is often easier to associate these latest generation mobile computing devices by the sales and marketing classification they are most commonly given: Smart Phones. While these devices provide uses beyond that of simple telephones, in this paper, we focus primarily on the phone, the PDA, and the tablet devices most associated with the IMT-2000 3rd Generation (3G) and 4th Generation (4G)-capable devices.

What is distinctly characteristic of these devices is that they foster and flourish a software application "ecosystem," typically characterized by "apps" and "app stores." Additionally, this current generation of mobile computing devices is generally represented by the two major and competing operating systems for the devices: Apple's *iOS* and Google's *Android*. Thus, we have limited our examination of current-generation mobile devices to *Android* and *iOS* devices for the following reasons: 1) both Apple's and Google's operating systems are fairly representative of the capabilities and features of the current generation devices; and, 2) the devices powered by Apple and Google represent a sizeable portion of market share (both current and projected).

From a curricular standpoint, what also distinguishes these current-generation devices is the nature of the methods used for the delivery and maintenance of software. These devices are characterized by always-on access to the Internet and World Wide Web, access to a software shopping, purchasing, distribution, and maintenance infrastructure commonly and colloquially known as application stores, or "app stores." Additionally, these devices have considerable processing power, memory, video acceleration, and audio processing capabilities such that a variety of software can be written to utilize these capabilities. In short, these are more hand-held computers than mobile phones.

Mobile Application Development Concerns

While the aim of this paper is to discuss an approach to incorporating mobile application development into the IS curriculum, some discussion of the logistics and particulars of creating mobile applications is in order. First, we will characterize and classify the software development concerns and particulars for developing for both platforms. Then, we will relate our own experiences and how we incorporated a Bower and Christensen (1995) approach to researching and developing a disruptive technology for incorporation into our curriculum.

Eric Raymond, in his classic tome on software engineering methods, *The Cathedral and the Bazaar* (1999), likened certain development processes as being akin to either "Cathedrals" or "Bazaars," depending on the openness communication and the availability of source code. When considering Apple's *iOS* and Google's *Android*, we will illustrate how working with Apple's *iOS* SDK is more akin to the "Cathedral," whereas working with Google's *Android* SDK is more akin to the "Bazaar." While this characterization may be somewhat hyperbolic, we find it useful based on our experiences.

Working with the iOS SDK – The Cathedral

During our research and development work, Apple's *iOS* Software Development Kit (SDK) is the disruptive technology on which we spent most of our development, prototyping, and piloting efforts. Therefore, our experience with Apple's *iOS* is much more extensive than with Google's *Android*.

The *iOS* Software Development Kit (SDK) is available to *iOS Developer Program* members or those who have enrolled their department into the freely-available *iOS Developer University Program*. The advantage of this program is that there are no licensing fees and the program allows designated faculty, and up to 200 students, to develop, test, and deploy mobile applications. While it is not possible to upload applications developed under the *iOS Developer University Program* to Apple's *App Store*, it is possible to individually provision each faculty and student mobile device with a license which allows downloading to the device from the development environment.

iOS SDK - Language, Library, and Tools

As the majority of IS programs use either Java, C#/.NET, or VB.NET as a programming language, the steepest learning curve in learning *iOS* development will be in the tools and language area. The development language for creating *iOS* applications is Objective-C. While Objective-C is a wrapper around C, there are idioms in the syntax and object interaction of Objective-C which will be unfamiliar regardless of familiarity with C, C++, Java, or C#. As Objective-C is not a managed language, direct memory allocation and management will likely be foreign to most IS students.

The Integrated Development Environment used for *iOS* development is *XCode*. XCode's workflows will be fairly unfamiliar to students who are used to *Visual Studio*, *Eclipse*, or *Netbeans*. The Cocoa-based SDK libraries used in *iOS* development are straight-forward maps to the Cocoa Touch, Media, Networking and OS/Kernel-level features of the *iOS*. Faculty and students familiar with the .NET *Framework Class Library* documentation or the *Java Class Library* documentation should do well with the documentation and examples for the *iOS* SDK. In general, the *iOS* development experience is certainly closed-source and "Cathedral"-like. Information regarding the tools and resources mentioned in this section are available online at http://developer.apple.com.

The Android SDK – The Bazaar

Whilst arriving to the market after Apple's *iOS*, the *Android* OS, designed to run in a number of hardware environments, is the fastest-growing OS environment for smart phones and other current-generation mobile devices. Being that *Android* is based on a Linux kernel, it is at its heart, a more "Bazaar"-like endeavor. In our testing, we concluded that *Android* development should be easier for most existing Information Systems (and Computer Science) faculty and students. Thus, we selected *iOS* as it would afford greater research and development value.

Android SDK - Language, Library, and Tools

Perhaps the most welcome news for many IS educators is that the learning curve for the tools and language supporting the *Android* SDK is no steeper than what is already the case in the majority of IS programs. This is so as the programming language for *Android* Development is primarily Java, which is still widely used by many IS and CS programs around the world. This also means that there are no development restrictions, such as the requirement for a particular hardware and system architecture for the development machine.

Comparison of the SDKs

Hopefully, Raymond's (1999) "Cathedral" and "Bazaar" conceptualization was a useful metaphoric device in understanding the different premises and assumptions when working with both toolsets. While there are many reasons to go with *Android* only, the largest players in the "App store" model will likely remain Apple and Google/*Android*. It remains to be seen what will happen with Nokia as they plan on moving forward with *Windows Mobile* solutions (Elop & Ballmer, 2011). The *Windows Mobile* option represents a "middle way" between the "Bazaar" of the *Android* ecosystem and the "Cathedral" of the Apple approach. It should be noted that a .NET environment would be easier for an IS program to transition to as opposed to the Apple *iOS* environment. Table 3 presents a side-by-side comparison of the *Android* and *iOS* environments (Chikkala, 2011).

4. A DISRUPTIVE-TECHNOLOGIES APPROACH

In 2009, we determined that several key technologies, most of which appear in Table 2, required further consideration. We again heeded advice to isolate, incubate, and otherwise nurture a research & development project for our exploration of mobile application development (Christensen, 1997). As of this writing, there are other universities offering courses in *iOS* and *Android* mobile applications development – in fact, there are free online courses at the Massachusetts Institute of Technology, Stanford University, and the University of California at Berkeley for this purpose. Like many institutions, our university lacks the critical mass, both literally in terms of students, and figuratively in terms of resources, renown, and prestige, to absorb risks in the manner that these higher-order institutions can. Table 4 provides a list of some universities offering a course in mobile development that includes either iPhone development, *Android* development, or both, as of the summer of 2011. Our process for finding these schools and programs was simple and straight-forward: we used the search terms "mobile application development" and "*iOS*" and "*Android*," where sites searched were limited to the `.edu` top-level domain. Rather than creating an exhaustive list, we focused on the most relevant findings from the first 50 returns. Results were corroborated between Google's search engine and Microsoft's "Bing" search engine.

Overcoming the Risks and Challenges: A Pilot Approach

Rather than embark on an experimental course, we undertook a pilot/prototype approach whereby the department hired a few of our best, most-capable, and well-rounded undergraduate and graduate students to work on an internal iPhone/*iOS* app for the department under the supervision and direction of a faculty member. We next offer a synopsis of the findings, lessons learned, and emerging concerns from this pilot effort.

The High-risk and low-initial-ROI problem

While it was crucial to allocate a faculty member to this endeavor, this allocation represents a risk. It is never certain that either the professor or the student would retain or convey any material that would be useful to the department and the undergraduate program. Another risk of the experiment is that all knowledge and expertise were allocated to the faculty member and students assigned to the project. Should anyone disengage from the project, there is a danger that these resources would be lost. Also, being a pilot project, the immediate payoff would be less than clear to many stakeholders and constituents.

Standards

While Objective-C is a well-specified and documented language, and while the closed environment of the *iOS* and its SDK have well-documented API and libraries, there is a risk in investing in a technology area largely void of standards. While web technologies are based on standards, many large vendor-driven SDKs and APIs, such as Apple's Cocoa technologies in the *iOS*, are subject to unilateral changes and the deprecation of any portion of the SDK.

Platform and Development Knowledge

While faculty mentor and student were sufficiently skilled in application development, we were concerned for what a beginner's experience might be. Our conclusion is not surprising: like any other innovation, utilizing the IT innovation requires the same hard-skills in application development as would any other innovation related to application development. In short, there is no "magic" in these technologies, they require many of the same skills we've been training our students on for decades now.

Difficulty to Test and Deploy

Another concern arose in that mobile development often requires that you test in an emulator rather than, or at least prior to, testing on an actual device. Also, deployment is very closely controlled by the vendors who control the App Stores, making ad-hoc distribution especially challenging in the *iOS* case.

Ancillary Concerns

When working with the *iOS* SDK, some faculty may feel as though they are stepping backwards a bit in that resource allocation, management, and de-allocation are once again first-order concerns. Also, these devices present new data and location privacy concerns that have fewer equivalents in a static computing model (Keith et al, 2010).

Outcomes Informing Next Steps

By undertaking a low-risk and low-profile initial pilot application, we were able to "dry run" and "what if" issues that we anticipated and those we did not. Furthermore, by including students, we were also able to discuss potential content for the course from the student's perspective. Through this experience, we have been able to demonstrate to other faculty in the department, in the college, and in the university, our new expertise. Among the evidence of success of our approach is that our student, upon graduation, was subsequently hired by the university to continue a mobile development strategy for the institution.

There are many avenues yet available for incorporating mobile application development into the IS undergraduate curriculum at our institution, and the pilot allowed our department the opportunity to test those waters in an unobtrusive way. We concluded that any effective course would not likely be suited to absolute beginners: the sophistication of the required tools and techniques suggest that upperclassmen and graduate students would be the best target audience. The data in Table 4 implies that several other programs around the country have also made this determination.

5. CONTENT FOR A PROPOSED COURSE

Our next step in the process is to design and offer a course. The initial course would present a survey of topics focusing on both *iOS* and *Android* development. In general, of the other institutions we surveyed, we found the University of Notre Dame's approach to be sound. Specifically, we agree with and share the following aims to prepare students for careers in mobile application development (Laneman, Flynn, & Poellabauer, 2010):

- Increase the number of professionals in mobile application development and related technologies
- To foster the development of skills which address real-world problems with the tools and skills required for mobile application development
- To enhance the ability of students to communicate with a variety of audiences through their applications.

An outline of topics, skills, and techniques, broken down by the weeks of a semester is depicted in Table 5. A short-list of the major topics is as follows: The Objective-C language; The XCode IDE; Project Life Cycle; The Cocoa API; Views; Touch and Animation; Interface Elements; Event-handling; Sub-frameworks: Audio, Video, Photos, Maps, Sensors; Persistent storage; Networking; Multi-threading

Required Resources

As with any other area related to application development, departments considering an mobile application development course would do well to prepare the requisite resources. We have discussed the technical requirements, but our experiences revealed that the most important resources were human.

Perhaps the most important outcome of our efforts in exploring disruptive technologies is the development of faculty expertise. In our department, this experimental approach had the department chair's full blessing, consent, and endorsement. While our in-house "vanity" project had seemingly little direct and upfront value, the department chair was able to isolate us such that we were able to develop familiarity, comfort, and expertise. Whereas many departments might tend to outsource new and upcoming areas to adjunct faculty, to do so is to miss an opportunity to keep full-time, tenure-track, and tenured professors up-to-date and steeped in the technologies that will impact the profession and the curriculum.

Fitting Mobile Application Development into the Curriculum

Of course, the ultimate outcome of our efforts should directly impact curriculum development in the form of new course offerings. Since it is common to take a "wait-and-see" approach in response to disruptive technologies, many run the risk of "missing the boat." Certainly, web application development hasn't turned out to be a passing fad and has, in fact, grown and evolved substantially; so much so that many departments now use web development to fulfill their programming and application development component. We would argue that application development for the web is now a *sustaining technology*. In our experience, we find that many of our graduates who go on to work in application development do so either fully or partially in a web-oriented context. Thus, our prognostication for where mobile application development will lead us is this: incorporation or usurpation. The simple fact that we've classified mobile application development as a subclass of "application development" implies that our principle concerns will be. Logically, disruptive technologies will grow and challenge our existing framework of what application development is. Historically, we have benefitted from these disruptions as they have brought new students to our discipline.

6. CONCLUSION

In this paper, we have outlined the importance of identifying, researching, and developing a curricular response to potentially disruptive technologies. We, as IS educators, recognize that our discipline is about technology-wrought change. However, we are also subject to influences which encourage us to sustain the status quo of the dominant paradigm. Our constituents, stakeholders, and even peers, may not provide the clues and incentives to explore potentially disruptive technologies as their benefits are not yet clear. Often, when the benefits of and demand for a disruptive technology are clear, IS educators are left to play "catch-up" in order to remain relevant. In this paper we have explored a risk-taking R&D approach whereupon we have accepted the Bower and Christensen (1995) advice to isolate and nurture a faculty-student partnership for exploring and developing disruptive technologies for curriculum development. We have also shared our experiences in adopting a mobile applications development strategy for our curriculum and we have outlined our intentions for a recommended course in this area.

We believe that our implementation of the disruptive technology approach is both valid and effective. We found that the keys to the success of our strategy were: 1) creating a team of capable students headed by student-focused faculty; and, 2) selecting faculty who understand curriculum issues and the challenges of developing a new course. For us, this was an effective approach as it developed and tested ideas outside of the normal and traditional process of curriculum development. This research and development approach provided us with an opportunity to 1) explore the mobile-computing topics that we believed would be important; 2) identify the appropriate and needed resources; and, 3) structure a course which could be effectively delivered.

We attribute our disruptive-technologies approach as being a key success factor for understanding how a new technology innovation might incorporate into our curriculum. If we simply outsourced this experimentation, our department would miss a key opportunity to learn new technologies, to understand how these technologies fit, and the occasion to share these experience with our peer IS educators.

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Appendices and Annexures

Table 1 Worldwide Mobile Communications Device Open OS Sales to End Users by OS (Thousands of Units) (Cozza, 2011)

OS	2010	2011	2012	2015
Symbian (Nokia)	**111,577**	**89,930**	**32,666**	**661**
Market Share (%)	**37.6**	**19.2**	**5.2**	**0.1**
Android	**67,225**	**179,873**	**310,088**	**539,318**
Market Share (%)	**22.7**	**38.5**	**49.2**	**48.8**
Research In Motion	**47,452**	**62,600**	**79,335**	**122,864**
Market Share (%)	**16**	**13.4**	**12.6**	**11.1**
iOS	**46,598**	**90,560**	**118,848**	**189,924**
Market Share (%)	**15.7**	**19.4**	**18.9**	**17.2**
Microsoft	**12,378**	**26,346**	**68,156**	**215,998**
Market Share (%)	**4.2**	**5.6**	**10.8**	**19.5**
Other Operating Systems	**11,417.40**	**18,392.30**	**21,383.70**	**36,133.90**
Market Share (%)	**3.8**	**3.9**	**3.4**	**3.3**
Total Market	**296,647**	**467,701**	**630,476**	**1,104,898**

Table 2 Top Strategic Technologies for 2011 and Beyond

Strategic Technology	Relevance to Current Generation Mobile Computing
Cloud Computing	This is no longer simply a concern for Enterprise computing, as evidenced by services like *Dropbox*, *MediaFire*, and *Hulu*
Mobile and Tablet Applications	By and large, it is the application ecosystem available for these devices that constitutes the appeal of these mobile platforms
Social Networking	It can be argued that social networking has reinvigorated the web and computing as all aspects, both private and corporate, of life are assimilated into social networks. Mobile devices are a popular access node.
Video	The capture and sharing of this data is also key to the demand for mobile devices
Next-Generation Analytics	Mobile devices, particularly location information, represent important and valuable metrics
Social Analytics	Brining a social network aspect into CRM and market development into the analytics picture. This approach is evident in Social Network Analysis
Context-Aware Computing	It is quite clear that mobile computing is the primary enabler of this concept. The latest generation of mobile devices allows for a full who, what, where, and when picture.
Ubiquitous computing	This is also possible largely through the mobile device and its ability to allow a user to never lose contact of the computing environment.

Table 3 Comparing the features of the Android OS and Apple iOS

Key Criteria	Android	Apple iOS
Definition	Android is a software stack for mobile devices that includes an operating system, middleware and key applications.	*iOS* is Apple's mobile operating system, Originally developed for the iPhone
Ownership	Google open Source.	Apple.
Operating System	*Android* is Google developed open source operating system.	Apple *iOS* is a proprietary operating system.
Ease of use	*Android* does not have the same level of simplicity as *iOS*, we can detach our brain and still manage to work the interface.	*iOS* has turned out to be the easiest mobile operating system.
Hardware Vendors	Samsung, Motorola, LG, Sony Ericsson, Dell, Huawei, HTC etc.	Apple.
Compatible Devices	Compatible with any Devices.	iPad, iPod Touch, iPhones.
Application Store	*Android* Market 200,000.	Apple Store 300,000.
Google Talk	GTalk Specific Client and Video Supported.	Web browser chat.
Gmail Client	Gmail Specific eMail client.	Only Apple general eMail Client.
Web Browser	Open source Webkit layout engine coupled with Chrome's V8 JavaScript engine.	Safari.
Features	*Android*'s biggest advantage over *iOS*, *Android* has features like multitasking, widgets, tethering, Wi-Fi hotspot and Adobe Flash support etc.	*iOS* can have the ability to install applications, multitasking, copy-paste, folders, etc.
Messaging	SMS,MMS,eMail and C2DM.	SMS, MMS, eMail.
Performance	When running on faster hardware, *Android* is never perfectly smooth.	*iOS* ran perfectly even on the modest hardware also.
Connectivity	Wi-Fi, Bluetooth and NFC.	Wi-Fi, Bluetooth.
Adobe Flash	Supported	Not Supported
Email Attachments	Multiple files.	Single file only.
Supports	*Android* supports Hotspot via Wi-Fi.	Apple *iOS* supports internet Tethering via Bluetooth.
Social Network	*Android* supports Social Network contact Sync.	N/A

Table 4 Search Results for Mobile Application Development Courses

University	Course	Platforms
Harding University – Searcy, AK	COMP 475 – Mobile Computing	*Android*
Olin College – Needham, MA	Mobdev 2010 – Experimental Class	*iOS*
University of Notre Dame	CSE40333 - Mobile Application Development	*Android*, *iOS*
Strathmore University – Nairobi Kenya	MIT Africa Information Technology Initiative	*Android*, *iOS*

University of Southern California – Los Angeles, CA	ITP-499 – Mobile Application Development	*Android*
UC San Diego – San Diego, CA	ART40544 – Basics of Programming *Android*; ART40545 – Basics of Programming *iOS*	*Android*, *iOS*
Austin Peay State University – Clarksville, TN	CSCI3010 - Mobile Software Development	*iOS*
Carnegie Mellon University – Heinz College- Pittsburg, PA	95-740 Mobile Software Development	*Android*
Brandeis University – Waltham, MA	COSI153 – Mobile Application Development; COSI153 – Mobile Game Development	*Android*, *iOS*
Northeastern University – Boston, MA	CS4520 - Mobile Application Development	*Android*
MIT – Cambridge, MA	IAP2010 - Introduction to iPhone Application Development	*iOS*
Purdue University – West Lafayette, IN	CNIT355 - Software Development for Mobile Computers	Java (*Android*?)
Boston University – Boston, MA	MET CS 683 Mobile Application Development	*iOS*, *Android*
Dominican University – River Forest, IL	CPSC 446 MOBILE APPLICATIONS DEVELOPMENT	*iOS*, *Android*
DePaul University – Chicago, IL	CSC 471: Mobile Application Development	*iOS*, *Android*
San Diego State University – San Diego, CA	CS 696 Mobile Application Development	*iOS*
Texas A&M University-Corpus Christi	COSC 4590 Special Topics: Mobile Programming	*Android*
Florida State University - Tallahassee, FL	CIS4930-01: Mobile Programming	*Android*
The University of Utah – Salt Lake City, UT	CS4962 - Mobile Application Programming: *iOS*	*iOS*
California State University – Los Angeles – Los Angeles, CA	CIS 454: Mobile Application Development	*iOS*, *Android*
Stony Brook University, Stony Brook, NY	Special Topics in Computer Science - Developing Mobile Applications	*iOS*, *Android*

Table 5 Outline for a Course in Mobile Application Development

Week	Topic/Theme	Concerns, Skills, and Techniques
1	Introduction to mobile computing	Basics of technologies which enable mobile computing
2	*iOS*	Illustrate tools, techniques, background, requirements, etc. Basic aspects of Objective-C and accessing the *iOS* SDK
3	*Android*	Illustrate tools, techniques, background, requirements, etc. Basic aspects of Java and accessing the *Android* SDK
4	Conceptualize a Project; Seek stakeholders	Building a context-driven and purposeful app provides motivation. Students select *Android* or

		iOS
5	Project concept evaluation and selection	Given the nature of the platforms, what is feasible?
6	Design	UI, User Experience, Event model, Application model. Study of a popular app, such as "Angry Birds." (Mauro, 2011)
7	Design	UI Widgets, Themes, and customiziations; 2D graphics; Saving data and state (CoreData/Data Storage)
8	Design Review	Mobile HCI guidelines and principles; modes of user interaction (gestures, etc.); Design guidlines
9	Prototype/Mockup	App deployment, testing, and provisioning
10	Design Revision	SDK Services: Emulator, Background/multi-processes; threads
11	Design Revision	SDK Services: Security, permissions, profiles, Location, Networking, Web
12	Implementation	Frameworks, plug-ins, 3rd party enhancements, App store deployment
13	Testing	Debugging and testing tools
14	Private Demo and Testing	Initial end-user "beta" testing
15	Public Demo / Contest	Public demonstration, feedback, and voting on "best app" for prizes

Improving the LMS Selection Process: Instructor Concerns, Usage and Perceived Value of Online Course Delivery Tools

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Abstract

Selecting or upgrading a university's Learning Management System involves complex decisions concerning curriculum delivery, students, financial commitments, technology and support services, and faculty. The purpose of this paper is to study faculty concerns, usage and perceptions of the instructional value of online course management tools. During a LMS selection process, a faculty survey was prepared and disseminated to all full-time, part-time and adjunct faculty of a university. This survey was designed and customized for a) faculty who have never taught an online course, b) faculty who were novice in using online courses, and c) faculty who had some expertise in designing online courses. Data concerning faculty discipline, level of teaching experience, academic rank, and preferences for learning management systems was also captured. An analysis of data collected, preliminary conclusions, and recommendations are presented.

Keywords: Blackboard, Learning Management Systems, Selection of a LMS, Online Course Delivery, Course Management Tools.

1. INTRODUCTION

During the last decade the use of online learning management systems has increased in terms of academic instructional delivery, diversity of disciplines, education levels, technology, availability of online teaching and course management tools. Selecting or upgrading a university's Learning Management System involves complex decisions concerning curriculum delivery (structure and content considerations), students delivery, mode, social networking), financial commitments (volume, add-ons, cost sharing), technology (in house, cloud, open source, RIE), support services, and faculty.

JoomlaLMS (2010) provides a detailed outline to compare learning management system tools and system features. The JoomlaLMS (2010) pedagogical comparison outline includes general categories such as general system features, user management, general course features, course materials, quizzes, communication tools, reporting and eCommerice. More technical system comparisons included fee type, source code availability, licensing model, installation type, business model, eLearning compliance standards, programming language, platform, content creation alternatives, and system integration. Juliaitani's Blog (2010) presented a detailed comparison of Angel 7.3, BlackBoard Learn 9.x, and Moodle 1.9. This valuation used the following criteria browser support, usabiltity, mobile support, communication tools, distingushing features, learning depositories, content organization and navigation, Web 2.0 (Ajax, drag-and-drop, etc.), reports, services, support and integration features.

While evaluation criteria such as cited by Joomla LMS (2010) and Juliaitani's Blog (2010) does have merit, both ignore one important factor: the faculty. Many institutions involve faculty with the LMS selection process. LMS vendors present the newest features of their product lines. In 2011, social networking tools, Virtual Learning Environments (VLE), and mobile access were the "hottest items." In his book "The Theory and Practice of Online Learning," Anderson (2008) presents numerous online instructional design strategies, or "learning paths," that takes advantage of asynchronous and synchronous communication, dynamic and updated content, virtual classrooms, adaptive content releases, chat, blogs, and other Web 2.0 tools.

The virtues of online instruction and the newest LMS tools may be just "dandy," but if the faculty do not use these online tools – should we care? Guidry & Lorenz (2010) found that: 1) Faculty in all disciplines rarely use blogs, collaborative editing tools, and games and simulations, and 2) Students and faculty have different expectations and use technologies in different contexts, which can create tension and misunderstandings between the two groups. The virtues of online instruction and the newest LMS tools may be just "dandy," but if the faculty do not use these online tools – should we care? To what degree should faculty 's online pedagogical, ownership, remuneration concerns be considered during the LMS selection process? Perhaps the LMS selection process should consider faculty concerns, use and perceived value of LMS systems and tools before selecting or upgrading an existing LMS system.

2. BACKGROUND AND METHODOLOGY

This study involves a university with an enrollment of approximately 5,500 undergraduate, graduate and doctoral students. A selection of undergraduate and graduate programs includes business, English, information systems, education, nursing, engineering, and media arts. Doctoral programs are offered in communication and information systems, education and nursing. An online course delivery system was introduced into the academic curriculum approximately thirteen years before this study was conducted. The eCollege Learning Management System was used for the first eight years, and Blackboard was used for the later five years.

Separate faculty and administrative committees were formed to study the selection of the next generation of LMS platform. The members of the faculty committee were representative of most academic disciplines and had varied backgrounds in the use of learning management systems. The role of the faculty committee was first to consider the advantages and shortcomings of the existing learning management system. Then a review was conducted to compare the features and online tools of four LMS platforms: Blackboard, DesireToLearn, eCollege, and Edvance360.

During a six-month review, the members of the faculty committee participated in vendor presentations with LMS administrative committee members. Hands-on trials were available for all four platforms. The faculty LMS selection committee ranked each of the four learning management systems, and the results were submitted to the administration. A technical administrative committee was responsible compared each technological infrastructure with applicable costs and benefits.

Faculty participants in the LMS selection process were impressed with the evolution of learning management system online technologies and pedagogical tools, e.g., collaboration, social networking technologies, rich internet environment, virtual classrooms, etc. However, some members of the faculty committee were concerned with the limited focus of the faculty LMS selection review. There was also a concern that the administrative committee could not adequately compare pedagogical benefits of various LMS tools to the cost of the platform. It was decided that a more comprehensive study should be conducted.

A faculty survey was prepared using the Vovici web based survey tool. This survey instrument was designed to collect data concerning faculty's use and perception of the pedagogical value of various online instructional content, course management, collaboration, and assessment tools. The survey was targeted to faculty members across different academic disciplines, academic teaching levels, and experience levels in on-line course development. The presentation of the survey was also controlled for those faculty members who had no online course development/delivery experience.

The survey design included sections to capture data concerning demographics, technology experience, online course development experience, pedagogical concerns of online instructional delivery, previous experience and preferences of specific learning management systems. The survey instrument was pilot-tested and reviewed by several online course development professionals.

The primary research questions were faculty concerns of online course management systems, faculty usage and perceived value of on-line course tools. All part-time, adjunct, and full-time faculty members were sent an email that included an introduction to the research project and a link to the survey on the Vovici website. The survey response data was captured and stored in the Vovici site for later analysis.

3. FINDINGS, ANALYSIS, AND DISCUSSION

Teaching Experience and Academic Rank

The participants consisted of 116 faculty members. The response rate was approximately 44% of the faculty. 70% of the respondents reported that have either used or developed online courses; 30% reported no use. For those faculty members who did not use online course delivery, 40% of the faculty members had over 20 years of teaching experience, and 54% had an academic rank of associate or full professor. See Tables 1 and 2.

Academic Discipline and Use of Online Delivery

Table 3 summarizes the general online course use and academic discipline. Type of use was summarized by the following categories: a) no use of online course, b) use of online courses provided by others, c) modification of online courses provided by others, d) basic, and e) advanced online course development. A few respondents selected multiple categories. 30% of the respondents did not use online delivery methods. Business, English, Math, Science and Engineering faculty accounted for 76% of the non-users. Reasons for non-use of online tools were not studied. 43% of all faculty users considered themselves basic online course developers, and 21% considered themselves as advanced online course developers. The discipline labeled “Other Disciplines” included: Library, Organizational Studies, Arts, and Leadership Studies.

Concerns for Online Course Delivery

Faculty concerns for online delivery systems may be a consideration for not using online courses. These online course delivery concerns may indicate why disciplines vary in the use of online courses. Respondents could have selected multiple concerns. Table 4 summarizes the differences between online course delivery concerns for users and non-users. Tables 5 and 6 summarize the differences between online course delivery concerns by discipline. The highest three concerns for all respondents and for the majority of disciplines were 1) Academic Quality Control, 2) Instructor Feedback and Interaction, and 3) Concerns of Employer and Other Perceptions.

English, Mathematics and Science, and Nursing had additional concerns for Inadequate Financial Incentives and Instructional Support. CS/IS, Mathematics, Science and Engineering respondents had additional concerns for appropriate course content and structure. Other concerns directly entered by the responders included technical problems with course delivery

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platform, copyright and ownership, grading of essays, and lack of instructor evaluation.

Previous Use and Preferences of Learning Management Systems

65% of the faculty had experience using the Blackboard learning management system. This previous experience may explain why 68% of the faculty preferred Blackboard. eCollege had been previously used by 36% of the faculty, but was only preferred by 15% of the respondents. See Table 7.

Use and Perceived Value of Online Tools

The survey organized online tool questions into three groups: a) Instruction Content Tools, b) Assessment Tools, and c) Course Management Tools. Though some online tools may be classified in more than one group, an individual online tool was only assigned to only one group. Participants with online course experience were asked to report their use of online course tools using one of five categories: "Never Used" was valued as 0, "1% -25%" as 1, "26%-60%" as 2, "61%-99%" as 3 and "Always" as 4.

Participants with online course experience were asked to report their perceived value of online course tools using one of five categories: "Unsure" was valued as 0, "No Current or Future Value" as 1, "Some Current Value" as 2, "Significant Current Value" as 3 and "Possible Future Value" as 4. These categories were not designed to collect ordinal data. However, these provide a continuum of values. For example, a faculty member may not have used a specific online tool, but considered an online tool to have some future pedagogical value. On the other hand, a faculty member, who had not used a specific online tool, may be unsure of its pedagogical value because of lack of use.

Table 8 summarized data for Online Instruction Content Tools. The mean was used to rank the most frequently and least frequently used online instruction content tools. The five most frequently used online instruction content tools were 1) online course syllabus and course objectives, 2) downloads of assignments, projects, and other instructional documents, 3) online course calendars, 4) URL links to content to support course, and 5) PowerPoint presentations developed by the instructor. The four least frequently used online instruction content tools were 1) import course content, quizzes, tests, packages or cartridges from publishers or other courses, 2) graphics, images, audio or video developed by the instructor, 3) PowerPoint presentations developed by others, and 4) graphics, etc., developed by others.

Table 9 summarized data for usage of Online Assessment Tools. The five most frequently used assessment tools were 1) online grade book, 2) online assignment submission, 3) discussion boards, 4) online quizzes or tests, and 5) online collaboration. The five least frequently used instruction content tools were 1) blogs or wikis, 2) virtual classroom, 3) student journals, 4) online groups, and 5) Turnitin or other anti-plagiarism tools. Data concerning the perceived value of online assessment tools is presented in Table 11. This data re-enforces the general pattern of use, with some differences. Online discussion boards and assignment submission had significant current perceived value. Anti-plagiarism tools, e.g., Turnitin, Wikis and Blogs were perceived to have future value. Virtual classroom, recorded video lecture, and online group tools were rarely used by the faculty, and the faculty perceived little value of these tools.

Table 10 summarized data for use of Online Course Management Tools. The five most frequently used online course management tools were 1) addition or deletion students/groups, 2) customized online grade books, 3) organization of course content by areas or folders, 4) copying or moving course content within a course section, and 5) copying or moving course content between course sections. The five least frequently used online course management tools were 1) student assessment passwords or other enhanced online assessment security, 2) online class dashboards for a course section, 3) HTML editing, 4) class performance reports, and 5) adaptive release of course content. While data concerning the perceived value of course management tools presented in Table 12 reinforces the general patterns of use, it is noteworthy to address the perceived value of exporting, importing and archiving course content.

4. CONCLUSIONS

Recommendations And Questions

After ten years' experience in online education initiatives, the results of this faculty survey and study indicated that 1) 30% faculty do not use online delivery methods, 2) the majority of faculty using online course delivery systems used or valued very few of the existing online tools, and 3) only 21% of the faculty would categorize themselves as an advanced user. There is more to online education than posting readings, downloading and uploading assignments. For example, the data in Table 6 indicates a high concern for lack of Academic Quality Control of online course delivery across disciplines. However, Table 8 indicates that most faculty members rarely use the existing online and offline quality control tools available, e.g., Turnitin, randomized blocks, assessment passwords, or supplemental on-ground tests.

The data clearly indicated that faculty do not currently use or value most existing online tools. Now these faculty members are asked to render their opinions on the selection of a future Learning Management System, which is to be confirmed by administrators who may even be less knowable about a pedagogically sound online system.

Selecting and delivering online learning systems involves the consideration of many components: a) curriculum content and structure, b) quality control, c) faculty commitment, d) faculty support, e) student target market, f) pedagogical and technological capabilities of the learning management system, and g) incremental revenues and costs. A learning management system selection process that focuses on new online tools, incremental revenues and costs is comparable to purchasing a new car only on the basis of miles-per-gallon. This approach does little to focus on the quality of "student delivered" online education.

All become more resistant to change as we mature and age. Tables 1 and 2 provide data to support the lack of involvement by senior faculty in online course delivery. One solution has been to staff less experienced adjunct, part-time and younger faculty. But, even these faculty do not use most of the available online tools.

Based on the results of this study, the following three recommendations are made. First, supporting and obtaining faculty commitment is as, or more, important than the selection of learning management system used. Faculty are the curriculum and content experts. The value of large-group support classes to support faculty for online development is questionable. Faculty support varies by course content, structure, and learning objectives. Face-to-face individualized instruction and support by an experienced, online support staff is needed. The data indicates that the greater number of years of teaching experience, the less likely a faculty member will use online course delivery and online course tools.

When was the last time an experienced faculty member attended a large-group lecture or hands-on instruction that had no application to his or her discipline? It is important to customize the support to the needs of the individual faculty member, delivered in their environment, focused of his or her individual online courses. This type of customized support takes resources that are often ignored during LMS selection processes.

Sharing online resources without violating expectations of ownership of course materials may help faculty members convert their on-ground course to an online format. And, online courses and course materials should be periodically reviewed by faculty peers to provide faculty support, quality and consistency.

Secondly, an online course delivery system needs to address faculty concerns: a) academic quality control, b) perceptions of external parities concerning online course curriculums, and c) interactions between faculty and students. Each of these challenges may be address by appropriate online curriculum design and marketing to external parties. Again these types of resources are often ignored during LMS selection processes.

Thirdly, faculty surveys similar to the one analyzed in this study are necessary to make informed decisions concerning the selection of alternative learning managements systems. After a ten-year commitment to online education, the data presented in this study indicated that few faculty had used few online tools. There are many questions that need to be answered.

"How will a new online or changed learning management system help if faculty do not use what they already have available?"

Will the selection of a new and different learning management system be the silver bullet to motivate faculty to create better online curriculums?

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Appendix

Table 1. Use/Non-Use of Online Courses by Years of Teaching Experience (n=116)		
Years of Teaching Experience	Use/Develop (n/ col %)	Do Not Use (n / col %)
Less than 4 years	13 / 16%	7 / 20%
4 - 9 years	19 / 24%	5 / 14%
10 - 19 years	25 / 31%	9 / 26%
20 – 29	14 / 17%	4 / 11%
Over 30 Years	10 / 12%	10 / 29%
Totals N/col %/overall%	81 / 100% / 70%	35/ 100% / 30%

Table 2 Use/Non-Use of Online Courses by Academic Rank (n=116)		
Years of Teaching Experience	Use/Develop (n/ col %)	Do Not Use (n / c ol%)
Adjunct or Part-time	33 / 41%	12 / 34%
Lecturer	7 / 9%	0 / 0%
Assistant Professor	11 / 14%	4 / 11%
Associate Professor	24 / 30%	11 / 31%
Full Professor	6 / 7%	8 / 23%

Table 3. Academic Discipline and Use of Online Delivery (n=81) (row % not mutually exclusive)					
	No Use	Use Other's Courses	Modify Other's Courses	Basic Development	Advanced Development
Business (n=20)	40%	10%	5%	40%	15%
CS/IS (n=18)	22%	5.6%	6%	50%	6%
English (n=36)	36%	11%	6%	44%	17%
Education (n=11)	9%	9%	27%	45%	36%
Social Science (n=12)	25%	8%	8%	58%	25%
Mathematics/ Science (n=10)	50%	20%	0%	20%	10%
Engineering (n=4)	50%	25%	0%	25%	0%
Nursing/ Medical(n=7)	0%	28%	0%	57%	14%
Other(n=7)	14%	28%	28%	57%	28%
Total %	30%	12%	7%	43%	21%

Table 4
Use/Non-Use Concerns of Online Course Delivery (n=81) (col % not mutually exclusive)

Concerns	Use/Develop (n/ col %)	Do Not Use(n / col %)
Inadequate Instructional Support	21 / 26%	9 / 26%
Inadequate Financial Incentives	23 / 29%	2 /6%
Hybrid or Online Course Not Scheduled	8 / 10%	4 / 11%
Inappropriate Course Content	22 / 27%	10 / 29%
Inappropriate Course Structure	17 /21%	9 / 26%
Development Time Exceeds Instructional Value	19 /23%	4 / 11%
Academic Quality Control	41 / 51%	13 / 37%
Lack of Instructor Feedback and Interaction	40 / 49%	11 / 31%
Employer and Others Perceptions	27 / 33%	8 /23%

Table 5
Concerns of Online Course Delivery by Academic Discipline (n=81)

	Instructional Support	Financial Incentives	Inappropriate Course Content	Inappropriate Course Structure
Business (n=20)	15%	15%	20%	10%
CS/IS (n=18)	22%	17%	34%	39%
English (n=36)	42%	33%	31%	22%
Education (n=11)	27%	9%	0%	9%
Social Science (n=12)	0%	8%	8%	17%
Math/Science (n=10)	50%	0%	40%	40%
Engineering (n=4)	25%	0%	25%	50%
Nursing/ Medical (n=7)	29%	57%	14%	14%
Other (n=7)	27%	43%	28%	22%
Total %	26%	22%	28%	22%

Table 6. Concerns of Online Course Delivery by Academic Discipline (n=81)

	Development Time Exceeds Instructional Value	Academic Quality Control	Feedback and Interaction	Employer And Other Perceptions
Business (n=20)	5%	50%	30%	30%
CS/IS (n=18)	11%	29%	50%	57%
English (n=36)	31%	47%	56%	33%
Education (n=11)	9%	36%	46%	18%
Social Science (n=12)	17%	25%	17%	8%
Math/Science (n=10)	10%	70%	40%	40%
Engineering (n=4)	25%	75%	25%	25%
Nursing/ Medical(n=7)	43%	43%	71%	14%
Other (n=7)	43%	57%	43%	29%
Total %	20%	47%	44%	30%

Table 7. Preferences and Previous Use of Learning Management Systems (n=81) (col %)		
	Preferred LMS	Previously Used
Blackboard	68%	65%
eCollege	15%	36%
Other	8%	4%
Moodle	3%	6%
Desire to Learn	1%	3%
Sakai OLE	1%	2%

Table 8. Academic Quality Control Concerns and Tool Usage and Perceived Value (row %)					
	Never used	1-25%	26-60%	61%-99%	Always
Turnitin/Anti-Plagiarism Tools	51%	11%	14%	8%	16%
Used Randomized Question Blocks	62%	5%	9%	7%	17%
Used assessment password or other security	74%	5%	12%	2%	6%
Required on-ground assessment to accompany online course	74%	10%	11%	0%	5%
	Unsure	No current of Future Value	Some Current Value	Significant Current Value	Possible Future Value
Turnitin/Anti-Plagiarism Tools	22%	6%	13%	35%	24%
Used randomized question blocks	20%	7%	18%	35%	20%
Used assessment password or other security	33%	12%	16%	12%	28%
Required on-ground assessment to accompany online course	30%	16%	11%	7%	33%

Table 9
Reported Use of Online Instructional Content Tools (n=81) (% of row)

Instruction Content Tool	Never Used	1% - 25%	26% - 60%	61% - 99%	Always	Mean	SD
Availability of online course syllabus, course objectives, rules, and other course administration information.	4%	4%	7%	7%	78%	3.52	1.541
Online course calendar or schedule of assignments, projects, quizzes, tests and other schedule information.	13%	11%	12%	13%	51%	2.78	1.64
Downloads of assignments, projects, and other instructional documents, workbooks or databases.	8%	13%	9%	9%	60%	3.00	1.58
Online availability of PowerPoint Presentations developed by others.	45%	20%	7%	4%	24%	1.71	16.1
Online availability of PowerPoint Presentations modified or developed by the instructor.	22%	12%	15%	9%	42%	2.36	1.68
Online availability of graphic, image, audio or video developed by others.	29%	24%	11%	9%	28%	1.82	1.59
Online availability of graphic, image, audio or video modified or developed by the instructor.	46%	15%	10%	15%	15%	1.36	1.48
Use of URL or other links to content to support course.	15%	9%	18%	13%	45%	2.64	1.59
Import course content, quizzes, tests, packages or cartridges from publishers or other courses.	52%	12%	11%	13%	12%	1.21	1.43

Table 10
Reported Use of Online Assessment Tools (n=81) (% of row)

Assessment Tool	Never Used	1%-25%	26%-60%	61% - 99%	Always	Mean	Standard Deviation
Use of online quizzes or tests.	36%	12%	9%	12%	32%	1.94	1.69
Use of online assignment submission.	17%	15%	5%	15%	49%	2.61	1.69
Use of Turnitin or other anti-plagiarism tools.	51%	11%	15%	80%	16%	1.26	1.46
Use of online grade book and online grading.	18%	7%	8%	8%	60%	2.82	1.74
Use of online groups.	57%	25%	9%	9%	9%	1.09	1.27
Use of online student journals.	63%	13%	8%	4%	12%	.88	1.30
Use of online collaboration.	45%	21%	11%	4%	20%	1.32	1.48
Use of online discussion boards.	24%	13%	12%	8%	43%	2.34	1.73
Use of a wiki.	74%	15%	8%	3%	1%	.43	.796
Use of a blog.	80%	13%	1%	1%	4%	.36	.859
Use of a real time virtual classroom.	75%	16%	4%	3%	3%	.42	.853
Use of captured (recorded) instructor lectures.	71%	11%	8%	5%	4%	.62	1.03

Table 11
Perceived Value of Online Assessment Tools (n=81) (% of row)

Assessment Tool	Unsure	No Current or Future Value	Some Current Value	Significant Current Value	Possible Future Value	Mean
Online quizzes or tests.	11%	13%	17%	46%	13%	2.38
Online assignment submission.	7%	1%	18%	53%	21%	2.80
Turnitin or other anti-plagiarism tools.	22%	7%	13%	35%	24%	2.32
Online grade book and grading.	10%	3%	12%	60%	16%	2.67
Online groups.	16%	13%	32%	25%	15%	2.29
Online student journals.	31%	16%	16%	20%	18%	1.77
Online collaboration.	25%	8%	25%	26	17%	2.02
Online discussion boards.	15%	5%	20%	46%	15%	2.40
Wiki.	36%	8%	20%	10%	26%	1.81
Blog.	36%	9%	24%	7%	26%	1.78
Real time virtual classroom.	29%	15%	16%	11%	29%	1.96
Captured (recorded) instructor lectures.	23%	9%	21%	18%	25%	2.06

Table 12
Reported Use of Online Course Management Tools (n=81) (% of row)

Course Management Tool	Never Used	1%-25%	26%-60%	61% - 99%	Always	Mean	Standard Deviation
Organization of course content by areas or folders.	11%	8%	8%	17%	56%	2.58	1.63
Copying or moving course content or folders within a course section.	25%	4%	20%	9%	41%	2.37	1.72
Copy or moving course content or folders between course sections.	31%	8%	11%	12%	39%	2.24	1.75
Use of online early warning systems course section.	72%	12%	7%	4%	5%	.59	1.06
Use of adaptive release of course content or assessment tools.	55%	13%	12%	9%	10%	1.08	1.36
Use of online class performance reports for a course section.	53%	8%	12%	11%	15%	1.26	1.48
Use of online class dashboards for a course section.	61%	15%	10%	8%	6%	.85	1.20
Edit, manage or customize online grade books for a course section.	24%	4%	8%	11%	53%	2.63	1.78
Add or delete students or groups within a course section.	19%	11%	7%	8%	55%	2.68	1.78
Export, import or archive course content or assessment data.	26%	12%	14%	7%	42%	2.27	1.72
Create or edit online assessment questions or surveys using text.	45%	7%	14%	10%	25%	1.61	1.63
Create or edit any online course content using HTML.	60%	11%	10%	10%	10%	.97	1.31
Use of randomized question blocks in an online assessment.	56%	6%	7%	10%	22%	1.35	1.64
Use of student assessment passwords or other enhanced online assessment security.	72%	7%	10%	5%	7%	.73	1.23
Required on-ground assessment or student requirement for an online course.	72%	8%	10%	4%	7%	.67	1.22

Table 13.
Perceived Value of Online Course Management Tools (n=81) (% of row)

	Un-sure	No Current or Future Value	Some Current Value	Significant Current Value	Possible Future Value	Mean
Organization of course content by areas or folders.	8%	1%	14%	63%	14%	2.72
Copy or moving course content or folders within a course section.	10%	0%	18%	56%	16%	2.69
Copy or moving course content or folders between course sections.	12%	1%	15%	52%	19%	2.64
Use of online early warning systems course section.	36%	12%	19%	11%	22%	1.71
Use of adaptive release of course content or assessment	34%	80%	22%	19%	19%	1.86
Use of online class performance reports for a course section.	26%	10%	19%	23%	22%	2.05
Use of online class dashboards for a course section.	38%	8%	19%	16%	17%	1.67
Edit/manage/customize online grade books for a course section.	12%	3%	17%	56%	12%	2.52
Add or delete students or groups within a course section.	15%	1%	22%	46%	5.3%	2.44
Export, import or archive course content or assessment data.	13%	6%	20%	45%	17%	2.47
Create or edit online assessment questions or surveys using text.	17%	6%	27%	348%	17%	2.28
Create or edit any online course content using HTML.	33%	10%	17%	20%	20%	1.84
Use of randomized question blocks in an online assessment.	21%	11%	15%	35%	18%	2.18
Use of student assessment pwd or other enhanced online assessment security.	30%	13%	16%	13%	28%	1.97
Required on-ground assessment or student requirement for an online course.	31%	20%	11%	11%	27%	1.83