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- Times New Roman, 12 font-size text within article
- Bold and center primary headings, with major words capitalized
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- No footnotes or endnotes
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Include the References page (Works Cited only) at the end of the manuscript, followed by any appendix information, if necessary.

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Communication Effectiveness: The Effect of Technology on Message Form

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Abstract

Mobile devices are ubiquitous in the communications infrastructure of many individuals and organizations. However, little is known about how these devices impact the form of the written communication that they are used to create. The researchers investigated the role technology plays in this communication by leveraging the theories of planned behavior and task technology fit to create a theoretical model to explain the impact that mobile keyboards have on written communication versus the communications created with standard-size keyboards. A study was conducted based on this model, and the results showed that the technology used to create the message did have a significant impact on the form the message takes. Messages created with mobile devices had significantly poorer form with respect to the formality and organization of the message. Implications of the study as well as recommendations to academia and practice are discussed.

Keywords: Mobile Devices, Business Communication, Message Form

Introduction

As computing platforms are becoming more mobile, many of the message mediums that were traditionally created using personal computers can now be created on mobile devices. For example, only a few years ago, the only messaging format available to a mobile device was a 160-character SMS text message. Today's mobile devices can send messages in many of the formats of the traditional platforms including email, instant messaging, and video messaging.

Gartner, Inc., (2010) one of the leading information technology research and advisory group in the world, reported that the worldwide sales of mobile devices totaled over 325 million units in the second quarter of 2010. This volume was an increase of over 13 percent from the second quarter in 2009. Gartner projects that new users are facing a decreased barrier to entry as communication service providers are making cost of ownership less through affordable tiered data plans. *The ECAR Study of Undergraduate Students and Information Technology, 2010* (2010) reports that about two-thirds of respondents own an internet-capable mobile device. The increasing influence of mobile device use on communication within the corporate environment challenges educators to develop strategies for teaching the strategic integration and use of such emerging technologies in today's workplace (Policies Commission, 2003).

How the use of mobile devices impacts communication effectiveness must be evaluated. Any basic model of the communication process confirms that a message "sent" does not equate a message "received" (Graham, 2004); many factors affect the process, including the message type, content, style, and format in addition to the channel of communication (Flatley & Rentz, 2010).

When sending messages via a mobile device, a major factor impacting the communication effectiveness is the correctness of the message. Messages must be constructed correctly as well as written concisely and with clarity and use appropriate etiquette (Agnew & Hill, 2009; Flatley & Rentz, 2010); the message represents the organization. "Bad spelling, illogical punctuation, awkward wording and other flaws stand out like sore thumbs. Such errors reflect on the writer. And they can reflect on the credibility of the message" (Flatley & Rentz, 2010, p. 31). Likewise, appropriate formality must be used in a business context (Flatley & Rentz, 2010; Graham, 2004). As organizations further integrate mobile devices into the system of work design, the familiarity with mobile device use may lead to a disregard for such basic communication rules of practice. The ready availability of communication devices can also promote lack of planning, because users can send "last-minute" messages to meet deadlines or requests (Graham, 2004).

In addition, many mobile devices do not have a full QWERTY-style keyboard, instead opting for a telephone-style input device. If the device does have a full keyboard, it is much smaller than the keyboard of personal computers or even laptops.

These personal, cultural, and technical circumstances lead to the following research question: Does the technology used to communicate have an effect on the form of the message communicated? In this study message form is defined by Te'eni (2001) as the "characteristics of the form of the information communicated: size, distribution, organization, and formality of the message" (p. 257). To attempt to answer this research question, the researchers developed a conceptual model founded on the theory of planned behavior and the theory of task technology fit.

Theoretical Background

Three theories guided the development of the theoretical model in this paper. The first theory guided how the message was modeled, and the remaining two theories guided the model relating to how technology can affect the form of the message.

Cognitive-Affective Theory of Communication

Te'eni (2001) has noted that information technology has an impact on not only the methods of communication but also the content of the message. To explain this impact, he created a model with the goal of explaining how communicators derive the form and medium of their message from the goals of the communication and the situational context. Te'eni's (2001) model captures the cognitive and affective aspects of communication by breaking the communication process into the inputs of the communication, the process of communication, and the impact of the communication on the intended recipients. The model is thought to have design implications for technologies intended to support communication; however, the technology used to create the message is not explicitly addressed in the model.

Theory of Planned Behavior

The theory of planned behavior basically states that behavior is driven by behavioral intentions. These behavioral intentions that drive actual behavior are a product of a person's attitude toward the behavior to be engaged in, the norms that surround the behavior, and the ease with which the person can perform the behavior (Ajzen, 1991). The theory suggests that when using information technology to create a message, the ease of using the technology to create the message may have an impact on the form of the message. For example, if a technology makes it easy to engage in the behavior of creating a message that is well organized and formal, then a person will be more likely to create such a message.

Theory of Task Technology Fit

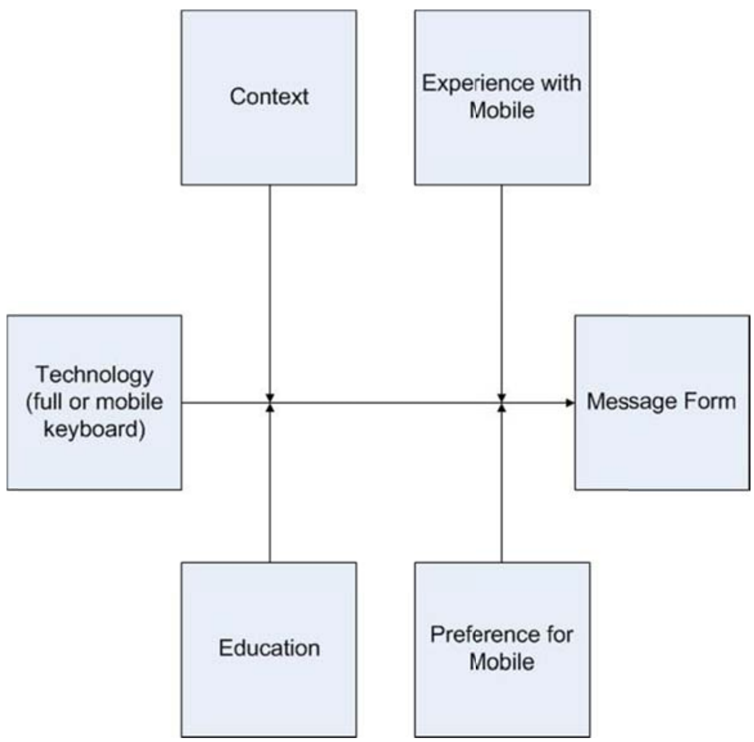
The major premise of the theory of task technology fit is that the user will be more likely to perform better on a task if the capabilities of the technology used to perform the task fit well with the task that the technology is used to perform (Goodhue & Thompson, 1995). The implication of this theory on this study is that it suggests that the technology a person uses to create a message may have an impact on his or her performance in creating that message. So if the technology that a person uses to create a message is not a good fit for the task of creating a message of a certain form, the impact of the message may be diminished since message form plays a part in determining the impact of communication (Te'eni, 2001).

Having identified the lack of specific mention of how technology affects message form in the Te'eni theory and having presented two theories that relate to that impact, the researchers developed the following conceptual model.

Conceptual Model

The theory of planned behavior and the theory of task technology fit guided the creation of the conceptual model presented in Figure 1. As illustrated in the model, technology characteristics directly affect the form of the message that is being created using that technology. The definition of message form from Te'eni (2001) discussed earlier is here leveraged. Of the factors that constitute message form, the researchers measured the formality and organization of the message, while controlling for the distribution and size.

Figure 1. Conceptual Model



The following hypothesis was designed to test the model:

- H1 – The technology used to create the message will significantly impact the form of the message.

In addition, variables have been added to the model that are believed to confound the hypothesized effects that technology may have on message form. Four effects were chosen to classify as covariates: a user's preference for mobile devices over traditional ones, a user's experience using mobile devices, the education a person has relating to proper message form, and the context of the message.

The variable of preference for mobile devices was included based on guidance from the theory of planned behavior. It is assumed that if one prefers a mobile device over a standard full-size keyboard device, then that preference may influence the attitude of a person using the device to create the message. That, in turn, can affect the form of the message that is used. Experience with mobile devices was included in the model based on the theory of task technology fit. If a person has experience using a type of device (mobile or full-size keyboard) to create messages, then it can be reasonably assumed that the person deems that device appropriate to the task. This variable differs from the variable of preference for mobile devices in that one may deem a given technology appropriate to perform a task, but may not have positive behavioral intentions about using the device. Given the sample population, it can be assumed that all study participants have similar experience using full-size QWERTY keyboards to create messages. The same assumption cannot be made about experience using mobile devices to create messages, because many people still do not have devices with the mobile QWERTY keyboard. Education was chosen as a covariate because it is assumed that people who have received formal education in proper message form will create better formed messages than those who do not have such formal education. The context of the message was chosen as a covariate because it is assumed that the form of a message will vary based on whether the message is for a friend or for a business contact.

An example may better serve to explain the model. Imagine that an employee is away from the office, and a client has sent that employee a very important email. Business etiquette would dictate that the form of the reply message would be formal, well organized, and businesslike. However, that form may be difficult to accomplish if using a mobile device that does not have a full QWERTY keyboard or if the device does not have a spell check or sufficient space on the viewing screen to examine the message before sending. If the employee has just begun using the mobile device, he or she may be less skilled in text creation and editing on it. Likewise, if the employee does not prefer using the device, the behavioral intentions required to perform the message creation task with ease may be lacking.

Methodology

The study was designed to determine how message form is impacted by communication technology, as moderated by user preference for and experience with the technology, by user education, and by communication context. In order to validate the proposed model, the researchers designed an experiment in which participants created messages related to a situation provided by the researchers using different technological devices.

Students in an AACSB-accredited college of business at a Carnegie Doctoral 2 university participated in the study. Data collection consisted of two steps. First, participants completed a questionnaire designed to determine preference for and frequency of use of various communication devices (mobile keyboard device versus full-size keyboard device) to send messages. Participants were also requested to indicate if they had previously completed a business communication course. The second step of data collection consisted of students being randomly selected to respond to either a personal or business situation using either a full-keyboard computer or a mobile device with a mobile QWERTY keyboard. Spell checking and grammar checking were disabled on both types of devices in order not to skew the results.

The messages that were collected were assessed regarding formality and organization, which represented the message form. As stated earlier, the other elements that constitute form, size, and distribution were controlled for. Size was controlled for by providing each participant specific elements that the message should address. The distribution of the message was controlled for by directing the participants to address the message to a specific individual. Each element of the remaining two aspects of form was broken into specific elements and assigned a score based on a predetermined rubric as shown in Table 1.

Table 1. Elements of Formality and Organization

Formality Elements	Organization Elements
Spelling Errors	Sentence Structure Errors
Punctuation/Capitalization Errors	Salutation Errors
Grammar Errors	Closing Errors
	Emoticon Usage

Each message was scored by multiple reviewers; reviewers met to resolve any differences in scoring. Scores and responses from the questionnaire were analyzed using SPSS for Windows. Since the experiment looked at the difference between two groups with respect to multiple dependent variables and corrected for covariates, MANCOVA was chosen as the appropriate methodology by which to analyze the data.

Survey Population

A total of 84 students participated in the study, resulting in 67 usable survey/message pairings. The survey population consisted of more males (61.1%) than females (38.9%). The majority of the participants reported to be between the ages of 21-25 (47.6%), followed by those who reported to be between the ages of 25-28 (25.0%), 17-20 (14.3%), 33 or older (10.7%), and 29-32 (2.4%).

The majority of participants had junior class standing (58.3%), followed by seniors (31.0%) and then sophomores (10.7%). The majority of the students had either completed training in business communications (45.2%) or had been actively taking the course at the time of the data collection (39.3%). Because the data collection for this study was immediately before final exams, the students currently enrolled in a business communication course were assumed to have completed the curriculum for the course. More than three fourths of those surveyed (76.2%) had also received some formal training in using computer applications used in this study to compose messages.

Results

As stated earlier, the experiment was designed to determine differences in the form an electronic communication takes based on the technology that a person uses (mobile versus full-keyboard device) to compose it. A MANCOVA procedure was used to analyze the data because it is assumed that the weighted aggregate of the scored items on the rubric will ultimately reflect the form of the message and because the statistical method corrected for some confounding variables in the analysis.

Although the sample sizes for the groups were slightly unequal (34 full keyboard as opposed to 33 mobile keyboard), MANCOVA was deemed to be a suitable procedure because the covariance matrices across the groups were not different to a statistically significant degree as shown in Table 2.

Table 2. Box's Test of Equality of Covariance Matrices[a]

Box's M	6.305
F	2.032
df1	3
df2	783759.150
Sig.	.107

a. Design: Intercept + context + PrefMobile + ExpMobile + BusCom_Rhet + Tech

Overall, the differences between the technologies used to create the message accounted for 15.6% (η2) of the total variance in the multivariate scores, Wilks' λ = .844, F(2,60) = 5.532, p = .006 as shown in Table 3.

Table 3. Multivariate Tests[c]

Effect	Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[b]
Wilks' Lambda	.844	5.532[a]	2.000	60.000	.006	.156	11.064	.836

a. Exact statistic

b. Computed using alpha = .05

c. Design: Intercept + Context + PrefMobile + ExpMobile + BusCom_Rhet + Tech

Analyses of variance (ANOVA) for each dependent variable (formality and organization) were conducted as follow-up tests to the MANOVA. Using the Bonferroni method of adjusting Type I error for multiple comparisons, each ANOVA was tested at the .025 level. The ANOVA of the formality dependent variable was significant, F(1,61)=5.638, p =.021, η^2=.085; the ANOVA based on the scores of the organization dependant variable was also significant, F(1,61)=6.907, p =.011, η^2=.102. Of the covariates in the model, context was found to have a statistically significant impact on the organization of the message (F=4.184, p=.045), but not on the formality of the message. None of the other covariates had statistically significant impact on the formality or the organization of the message.

Having established that the message form differs between the two technology groups, a review of the group centroids showed that the messages created with full-size keyboards did have significantly lower values for both formality (2.2059) and organization (1.7941) than did the messages created with mobile keyboards (3.7273 and 2.7273, respectively). This finding indicated that the messages that were created with full-size keyboards had better form than those created with mobile keyboards as indicated by the mean number of errors in each dependent variable category as shown in Table 4.

Table 4. Descriptive Statistics

	Tech	Mean	Std. Deviation	N
Organization	Laptop	1.7941	1.22547	34
	Mobile Phone	2.7273	1.84175	33
	Total	2.2537	1.61755	67
Formality	Laptop	2.2059	2.54391	34
	Mobile Phone	3.7273	2.87525	33
	Total	2.9552	2.79845	67

Study Limitations

Two limitations to the study should be addressed. The first limitation deals with the technology. The students were assessed using a Samsung Saga mobile device. While using this one mobile device adds some level of consistency to the results, it also tends to limit the results because participants may have a high preference for their particular mobile device, but not for the one provided to them to complete the study. Additionally, there could have been some other design features specific to the mobile device used that impacted the results other than the size of the keyboard. Examples of these design considerations could be how capital letters or punctuation marks were accessed on the device.

The second limitation to the study is that the sample population consisted of undergraduate students. While the majority of the participants had some work experience and had been educated in business communication, few actually leveraged their devices to compose messages with the proper organization and form dictated by business etiquette on a daily basis. Rather, their experience with the devices is limited to sending messages to personal friends where the organization and formality requirements are less stringent.

Summary and Conclusions

Results showed that the technology used to create a message did impact the elements of message form measured in this study, suggesting that Te'eni (2001) was correct in that the cognitive-affective communications model can have design implications for communication technologies. Those inputting with a handheld device had more errors in message form (both organization and formality) than did those composing using a full-size QWERTY keyboard. While it was expected that the context of the message would impact the organization, it was surprising to see that it did not impact the formality of the message. Also somewhat surprising was that instruction in business communication did not significantly impact message form.

Hypothesized reasons for the findings include the following:

1. Design of the mobile device results in increased errors in message form.
2. Students have limited experience using handheld devices for messages other than personal texting.
3. Lack of familiarity with the mobile device results in increased error in message form.

4. Students have a distorted perception of what is "appropriate communication" when using a handheld communication device.
5. Dependence on the "spell check" feature impacts errors in message form.
6. Lack of attention to message form in composing personal text messages transfers to more formal communication situations.
7. Experience with length-limited text messaging situations impacts other mobile communication experiences.

Recommendations

Based on the findings of this study, the following recommendations are provided for academics and practitioners.

Academics

More research needs to be completed in the area of using mobile devices for business communication. Follow-up studies can be conducted that use a more professional sample population rather than students, or participants can be allowed to use the type of mobile device that they normally use. Additionally, academics can investigate how experience using mobile devices in personal context translates to use in the business context as well as examining what design features of mobile devices impact the form of a message more than others.

Practitioners

Organizations need to provide training on mobile devices they have adopted to assist users in more effectively using them to create messages. If users are trained in creating messages using mobile devices as a part of their role in the organization, they may be less likely to associate the device with personal messaging and be more cognizant of the form the message takes.

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Enhancing Online and Hybrid Teaching and Learning with Inexpensive Web 2.0 Tools

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Abstract

Teaching millennial students is a challenge, as these techno savvy multitaskers need to be engaged in their learning. This paper addresses some of the literature related to the impact Web 2.0 technologies can have on student learning, whether as assignments for face-to-face classes or for use in online or blended learning course formats. Fifteen specific Web 2.0 tools are identified, all available for free or at minimal cost. Findings from a survey of faculty usage of these tools at a mid-sized southwestern U.S. public university are also included. Finally, additional classroom uses in IS/IT courses are also provided by the authors.

Keywords: Student Learning, Web 2.0, Instructional Technology, Pedagogy

Introduction

Today's undergraduate students, as well as many graduate students, are predominantly students labeled as "millennials." Born between 1982 and 2001, they have never known a time without computers. In any given day they repeatedly use technology such as their laptop computers, cell and smart phones, and iPods, actively engaging in texting, twittering, communicating through social networks such as Facebook, and so forth. They do all this while multitasking. Meister and Willyerd (2010) note that these mobile technologies are becoming so pervasive that in just five years Internet access through these mobile devices will surpass desktop pc access.

Because millennials are described as techno savvy and multitaskers, they present faculty with more challenges than ever before as faculty seek to engage them and facilitate their learning. Many faculty teach complete online courses, as well as some face-to-face classes.

Even in face-to-face classes, faculty experience the challenges of engaging today's students. McGlynn (2008) reminds educators that although millennials may demonstrate multitasking skills, they are "also known for attention problems and an inability to delay gratification" (p. 7). Thus, she recommends a strong focus on active learning and the inclusion of examples that students can relate to in order to further link students' life experiences to materials presented in college classes.

In addition to retooling pedagogical practices to include new technology tools, faculty at many schools across approximately 90 percent of the 50 states also face the challenges of restricted budgets because of state budget cuts to higher education, drops in endowment fund values, or decreases in alumni annual giving. Faculty may be left wondering, "where do I or my department get the money to support these new pedagogical needs?"

The remainder of this article will address both more specifics concerning teaching millennials and some free or low-cost Web 2.0 tools that will support faculty in their efforts to modify their teaching tools and pedagogy. The authors also provide survey responses about how faculty across numerous disciplines are using some of these specific tools, as well as suggestions for use of the tools in IS/IT courses.

How Can Faculty Engage Millennial Students?

Successfully reaching millennial students is not easy. In fact, Stewart (2009) suggests no educator "is likely to be able to create the precise balance of academic challenge, emotional and tutorial support, and interpersonal connectedness that will move all of our students to overcome their resistance to substantive reading, impatience with the writing process, inclination to memorize rather than understand, and general intolerance for the necessary frustrations of academic work" (p. 116). If that is not a sobering enough thought, Dede suggests that the next generation, the "neomillennials," will present even more challenges in regard to engaging students (as cited by Cummings, 2007).

Howe and Strauss (2003) use seven descriptors for these Millennial Learners: (1) taught by adults that they are special, (2) sheltered as children, (3) believe they can change the world, (4) oriented to work in teams, (5) recognized as achievers, but not in the way instructors think, (6) pressured to grow up and to perform, and (7) learn in conventional ways, needing checklists, formulas, and recipes for learning. Howe and Strauss (2003) also stress that the millennial generation expects student-centered learning. These descriptors are frequently recognized in other writings such as those of Raines (2002) and Sutherland and Hoover (2007).

Much research over several decades has focused on various issues such as learning styles, thinking styles, and individualized cognitive processes (Mandernach, 2009). A common theme that has emerged for today's teaching and learning is the need for diverse instructional strategies that reach out to a variety of cognitive styles.

Mandernach (2009) encourages the use of multimedia for presentation of information, ensuring that more than one media, and thus more than one of the learner's senses, is involved; text in combination with graphics, audio, music, or video is a vital design requirement in presentation of information. Matulich, Papp and Haytko (2008) note that "digital natives" is a term that can be attached to millennials—they have been networked most of their lives, with instantaneous access to the Internet, downloaded music, instant messages, and phones in their pockets. They prefer using the web, cell phones, instant messaging, MP3s, and online communities. Christen (2009) further supports use of multimedia presentations, suggesting that we need educational transformation that better aligns learning with the learners themselves, providing instruction that is synchronized with the way students live and interact, representing a strong integration of technology and pedagogy. Mandernach (2009) suggests that multimedia featuring the course instructor discussing concepts, instead of commercially produced pieces, increases the visibility of the instructor and may promote stronger faculty-student connection in online courses specifically.

Magolda and Platt (2009) remind educators that technologies are always evolving. Because of these evolving changes, college and university faculty can change the depth and complexity of interactions between themselves and their students. Magolda and Platt (2009) suggest use of Web 2.0 tools such as social bookmarking services, Google Documents, blogs and wikis, in-media critiques and conversations, and information collection applications, noting that these tools place students in the center of their learning experiences.

Although this manuscript does not reflect a complete review of the multitude of literature available concerning teaching millennials, the theme is clear—millennial students need to be engaged in their learning in ways that relate to how they use technology on a daily basis. Stapleton, Wen, Starrett, and Kilburn (2007) have some encouraging words for those who stress that *everything* must change, and that they cannot do it all: "What appears to be more important than isolated focus on utilizing advanced technology is a balanced integration of technology with appropriate pedagogical strategies" (p. 108). Those faculty who have already been including interactive activities in their classrooms are already well on the road to the finish line.

What Web 2.0 Tools Can Support Engaged Learning?

Building from suggestions from the literature related to how to engage millennials in the learning process, it becomes essential to explore some of the tools to accomplish this engagement.

Mandernach (2009) and McGlynn (2008) report that because many millennials are visual learners, multimedia lectures that contain websites and video examples are popular. These approaches to content presentation engage today's students to help them learn. Fortunately, instructors can capture audio/video lectures inexpensively, using tools such as ScreenCorder, Camtasia, Adobe's CreativeSuite, or Box Populi's Podcast in a Box. Nelson, Christopher, and Mims (2009) further note that students and teachers can select from hundreds of *free* Web 2.0 technologies to assemble original multimedia presentations, such as Jing and CamStudio for audio and screen casts.

Pollacia and McCallister (2009), in their discussion of Quality Matters standards to measure quality of instruction and design in online or hybrid courses, note the requirement of using the latest tools and technologies. They state that, "in many instances, Web 2.0 technologies are the most appropriate for supporting this course content" (p. 157). Web 2.0 technologies, which support online learning, offer user-generated content, extremely large amounts of data, dynamic content, and social sharing and bookmarking. Rich (2008) further notes that Web 2.0 technologies are perhaps most familiar to Internet users through blogs and wikis—particularly the wikis at Wikipedia. Pollacia and McCallister (2009) report that online instructors have embraced the use of blogs because they are easy to set up and maintain, published through open-access providers, and offer easy access to class participants to contribute ideas and comments. Harris and Rae (2010), likewise, indicate wikis have a definite place in information systems (IS) education because they can contribute to such activities as critically reading and responding in a constructive and public way to others' work, being used in progressive problem solving, and promoting collaboration and interaction. Harris and Rae (2010) indicate that blogs are also useful in IS education to provide for networking and personal knowledge sharing and to allow students to practice reflective writing. Simply stated, blogs can enhance knowledge sharing and knowledge management of the class.

Nelson, Christopher, and Mims (2009) further support the concept of “collective contribution,” allowing students to contribute specific content to wikis and blogs, participating in knowledge building that includes the efforts of professionals, experts, and the general public. Through this participation, students can experience that the sum is greater than the individual parts. Nelson *et al* also suggest sites such as Diigo.com to support global collaboration.

Academicians are not the only group concerned with providing effective learning tools for adults. Sherman, (2009), writing in the *Chief Learning Officer* publication, recognizes the connectivity value of social media such as Twitter in gathering and sharing information rapidly within a business or organization. He suggests that incorporating social media such as Twitter into a company’s learning strategy can meet the learning styles of millennials especially. However, Harris and Rea (2010) suggest that more research needs to be done in using tools such as Twitter in a learning environment. Meister and Willyerd (2010) predict that in the next ten years most learning will incorporate use of a mobile device. While their predictions may relate more to corporate training and learning than to higher education per se, given their backgrounds in IT companies and in enterprise learning, they note that the majority of Internet users will connect via mobile devices in just a few short years. Thus they focus on Web 2.0 technologies becoming more embedded in learning in the organization.

A careful review of the literature related to Web 2.0 in the learning environment reveals that it is not a panacea that will guarantee all students will learn what faculty wants them to learn within their curricula. Rich (2008) cautions educators that Web 2.0 content is not perfect—it can be good, bad, accurate, inaccurate, objective, or partisan. Pence (2010) reminds faculty that "designing web assignments . . . should encourage high level thinking skills, like synthesis, analysis, problem solving, creativity, and judgment" (p. 106). Harris and Rea (2010) point out both advantages and disadvantages of Web 2.0 tools. They identify advantages including: (1) students become part of the lesson, (2) the world becomes the classroom, (3) collaboration and competition increase learning, and (4) the classroom is available 24/7. Harris and Rea (2010) also identify the following disadvantages: (1) computing resources must be available, (2) web resources can be vandalized or sabotaged, (3) plagiarism is quite possible, and (4) the level of openness can impact assessment and grading. Magolda and Platt (2009) provide a clear reminder to educators, "the trick to using technology effectively in curricular and cocurricula contexts is not just knowing the technology; it is knowing when to use it" (p. 15).

Research Problem and Methodology

Based on many recommendations in the literature of the need for incorporating up-to-date technology into the online learning environment or to provide supplementary materials for the hybrid or blended learning environment, the authors have identified some free or inexpensive Web 2.0 tools to support the following faculty and/or student endeavors:

- Collaboration through social networks or wikis
- Audio recordings
- Podcasting
- PowerPoint, photo, and video sharing
- Video chats
- Real time messaging
- Survey design and analysis

- Demonstration and video tutorials
- Screen captures
- Social book marking
- Information capture (text and/or images for accessing later from any technology device)

The specific Web 2.0 tools selected by the authors included the following:

- Audacity
- Slideshare
- Flickr
- Twitter
- iTunesU
- dimdim
- Jing
- Delicious
- Screenhunter
- Evernote
- PBworks
- Pageflakes
- Blogger
- Google Docs Forms
- Dropbox

The authors have identified that these tools are reasonably easy to learn, which is an essential requirement of today's faculty who must balance the time invested in changing their teaching approaches while still meeting the research and service expectations of their universities. All these efforts must be accomplished while perhaps spending more communication time outside of class with their students than ever before. Although Ning and Survey Monkey had been included in the authors' list for an earlier stage of this project, Ning has been dropped from the current list because the software is no longer available in a useful free version. Survey Monkey has been dropped from the earlier list because of the limited number of survey questions that can be included in its free version.

In addition to researching the tools' descriptions found through their websites, the authors, who teach computer and information systems courses, identified potential usage for IS/IT courses. To provide further suggestions of how some of these tools can be used in blended or online courses in other disciplines, the authors surveyed faculty at their institution to determine which tools were being used and how they were being used. The researchers used Google Docs Forms to design the survey, as well as capture respondent data.

The survey design was simple: for each of the 15 tools the researchers identified above, participants were asked if they had used the tool. If a respondent answered "yes" to a tool's usage, he/she was invited to give a brief description of which class the tool is being used in and how it is being used. Five additional demographic questions were also presented. In an open-ended question, participants were also invited to add other Web 2.0 tools they were using in one or more classes. Participants were provided a ten-day timeframe in which to complete the survey for inclusion in the analysis.

Survey Results

Of the 253 faculty members at the university who received the email link to the survey, 43 chose to participate (17 percent). Sixty percent of the respondents were male and forty percent were female. Almost half the respondents were age 50 or older. Assistant professors, associate professors, and professors were fairly equal in percentage of respondents. Arts and Sciences, the college with the largest number of faculty employed at the university, represented almost 40% of the responses. Slightly more than 50% of the respondents had been using technology in teaching for at least 10 years; another 30% had used technology in teaching for at least 6 years. A complete breakdown of respondent characteristics is detailed in Table 1 on the next page.

Several of the Web 2.0 tools listed in the instrument are not being used by the faculty who responded to the survey. These tools not being used include Slideshare, Flickr, PBworks, Pageflakes, and Google Docs Forms.

Audacity, iTunesU, and Jing are each being used by 7% of the respondents while dimdim and Blogger are each being used by 5% of the respondents. Twitter, Delicious, Screenhunter, and Evernote are each being used by 2% of the respondents. Table 2 contains descriptions of usage provided by faculty respondents. Not all faculty who responded that they are using a Web 2.0 tool provided a brief discussion or illustration of its use.

Table 1. Participant Characteristics

Characteristic	Percentage
Gender	
Male	60.0%
Female	40.0%
Age	
Under 30	2.3%
30-39	25.6%
40-49	25.6%
50+	46.5%
Rank	
Instructor	14.0%
Assistant professor	30.2%
Associate professor	25.6%
Professor	30.2%
College Affiliation	
Arts and Sciences	37.2%
Business Administration	18.6%
Education	25.6%
Nursing and Allied Health	9.3%
University College	9.3%
Years of Using Technology in Teaching	
15+ Years	30.2%
10-14 Years	20.9%
6-9 Years	30.2%
3-5 Years	14.0%
2 years or less	4.7%

The reference to the remaining tool, Dropbox, was misunderstood by some of the respondents. The researchers were inquiring about the Web 2.0 tool, but some of the faculty members thought they were inquiring about the Digital Dropbox component in Blackboard, the online course management system in use at the authors' university. Therefore, the percentage of affirmative response, 23%, is inaccurate. The researchers believe a more accurate percentage of responses is 12%. This belief is based upon the respondents' descriptions of how they are using Dropbox in their classes.

Table 2. Web 2.0 Tools and Their Usage

Tool	Usage
Audacity	• "To edit MP3 from various news agencies and podcasts. For example, I sometimes give the CarTalk puzzler in class; I use audacity to remove the clip from the 1-hour radio show."
iTunesU	• "Used occasionally to show video/podcasts of interest to our subject matter in Contemporary Art."
Jing	• "Am preparing materials for PSYC 508." (introduction to psychometrics course)
Screenhunter	• "I use this for Biol 404 and Biol 537. I use screenhunter to capture open windows in Excel so I can create a document that demonstrates step by step processes to do analyses and create graphs." (ecology class and applied ecology class)
Blogger	• "Used as "wrapper" for Q&A videos posted on YouTube."
Dropbox	• "Used by students so that they always have access to their documents." • "Am using Dropbox for research activities, to collaborate with others regarding data collection and manuscripts."

Faculty participants were also invited to comment on tools they use that were not included in the authors' survey. Tools not included in the instrument but being used by faculty include Ning, SurveyMonkey, YouTube, Acoustica Audio Mixer, Google Knol, and Google Docs. Table 3 lists the different tools and how some faculty members are implementing the tools in their classes.

Table 3. Suggested Tools and Their Usage

Tools	Description
Ning	• "This was used in an interdisciplinary course for computer science and English majors to foster communication among the group." • "I have used NING for the graduate course associated with my LaSIP grant. It is being used for teachers to share ideas and also a discussion board option."
SurveyMonkey	• "I've used it as an evaluation tool for the course in an upper level dietetics course." • "Used it in the past for class surveys and research." • "I have not used it – my students have."
YouTube	• "For watching videos." • "I occasionally assigned specific You Tube videos for students to watch outside of class. These videos are the basis for class discussion and support the course content."
Acoustica Audio Mixer	• "I have used this program for advertising. Students are required to create a 30 second radio ad as part of their promotional campaign. The program can be downloaded/installed for a 10 day trial versus purchasing a site license for the software program (or having students purchase it for $30) to be used for one class assignment."
Google Knol	• "Collaborative lab report writing in CHEM 304, 306. Has LaTeX equation editor; especially useful for math/scientific documents. Similar to wiki; not good for real-time collaborations -- does not manage version collisions well."
Google Docs	• "Real-time collaborations for lab report writing and help sessions. CHEM 303, 304, 305, 306." (physical chemistry courses and labs)

Table 4 provides the complete list of the 15 tools included in the survey distributed by the authors. These tools can provide faculty with Web 2.0 interaction and multi-sensory opportunities to enhance student engagement and learning. For each tool, the authors provide a brief description, specific website address, and suggestions for use in teaching information systems and/or information technology courses.

Table 4. Free or Low-Cost Tools for Online Instruction

Software	Description	Uses in IS/IT Courses	URL
Audacity	**Audacity is an audio recording tool.** This free tool allows a user to record audio from any basic microphone. The user can edit multiple audio tracks together, enhance audio, create podcasts, etc.	• Faculty creation of podcasts of additional content • Student team creation of podcast about new technology and its uses	http://audacity. sourceforge.net
Slideshare	**Slideshare is a PowerPoint and photo sharing tool.** This free tool allows the user to upload and share PowerPoint presentations, OpenOffice documents and Adobe PDF Portfolios. Users can share publicly or privately. Audio can be synced with slides.	• Student sharing of presentations • Location of presentations created by others having a common interest	www.slideshare.net
Flickr	**Flickr is a picture and video sharing tool.** The tool (free) allows users to make their pictures and videos available to their family and friends and other contacts.	• Use of photos as writing prompts – faculty or students • Visual documentation of project stages • Digital visual portfolios	www.flikr.com
Twitter	**Twitter is a real-time short messaging service.** Twitter works over multiple networks and devices. Educational users can set up "class blasts" that are sent out to students at any time about current topics, timely events or questions, etc.	• Track a word • Follow a professional • Team updates	http://twitter.com
iTunesU	**iTunesU is a podcasting tool.** Using iTunes U, faculty can distribute digital lessons to students, providing audio and video podcasts that let students study at their own pace, wherever and whenever.	• Podcasting of lessons • Podcasting of training materials for end users	www.apple.com/ education/mobile-learning
dimdim	**Dimdim is a voice/video chat tool.** The free version allows up to twenty people to participate in voice chat, text chat, and webcam viewing. Screen sharing, not available through programs such as Skype, is also available. A professional version for purchase accommodates more people.	• Virtual classroom for synchronized teaching/learning • Synchronized screen sharing	www.dimdim.com

Tool	Description	Uses in IS/IT Classes	URL
Jing	**Jing is a demonstration and video tutorials tool.** This free software allows the user to add visuals to an online conversation, thus creating a video tutorial. Users can snap a picture of a screen, record video of on-screen actions, and share over the web, IM, or email. It offers a quick solution for producing simple video tutorials.	• Teacher demonstration of step-by-step process for task completion • Student demonstration of step-by-step process for end user training	www.jingproject.com
delicious	**Delicious is a social bookmarking service.** This free tool allows users to tag, save, manage and share web pages from a centralized source. By storing bookmarks/favorites online, users can access their bookmarks from any computer, facilitating sharing of bookmarks between home and office.	• Student bookmarks of web pages for papers and projects • Learn what other people in your network are locating	http://delicious.com
screenhunter	**Screenhunter is a screen capture tool.** With this free tool a user can capture any part of the computer desktop, a window or full screen with mouse point. The captures can be saved as BMP, JPEG, or GIF files. Plus and Pro versions with expanded capabilities are available for purchase.	• Screen captures for papers, projects, and/or instruction	http://wisdom-soft.com/products/screenhunter_free.htm
Evernote	**Evernote is an information capture tool.** With this free tool a user can capture text and/or images and have it accessible at any time, from any place, from whatever electronic device. Everything put into Evernote is synchronized across all of your devices at all times and is searchable by keywords, titles, and tags.	• Students select and tag articles and images for future use • Faculty tag articles and images at home and access at school	www.evernote.com
PBworks	**PBworks is a wiki tool.** A user can create a simple, secure workspace in just a few minutes. (Wikis are simple web pages that groups can edit together). A wiki provides the features of an evolving document, although the user can maintain tracking and access controls for monitoring purposes. Workspaces can be made public or private. The PBWorks site boasts that it hosts more classroom workspaces than anyone else in the world. The basic version is free.	• Students share and collaborate on files at the same time; a complete history and audit trail is created of all changes	http://pbworks.com/academic.wiki

Tool	Description	Use in IS/IT Courses	URL
Pageflakes	**Pageflakes is a customizable homepage.** A user can add "Flakes" to their homepage, participate in the Pageflakes community, and connect with other users around the world. There are thousands of Flakes (widgets or modules) that can be added to your page. Included in the available list are Facebook, YouTube, Twitter, RSS feeds, a universal News Search, photos, music, videos, and much more.	• Students can have at their fingertips many sources, news and otherwise, without having to have several tabs or windows open	http://www.page flakes.com
Blogger	**Blogger is a free blog publishing tool from Google.** Blogger can be used to keep your own professional diary or your students can keep their own journals. Using a simple-to-use interface, you can create a customized blog for your use including photos and videos. Readers can leave comments and they can subscribe to your blog's feeds. In addition, Blogger is available in 41 languages.	• Portfolios, group collaboration, class notes pages, student reflection space, and online assignment posting and peer reviews are some of the uses of blogs	http://www.blogger. com
Google Docs Forms	**The Forms component in Google Docs is a free form builder.** Forms can be used to create online polls and surveys. The forms are mobile friendly, allow an unlimited number of participants, support a variety of question types, and record all responses to an Excel spreadsheet. One caution is that a participant could take the survey more than once.	• Data collection for research purposes • Information collection for meetings and workshops	http://docs.google. com
Dropbox	**Dropbox is an easy way to share, store, and sync files online.** Users have no more excuses for not having needed files available due to a forgotten jumpdrive. Wherever you are, if you have Internet access, you will have access to your files. With the free account, 2GB of space is provided. For each referral, you receive an additional 250MB of bonus space (up to 8GB). Files of any type and size can be sent between Windows, Mac, and Linux computers and mobile devices.	• Access to files of all sizes and types via the Internet regardless of operating system (Windows, Mac, and Linux)	http://www.getdrop box.com

Conclusions and Recommendations

Today's college and university educators face the daily challenge of reaching the many millennial students who enroll in face-to-face and online classes. While these students are multitaskers, they may also have some short attention spans. Many articles support the use of Web 2.0 technologies and tools to bring students into the center of their learning. Schools on tight budgets do not have to invest large amounts of money to enable faculty to incorporate some of these tools. This article has focused predominantly on 15 of the literally hundreds of free and/or inexpensive tools that are available. Use of only one or two of these tools can add more multi-media, multi-sensory presentation of content and more student involvement in writing and building knowledge within a course. The tools specifically identified in this project offer support for faculty who wish to add techniques such as audio recordings, podcasts, video chats, video tutorials, and collaboration through social networks or wikis to their course learning environments.

Faculty responses showing overall low tool usage rates in the short survey the authors conducted were not overly surprising to the researchers. Although the general public may not be knowledgeable about all the additional demands on faculty beyond their teaching, faculty struggle to balance all their job requirements and additional communication channels available to students. They must do all this while still finding time to first, assess which new tools are a good fit with student learning in the disciplines they teach and second, learn how to use the tools successfully. The percentage of older faculty respondents at higher ranks who reported using some of these tools indicates that the new technology is not simply being left to the younger, newer educators to bring into the learning environment.

As technology continues to evolve and university students become even more interconnected through their mobile devices, social networks, and so forth, faculty will need to continue their exploration and incorporation of technologies that draw their students into the center of their learning within courses. A replication of the authors' survey in the future can gather data concerning the evolution of Web 2.0 technologies into the institution and the curricula.

For those educators who have not yet tried any of this technology, the recommendation is to get started with one or two of the tools that require very short learning times. Trying out a tool such as Audacity may be a simple way to get started, as it involves recording audio from any basic microphone. With little effort, podcasts can be created, which quickly provides today's multitasking students another way to use the technology tools they prefer while hearing the instructor's voice.

Another Web 2.0 tool that is very easy to master is Dropbox. When Dropbox is installed on one's computer, a folder labeled "My Dropbox" is added under the My Documents folder. The learning curve in using Dropbox is minimal; the user only needs to know where to place his/her files. Being able to access one's files from anywhere there is Internet access can eliminate frustration in not having access to a critical file at any given moment.

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Prompting Students to Think Critically in the Business Information Systems Classroom

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Abstract

Critical thinking takes students beyond memorization of facts and concepts. As educators, our goal is to help students to become "critical thinkers." If educators use critical thinking instructional strategies to teach the foundational concepts of business and give students learning activities to promote critical thinking, we can *try* to force students to "think about their thinking." Critical thinking processes can help students learn to investigate, analyze, evaluate, synthesize, and make decisions effectively.

Keywords: Critical Thinking, Business Information Systems, Pedagogy

Historical View of Critical Thinking

Over the past century, the literature has been and continues to be rich with critical thinking theory and research (Anderson & Krathwohl, 2001; Bloom, 1956; Dewey, 1909, 1933; Elder & Paul, 2007, 2009; Paul & Elder, 2006a, 2007, 2008; Scriven & Paul, 2007). From Dewey's *How People Think* to Bloom's Taxonomy and from Krathwohl's updated Bloom's Taxonomy to the Critical Thinking Institute with experts such as Richard Paul and Linda Elder and their several guides to critical and creative thinking and intellectual standards.

Critical thinking can be traced back to Socrates and his method of questioning students. Socratic questioning is a good precondition for the development of critical thinking skills (Buraphadeja & Dawson, 2008; Duron, Limbach, & Waugh, 2006; Facione, 2010; Macknight, 2002; Paul & Elder, 2006b; Yang, Newby, & Bill, 2005). To help students learn and use the standards, professors should pose questions which probe student thinking; questions which hold students accountable for their thinking; questions which, through consistent use by the instructor as facilitator in the classroom, become internalized by students as questions they need to ask themselves (Elder & Paul, 2006; Paul & Elder, 2006b). Not only does learning intensify for students in the classroom, but also teaching is more rewarding for faculty because students become more engaged, thereby enriching classroom discussions and improving student performance. Socrates facilitated learning by encouraging his students to identify their inconsistent and irrational thought processes that were confusing, lacking evidence, and contradicting their current level of information (Paul & Elder, 2006b). Students should learn to develop questions to strengthen their reasoning in the thought process (Elder & Paul, 2006; Paul & Elder, 2006b). This process drives their thinking so students learn to clarify and elaborate when asked questions that build on supporting reasons, evidence, assumptions, and implications (Macknight, 2000). The ultimate goal, then, is for these questions to become instilled in the thinking of students, guiding them to deeper, broader, and more complex reasoning.

Today's emphasis on critical thinking actually began with Bloom's Taxonomy in the 1950s (Bloom, 1956); critical thinking instruction became a focal point in the United States when the National Education Goals Panel (1991, p. 62, as cited in Halpern, 1999) noted "the proportion of college graduates who demonstrate an advanced ability to think critically, communicate effectively, and solve problems will increase substantially" as one of the goals for the year 2000. For over the past decade, critical thinking has been a common objective of many disciplines (Macknight, 2000). "Changes in technology and the workplace have made the ability to think critically more important than ever before" (Halpern, 1999, p. 69), and critical thinking continues to be an important and necessary skill required in today's workplace (Duron, Limbach, & Waugh, 2006).

This article focuses on the implementation of the Richard Paul and Linda Elder Model as a method of developing student critical thinking skills in the Business Information Systems classroom. Once students have the problem clearly before them, the most important component of the process is their arriving at a solution. The critical thinking process puts them on solid ground; and hopefully, they will begin and continue to use the critical thinking process daily in their working with technology. For example, when their computer won't boot, they have to decide what the problem is. When the student has a computer virus, that student must use critical thinking to deal with the issue. Activities using the critical thinking models are used to demonstrate the instructional strategies. Sample assignments in information systems are given for instructors to use in their own classes.

Critical Thinking Defined

Over the past century, educational theorists have been researching how people think; and the definition has remained fairly constant. Thinking is active, persistent, and based on careful consideration of knowledge and supporting evidence along with the conclusions that follow (Dewey, 1909, 1933). Ennis (1993) stated that "critical thinking is the process of reasonably deciding what to believe or do" (p.180). Critical thinking is an intellectual process of questioning, conceptualizing, applying, analyzing, synthesizing or evaluating information generated by observation, experience, reflection, reasoning, or communication (Elder & Paul, 2007, 2009; Paul & Elder, 2006a, 2007; Scriven & Paul, 2007). The elements of thought summarizes critical thinking as "thinking about thinking" so as to identify strengths and weaknesses using analytic and evaluative thinking--and to apply intellectual standards to assess and improve that thinking (Elder & Paul, 2009; Paul & Elder, 2007, 2008; Scriven & Paul 2007). All critical thinking must be evaluated using these select intellectual standards of clarity, accuracy, precision, relevance, depth and breadth, logic, significance, and fairness (Elder & Paul, 2007, 2009; Paul & Elder, 2006a, 2007, 2008).

When we test our understanding of critical thinking further, we may ask questions: "How do critical thinking and native intelligence or scholastic aptitude relate? Does critical thinking focus on the subject matter or content that you know or on the process you use when you reason about that content?" (Facione, 2010, p. 2). To promote critical thinking in the classroom, the instructor must make a conscious effort of forcing students to be active learners in intellectual activities to discover, analyze, evaluate, and communicate implications and consequences to problems, questions, and alternatives so that they arrive at effective solutions and decision-making. Students should have the ability "to take charge of their own thinking" (Duron, Limbach, & Waugh, 2006, p. 160) and to build upon what they already know (Macknight, 2000). They need to raise fundamental questions and problems, formulate them clearly, filter relevant information, use abstract ideas, think open-mindedly, analyze and evaluate information, and communicate effectively (Duron, Limbach, & Waugh, 2006). Further, students should be able to exercise reasoned judgment, examine logical relationships, construct arguments, respect diverse perspectives, and address different points of view (Macknight, 2000).

While these and many more definitions for critical thinking exist, ultimately, the elements of thought are the same or relatively similar. The Paul and Elder model encourages instructors to help students apply intellectual standards to the eight elements of reasoning (thought) with a goal of developing intellectual traits.

Models of Critical Thinking

While the focus of this paper is on the Paul and Elder Model of Critical Thinking, similar models exist with similar elements of thought, intellectual standards, and traits. Basic structures of reasoning are present in all thinking: Whenever we think, we think for a *purpose* within a *point of view* based on *assumptions* leading to *implications* and *consequences*. We use *concepts, ideas*, and *theories* to *interpret data, facts*, and *experiences* in order to *answer questions, solve problems*, and *resolve issues* (Elder & Paul, 2007, 2009; Paul & Elder, 2006a, 2007, 2008).

Thinking, then, generates purposes; raises questions; uses information; utilizes concepts; makes inferences; recognizes assumptions; generates implications; and embodies a point of view.

Universal intellectual standards can be applied to thinking whenever one is interested in checking the quality of reasoning about a problem, issue, or situation. Critical thinking entails having command of these standards (Elder & Paul, 2008). For example, one of the intellectual standards is accuracy (correctness or truth). Truth is a central issue for all forms of reasoning (Wegner & Goldin, 2006). Since solutions need to be correct (true), problem solving is related to accuracy (truth). Oftentimes, historians and philosophers describe truth generally in terms of beliefs and practices desired by the proponent rather than by provable assumptions and arguments about validity. Again, the intellectual standards are necessary for critical thinking. The inaccuracy of assumptions in problem solving can come from flawed reasoning that prevails in different modes of thought (Wegner & Goldin, 2006).

Paul and Elder's Model (2008) lists the Elements of Thought for students to identify:

1. The **purpose** is the goal, objective, function, motive, or intentions of what is trying to be accomplished.
2. The **question** lays out the problem or issue and guides thinking. The question should be clear and precise enough to productively guide student thinking.
3. **Information** includes available facts, data, evidence, or experiences used to figure things out. It does not necessarily imply accuracy or correctness.

4. **Inferences** are **interpretations** or conclusions that students arrive at. Inferring is what the mind does in figuring something out.
5. **Concepts** are ideas, theories, laws, principles, or hypotheses used in thinking to make sense of things.
6. **Assumptions** are beliefs that are taken for granted. They usually operate at the subconscious or unconscious level of thought.
7. **Implications** are claims or truths that logically follow from other claims or truths. Implications follow from thoughts. **Consequences** follow from actions. The question might be asked, "What happens if the problem is solved vs. if the problem is not solved?"
8. **Point of view** is literally "the place" from which something is viewed. It includes what is being looked at and the way it is being seen.

Analyzing these eight "Elements of Thought" from the Paul and Elder Critical Thinking Model, and reasoning all the pieces together, can result in more effective outcomes.

It should be noted that critical thinking stems from the higher levels of Bloom. As a refresher, Bloom's Taxonomy (1956) is listed below:

1. **Knowledge** – memorizing and reciting concepts
2. **Comprehension** – understanding, relating, and organizing knowledge
3. **Application** – connecting ideas according to rule in that situation or other experiences
4. **Analysis** – critical thinking focused on theories, assumptions, fallacies and their functionality in the whole

5. **Synthesis** – critical thinking that explores and builds new understanding or formulates new ideas putting parts together to form a new and original whole
6. **Evaluation** – critical thinking focused on valuing, critiquing, and making judgments using concepts and information.

Integrating Critical Thinking into the Business Information Systems Curriculum

To instill higher levels of critical thinking in college students, problem solving should include a six-step process, similar to the general scientific approach for solving any dilemma, and also incorporating elements from both Bloom's Taxonomy and the Paul and Elder Model:

1. Identify and formulate the problem or opportunity – Explain the purpose.
2. Define and clarify the context – State the facts and what is known.
3. Collect data and evidence – Layout the options.
4. Analyze and evaluate alternatives – Make a decision based on analysis.
5. Develop implementation strategy – Create plan by phases, goals, or timeline.
6. Assess outcomes – Review progress and feedback; revise as necessary.

Of course, before students are able to think critically and apply these problem-solving steps, they must have the foundational knowledge and conceptual basics for the field of study. The ability to use technology does not mean the student can find information, evaluate it, and use it effectively (Sutton & Kousha, 2010). Students in majors other than Business Information Systems must have a basic understanding of the information technologies used by today's organizations. Likewise, Business Information Systems professionals need to understand the various business functions (other than BIS) to promote their ability to interpret business problems and develop relevant technical solutions (Hajnal & Riordan, 2004). Conversely, if students do not combine applied technology with critical thinking skills, they impede learning and academic progress (Sutton & Kousha, 2010). In today's technology and information rich society, students must have the technical skills along with critical thinking abilities to take them beyond college, into the workplace and other real world events to help them achieve success.

Active Learning Based on Foundational Knowledge

Critical thinking is a disciplined, productive practice, not just an isolated, passive event in the student's (or future employee's) life and career. Interactivity combined with active reflection and elements of reasoning is essential. Discussion and feedback are necessary for students to develop this reflective and metacognitive thinking. Bloom's taxonomy provides a straightforward method to classify instructional activities as they progress in the level of difficulty (Bloom, 1956). Creation of new knowledge depends on students' capabilities to think critically and go beyond facts and use knowledge in the exercise of judgment (recognize assumptions, implications, and consequences) (Macknight, 2000, 2002). Active learning facilitates critical thinking in students by stimulating them to comprehend the material through application of their learning and reflection on the meaning of the outcome (Duron, Limbach, & Waugh, 2006).

Higher Levels of Thinking

Students should know how to combine their technical knowledge, reflective dialog, and work experiences with their foundational thinking (Buraphadeja & Dawson, 2008; Duron, Limbach, & Waugh, 2006; Sutton & Kousha, 2010), thus giving them ample opportunity for engaging in upper levels of Bloom where critical thinking occurs (Duron, Limbach, & Waugh, 2006). They can then justify significant alternatives relevantly by analyzing, evaluating, inferring, and explaining how conclusions were drawn (Facione, 2010). Therefore, critical thinking refers to the higher levels of Bloom's taxonomy including analysis, synthesis, and evaluation (Buraphadeja & Dawson, 2008; Facione, 2010). Critical thinking skills are progressive in the continual process of questioning assumptions, exploring alternatives, and engaging in reflective dialog. Critical thinking also includes exploring complex problems in depth (Macknight, 2000) using several interdependent attributes of critical thought, such as keeping an open mind, seeking alternatives, evaluating credibility, formulating plausible hypotheses, and drawing conclusions (Ennis, 1993). For example, some information available on the Internet is not reliable, and some of it is deliberately and dangerously deceptive. Therefore, critical thinking includes the ability to judge credibility of information sources (Halpern, 1999).

Business Information Systems Curriculum

In the Business Information Systems classroom, professors should develop a critical thinking definition that works for them, their students, and their student learning outcomes. For example, student success requires more than just being "tech-savvy" (Hajnal & Riordan, 2004; Sutton & Kousha, 2010). The following steps could be used to help students achieve Student Learning Outcomes in the Business Information Systems classroom:

1. Create learning activities that meet the professor’s critical thinking definition for Business Information Systems students.
2. Ensure that the teaching reflects the critical thinking definition (problem).
3. Operationalize and assess student learning outcomes based upon the student learning objectives and critical thinking standards.
4. Evaluate student progress toward critical thinking and student learning objectives.

Reiterating that the Business Information Systems function is more than just technology (Hajnal & Riordan, 2004), technology has provided us with ways to teach and has increased the need for critical thinking skills. The availability of massive amounts of information makes the ability to evaluate and sort information more important than ever (Halpern, 1999). Students need to incorporate critical thinking skills when they perform an Internet search and filter the resulting data, before they can apply critical thinking skills to make a decision. Navigating, critically evaluating, and assessing information are critical thinking skills that will assist students to use the technology to make inferences, arrive at conclusions, and solve problems (Sutton & Kousha, 2010). Additionally, business management concepts that must be understood for students to implement e-business and enterprise systems are as significant as the technologies connected to the principles (Hajnal & Riordan, 2004).

For illustration, if Business Information Systems students are to learn effective business decision making, they need a curriculum that requires an integrated, cross-functional process perspective so they can benefit from enterprise resource planning (ERP). ERP allows for the integration of business functions and systems that critical thinking is seeking. Regardless of the students' major, they are able to integrate the functional orientation of the organization. This integration occurs through cross-functional processes, information flows, and information technology (Hajnal & Riordan, 2004). New technologies give us the tools to help students develop critical thinking skills and connect and establish meaning in many other disciplines (Macknight, 2002). Buraphadeja and Dawson (2008) found that the constructivist paradigm and computer-mediated communication (CMC), along with qualified instructor facilitation also lead students to high-level thinking. Even though scholars may differ in their beliefs about the definitions of critical thinking or the facilitation of asynchronous Web-based discussion, there is coalescence that active student participation can reach a higher-level thinking if they have qualified instructor facilitation. Finding, analyzing, and applying information in decision making and problem solving demonstrates effective use of technology (Sutton & Kousha, 2010).

Activities and Assignments in the BIS Classroom

Some strategies and assignment suggestions for improving students' critical thinking skills in the Business Information Systems course are explained in this section.

Elements of Thought Activity

One problem-solving method based on the critical and creative thinking process includes clearly identifying and assessing the following components using Business Information Systems examples:

1. Identify the *problem* (e.g., troubleshooting, virus detection)
2. Ask precise *questions* (e.g., Is the machine plugged in? Will a cold boot fix the problem?)
3. Acknowledge *assumptions* (e.g., what the end user knows, the last software installed)
4. Adapt *perspectives* from diverse sets of users (e.g., end users, support personnel, programmers)
5. Provide sufficient *data/information/evidence* (e.g., data dictionary, metadata, disk capacity, updates installed)
6. Pose precise *key concepts and principles* (with alternatives) (e.g., testing, training, simulations)
7. Support *interpretations/deductions/conclusions* (e.g., provide technical manuals, tutorials)
8. Make logical *recommendations/outcomes* (e.g., patches, updates)
9. Implement solution(s) (e.g., beta versions, pilot programs)
10. *Evaluate* feedback (e.g., version updates, "contact us" on website)

Specific criteria can be used to determine and evaluate each step of the problem-solving process. Examples for each of the steps can be more or less detailed and may overlap with other steps, depending on the assignment.

Higher-Level Thinking Activity

This assignment example provides questions for students to apply to different business situations (adapted from Duron, Limbach, & Waugh, 2006).

The topic for the session is computer security, and the objective is for students to *classify* common security threats by category. *Classify* is a verb for a behavior typically assigned at the *analysis* level of Bloom's Taxonomy (which is a level of critical thinking).

Three categories would be presented to students by using questions to enhance student understanding. The categories are natural disasters, employee errors, and crime. The questions might be:

- What natural disasters are common where you live?
- Are employee errors intentional?
- What computer crimes of fraud have you read about in the past few months?

Once an understanding of the three basic categories has been established, the students are placed in groups and assigned a business. Then they are asked to identify at least three security threats for each category for that business. Finally, each group shares their discussion with the class.

For individual assessment, students will be asked to classify security threats by category for a specific business on their exam.

This activity can be adapted to fit any topic in Business Information Systems.

Critical Thinking Process Activity

Use the basic steps to the critical thinking process in this assignment. Apply each of the first three steps to each of the key areas as described.

In developing student assignments to achieve learning outcomes, ask the obvious question, "How can I apply critical thinking to computer applications, programming, information systems development, web design, and networking components?" Then, reverse the question to "What is the role of computer applications (or other BIS concept) in the development of *critical thinking*?" The key process in these questions is *thinking*.

Integrated Curriculum Strategies

Faculty should have discussions within and outside of their own discipline, asking several questions about critical thinking and student learning outcomes that could include:

- How can we foster critical thinking through written assignments, oral presentations, and computer applications?
- How can we teach content better with the use of active learning, including reflective assignments (that require students to think through the content)?
- How can we increase student knowledge by teaching them how to think critically like a good programmer or a networking consultant?
- How can we teach students how to assess their own computer programs and give effective feedback for improvement by applying the Paul and Elder intellectual standards?
- How can we give students multiple spreadsheet assignments and have them do peer review for assessment?

In addition to self-reflection of these questions and discussions, several strategies can be used to promote critical thinking in Business Information Systems or any other discipline:

- Rather than having students ask questions and seek answers from the professor, students should seek questions and provide answers through active participation during in-class discussion.
- When students ask a question, the professor can pose the question to the class for other students to answer. Perhaps students could work through the question and provide the solution during the next class period.
- Students can be asked what they learned from a lesson and how they will use that new knowledge in their work life.
- Professors can use activity-oriented and assignment-centered teaching. The professor serves as a resource and facilitator. The student serves as a discoverer and explorer of new knowledge and is stimulated to engage in critical thinking.
- Students can also be engaged with active and collaborative learning, enhancing their thinking and accountability processes.
- Students can be guided to outcome-based decisions from their analysis and rationale of the situation.
- Professors can provide rubrics with checkpoints and expectations, based on the elements of critical thought and intellectual standards, so students can use the process.
- Professors should conduct progress checks and provide feedback to the process.
- Professors can promote cognitive dissonance; put students outside their comfort zone to make them think strategically, outside their normal realm.
- Students can be put in the position to debate the opposite of their belief.

- Students can be provided with a vague sample of a result, without much detail, so they can be creative in their thought process without focusing on a template.

To keep students motivated, instructors must balance student learning outcomes, critical thinking activities, and needs-based assessment. Projects and assignments in Business Information Systems must be centered on active learning; for example, using hands-on computer applications, and not focusing solely on memorization content and lecture.

Summary, Conclusions, and Recommendations

Critical thinking skills require a reflective thought process beyond rote memorization and comprehension. They require application--towards the higher levels of Bloom's Taxonomy. The focus turns to analysis, evaluation, and the creation of new knowledge through student independent, critical thinking. Students learn to separate data findings, make connections, evaluate evidence, and assess alternatives. They not only summarize, but also synthesize and put the elements of the problem together to form a whole solution, and to make recommendations from logical inferences, arriving at a deeper understanding of concepts.

In Business Information Systems, we discuss "metadata," or data about data. In critical thinking, we can base the thought process on the same premise using the *meta* prefix. Metathinking is "thinking about thinking." Business Information Systems professors can incorporate effective metathinking instructional strategies that require reflective, intellectual, logical, and independent thinking for improving critical thinking skills of students. It is essential for Business Information Systems students to be able to use proper grammar, punctuation, sentence structure, and adhere to all of the intellectual standards. In other words, Business Information Systems students should be able to take a programming line of code and write a complete sentence about it, or explain the process of debugging a virus, or write a technology training manual.

The Business Information Systems college classroom must provide a transitional (transferable) set of critical thinking skills that can be used long after graduation and into the workplace of the information systems professional. Employers want employees who have developed specific critical thinking ability in the information systems field; for example, problem solving, troubleshooting, and diagnostics. But, they also want employees to be able to identify a problem, ask questions, make inferences, establish assumptions, explore and evaluate alternatives, respect diverse perspectives, and communicate results.

As prospective employers want college graduates from business information systems programs who can think critically, the curriculum needs to include critical thinking as a student learning objective. Just as with the scientific approach and the Systems Development Life Cycle (SDLC), the beginning step is to identify the problem. Then, state the purpose and specifics of the situation, including questions and assumptions through applying the Paul and Elder Model of critical thinking elements and intellectual standards.

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Digital Knowledge and Application Skills: A Comparison Study of Entering Freshman

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Abstract

Ninety-seven first-time freshmen participated in a pilot study investigating their experience, confidence, and competence in the use of office applications. Moderating factors examined included gender and learning styles. Results showed that high school experience in the technologies was more related to confidence than competence. The learning style variable exhibited no significant correlation with other variables. Female students had significantly higher performance on two of the four tasks (Word and Access) than that of male students. This study identified several important methodological issues which will be addressed in future research.

Introduction

Technology is a term included in the vision and mission statements of most standards associated with the global business community. In fact, AACSB states in Standard 15 that "Curricula without these two (globalization and information systems) areas of learning would not normally be considered current and relevant" (AACSB, 2010). For this reason, and in well-designed learning environments, the planning needed to integrate technology is crucial to effectively defining course content and curriculums (Kennedy, et al., 2006). Inherently, we seem to assume that because students are using particular technologies in their everyday lives this supports a general confidence in their understanding and knowledge of technology (Oliver & Goerke, 2007).

Various stakeholders hold universities and colleges responsible for preparing the work force. Coll and Zegwaard (2006) analyzed the reported perceptions of desirable graduate competencies from the perspective of various stakeholders, students, graduates, and faculty. From the business student perspective, the top five ranked competencies were computer literacy, customer service orientation, teamwork and cooperation, self-confidence, and ability and willingness to learn. These rankings are similar to those of the business graduates who specified four of the same five competencies (ability and willingness to learn, customer service orientation, computer literacy, self-confidence, and initiative). As required job knowledge and skills change, educators must be future thinkers in regards to maintaining current course content. According to Coll and Zegwaard (2006), the top five competencies ranked by faculty were ability and willingness to learn, written communication, analytical thinking, computer literacy, and team work and cooperation. Hanneman and Gardner (2010) surveyed business and industry to identify knowledge and skills needed by college graduates. The following skills were identified: higher-order thinking, ability to communicate ideas, ability to function as a member and leader of teams, and ability to utilize technology to make or save the company money. Companies were asked to list the desired qualities and skills needed by applicants. Listed among the top eight desired skills and qualities were computer skills, communication skills, and leadership skills. (CollegeGrad.com, 2009)

For business (other), finance, and accounting majors, Hanneman and Gardner (2010) reported that employers identified the following desired skills and qualities as needed by graduates: engage in continuous learning; analyze, evaluate, and interpret data; and build professional relationships. The executive summary of the Michigan State University (MSU) study (Gardner, 2010a) reports a business shift in the demand for business majors to possess the technology skills aligned with the companies repositioning for more Internet business and to seek candidates with acumen in these areas. Adding to the demands for extensive skills and training is the increasing attention given to social media by those involved in the hiring process (Gardner, 2010b). Moreover, these characteristics are not only important to enter the job market, but also to maintain and achieve promotions and new assignments. Gardner (2007) states that the top seven characteristics that lead to promotion and new assignments as reported by employers were taking initiative, self-management, personal attributes, commitment, leadership, show and tell, and technical competence. In his study, he defines technical competence as "possessing core knowledge in area of study, demonstrating technical acumen appropriate for position, obtaining mastery of current position, displaying high level of competence" (p. 5). It is important to stress that from every stakeholders' point of view analyzed in the above mentioned studies, technology competencies are one of the top desirable skills for graduates. For this reason, this study seeks to determine whether students are as competent in business technology as they perceive themselves to be.

In an effort to enhance best practices and establish base line data, we must assess students' perceptions and application knowledge of their skill sets for various software applications. Using multiple instruments of measurement and comparing the influences that each of these measurements may have to the overall students' abilities and perceptions is the first step in providing this base line.

Learning styles, an important potential mediating factor, are also measured. Learning styles (Kolb, 1984) have been posited to explain differences in the way that students learn. This study sought to find relationships between cognitive learning styles, students' perceptions of technological abilities and their actual performance of technical skills. Significant learning styles differences compared to their perceptions and actual skill levels may allow the establishment of cooperative grouping in the classroom to better tailor methods of instruction aligned with their learning styles.

Specifically, the study examined the discrepancies between students' perceptions of their digital skills compared to their actual performance on business computer software applications. These two factors were compared to their identified learning styles. Information collected from the study was used to implement revisions to the subject matter and best practices in business courses at the post-secondary level, namely the computer literacy course. In addition, the information was used to meet the goals and objectives required by accreditation authorities related to assurance of learning.

Purpose

The purpose of this study was to collect information to identify specific content changes and best practices for the introductory course identified as CIS 1800—Introduction to Information Technology and other business courses.

Population

The population of the study was entering freshmen. The accessible population was entering freshmen enrolled in the business orientation course in the fall 2009 semester at a small regional four-year public institution.

Methodology

Three instruments were utilized. First, permission was received to use and modify an existing instrument to measure students' perceptions of their technology abilities (Grant, Malloy & Murphy, 2009). The survey was presented as part of the College of Business Orientation course and made available to the students via the Blackboard Internet delivery system.

After the initial survey was collected, a second instrument was administered via computer as an undergraduate computer skills assessment pre-test originally developed by Creighton, Kilcoyne, Tarver, and Wright (2006) to assess skills in the CIS 1800 course. This assessment test was modified for the current study using preloaded databases, documents, and various other items for the students to use in completing the required tasks.

Lastly, Jester's "A Learning Style Survey for College" (2000) online was used to assess the student's learning styles. These instruments were administered as part of a continuing class project in the College of Business freshman orientation course in the fall of 2009.

Data Analysis

Descriptive statistics and statistical data analysis were performed. A Pearson product-moment correlation coefficient, measuring the strength of the relationship between two continuous variables (Pearson, 1986), was computed to assess the relationship between the students' perceptions and their actual performance.

Demographics. A total of 97 students participated in the final computer skills assessment. Of these, 89 completed the initial perceptions survey and the learning styles questionnaire. The participants were predominantly female (60%).

Differences by Learning Styles. Significant differences in performance on the application skills exams could point to instrument bias (the format of the skills test favoring a particular learning style) or to the need to tailor classroom computer instruction to better teach "disadvantaged" learning styles. To this end, student results on Jester's learning style survey were used as correlates to student performance on the computer skills assessments. No significant correlations were found. As a result, the learning styles survey will be dropped in future research.

Differences by Gender. An important question for educators is whether there exist gender differences in the computer experiences and abilities of high school students. This gender gap has been posited for more than 20 years and is the subject of recent research including Sink et al. (2008).

Subject self-reported experiences with computer applications grouped by gender are shown in Figure 1. Contrary to much of the current research in the subject, our data shows no disadvantage to female subjects with regards to computer experience. In fact, the only significant differences in performance by gender actually favored women as shown in Figure 2. Women performed significantly better than their male counterparts on both the Word and Access portions of the skills assessments (p-values of .019 and .002 respectively).

Relationships between Perceptions of Ability, Experience, and Skills. Significant relationships were found between student experience with applications in high school and their perceptions of their ability levels in these applications for Word, PowerPoint, and Access (see Table 1). Significant correlations were found between self-rating and skill level only in the case of Excel (see Table 2). No significant correlations were found between application experience in high school and measured performance skill level (see Table 3). High inter-correlations were found between almost all pairings of the skills performance tests (see Table 4).

Discussions and Conclusions

A major objective of this stream of research is to provide insight into what computer skills need to be taught as foundation courses in a university. Specifically this study examined prior experience in high school computer classes, self-ratings of computer ability and performance of tasks using the four most commonly used application packages – Word, Excel, PowerPoint, and Access. This research provides prescriptive guidance in two of these areas.

The Access exam will be dropped from the next administration. Less than 15 percent of the incoming students indicated that they had experience with Access. And, the average score on the Access portion of the exam was less than 5 percent correct. Thus, retaining the Access component in this study would seem to yield little knowledge. It seems clear that Access needs to be taught at the college level.

Conversely, the results of the PowerPoint portion of the skills suggest exactly the opposite. Although PowerPoint had not been taught in the college course in which many of these students were enrolled, the average score on the PowerPoint skills exam was about 87 percent correct. This strongly suggests that the time spent on PowerPoint in the current computer literacy course would be better spent on other topics.

Results of the skills tests in Word and Excel are less clear, largely due to methodological problems with the current study. Unfortunately, the skills exam was administered after the middle of the semester. This late administration confounded the skills possessed by students entering college with those obtained in college and could account for the lack of relationships between prior experience and performance. Specifically, both Word and Excel had been taught in the computer literacy class attended by many study participants. The next administration of the skills test will be in the first week of classes to eliminate this issue.

Our results do suggest that prior experience with technology has a stronger relationship to task confidence (the perceived ability to do a task) than it has to task competence (the actual ability to do the task). This could be a result of a lack of efficacy of teaching technology at the high school level, inherently short retention periods for the skills taught, or weaknesses in the methodology of the study.

A second point of the research is further investigating the relationships between experience, confidence and performance. It has long been thought that increased confidence in the ability to perform technical tasks tends to lead to an increased measure of performance. This hypothesis was not reflected in our current results.

A third point of the research is segmentation of the sample to identify subpopulations that might require different methods of teaching. Females have long been posited to be at a disadvantage in technical classes. Differing learning styles are another potential way to segment the population.

Our research yielded a somewhat surprising result—that, if there is an advantage, it lies with the female study participants who had both greater experience with technology in high school and greater performance on both the Word and Access portion of the skills exam. These results are seemingly in contradiction to other studies (Sink et al., 2008). This suggests that the differing results need to be investigated further.

Learning styles were not found to have a significant moderating effect on experience, perceptions, or skills and will be dropped in the next iteration of the study. This is not to say that the importance of identifying student's learning styles should be diminished when researching the value of pedagogy in classroom content delivery.

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Table 1. Self Ratings vs. Application Experience

		Word Experience	Excel Experience	PowerPoint Experience	Access Experience
Word Rating	Pearson Correlation Sig. (2-tailed) N	**.254(*)** **0.016** **89**	.260(*) 0.014 89	.265(*) 0.012 89	-0.024 0.825 89
Excel Rating	Pearson Correlation Sig. (2-tailed) N	0.007 0.947 89	**0.130** **0.224** **89**	0.085 0.426 89	0.154 0.150 89
PowerPoint Rating	Pearson Correlation Sig. (2-tailed) N	.221(*) 0.037 89	.234(*) 0.027 89	**.312(**)** **0.003** **89**	0.161 0.132 89
Access Rating	Pearson Correlation Sig. (2-tailed) N	-0.141 0.187 89	-0.040 0.708 89	0.103 0.335 89	**.304(**)** **0.004** **89**

* - significant at the .05 level ** - significant at the .01 level

Table 2. Self Ratings vs. Application Performance

		Word Performance	Excel Performance	PowerPoint Performance	Access Performance
Word Rating	Pearson Correlation Sig. (2-tailed) N	**0.010** **0.922** **89**	.240(*) 0.023 89	-0.030 0.777 89	0.079 0.463 89
Excel Rating	Pearson Correlation Sig. (2-tailed) N	-0.077 0.476 89	**.295(**)** **0.005** **89**	0.023 0.831 89	0.109 0.311 89
PowerPoint Rating	Pearson Correlation Sig. (2-tailed) N	-0.152 0.155 89	.210(*) 0.048 89	**0.121** **0.258** **89**	.227(*) 0.033 89
Access Rating	Pearson Correlation Sig. (2-tailed) N	-.215(*) 0.043 89	-0.068 0.527 89	0.014 0.893 89	**0.100** **0.352** **89**

* - significant at the .05 level ** - significant at the .01 level

Table 3. Application Experience in High School vs. Application Performance

		Word Performance	Excel Performance	PowerPoint Performance	Access Performance
Word Experience	Pearson Correlation	**0.004**	0.183	0.005	0.083
	Sig. (2-tailed)	**0.967**	0.086	0.959	0.441
	N	**89**	89	89	89
Excel Experience	Pearson Correlation	0.036	**-0.018**	0.113	0.129
	Sig. (2-tailed)	0.735	**0.867**	0.292	0.228
	N	89	**89**	89	89
PowerPoint Experience	Pearson Correlation	-0.052	0.166	**0.206**	0.100
	Sig. (2-tailed)	0.628	0.121	**0.053**	0.351
	N	89	89	**89**	89
Access Experience	Pearson Correlation	-0.113	-0.020	0.162	**0.049**
	Sig. (2-tailed)	0.291	0.851	0.129	**0.649**
	N	89	89	89	**89**

Table 4. Performance Inter-Correlations

		Word Performance	Excel Performance	PowerPoint Performance	Access Performance
Word Performance	Pearson Correlation	1	.237(*)	.277(**)	0.193
	Sig. (2-tailed)		0.019	0.006	0.058
	N	97	97	97	97
Excel Performance	Pearson Correlation	.237(*)	1	.213(*)	.318(**)
	Sig. (2-tailed)	0.019		0.036	0.002
	N	97	97	97	97
PowerPoint Performance	Pearson Correlation	.277(**)	.213(*)	1	.215(*)
	Sig. (2-tailed)	0.006	0.036		0.034
	N	97	97	97	97
Access Performance	Pearson Correlation	0.193	.318(**)	.215(*)	1
	Sig. (2-tailed)	0.058	0.002	0.034	
	N	97	97	97	97

* - significant at the .05 level ** - significant at the .01 level

Figure 1. Computer Experience By Gender

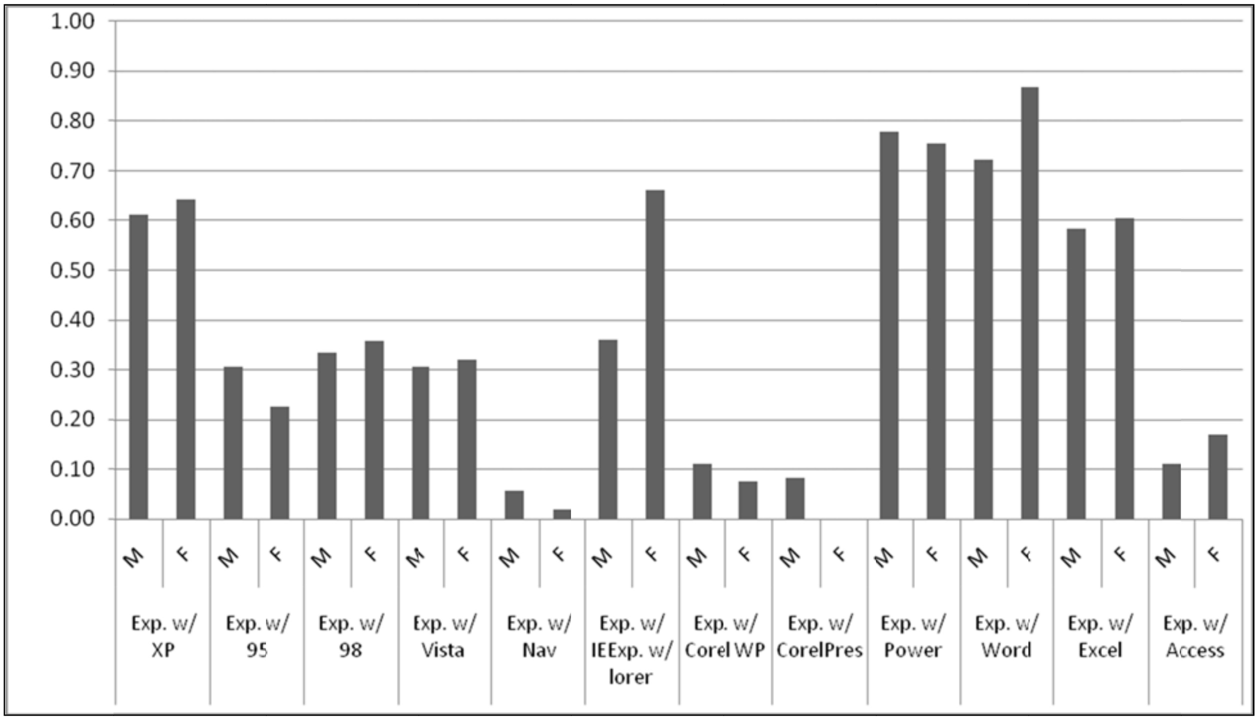
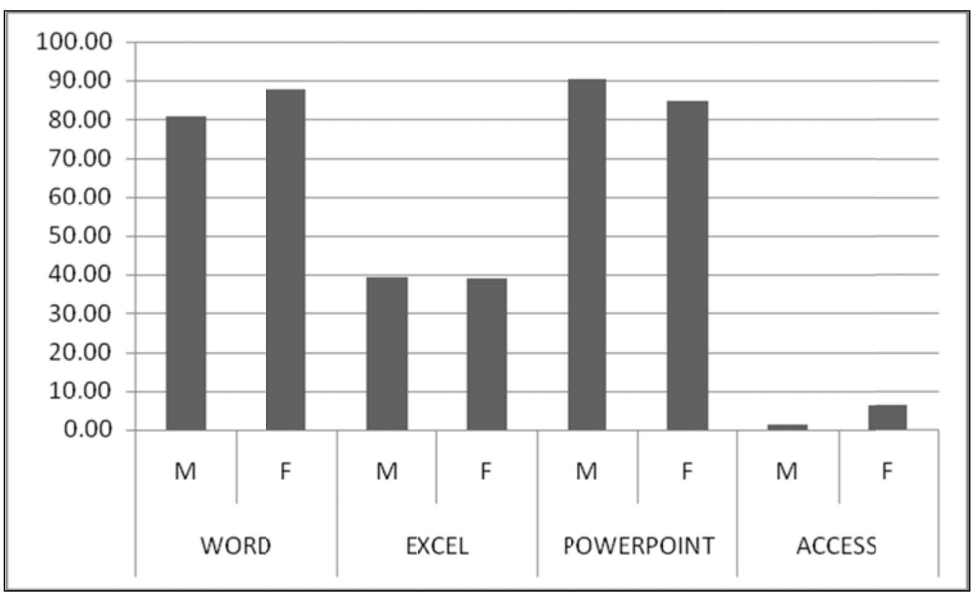


Figure 2. Computer Application Skill Score by Gender



Clickers in the Classroom: Do They Enhance Good Pedagogy or Just Patch a Problem?

Mr. Jim Larsgaard, Eastern Kentucky University

Abstract

Clickers, or student response systems, have been incorporated in classrooms to facilitate active learning with mixed success. Pedagogy and its possible implications to clickers increasing student performance is discussed. One hundred four students participated in research that investigated student learning outcome differences between students who used clickers and those who did not in highly interactive lectures. In addition, challenges to adding clickers to the classroom and further research recommendations are discussed.

Keywords: clickers, interactive, active learning, time, engagement

Introduction

Faculty at educational institutions large and small, in the U.S. and abroad have begun using audience response systems, more commonly called clickers. While not all educational experiences with clickers are positive (Kenwright, 2009), often faculty and students are enthusiastic about the positive outcomes related to clickers in the classroom (Beatty, Gerace, Leonard, & Dufresne, 2006). Because clickers allow every student to submit a response, clickers may increase student participation in the classroom and thereby facilitate active learning as they become more engaged in the process of learning. In addition, these systems can not only provide valuable feedback to both instructor and students during a class, but also can facilitate changes in both student and instructor behavior that enhance teaching and learning (Wood, 2004).

Teachers have recognized the effectiveness of active learning since at least the time of Socrates who stimulated active learning through questioning. Further, questioning with clickers meets at least three of Chickering and Gamson's (1987) seven principles for good practice in undergraduate education. Those three principals include the following practices:

- Encourages contacts between students and faculty.
- Uses active learning techniques.
- Gives prompt feedback

In addition, the ways different institutions implement good practice depend very much on their students and the circumstances (Chickering & Gamson, 1987).

Clicker technology has been successfully used in a broad array of contexts including but not limited to optional tutorials, formal standard lectures, in small classrooms with 15 or fewer students, to large classrooms with more than 200 students (Caldwell, 2007). While clickers have been incorporated into many education contexts, Beatty, et al. (2006) point out that clickers are a tool to facilitate active learning and not a magic cure for poor pedagogy or poor classroom management!

Goal of Clickers in the Classroom

While expressed goals of using clickers in the classroom vary, many of those goals relate to promoting a higher level of active learning by increasing student involvement and participation in the classroom through questioning. Clickers may be a technology that can enhance student participation by allowing them the comfort and security of anonymous responses. Draper (1998) reported that many instructors have adopted clicker technology to compensate for the passive, one-way communication inherent in lecturing and the difficulty students experience in maintaining sustained concentration. Other faculty have expressed goals that include: help students explore, organize, integrate, and extend their knowledge (Beatty, et al., 2006). Further, Martyn (2007) relates that most research has targeted clicker's affective benefits, which include greater student engagement, increased student interest, and heightened discussion and interactivity. Therefore, however stated, one of the principal goals of clickers in the classroom can be to increase student participation and thereby increase the active learning component of classroom instruction.

Increasing student participation through questioning goes back at least as far as Socrates. However, the difficulty of actively questioning students becomes much greater as class sizes increase. Students in large classes are often hesitant or unwilling to speak up because of fear of public mistakes or embarrassment, or even pre-existing expectations of passive behavior in a lecture course both on the part of the lecturer and on the part of the students (Caldwell, 2007). Therefore, clickers may offer a unique opportunity to increase student participation in especially in large classes.

On the other hand, incorporating clickers into the classroom is not without challenges. In addition to monetary costs, the time required to implement clickers properly can be considerable. Clickers can require the instructor to spend upwards of 20 hours just for learning the software (Hatch, Jensen, & Moore, 2005), time for preparation including development of appropriate questions designed for clicker response (Beatty, Gerace, Leonard, & Dufresne, 2006), in class organization time (students picking up and signing for clickers), and increasing class time to accommodate clicker use.

Purpose

The purpose of this research was to examine the difference in student learning outcomes between two groups of students in highly interactive classrooms with one group using clickers and the other group experiencing the same lecture format without clickers.

Design of the Study

Researchers have refocused teaching core concepts using a sequence that involves cycles of short presentations followed by concept questions, immediate feedback, and peer group and/or class-wide discussion (Nicol & Boyle, 2003).

Students enrolled in four sections of a 200-level Computer Information Systems course at a mid-size Southeastern US public university participated in this research. As illustrated in Table 1 Study Participants and Groups, two course sections (n=24 and n=27) were randomly selected to be in the treatment group, and the remaining two sections (n=26 and n=27) comprised the control group. Both groups (treatment and control) experienced the same instructional unit during the same two-week timeframe.

Table 1. Study Participants and Groups

Treatment - All Used Clickers/ Every Question	Section 1 n = 24	Section 2 n = 27	Total Treatment Group Using Clickers n = 51
Control Used 1 Student Verbal Response/ Question	Section 3 n = 26	Section 4 n = 27	Total Control Group Using 1 student Verbal Response/Question n = 53

A PowerPoint presentation was modified to include not only the instructional unit content, but to also include 16 slides with one multiple-choice question per slide. Each slide with a question also included four answer choices with only one of the choices being correct. Question slides were embedded in the unit PowerPoint immediately following the slides that contained the information to which the question related. The same PowerPoint including embedded questions was used during the unit delivery for both the Treatment and the Control groups.

Before the unit was delivered, participants [by class section] took the pretest. The instrument consisted of thirty fill-in-the-blank items worth two points each, and the same instrument was used for both the pretest and the posttest. Following the pretest, the instruction proceeded. The researcher taught all four course sections with a highly interactive pedagogy. In addition to the questions embedded in the PowerPoint, every student in both groups was addressed by name at least once during every class meeting, and the exchange required a verbal response from the student.

During the instructional unit delivery, when PowerPoint slides with the questions came onto the screen, all class participant in the treatment group answered the question with a response from their clickers. After clicker responses were complete for each question slide, the responses were displayed on the screen as a column chart. The columns in the chart indicated the number of responses for each of the four response options. After the chart was displayed, the researcher lead a brief class-discussion related to the question, the correct answer, and the responses.

The control group experienced the same PowerPoint slide set, including embedded questions, as the treatment group. However, the researcher chose one student per question slide to select an answer from the four choices with a verbal indication of selection. After the student made an answer selection, the researcher lead a brief class-discussion related to the question, the answer, and the answer choices offered in the PowerPoint. During the class period following the instructional unit, participants [by class section] took the posttest.

Findings

Of the 119 students registered in the course in which this research was conducted, 104 of the students attended all class meetings and submitted assessment instruments. Results of the data analysis are summarized as follows.

Demographics. Males represented 52.1% of the respondents, and females represented 47.9% of the respondents. As illustrated in Figure 1, 32 of the 104 respondents are Business majors, which is the major with the largest number of respondents in this study. In addition, 27 of the respondents were in majors that each accounted for fewer than two percent of the total. No relationship between student's major and gain score was observed.

Student learning outcomes. Student learning outcomes were assessed through pre and post testing. The total value of the thirty-item instrument was 60 points. As illustrated by Table 2, pretest scores were very low with the Treatment group average at only 7.9000 points or 13.17% and the Control pretest average at only 7.5584 points or 12.59%. Further, the posttest scores for the treatment and control groups were also both very low at 30.7750 points or 51.29%

and 29.4615 points or 49.10% respectively. Gain scores revealed that the Treatment group mean gain score was .9719 point higher than the control group mean gain score.

Table 2. Pre and Posttest Results

Group	Pretest Score Means	Posttest Score Means	Gain Score Means	Gain Score SD
Treatment – Clickers n=53	7.9000 (13.17%)	30.7750 (51.29%)	22.8750	11.74
Control – Verbal n=51	7.5584 (12.59%)	29.4615 (49.10%)	21.9031	10.23

Results of the paired t test between the gain scores of the treatment and control groups with the alpha level set at .05 revealed that there was no statistically significant difference. The two-tailed P value equals 0.6579. The treatment and Control Gain Score Means, Standard Deviations, and Standard Error of the Means are illustrated in table 3.

Table 3. Treatment and Control Gain Score Statistics

Group	Treatment	Control
Mean	23.00	21.91
SD	11.74	10.28
SEM	1.64	1.41

Discussion and Implications

The literature is rich with research demonstrating the benefits of active learning pedagogies, and clickers are a technology used to stimulate active learning (Martyn, 2007). On the other hand, reviews of the literature also indicate that it is possible that the alteration of teaching methods associated with clickers is responsible, rather than the use of clickers (Caldwell, 2007).

In this research, the same instructor delivered the same instructional unit to both groups using a highly interactive pedagogy. In addition, the same PowerPoint and consequently the same embedded question set was used for both groups, and both groups experienced the instructional unit over the same timeframe. Finally, both groups experienced the same pre/post assessment instrument.

While the treatment group experienced the added active learning stimulus of using clickers to answer the questions that were embedded in the PowerPoint, only one control group participant responded verbally to each PowerPoint question while the other participants listened. Therefore, one may infer that the level of active learning would be greater in the treatment group. However, considerations in addition to the number of student responses in the classroom may influence the level of active learning in this situation. For example, the teaching style of the instructor in this research is energetic and interactive.

In both groups, every student was addressed by name once during each class period, and a response from each student was expected. It may be possible that the active learning enhancement with clickers in an energetic collaborative pedagogy is different from the active learning enhancement in a non-collaborative pedagogy. Draper and Brown (2004) found that empirical indications support the theoretical view that learning benefits [of electronic voting systems] depend upon putting the pedagogy (not the technology) at the focus of attention in each use. Further, Draper and Brown (2004) point out that one of the weakest points in teaching at many universities is the use of lecturing, and the weakness in lecturing is often the lack of interactivity. Perhaps pedagogy was a change-mediating factor in this research. Therefore, a series of questions an instructor could ask when making the decision to use clickers could include:

1. What is the level of active learning in my classroom?
2. How do I perceive the goal/role of clickers in my classroom (enhance the active learning component of my teaching: exploration, organization, integration of knowledge; formative assessment, other)?
3. How do I perceive the use of clickers in my classroom (e.g., discussion, opinions, assessment)?
4. How much time will it take me to learn the software, develop the questions, distribute and collect the clickers, and use them in the classroom?

Recommendations for Further Research

Despite the lack of statistically significant results in this study, the fact remains that the literature includes both statistically significant studies and studies where no significant difference was observed. So the question remains, do clickers in the classroom enhance good pedagogy or just patch a problem? Following the work of Draper and Brown, researching pedagogical factors in addition to the inclusion of clickers in the classroom appear warranted. In this research, the instructor used the same highly interactive teaching pedagogy (with the exception of clickers) with both groups. Future research will include two groups, both with clickers. One group will experience a formal lecture with a low level of energy and minimal student/teacher interaction in addition to the clickers. A second group will experience a high-energy lecture with every student being addressed by name and a response will be expected.

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An Examination of College Students' Computer Self-Efficacy as Related to Various Demographic Characteristics

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Dr. S. Ann Wilson, Stephen F. Austin State University

Abstract

Despite extensive computer exposure, today's students vary in their judgments of their capabilities in using technology, referred to as computer self-efficacy (CSE). A survey of university students revealed highest CSE in word processing skills followed closely by file management and presentation skills. Students reported moderate ability levels in spreadsheet skills and less than moderate skill levels in database management, webpage design, and computer programming. Females tended to report higher CSE in file management and word processing applications, whereas males indicated higher CSE in web page development. Students whose parents did not attend college were likely to have lower CSE in spreadsheet applications, presentation software, and database applications as compared to students whose parents attended college.

Keywords: computer self-efficacy, computer confidence, computer anxiety, college student computer skills

Introduction

Computer technology has permeated every aspect of society, particularly the way we work, play, and communicate. Teaching and learning, like many other life activities, have been transformed by readily available technologies that allow communication and collaboration via the Internet and personal computing devices. Educators committed to the integration of technology into the learning process believe it will expand learning and better prepare students to interface in today's workplace. Employers demand workers who can not only use technology to complete a variety of work tasks and processes, but who also can leverage technology to advance the firm's strategic operations.

Despite extensive exposure to computers from an early age, today's students vary in their confidence levels concerning technology usage. Computer self-efficacy (CSE) refers to individuals' judgments of their capabilities to use computers in diverse situations (Marakas, Mun, & Johnson, 1998). Kinzie, Delcourt, and Powers (1994) described self-efficacy as an individual's confidence in his or her ability, which may impact the performance of tasks. CSE has been shown to influence an individual's choice to engage in a technology task and the effort expended to accomplish it (Bouffard-Bourchard, 1990). A study of Canadian managers and professionals revealed that CSE exerted a significant influence on individuals' expectations of the outcomes of using computers, their emotional reactions to computers, and their actual computer use (Campeau & Higgins, 1995).

Researchers have also postulated that positive attitudes toward computers, high computer self-efficacy, and low computer anxiety levels can be important factors in helping students learn computer skills and use computers effectively (Ertmer, Evenbeck, Cennamo, & Lehman, 1994; Hasan & Ali, 2004).

Review of Literature

Students currently enrolled in college have grown up as part of the Net Generation. For most, their computer experiences began in kindergarten or even earlier. Members of this group typically embrace technology in various forms, including cell phones, mp3 players, digital cameras, video games, iPads, electronic readers, and personal computers. The public education sector has generally recognized the critical need for high school graduates to possess computer skills. Some states require students to pass a computer proficiency test as part of their kindergarten through twelfth grade preparation (Grant, Malloy, & Murphy, 2009), and most require a technology applications course as part of graduation requirements. In a surprising departure from the national trend, the state of Texas recently dropped the requirement of a technology applications course as a high school graduation requirement (Tydings, 2009). While the decision could be defended from the perspective that current students generally possess informally acquired computer skills, others may argue that students' technology experiences may not include those generally required in the workplace. In spite of the extent of formal and informal computer exposure, today's students vary in their perception of their computer capabilities.

Students' CSE typically is influenced by both prior coursework and personal experiences. Thatcher, Zimmer, Gundlach, and McKnight (2008) found that CSE has two dimensions, external and internal. The external dimension focuses on how individuals perceive their ability to use computers with human assistance and other forms of external support. The internal dimension focuses on how individuals perceive their capacity to use computers independently. While many current students indicate a high degree of confidence in their computer skills, earlier studies of CSE found a significant percentage of college students in the United States suffered from technophobia (DeLoughry, 1993). Studies even in more recent years, however, reveal that many students continue to report high computer phobia and low CSE (McIlroy, Sadler, & Boojawon, 2007).

Keengwe (2007) found that in spite of the widespread availability of computers on college campuses, students lack various computer skills necessary to support and enhance their learning experiences. Johnson, Hornik, & Salas (2008) found CSE was related to both performance and satisfaction in an information systems course. Hasan (2003) showed that certain computer experiences had varying levels of impact on an individual's CSE. For instance, experience with computer programming and graphic applications was shown to have a strong and significant effect on CSE, while experiences with spreadsheet and database applications demonstrated weak effects.

While most current students can send email messages, download music, and chat online, employers are concerned with whether students can use a computer as a technology tool to address recurring business needs (Young, 2004). Work-related computer skills are typically thought of as consisting of proficiency in word processing, presentation programs, and spreadsheet applications, with other skills sometimes included such as file management and web mastering. Computing experiences prior to college may be helpful to varying degrees in providing students with basic technology proficiency; however, they are only a start in assuring that students are proficient in work-related computer skills when they leave college for the workplace. Some colleges and universities require incoming students to demonstrate a prescribed level of computer proficiency (Wallace & Clariana, 2005). Others require one or more computer applications courses as part of their curriculum requirements. Students with significant computer backgrounds may not feel that further computer courses would be beneficial. However, research shows that those who have experienced success with computers may be more inclined to take additional computer course work. CSE has been shown to be a powerful influence on future intentions toward technology (Agarwal, Sambamurthy, & Stair, 2000).

Grant, Malloy, & Murphy (2009) compared students' CSE ratings with their actual performance on an author-developed computer skills test. The study demonstrated a discrepancy between what students perceived as their computing skills and their actual assessed skills, indicating a need for most students to receive further instruction in computing applications.

Various measures of technology proficiency have been developed that could be useful in assessment of students' computer skills. For several years, Educational Testing Service (ETS) offered the *iskills* test which was developed with participation of business and industry representatives to assess the mastery of technology skills necessary for workplace success. Cengage Learning offers the Skills Assessment Manager (SAM), designed in association with Microsoft Corporation to test knowledge of Microsoft Office computer software applications. It is used by various colleges and universities to test students' technology skills (Course Technology, 2011).

While some educators hold the perception that students are becoming progressively more computer literate, some researchers have found a significant discrepancy between perception of computer skill levels and the reality of lower competence. If students are becoming progressively more computer capable, the content and depth of college-level computer applications courses should be adjusted appropriately (Wallace & Clariana, 2005). Effectively preparing graduates for the technology expectations of the workplace demands that the content of basic computer applications courses be continuously examined in light of student preparation for such classes and workplace needs. Content must be appropriate to the level of student needs and reflective of industry requirements.

Research indicates that behavioral and psychological factors can impact CSE (Moos & Azevedo, 2009). Various studies have documented that the gender gap is closing on CSE (Sam, Othman, & Nordin, 2005), though there is some evidence that male students spend more time at the computer for personal purposes than do females, and males outperform females at some computer tasks (Imhof, Vollmeyer, & Beierlein, 2007). More time on task may logically translate into a higher level of perceived ability. More research is needed about the relationship between various demographic factors and CSE.

Purpose

The purpose of this research was to examine the relationship between university students' self-efficacy in regard to computer applications skills and various demographic factors.

Design of the Study

Students enrolled in selected sections of a freshman experience course at a mid-size Texas public university were surveyed about their computer self-efficacy. A one-page questionnaire consisting of 13 items was designed by the authors to survey students about their perceptions of their own computer skills in seven career-oriented computer applications: file management, word processing, spreadsheets, presentations design, database applications, web page development, and computer programming. Various demographic factors were solicited including gender, age, high school class rank, size of high school, whether high school was public or private, and college major. Additionally, responses were examined in regard to whether the respondent was a first generation college student, whether access to a computer was available at home, and whether the student brought a computer to college. Students were also asked whether they had taken a computer class in high school and if they intended to take a college-level computer applications course.

A total of 197 students from the selected freshman experience course sections completed the survey. Course instructors voluntarily chose whether to ask students in their classes to participate. Most students who chose to participate answered the survey completely; in less than 2% of cases, some survey items were left blank. The first 11 items dealt with demographic factors. Item 12 asked students to rate their level of skill in the seven computer skill areas. Ratings were indicated on a Likert scale of 0-5, with 0 being "never used," 1 being "low skill," and 5 being “high skill.” The final questionnaire item asked respondents to report whether they intend to take a college-level computer course.

Standard percentages of responses were calculated. A Kruskal-Wallis test for categorical data was employed to determine whether a difference existed in perceived level of computer skill when cross referenced with a demographic variable. A .05 significance level was used for the analysis.

Findings

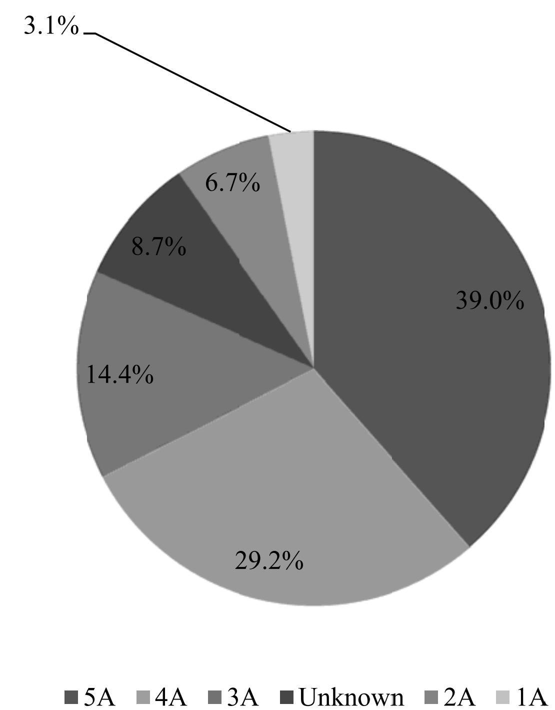
The results of the 197 student responses to the survey questionnaire are summarized as follows.

General Demographics

Females represented 62.9% of respondents, with 37.1% of respondents being male. The typical respondent to the survey was a female, age 17-19, who graduated in the top 25% of her class from a 5A public high school. Nearly all (97%) of respondents were in the age bracket of 17-19 years. The majority of respondents (57.5%) indicated being in the top 25% of their class, with 97.4% having graduated from a public high school.

In the state of Texas, the class 1A-5A system is used to identify school size by student enrollment, with 5A schools having the highest number of students. High school size in the survey was distributed predominantly in the 5A and 4A (larger school) categories as shown in Figure 1.

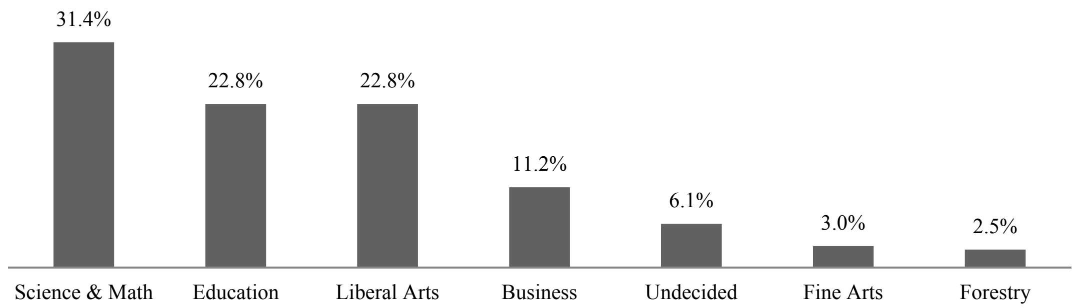
Figure 1. Distribution by High School Size



When asked whether one or both parents attended college, about two-thirds (62.8%) reported parental college attendance, while the remainder (36.2%) indicated that neither parent had attended college.

The reported college majors of responding students are summarized in Figure 2.

Figure 2. Reported College Majors



The survey group was dominated by majors reported from the colleges of Science and Mathematics, Education, and Liberal Arts.

Computer-Related Characteristics

All respondents indicated having had a computer at home, most (79.6%) for more than five years. Nearly all (94.9%) reported bringing a computer with them to college. The vast majority (95.9%) of respondents had taken a computer course in high school where it was typically required. Nearly half of respondents (47.1%) were not sure whether they would take a college computer class; about a quarter (25.1%) planned to take a computer course, and the remainder (27.8%) did not intend to take a computer course.

Students were asked to assess their skill level in several technology areas, using a Likert scale with 1 being “low skill” and 5 being “high skill.” A “never used” category was also provided. A brief explanation of each skill area was provided for clarity. The results of student responses are shown in Figure 3.

Figure 3. Student Self-Efficacy in Seven Technology Skill Areas

Skill Area	*0	1	2	3	4	5	Avg. Score	SD
Word Processing	0	0	4	33	55	104	4.32	0.83
File Management	2	3	10	29	49	102	4.19	1.08
Presentation	0	10	8	25	60	93	4.11	1.10
Spreadsheet	10	17	33	55	49	33	3.09	1.37
Database Management	23	30	33	64	30	17	2.48	1.48
Web Page Design	47	35	36	47	21	10	1.95	1.51
Computer Programming	54	47	33	37	13	13	1.73	1.52

*0 – Never Used 1 – Low Skill 5 – High Skill

Overall, students indicated (in descending order of confidence) stronger than moderate skills in word processing, file management, presentation applications, and spreadsheet applications. Students indicated less than moderate skills (in descending order of confidence) in database management, web page design, and computer programming skills. This finding concerning areas of low perceived skills is not surprising, in that all three areas receiving low self-efficacy ratings were not part of the state-mandated high school curriculum in business technology courses. Some students had been exposed to all seven skill areas in their high school programs, while others had not.

Relationships Between Demographics and Computer Skills Self-Efficacy

After examining the demographic responses of the reported self-efficacy as related to the seven computer skill areas, data analysis was conducted to cross-tabulate demographic factors with perceived computer skill levels. Virtually uniform results that were slanted to one single answer resulted for age, high school type, bringing a computer to college, and taking a computer class in high school. Thus, no relationship was shown to be present between these demographic factors and the perceived level of computer skill.

The remaining variables were cross-tabulated with the seven response questions concerning perceived skill levels: gender, high school size, high school class rank, parents attending college, major by college, and intention to take a college computer course. The following significant differences were found.

- **File management self-efficacy**. Gender is a borderline significant variable (p=.0552). Females are more likely to perceive themselves as highly skilled, while males are more apt to answer with perceived moderate skill.
- **Word processing self-efficacy**. Gender is highly significant (p=.0057), with females more likely to perceive themselves as highly skilled and males more apt to perceive themselves with moderate skills.
- **Spreadsheet applications self-efficacy.** The size of high school is borderline significant (p=.0730). However, this effect is true only in the case in which 3A schools and smaller are treated as one group and 4A and 5A schools are treated as the other group. Under this structure, smaller school students are prone to report higher perceived skill.

  Parents attending college is statistically significant (p=.0370) in relation to students' spreadsheet self-efficacy. If a student's parents did not attend college, then the student is more likely to have a lower level of perceived skill in spreadsheet applications. A student's plan for taking a computer skills class in college is borderline significant (p=.0616) in terms of spreadsheet self-efficacy. Students who are unsure about whether or they will take a college level computing class are more likely to profess less skill. If they state that they will take a college level computing class, then it is more likely that they perceive themselves as highly skilled in spreadsheet applications.

- **Presentation software self-efficacy.** Parents attending college is statistically significant (p=.0195) in relation to presentation software self-efficacy. If a student's parents did not attend college, the student is more likely to have a lower level of perceived skill in presentation software.
- **Database applications self-efficacy**. Parents attending college is statistically significant (p=.0147) in relation to database applications self-efficacy. If a student's parents did not attend college, then the student is more likely to have a lower level of perceived skill in database applications.
- **Web page development self-efficacy.** Gender is a borderline significant variable (p=.0997) as related to web page development self-efficacy. Males are more likely to perceive themselves as moderately skilled, while females are more apt to answer with perceived low skill in web page development. A students' high school rank is highly significant (p=.0085). Students with a higher class rank are more likely to perceive themselves as highly skilled in web page development.
- **Computer programming self-efficacy.** No demographic variables were found to be statistically significant when cross-tabulated with perceived skill in computer programming.

Discussion

The study examined responses to a survey from students enrolled in selected sections of a freshman experience course. The survey gathered information about demographics and computer-related characteristics, as well as students' self-efficacy as related to selected computer skills. The percentage of females in the study closely approximated that of the entire campus population. Those sampled were primarily traditional freshman students who had attended larger public high schools. Virtually all of those sampled had been exposed to computers in their homes and brought their own computer to campus. The vast majority had completed a required basic computer applications course in high school. The majority of respondents reported being in the top quarter of their high school class and had one or both parents who attended college.

The majority of students were enrolled in majors in either Science and Mathematics or Education. Overall, students reported highest self-efficacy in word processing skills followed closely by file management and presentation skills. Students reported moderate ability in spreadsheet skills and less than moderate skill in database management, webpage design, and computer programming.

Concerning the demographics that most explain differences in self-efficacy, students' gender and parents' college experiences were most often judged as predictive. Females tend to perceive higher skill in file management and word processing applications, whereas males indicate higher skill level in web page development. If a student's parents did not attend college, then the student is more likely to have a lower level of self-efficacy in spreadsheet applications, presentation software, and database applications. Other demographic variables were predictive of perceived skills in isolated instances.

Nearly half of the respondents were not sure whether they would take a college computer class; about a quarter planned to take a computer course, and the remainder did not intend to take a computer course.

Implications

Freshman students in the study were reasonably confident of their computer skills. Most students in the study reported having had a high school computer applications course, which presumably impacted their level of confidence in their computer skills. A concern is that in Texas where the computer technology course has been eliminated as a requirement for graduation, students may enter college less prepared and with lower computer self-efficacy. Preliminary tacit information gathered from the Texas business community indicates that employers are concerned with the level of computer skills newly hired employees will bring to the workplace if the technology credit is not restored to the curriculum.

In instances where high school students who are not required to learn appropriate business technology skills, students may need encouragement to take college computer courses, either through requiring them or making them attractive choices for electives. Additionally, students who are less confident in their computer skills may need further computer experiences more so than the general student population. Colleges and universities with a significant number of first generation students may want to pay particular attention to the computer skill preparation of its students.

Opportunities for Further Research

Another concern is that students with high computer self-efficacy may not necessarily be as strong in skills as they believe they are. In order to validate that students' beliefs match their actual skills, a second phase of this research could involve having freshman students not only complete the self-efficacy survey, but also take a computer skills test. Self-efficacy ratings could then be compared to actual performance on the skills test.

Increasingly, higher education institutions are required to be more accountable to all stakeholders. As a major part of accountability, institutions of higher learning must not only satisfy accreditation agencies, but they must also consider the magnitude of their responsibility to employers to assure that graduates possess skills necessary for workplace success. Ongoing research is necessary to stay informed about the computer skills that college graduates need to be successful in their careers.

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