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INFORMATION SYSTEMS EDUCATION JOURNAL

Clone Yourself: Using Screencasts in the Classroom to Work with Students One-on-One

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Abstract

Despite the fact that screencasts have been used in higher education for years, little is known about the effectiveness of using them inside the classroom – as part of a lecture. One of the main benefits of using screencasts in class is that it allows the professor to work with students one-on-one. This novel instructional method was implemented to teach the fundamentals of Microsoft Office and Google Sites as part of a required freshman undergraduate Computer Information Systems class. Effectiveness was evaluated at the end of the semester (N = 72). Results support the efficacy of screencasts over traditional lectures for step-by-step instruction. To maximize effectiveness, students should follow along with the screencasts during class time. Moreover, professors should consider interspersing screencasts with collaborative group work. Also, professors should ensure that the screencasts have an adequate level of difficulty for the students. Moreover, students should be encouraged to follow the screencast in real time, possibly by dividing the computer screen between the screencast and their workspace. Lastly, students should review screencasts after class to further increase learning outcomes. This paper discusses these and additional findings in detail and positions contributions in the context of prior research.

Keywords: screencast, differentiated instruction, flipped classroom, hybrid learning

1. INTRODUCTION

"Everyone can work independently, while still having the professor available for help. It's like cloning yourself." – Student

A screencast is "a digital movie in which the setting is partly or wholly a computer screen, and in which audio narration describes the on-screen action" (Udell, 2005, n.p.). The use of screencasts as an instructional tool in higher education is not new (Peterson, 2007; Winterbottom, 2007) and its efficacy has been addressed before (see e.g. Lee & Dalgarno, 2008; Ashdown, Doria, & Wozny, 2011; Pinder-Grover, Green, & Millunchick, 2011). Moreover, the recent rise of flipped classroom and hybrid learning models, as supported by Khan Academy, Udacity, Coursera, and EdX, has put screencasts back in the center of attention (Wakeman, 2013). However, most research has addressed the use of screencasts outside of the classroom – to replace or supplement traditional lectures (Sugar, Brown, & Luterbach, 2010). In contrast, this study concerns the use of screencasts inside the classroom – as part of a lecture.

The idea to use screencasts in the classroom arose in an undergraduate Computer Information Systems class during which fundamentals of Microsoft Office and Google Sites were taught to freshmen. Traditionally a specific function would be demonstrated, such as creating a chart in Excel, in front of the class using a video projector. Meanwhile, students would follow along on their personal laptops. In essence, the traditional lecture format was applied to technical content. However, often one or two students missed a step in the process and were unable to follow along. As a result, the professor would interrupt the demonstration and help the students catch up while the rest of the class waited. Despite being an unproductive use of time for students who were following along, it was stressful for students having to admit that they are unable to master a certain step in front of the whole class.

To address this issue, seven screencasts were created containing step-by-step instructions for Microsoft Excel, Microsoft Word, and Google Sites. Four screencasts covering Excel dealt with financial models, revenue forecasts, and loan payments. Two screencasts showed how to create a website in Google Sites and integrated it with a form to collect data. Finally, one screencast showed how to create a professional report in Word, using automatic table of contents, site numbers, and tables. Each 50-minute class began with a brief introduction of the activity by the professor, followed by individual work on the screencasts. Students wore headphones to avoid disturbing others. The professor walked around the room and worked with students who needed additional support. Students that completed a screencast were asked to help other students.

It was hoped that the use of screencasts in the classroom would allow students to work at their own pace, while allowing the professor to work one-on-one with students that need additional support – an approach known as differentiated instruction (Tomlinson, 1999). At the end of the semester, a survey was conducted (*N* = 72) to capture students' attitudes towards the use screencasts for step-by-step instruction. Of specific interest were the following questions, which this paper aims to address:

- What are students' screencast preferences?
- How do students utilize screencasts?
- What are the perceived benefits of screencasts vis-à-vis lectures?
- What are the perceived disadvantages of screencasts vis-à-vis lectures?
- Do students prefer screencasts over lectures for step-by-step instruction?
- How does the use of screencasts influence learning outcomes?

The remainder of this paper is structured as follows. First, prior research related to the use of screencasts in higher education is reviewed. Next, a description of the methodology of work, followed by the results of the survey is presented. Lastly, the results in terms of lessons learned are discussed.

2. LITERATURE REVIEW

Screencasts for instructional use range from simple lecture capture, such as narrated PowerPoint presentations, to more involved demonstrations of problem-solving or application usage. Screencasts have been successfully implemented in online education, for the recording of lectures (e.g. podcasting) and to augment classroom material. Pindar-Grover et al. (2011) used screencasts to explain assignment solutions and difficult topics in their Engineering courses. Their results indicated that students perceive screencasts to be helpful and they tended to use the resources as a study supplement. Pindar-Grover et al. (2011) found usage to be positively and significantly correlated with course performance. The most significant effect was found in students with the least amount of prior exposure to the concepts used in the course material.

Mullamphy, Higgins, Belward and Ward (2009) gathered students' opinions on the effectiveness of screencasts in teaching math at James Cook University. Ninety-eight point one percent of students found that the screencasts were useful. Eighty seven percent believed that they should be used as a supplement for lectures, but only 39 percent believed that they should be used to replace lectures.

Lloyd and Robertson (2012) used screencasts to assist in teaching statistics to undergraduate psychology students. They found that the students "were not just following algorithms based on rote memorization, but that their demonstrated enhanced learning arose from better conceptual understanding and problem-solving transfer."

Some of the benefits of screencasting include:

- Greater flexibility and access. Students prefer asynchronous access to learning materials to access them when it suits their schedules and life styles (Roach, 2006);
- Students can review the material at their own pace, rewinding and pausing as needed;
- Students engage better with familiar technology (Mullamphy , 2009);
- Increased student performance (Falconer et al., 2009; Lloyd, 2012 Pindar-Grover et al., 2011);
- Materials can be reused and shared across courses;
- Students can listen to the instructor explain the problem solving strategies that are used (Falconer et al., 2009);
- The number of views can be tracked when the screencasts are posted in a course management software system.

Screencasts have been shown to be an effective supplement to class materials. In numerous documented cases, student feedback has been positive and they feel that it is a valuable tool that aids in their learning process (Falconer et al.,2009; Mullamphy et al., 2009; Pindar-Grover, 2011).

3. METHODOLOGY

Seven screencasts were created with an average duration of 24:51 minutes (*SD* = 6:59 minutes) using Camtasia Relay, a commercial screen recording software (TechSmith Corp., n.d.). All screencasts were recorded on a Windows laptop. The software automatically converts a recording into MP4 format, uploads it to a video streaming server, and creates a public link. Four screencasts covered Excel (financial models, revenue forecasts, and loan payments), two covered Google Sites (how to create a website and contact form), and one covered Word (automatic table of contents, site numbers, and tables). The purpose of the screencasts was to replace the traditional lecture. Given that the class time was 50 minutes, the instructor aimed to create screencasts that would fill an entire class session, while still leaving enough time for an introduction and giving students the option to pause the screencast and ask questions. Students that finished a screencast early were asked to help other students.

Student learning based on the screencasts was assessed using a combination of project work and Excel-specific questions on the final exam. The project task, which spanned the entire semester, asked students to develop an idea for an iOS app, create a website marketing the app, and write a business case for their app as a final report and presentation. This project required students to apply the skills covered in the screencasts (e.g. develop a financial model, forecast revenues, calculate loan payments, create a website, and design a professional report). Moreover, the final exam included two Excel-specific questions, which required students to calculate loan payments (see Appendix A).

At the end of the semester, a student survey consisting of 14 multiple-choice and 2 open-ended questions was given. The order of questions was randomized for each respondent. Given that four out of seven screencasts dealt with Excel, questions were worded with a focus on Excel (see Appendix B). Students were encouraged to complete the survey and 72 usable responses were received, representing a 100% response rate.

4. RESULTS

What are students' screencast preferences?
To better understand students' preferences for screencasts, they were asked how they felt about the level of difficulty, amount of spoken instructions, pace in the screencasts, and length of screencasts. Almost everyone (94.5%) felt that the level of difficulty was "just right," while 4.1% thought it was "too high" and only 1.4% thought it was "too low." Similarly, 90.4% of students felt that the amount of spoken instructions was "just right," whereas 2.7% thought it was "too little" and 5.5% thought it was "too much." More than two thirds (79.5%) felt that the pace in the screencasts was "just right" and 5.5% thought it was "too slow." Interestingly, 15.1% felt the pace was "too fast," indicating a potential for improvement. In a similar vein, although 78.1% of students stated that the length of the screencasts was "just right," almost a quarter (21.9%) felt that it was "too long." Thus, it appears that a duration of maximum 25 minutes suits most students.

How do students utilize screencasts?
Students were also asked about their mode of consumption with regards to screencasts. Given that for all but 2 (2.8%) students, this was the first class in which a professor used screencasts,

it is particularly important to understand the evolving consumption practices for this medium. Specifically, they were asked how they watched the screencasts (screencast and Excel open side-by-side vs. switching back and forth between screencast and Excel) and how they followed the instructions (while the screencast was playing vs. while the screencast was paused). Although, all four combinations are equally possible, students who had the screencast and Excel open side-by-side were more likely to follow the instructions while the screencast was playing than students who switched back and forth between the screencast and Excel (χ^2 (1) = 11.567, *p* = .001). In fact, the majority (58.3%) of students used this mode of consumption for the screencasts. The distribution among the four combinations can be seen in Table 1.

	Could see screencast and Excel at the same time	*Could not see* screencast and Excel at the same time
Followed instructions while screencast was *playing*	42 (58.3%)	11 (15.3%)
Followed instructions while screencast was *paused*	7 (9.7%)	12 (16.7%)

Table 1: How did you watch the screencasts?

Interestingly, it was found that the mode of consumption is related to the perceived level of content difficulty. Students who had the screencast and Excel open side-by-side perceived the content of the screencasts to be less difficult (*M* = 1.98, *SD* = .143) than students who switched back and forth between the screencast and Excel (*M* = 2.13, *SD* = .344, *t*(70) = -2.636, *p* = .010).

In addition, of interest was understanding whether students would have preferred a "flipped classroom" model (Frydenberg, 2012), in which students watch screencasts on their own at home, thus freeing up class time for additional exercises and discussions. When asked if they would have preferred to watch the screencasts on their own at home and use class time for other activities, the majority (57.6%) were against (responded "strongly disagree" or "disagree"), while almost a quarter (23.3%) were in favor. It is important to note that students were not assigned any additional homework or preparation for the screencasts. Figure 1 below presents the distribution for this item.

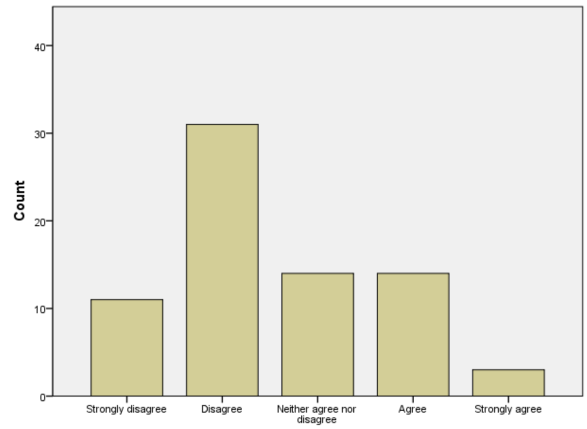

Figure 1: I would have preferred to watch the screencasts on my own at home and use the class time for other activities.

Students were also asked if they reviewed the screencasts on their own after class. In what appears to be honest self-reporting, 34 (46.6%) students responded that they "never" reviewed the screencasts and 36 (49.3%) responded that they reviewed the screencasts "sometimes" after class. The results are presented in Figure 2 below.

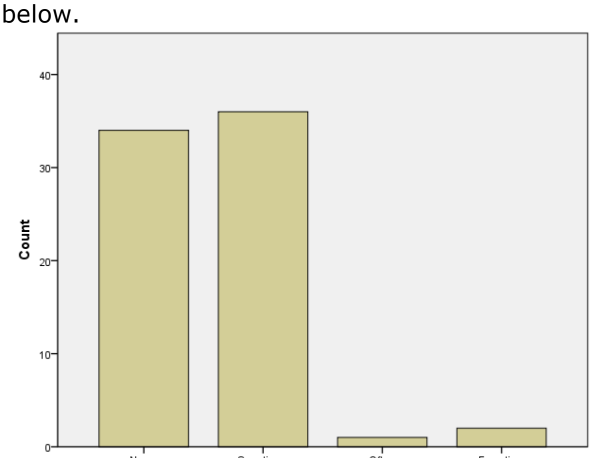

Figure 2: I reviewed the screencasts after class.

The amount of time spent reviewing is negatively correlated with the extent to which students felt the pace in the screencasts was too fast (*r*(70) = .366, *p* = .001). Thus, the more a student felt that the screencasts were moving too fast, the more time he or she spent reviewing the screencasts after class.

What are the perceived benefits of screencasts vis-à-vis lectures?

Next, questions were asked to assess students' perceived benefits of using screencasts. To better understand if students felt that personal attention by the professor was increased using screencasts vis-à-vis regular lectures, we asked students to indicate their agreement with the statement "the professor can give me more personal attention when the class is using screencasts than during regular lectures" (on a scale from 1 – strongly disagree to 5 – strongly agree). As can be seen in Figure 3, almost three quarters (74%) of students either agreed or strongly agreed with this statement.

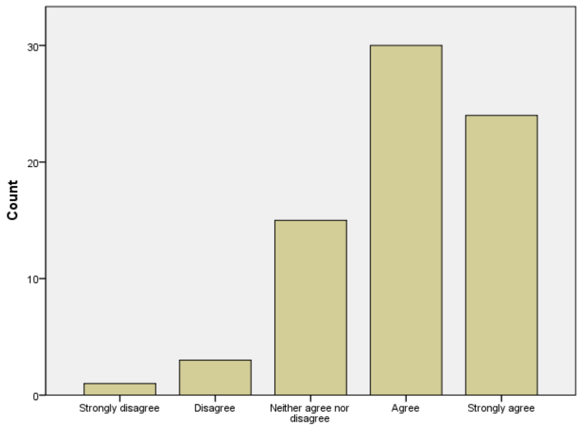

Figure 3: The professor can give me more personal attention when the class is using screencasts than during regular lectures.

Interestingly, the feeling that the professor can give more personal attention when the class is using screencasts than during regular lectures is negatively correlated with the preference to watch the screencasts at home ($r(70) = -.334$, $p = .004$). Thus, the more a student perceives the benefits of using screencasts during class (i.e. the professor giving him or her more personal attention), the more he or she prefers to watch the screencasts during class.

Next students were asked if they felt more comfortable following instructions using screencasts than following instructions during a regular lecture (on a scale from 1 – strongly disagree to 5 – strongly agree). Students' responses suggest that almost two-thirds (65.4%) felt more comfortable following instructions using screencasts than during regular lectures (responded "strongly agree" or "agree"). The results are shown in Figure 4.

Importantly, the extent to which students felt more comfortable using screencasts than during regular lectures is negatively correlated with the perceived level of difficulty ($r(70) = -.360$, $p = .002$). Therefore, the more students felt that the level of difficulty in the screencasts was too high, the less they felt comfortable using screencasts. Also, the extent to which students felt more comfortable using screencasts than during regular lectures is positively correlated with the feeling that the professor can give more personal attention when the class is using screencasts than during regular lectures ($r(70) = .316$, $p = .007$). Thus, the more students felt the benefit of increased personal attention by the professor, the more they felt comfortable using screencasts.

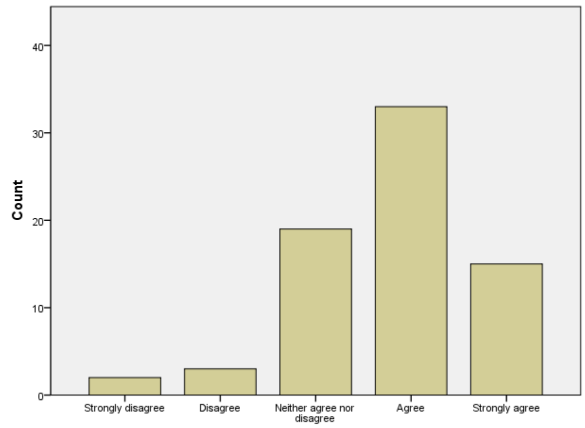

Figure 4: I felt more comfortable following instructions using screencasts than following instructions during a regular lecture.

In addition, students were asked for open-ended feedback to the question "what are the main benefits of using screencasts from your point of view?" Seventy-one out of 72 (98.6%) students responded to this question. Three main benefit-themes emerged out of an in-depth reading of the responses: (1) moving at your own pace, (2) catching up if you missed class, (3) receiving individual attention from the professor. The following sections address each of the themes.

<u>Moving at your own pace</u>
A lot of responses highlighted the fact that screencasts allow student to go through the material at theirr own pace. As one student noted: *"I'm a slower worker so being able to start and stop the screencasts helped."* Moreover, other students specifically pointed to the fact that screencasts allowed them to ask questions without the potential of being embarrassed or holding back the rest of the class. For example, one student stated: *"If you miss something you can always rewind the video instead of asking a question which saves some students the embarrassment and saves you time."*

Some of the students pointed out that screencasts allowed them to skip content. For example, one student stated: *"I found I could skip ahead if I already knew how to do a certain activity in Excel, so that was nice."* In a similar vein, some students were happy about not having to wait for other students. For example, another student stated: *"You can move at your own pace and don't need to wait for people who are slower."*

<u>Catching up if you missed class</u>
Several students specifically noted the advantage of being able to watch the screencasts if one missed class. For example, one student stated: *"If you miss a lecture you can still be up to date on what happened in class."* Similarly, another student stated: *"The main benefit is for kids that missed class because they wont [sic!] be as confused trying to complete the assignment outside of class."*

<u>Receiving individual attention from the professor</u>
Lastly, several students noted the benefits of receiving individual attention from the professor. For example, one student stated: *"Using screencasts allows you to get all the work done easier and faster because it's like having a one-on-one class. You are receiving individual attention as opposed to learning with the whole class."* Another student simply stated: *"It's like cloning yourself."*

What are the perceived disadvantages of screencasts vis-à-vis lectures?
Similar to the benefits, students were asked "what are the main disadvantages of using screencasts for instructions from your point of view?" Sixty-four out of 72 (88.9%) students responded to this question. A close reading of the responses led to the emergence of four main disadvantage-themes: (1) having a different software version, (2) being easily distracted, (3) following instructions without thinking, (4) having less personal interaction. The following sections address each of the themes.

<u>Having a different software version</u>
A lot of students have a Mac computer, while the screencasts were created on a Windows PC. Despite the fact that students could use a virtual application server, such as Citrix, to access the latest Windows version of Excel, many preferred to use the native Mac version of Excel. Thus, several students complained about the differences resulting from disparities in software versions. For example, one student noted: *"Using a Mac and following Windows instructions can be somewhat difficult."*

<u>Being easily distracted</u>
Several students were honest about being easily distracted on their own computers – especially when watching screencasts on the Internet. For example, one student stated: *"I just felt like I got distracted with other things on the computer because I knew that I could go back if I wanted to and re-listen."* Similarly, another student noted: *"Just having so many distractions at your disposal makes it tough to focus."*

<u>Following instructions without thinking</u>
Although noted by just one student, students might be tempted to follow instructions without really thinking about what they are doing which might be a disadvantage of screencasts. The student stated: *"Sometimes I don't focus on the content, I just do exactly what is done on the screencast without thinking about it."*

<u>Reducing personal interaction</u>
Lastly, several students stated that the use of screencasts precludes more personal interaction among students. Statements such as *"its [sic!] less interaction as a class"* and *"not very collaborative"* point to this shortcoming. Also, some students found that screencasts make teaching feel less personal – especially for students not asking any questions. As one student noted: *"Could be less personal if you do not ask the professor for help."*

Do students prefer screencasts over lectures for step-by-step instruction?
To understand students' general preference for screencasts over lectures for step-by-step instruction, they were to rate the statement "I prefer screencasts over lectures for step-by-step instructions" on a scale from 1 – strongly disagree to 5 – strongly agree. As can be seen in Figure 5, the majority (51.7%) indicated preference for screencasts over lectures for step-by-step instruction (responded "strongly agree" or "agree").

Surprisingly, general preference for screencasts vis-à-vis lectures for step-by-step instruction is influenced by the mode of consumption. Specifically, students who had the screencast and Excel open side-by-side were more likely to prefer screencasts over lectures for step-by-step instructions (M = 3.86, SD = .913) than students who switched back and forth between the screencast and Excel (M = 3.26, SD =

1.287, $t(70) = 2.258$, $p = .027$). This suggests that encouraging students to have the screencasts and Excel open side-by-side could increase overall preference for screencasts.

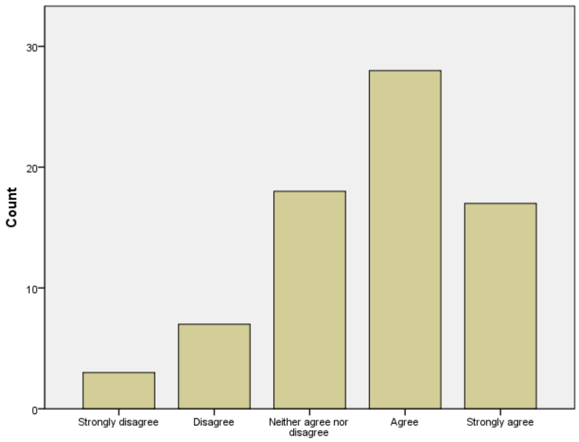

Figure 5: I prefer screencasts over lectures for step-by-step instruction.

Moreover, preference for screencasts over lectures is positively correlated with the extent to which students feel that the professor can give more personal attention when the class is using screencasts ($r(70) = .271$, $p = .021$). This further underlines the importance of individual attention for the effective use of screencasts during class time. Lastly, preference for screencasts is related to the perceived level of difficulty ($r(70) = -.297$, $p = .011$). Thus, the more a student felt that the screencasts were too difficult, the less he or she prefers screencasts over lectures for step-by-step instructions.

How does the use of screencasts influence learning outcomes?

To understand the impact on learning outcomes, students were asked how comfortable they felt using Excel prior to this class (on a scale from 1 – strongly disagree to 5 – strongly agree). Results suggest that students' self-reported level of prior knowledge varied significantly. In fact, 40.3% stated that they did not feel comfortable (responded "disagree" or "strongly disagree") while 42.4% stated that they felt comfortable using Excel prior to this class (responded "agree" or "strongly agree"). Thus, students began this class with significant differences in their perceived Excel skills. The specific distribution is shown in Figure 6 below.

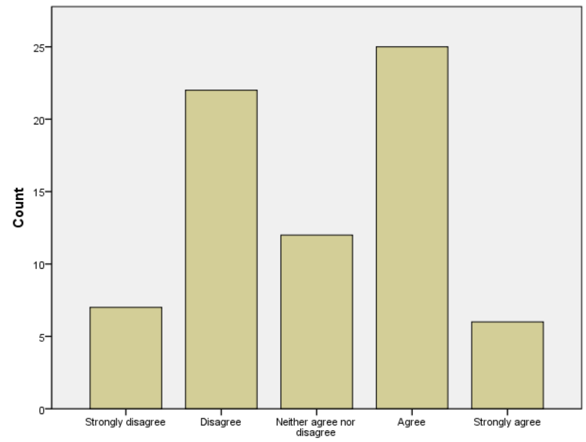

Figure 6: I felt comfortable using Excel prior to this class.

Perhaps not surprisingly, students' level of Excel skills prior to class is correlated with the extent to which students felt that the pace in the screencasts was too fast ($r(70) = -.268$, $p = .023$). In other words, students who were more comfortable using Excel prior to this class were less likely to feel that the pace of the screencasts is too fast. Moreover, students' perceived level of Excel skills is correlated with the extent to which students reviewed the screencasts after class ($r(70) = -.263$, $p = .025$). Thus, students who were more comfortable using Excel prior to this class were less likely to spend additional time outside of class reviewing the screencasts.

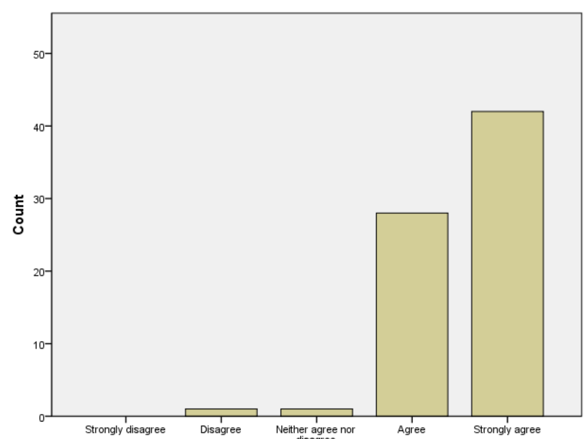

Figure 7: This class improved my Excel skills.

Next, students' perceived improvement of Excel skills as a result of this class was explored. Almost all students (95.9%) agreed or strongly agreed with the statement that this class improved their Excel skills. The specific distribution for this question can be seen in Figure 7.

Note that students' prior knowledge is not significantly correlated with skill improvement ($r(70) = -.109$, $p = .360$). This suggests that this class was effective in improving students Excel skills for learners at all levels. However, students' perceived improvement in Excel skills is significantly correlated with the extent to which students reviewed the screencasts after class ($r(70) = .253$, $p = .032$). Thus, students who spent more time reviewing screencasts after class were more likely to believe that their Excel skills improved.

Lastly, students' project work and Excel-specific final exam questions allowed for a partial assessment of student learning outcomes. Although students had to apply the skills they obtained in the screencasts in their final report and presentation, these artifacts were not graded solely based on mastery of Excel, Word, and Google Sites. However, given that students did very well in their final reports (the average grade was 91.33%, SD = 6.39%), it is reasonable to suggest that students learned most of the required skills. Moreover, almost half (47.3%) of the students answered correctly to the two Excel-specific problem-solving questions in the final exam (see Appendix A). Although these measures assess only parts of the skills that were covered in the screencasts, they are nevertheless a good indication of successful student learning.

5. DISCUSSION

The results of the survey can be distilled into five best practices. Obviously, these best practices are preliminary in nature and must be viewed with caution, as they are solely based on the experience of using screencasts for differentiated instruction in two introductory computer information systems classes. Each insight should be further investigated and thus points to potential for future research. Also, it is important to point out that findings are based on a self-reported survey and thus may be biased by students' perceptions of their own behavior and learning. The following sections describe each of the proposed best practices.

First, students should be able to work on screencasts during class time. Especially in introductory classes, where the level of skills can vary greatly, students feel an increased level of comfort if they are able to work on the screencasts in class – with fellow students and the professor present to answer questions. Similarly, professors should assign class time to screencasts if the level of difficulty of a screencast is particularly high. It might be adequate to assign screencasts as homework if – and only if – the level of difficulty is sufficiently low that students are unlikely to encounter difficulties or raise questions in the process.

Second, professors should intersperse screencasts with collaborative group work. Two disadvantages of screencasts – the potential to follow instructions without thinking and reduced personal interaction – could be addressed by having students pair up and work on an assignment that is posed after they completed a screencast individually. This way, students could work in pairs and apply the newly-gained knowledge while also increasing personal interaction.

Third, professors should ensure that the level of difficulty of the screencasts is not too low and not too high. For example, professors could regularly elicit student feedback regarding the level of difficulty in the screencasts. Quick student surveys after the first, fifth, tenth, etc. screencast could be used to ensure that the level of difficulty is adequate for the majority of students. The perceived level of difficulty is extremely important, since the survey has shown that it influences students' level of comfort with screencasts, as well as their general preferences for screencasts as an instructional tool.

Fourth, students should be encouraged to have the screencast and Excel (or whatever they are working on) open side-by-side. Being able to see the screencast and work simultaneously was found to be related with reduced perceptions of content difficulty and an increased preference for screencasts overall.

Fifth, students feeling that the screencasts are moving too fast or are too difficult should be encouraged to review the screencasts after class. Here, it is important to point out that this should only apply to a small minority of the class, since an adequate pace and level of difficulty are key factors influencing the successful use of screencasts in the class room. Also, students that missed a class should be encouraged to review the screencasts on their own, while making adequate arrangements to address any questions they might have.

6. CONCLUSIONS

Despite the widespread use of screencasts to support or replace lectures outside of the classroom, little is known about their effectiveness as an instructional tool inside the classroom. Screencasts were used to teach fundamentals of Microsoft Office and Google Sites as part of a required freshman undergraduate Computer Information Systems class and their effectiveness was evaluated at the end of the semester.

Results of the student survey (*N* = 72) suggest that students prefer screencasts over traditional lectures for technical, step-by-step instruction. Moreover, results indicate five best practices that can increase the effectiveness of screencasts: (1) students should be able to work on screencasts during class time, (2) professors should intersperse screencasts with collaborative group work, (4) students should be encouraged to follow the screencast in real time, possibly by dividing the computer screen between the screencast and their workspace, and (5) students should be encouraged to review the screencasts after class. Taken together, these findings lend strong initial support to the efficacy of using screencasts in the classroom to work with students one-on-one.

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Appendix A: Excel-Specific Final Exam Questions

You want to start a new company and need to borrow $50,000. A bank offers you a loan to be paid back over 10 years at an annual interest rate of 5%. You will make monthly payments, due at the end of each month. You want to completely pay off the loan in 10 years. What is the monthly payment you have to make? [*Note: The order of answer choices was randomized. Percentage of students who chose an answer is provided in brackets.*]

a) $528.13 [*23.0%*]
b) $530.33 [*50.0%; correct answer*]
c) $2,507.19 [*5.4%*]
d) $5,115.30 [*4.1%*]
e) $6,475.23 [*17.6%*]

You want to buy a house and need to borrow $500,000. Several banks offer 30-year mortgages. Payments are always due at the end of each month. You intend to pay off the mortgage in 30 years. What is the Annual Percentage Rate (APR; rounded to two decimal places) at which monthly payments are exactly $2,500? Hint: Use Excel Goal Seek to find the answer. [*Note: The order of answer choices was randomized. Percentage of students who chose an answer is provided in brackets.*]

a) 4.16% [*17.6%*]
b) 4.39% [*44.6%; correct answer*]
c) 4.42% [*27.0%*]
d) 4.78% [*10.8%*]

Appendix B: Survey Items

Question	***Answer choices***
1. This was the first class in which my professor used screencasts.	(1 = True; 2 = False)
2. How did you watch the screencasts?	(1 = I had the screencast and Excel open side-by-side and could see both at the same time.; 2 = I switched back and forth between the screencast and Excel and thus could not see both at the same time.)
3. How did you follow the instructions in the screencasts?	(1 = I followed the instructions "live" while the screencast was playing; 2 = I followed the instructions while the screencast was paused.)
4. I felt comfortable using Excel prior to this class.	(1 = Strongly disagree; 2 = Disagree; 3 = Neither agree nor disagree; 4 = Agree; 5 = Strongly agree)
5. I felt more comfortable following instructions using screencasts than following instructions during a regular lecture.	(1 = Strongly disagree; 2 = Disagree; 3 = Neither agree nor disagree; 4 = Agree; 5 = Strongly agree)
6. I prefer screencasts over lectures for step-by-step instructions.	(1 = Strongly disagree; 2 = Disagree; 3 = Neither agree nor disagree; 4 = Agree; 5 = Strongly agree)
7. I would have preferred to watch the screencasts on my own at home and use the class time for other activities.	(1 = Strongly disagree; 2 = Disagree; 3 = Neither agree nor disagree; 4 = Agree; 5 = Strongly agree)
8. The professor can give me more personal attention when the class is using screencasts than during regular lectures.	(1 = Strongly disagree; 2 = Disagree; 3 = Neither agree nor disagree; 4 = Agree; 5 = Strongly agree)
9. This class improved my Excel skills.	(1 = Strongly disagree; 2 = Disagree; 3 = Neither agree nor disagree; 4 = Agree; 5 = Strongly agree)
10. I reviewed the screencasts after class.	(1 = Never; 2 = Sometimes; 3 = Often; 4 = Everytime)
11. The amount of spoken instructions in the screencasts was ___________.	(1 = Too little; 2 = Just right; 3 = Too much)
12. The length of the screencasts was ___________.	(1 = Too short; 2 = Just right; 3 = Too long)
13. The level of difficulty of the screencasts was ___________.	(1 = Too low; 2 = Just right; 3 = Too high)
14. The pace in the screencasts was ___________.	(1 = Too slow; 2 = Just right; 3 = Too fast)
15. What are the main benefits of using screencasts for instructions from your point of view (as a student)?	(Open-ended)
16. What are the main disadvantages of using screencasts for instructions from your point of view (as a student)?	(Open-ended)

Educational Software for First Order Logic Semantics in Introductory Logic Courses

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Abstract

Basic courses on logic are common in most computer science curricula. Students often have difficulties in handling formalisms and getting familiar with them. Educational software helps to motivate and improve the teaching-learning processes. Therefore, incorporating these kinds of tools becomes important, because they contribute to gaining practice in dealing with formalisms. In particular, semantic analysis of first order logic formulas is an issue that presents several difficulties. For this reason, we developed two educational tools, *FOLST* and *LogicChess*, to support the teaching/learning process in first order logic semantics. Both tools are didactic, visual, and interactive. They allow users to experiment with first order logic formulas to determine their truth value. They are implemented in C++, and they have been released under a free software license. In this paper, we present *FOLST* and *LogicChess*, and we propose to design a framework based on the development and use of these two didactic tools.

Keywords: Educational Software, First Order Logic Semantics, Teaching Resources, Logical Concepts.

1. INTRODUCTION

Basic courses on logic are common in most computer science curricula. In this kind of course, students have to do a lot of individual work to solve exercises and to gain experience in working with formalisms. In this context, the use of didactic tools that support the learning process, without taking too much time to learn how to use them, becomes really useful.

The undergraduate degree program in Systems Engineering in our University has an introductory course on Propositional Logic and First Order

Logic (FOL) that is offered in the first semester of the second year.
Learning these subjects requires substantial individual work by students, because they have to solve logic exercises in order to obtain skills in handling formalism. At first, we used lectures and a pencil-paper problem solving approach to teach course content. From our teaching experiences, we noticed that students were not as motivated and interested as in programming courses, though they could understand the concepts. As educational tools can offer useful pedagogical possibilities that motivate and enhance teaching/learning processes, we have developed several didactic tools that follow the same logical notation and methodology used in the course and which are very easy and intuitive to use, with a fast speed of learning (Mauco & Ferrante, 2009; Mauco, Moauro & Felice, 2010). These tools are part of a project for developing educational software to support teaching/learning processes in introductory logic courses for computer science students. Advanced students developed them with teachers´ assistance, by applying design and programming methodologies learnt in other courses in their careers.

FOL is an extension of Propositional Logic, which includes predicates and functions (specified over a domain), to define a model or formula interpretation (Ben-Ari, 2003). Besides, quantifiers may also be used. The truth value of a formula depends on the model in which the formula is evaluated, making its determination more difficult than in Propositional Logic. There are some strategies, for example, that try to find contradictions in formulas. For this kind of problems, some didactic tools have been implemented (Huertas, 2011). However, FOL semantics (Ben-Ari, 2003; Harrison, 2009; Huth & Ryan, 2004) is one of the topics that turn out to be more difficult to understand for students, as it is possible to define infinite arbitrary models when determining the truth value for a given FOL formula. *Tarski's World* (Baker-Plummer, Barwise & Etchemendy, 2007) and *Moros y cristianos* (LLorens Largo, 2013) are tools developed as support in this topic.

To complement FOL semantics teaching/learning process, we have developed two didactic, visual, and interactive tools, *FOLST* (Mauco, Maggiori, Gervasoni & Felice, 2012) and *LogicChess* (Kiehr & Re Medina, 2012), which assist in the evaluation of FOL formula in models defined by the user in the domains provided by each tool. *FOLST* (First Order Logic Semantics Tutor) allows teachers and students to experiment with FOL formulas and determine their truth value. In order to achieve this goal, *FOLST* provides the users with the possibility of defining their own models working on two frames called Farm and World. Each of these frames provides the necessary elements to define a concrete model (a domain, functions, relations) in order to evaluate well-defined formulas in each of them. *LogicChess* allows users experiment with FOL formulas and find out their truth value working with models defined over a chessboard. Both tools give assistance when introducing formulas and show the corresponding truth value of each written formula in the model defined by the user.

Though these tools allow users to experiment with FOL semantics in real situations, the domains, functions, and relations implemented by each tool limit models definition. FOL expressiveness power is based on the possibility of working with arbitrary domains, functions, and relations, defined considering the situation the user wants to formalize. In order to take advantage of teachers and students experience in the use of *FOLST* and *LogicChess*, we conclude the paper proposing the development of a framework to support FOL semantics teaching/learning process incorporating domains, relations, and functions defined by users.

The paper is structured as follows. In Section 2 main issues related to FOL semantics are briefly introduced. Section 3 presents the educational tools *FOLST* and *LogicChess*. Section 4 describes the evaluation of the use of both tools in a logic course. In Section 5 we present the proposal of development of a framework to support FOL semantics teaching/learning process. Finally, some conclusions and possible future work are mentioned in Section 6.

2. FIRST ORDER LOGIC SEMANTICS

As FOL extends propositional logic to a broader degree of expressiveness, determining truth and implication for FOL formulas is harder than in case of propositional logic. FOL languages need to be able to refer to the objects that appear in propositions, and they also need to describe relations between objects (Ben-Ari, 2003; Harrison, 2009; Huth & Ryan, 2004).

FOL formulas only make sense if a model or interpretation is defined, which involves specifying predicates, functions and a domain of discourse. A formula in FOL might be evaluated in different models, and even might have a different sense in each of them. That is why formulas are more difficult to analyze in FOL. Since the predicates and functions described by a FOL formula could be anything, and the particular state of the domain of discourse might also change their truth values, FOL is absolutely instance-dependent. That is the reason why it is not possible to determine the truth value of any FOL formula without considering the definition of the involved model. However, there are many algorithms that deal with, for example, finding contradictions in formulas (Ben-Ari, 2003; Harrison, 2009). In this way, if a contradiction is found, it can be well stated that no possible model would ever make that formula be true (but if a contradiction is not found, a model-dependent approach could be considered anyway in order to decide its truth value).
Clausula (Mauco & Ferrante, 2009) and *Clprover* (Mauco et al., 2010), the tools that had already been developed for our course, dealt with this kind of methods. The idea of *FOLST* and *LogicChess* was complementary to that: to let the user experiment FOL in realistic situations and evaluate formulas on them, in a totally instance-dependent way. This would let the user feel the meaning of FOL and understand its applications.

3. THE TOOLS: FOLST AND LOGICCHESS

FOLST (Mauco et al., 2012) and *LogicChess* (Kiehr & Ré Medina, 2012) are didactic, visual and interactive tools that give support for syntactic and semantic evaluation of FOL formulas in user-defined models over the domains provided by each tool. These tools were developed by third-year students in computer science careers as the final project for two courses that involve logic and algorithms analysis and design contents (both courses are taken in the first semester of the second year of the career). Both tools were implemented in C++ programming language, using Qt framework for the graphical interface (Blanchette & Summerfield, 2008). In addition, they are free software under GNU GPL v3.0 license (GNU, 2012). In the context of educational software, this is important mainly because of two reasons: regarding students, it allows them to explore, experiment and analyze concrete implementations of algorithms and thus, besides using them as support in their learning processes, it encourages them to participate in the development of their own tools. Regarding professors, it strengthens resource sharing between different universities and collaborative improvement of their courses.

As *FOLST* and *LogicChess* have been designed with the purpose of being a didactic tool, it is important to highlight the functionalities they include as regards FOL semantics teaching. During FOL semantics learning process, students may have to face the following issues:
- to determine if a FOL formula is syntactically correct;
- to evaluate a formula in a model and determine its truth value;
- to define new models to evaluate given formulas and observe changes in their truth value;
- to determine if a formula is logically valid (valid in every model), contradictory (false in every model), or just satisfiable (valid in one model but false in another one).

In all these cases both tools offer didactic support to verify exercises, giving confidence to students about the correctness of their results.

FOLST

The tool provides the implementation of two frames, Farm and World that allow the definition of different models. The Farm frame (Figure 1) consists in an image of a farm where different animals (pigs, ducks, cows, cocks) in different places (in the forest, on the grass, in the air, in the farmyard) may be added. Each animal has attributes (species, location, is sleeping), and predicates allowing the formalization of real information in this context. The frame provides eleven unary predicates, such as IsACow(x), IsOnTheGrass(x), and IsSleeping(x), and two binary ones, SamePlace(x, y) and SameSpecies(x, y). In addition, there is a function to return, given an animal, its closest one (THECLOSEST(x)). The World frame (Figure 2) consists of a map divided into continents where cities (capital/non capital ones) may be located and connected. Six unary predicates are defined, such as IsCapitalCity(x), IsInAmerica(x), IsInAsia(x), and five binary ones, as SameContinent(x, y) and ThereIsAPath(x, y). The function THEFARTHEST(x) returns, for a given city, the farthest one.

Formulas for a selected frame may be written in the editor window, which shows the logical connectives and quantifiers considered by the tool (Figure 1). The tool verifies if each formula is syntactically correct with respect to a context-free grammar defined to recognize FOL well-defined formulas. This grammar was implemented using the free tools Flex, for lexical analysis (Paxson, 2012), and Bison, for syntactic analysis (Donelly & Stallman, 2012) In case of an error, *FOLST* reports the type of mistake the user has made so that s/he could detect and correct it easily. This is important from a didactic point of view since the users are not only warned about the error but they also get some clues to correct it. For example, Figure 1 shows three formulas written in a model based on the frame Farm. The tool informs in each case which is the error in the definition of the formula; errors could be independent of the frame used to instantiate the model (a parenthesis missing as in Formula 1, or the presence of a free variable as in Formula 2) or they could be specific to a particular frame (the use of an undefined predicate as happens in Formula 3). This figure also shows that the tool gives users the possibility to work with many different models simultaneously.

For each formula in the editor window, *FOLST* computes its truth value in a model when the user selects the option *Verify formula*. The possible results are Valid, in case the formula is true in the considered model, and False otherwise. The user may change the model, for example adding some cities if working with the World frame, and ask the tool to recalculate the formula truth value. Figure 2 presents a model that is an instance of the World frame. Five formulas were defined for evaluation in this model. As all of them are syntactically correct, the tool shows for each one the corresponding truth value.

In addition, it is important to remark that *FOLST* allows saving/loading models and formulas.

LogicChess

This tool allows the user to write formulas in the editor window checking them to determine if they are syntactically correct. Correct formulas may be evaluated in user-defined models. Each model represents a chessboard composed by chess pieces (rook, knight, queen, king, etc.), which have attributes such as colour (black, white), type, and position. Figures 3 and 4 show the main elements to define a model in this tool: the chessboard and a piece. Users may define a finite set of models in an easy way by adding, deleting or modifying model components. The tool provides fifteen predicates classified in: identification predicates such as is Pawn (piece), isKnight (piece), etc.; position predicates as for example sameRow (piece1, piece2), isInL (piece1, piece2); and distance predicates such as distance (piece1, piece2, number), freePath(piece1, piece2).

Using the elements presented in the previous paragraph, in an analogous way to what FOLST does with farms and world maps, *LogicChess* allows students to introduce FOL formulas and perform on the fly modifications of the model. After modifying the chessboard, the truth value of the formulas is updated. The same happens when a formula is modified. In that way, users can modify both model and formulas having an instant verification of its satisfiability.

4. DISCUSSION AND ASSESMENTS

FOLST and *LogicChess* are being class-tested during this semester. They are being used in lectures, to introduce FOL semantics, and for homework assignments. Students are now reporting positive experiences with its use (we have approximately 100 students per year) indicating that both tools are easy and intuitive to use. They also appreciated the assistance provided by the tools to correct mistakes when writing FOL formulas thanks to the grammar checking; it helped them to understand the concept of well-formed formulas. As another advantage, they mentioned that working with simple-to-understand and natural models as farms, world maps or chessboards, allowed them to focus on the understanding of the formula semantics instead of putting attention in the complexity of the model itself. To interpret and express complex models in the context of FOL is a difficult task that necessarily requires having a previous thorough knowledge of FOL semantics; our tools help to gain this knowledge. Using *FOLST* and *LogicChess* enhance the student´s learning experience through engaging them in the formalization of realistic situations; this is particularly important because both tools were thought for beginner students without formalism handling experience.

5. TOWARDS A FRAMEWORK FOR FOL SEMANTICS

Although there are some tools for evaluating semantics of formulas in FOL in which users may define different models, all of these tools work on a predefined domain with relations and functions also predefined, limiting then the definition of models (Baker-Plummer et al., 2007; Kiehr & Ré Medina, 2012; Llorens Largo, 2013; Mauco et al., 2012).

The expressiveness of FOL lies precisely in the possibility of working with arbitrary domains, defined according to user needs. Users should also be able to specify the relations and necessary functions considering the situation that each one wants to formalize.

In this context, it is important to emphasize that the design of *FOLST*, for example, was thought to make the tool extensible. Thus, new domains can be easily added by simply setting their relations and functions, without having to work on parsing or semantic evaluation algorithms of formulas. However, it is necessary to have knowledge of the design and implementation of the tool in order to specify the appropriate classes in each case.

Though the experience using *FOLST* and *LogicChess* has been successful, we think it can be enhanced by offering a more general tool. For this reason, we conceptually conceived an interactive and visual tool, which through a friendly interface, allows specifying different domains with associated relations and functions to define specific models or interpretations, taking into account that the main users of this tool will be students from the early years of the career, with little experience in programming. In this way, abstract models are left out and users will be able to define real, tangible models, in which users can work to interpret each formula and determine its truth value. To the best of our knowledge, there is no educational tool with these features.

Considering this situation, we are working on the development of a framework that supports and assists the user in specifying different frames as a basis for defining models, where a frame is defined by a domain and a set of relations and associated functions. Because this tool is intended to become a didactic support tool for the teaching/learning process of FOL semantics, not only for students but also for teachers, the framework should provide support for:

- a simple and intuitive specification of frames;
- maintenance of library of frames;
- definition of multiple models and formulas for each frame;
- parsing of formulas;
- semantic evaluation of formulas in a model;
- error handling either in frames specification or in definition of models and formulas.

Moreover, as self-assessment contributes to students´ learning process, we consider it very important that the framework gives support to analyze the results of the students' practices and automatically returns information about their corrections. This functionality is not included by neither *FOLST* nor *LogicChess*.

Considering the pedagogical and academic profile that we want to provide to the tool, platform-independent technologies and free software will be used for the design and implementation. In addition, special emphasis will be given to the development of appropriate and complete documentation and examples with which allow users to understand how to use the framework. Besides, to design the tool interface, aspects of human-computer interaction that facilitate students' teaching-learning process will be analyzed in detail (HCI Bibliography, 2013).

6. CONCLUSIONS

In this paper we presented two concrete tools to support teaching/learning process in FOL semantics, and we set the basis for the development of a framework conceived as the abstraction of these tools. This proposal arises from the authors' experience with the development and use of *LogicChess* and *FOLST* tools, and from the fact that in the analysis of existing educational software we have done, no tools were found to work with arbitrary domains, relations and functions in FOL.

Advantages and disadvantages that students have expressed during their practices using the mentioned tools have greatly influenced our framework proposal. After experimenting the advantages that provides an interactive graphical tool to solve exercises in a formal language as FOL, students suggested the need of new domains, relations and functions to model different situations.

An important aspect of *FOLST* and *LogicChess* tools is that they are Free Software and they use platform-independent technologies, so that versions for other platforms could be released. When using Free Software in the teaching/learning process, students have the possibility of using and sharing the resources it offers, and they are encouraged to have a look at the code, which makes it even more interesting since these tools have been developed under the same technologies students are learning at the time. But above all, full potential of educational computer programs is exploited. Given the positive experience with these tools, the framework will be developed using Free Software.

FOLST and *LogicChess* were developed by students to be used by other students, which makes it motivating in the teaching/learning process. They are currently being used as a complementary tool throughout the course, and will be used for sure in the future too. The tools focused strongly on the appearance of formulas, making them as similar as they were in class, and it is geared toward letting the user work with multiple models and formulas at the same time. Experiences from both projects were presented and published at student's symposiums (Maggiori & Gervasoni, 2012; Kiehr & Ré Medina, 2012).

The aim of this kind of tools is to bring Logic down to earth, a science absolutely abstract by itself, and let the student experiment its scopes and limitations under a daily-life situation. This understanding is highly appreciated before and while facing FOL formula solving algorithms and techniques.

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Appendix

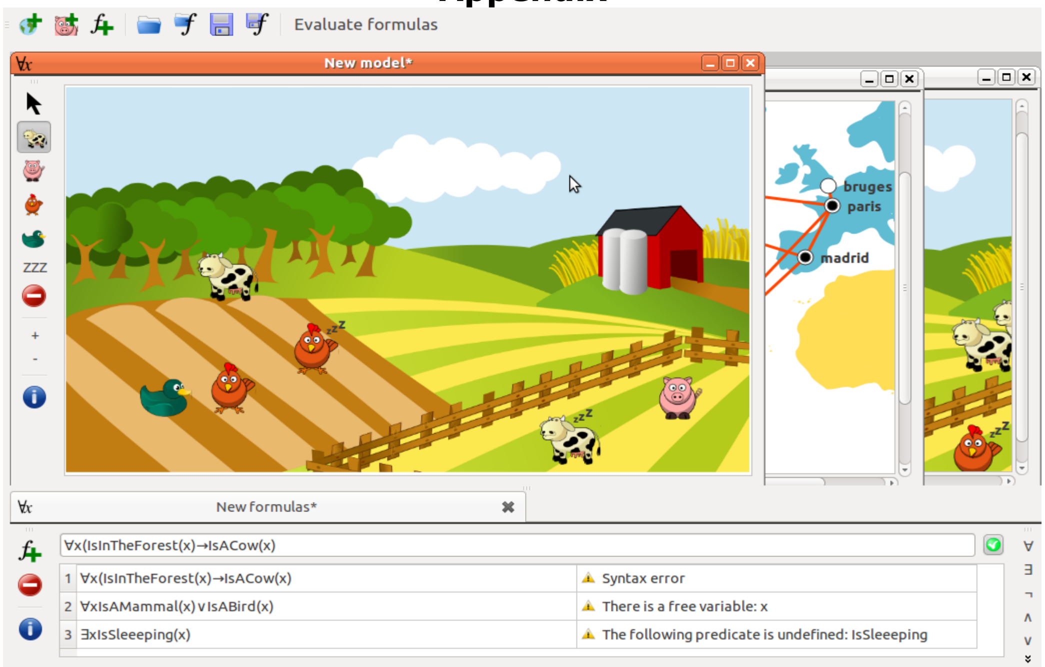

Figure 1. Model defined by the user in the Farm frame

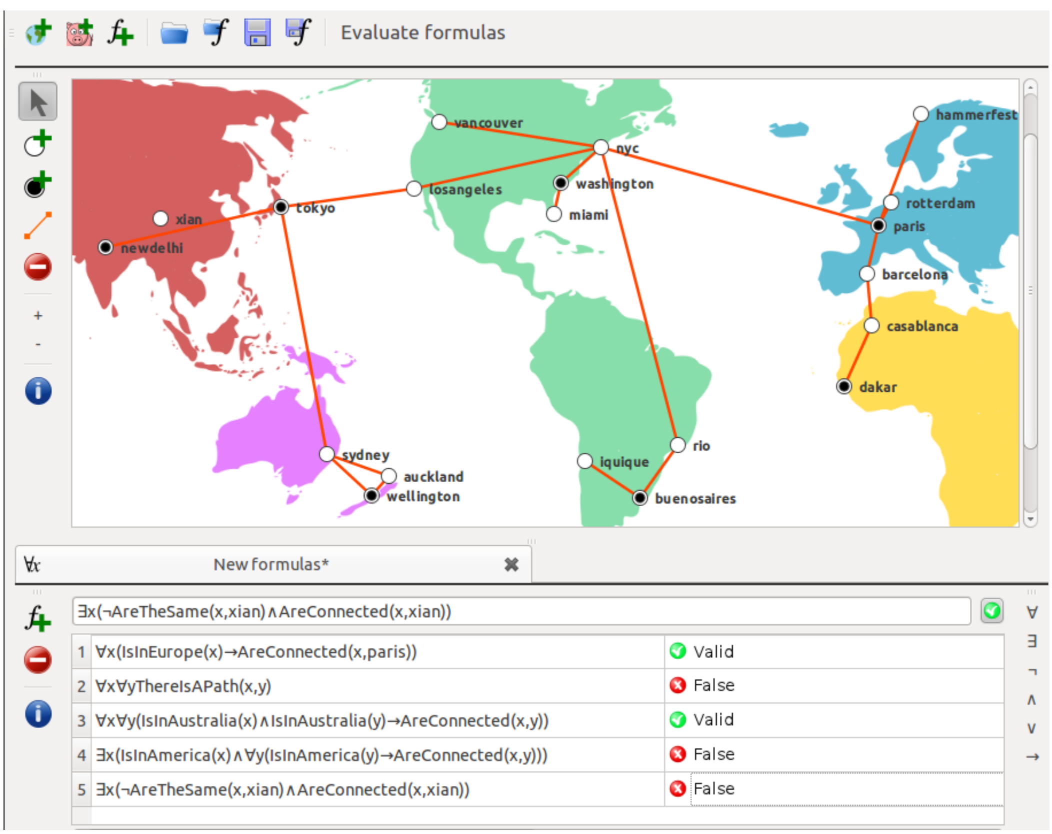

Fig. 2. FOLST evaluating truth values of formulas under user-defined World model

Figure 3. LogicChess evaluating a formula under user-defined model

Figure 4. LogicChess: a piece and its attributes

Distance Synchronous Information Systems Course Delivery

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Abstract

Teaching computer information systems via distance education is a challenge for both student and faculty. Much research work has been performed on methods of teaching via distance education. Today we are faced with a variety of options for course delivery. Asynchronous delivery via online or lesson instruction still remains most common. But alternative synchronous delivery methods such as Adobe Connect, Skype, and Eluminate Live are increasingly used as alternatives in a variety of situations and for a variety of purposes and classes. Our study reviews the use of synchronous distance course delivery and reports on specific experiences and results from two computer information systems courses over the past year. Post-class surveys from the students of these courses reveal interesting and useful insights into the acceptance and challenges of synchronous distance delivery methods including emphasis on technical stability and interaction.

Keywords: online teaching, distance education, computer information systems education, synchronous delivery, Adobe Connect

1. INTRODUCTION

Distance education has become a significant force in post-secondary education in the United States. In the 2006-7 year, 66% of two and 4 year post-secondary institutions offered "online, hybrid/blended online, or other distance education courses" (Parsad and Lewis, 2008). According to the U.S. Department of Education, National Center for Education Statistics (2003), there were 2,876,000 enrollments in college-level, credit -granting distance education courses with 2,350,000 undergraduate enrolments and 510,000 graduate enrolments. About 0.8 million, or 4 percent of all undergraduates, took their entire program through distance education. And most of these courses are offered online via the Internet in an asynchronous mode (90 percent). More recent information suggests how much this has grown. In 2007-8, there were 118,100 different courses offered, 89,600 of these were undergraduate and 27,500 were graduate. About 4.3 million undergraduate students, or 20 percent of all undergraduates, took at least one distance education course (National Center for Education Statisitics, 2011). But this phenomenal growth has not come without some issues. Concern has been expressed on the quality of distance education vis-à-vis traditional education. There have been many failures in distance education programs (NEA Higher Education 2002). But research has shown that done properly distance education can provide results similar to traditional education (Wegner, Holloway, and Garton 1999). Clearly, there are variables that affect the success or failure of a distance education course. One of those variables is the use of synchronous versus asynchronous delivery methods. This paper will review this area. First, we briefly review literature on distance education. Second, will be a brief review of Synchronous delivery literature and Adobe Connect implementations. Next, the authors will recount their experiences at their University with Synchronous delivery methods and results. Finally, the authors will explore various hypotheses on variables influencing suitability and likely future use of synchronous delivery methods via Adobe Connect.

2. REVIEW OF THE LITERATURE

Distance Education

Many authors have attempted to understand the reasons for success or failure in an online and/or distance education course. As a result, many factors have been proposed as important in determining whether a student will succeed or fail in an online distance education course. Alley and Jansak (2001) discuss key concepts in online success but first propose three levels of educational hierarchy. The first is a set of principles that are independent of learning environment or situation. They are the basic concepts that all knowledge transfer is based on. The second level is practice, which is specific to a type of delivery mode such as classroom or distance education. The final level is application specific, which deals with the unique situations in a particular course. This manuscript discusses general online variables that are at the second practice level as well as specific application situations and techniques that have proven successful in trying to teach information technology via distance education.

As noted, there has been an explosion in distance education courses and students over the past decade. The number has grown from 2.8 million students to 4.3 million students in only a six to seven year span from 2000 to 2006-7. And the number continues to grow. Many factors have contributed to this growth including flexibility for students, expanding access for students, and expanded course offerings (Bernard, Abrami. et. al. (2004) The economic pressures of today's economy and the rising cost of higher education have resulted in more and more traditional students needing to work during the school year to meet their financial obligations. As a result, work schedules often conflict with classes and students require the flexibility of distance education. Many students with disabilities are limited in their ability to meet in traditional settings. Distance education expands these opportunities. With distance education, classes can also be aggregated over greater geographical distances, allowing for a school to offer more varied and extensive course offerings than they have been able to if limited to only co-located students. Fabian (2008) suggests that travel is a significant factor in the move to online education with 79% of students living off-campus. The ability to attend class via distance methods and technologies reduces travel time and cost and provides an effective method to reduce overall energy consumption.

Advantages accrue to students, teachers, and the community at large. But one of the fundamental questions is whether distance education can provide the same quality of education as traditional classroom instruction. In one of the most comprehensive studies performed, Bernard, Abrami. Et. Al. (2004) performed a detailed analysis of distance education versus classroom instruction via a meta-analysis of 232 studies. Their overall conclusion was that there was little difference in education achievement between distance education and classroom instruction. To restate, after reviewing 232 separate studies on student achievement, there was found to be no significant difference between distance and classroom learning.

For distance education courses to be successful however, there are certain elements that must be present in the course design and development. Eastmond's (2000) findings focus on three primary areas – course design, support, and proficiency. Course design is critical to successful Internet course delivery. The factors that are advantages in distance education via online delivery, interaction, collaboration, hands-on learning, and reflection, all must be clearly and explicitly included in the overall course design. These do not just occur naturally in distance education, they must be explicit. Support in the form of individualized communications or help must be aggressively pursued. Again, it will not just naturally occur in an online environment. Finally users must be fully proficient in the technological delivery methods of the course or the course will fail. For information technology professionals or students, this may not seem to be an issue but even the most gifted students can be confounded by obscure and difficult to use interfaces and assignments.

Soong, Chan, Chua, and Loh (2001) performed a limited survey of students in three online courses to determine success factors in these courses. The authors analyzed results and proposed five factors that positively influenced results in online courses.

Human issues – Instructors must be skilled in motivation and adequately prepared for the online setting. They also must foster an enthusiastic environment.

Technical skills – Both the instructors and the students must understand and be able to easily use the systems.

Technical help – Help must be available to support the students if there are difficulties in utilizing the course website or resources.

Collaboration – High levels of successful communication and collaboration are strong indicators of success.

Mindset – Both the students and the instructors must view the online learning process positively.

Stidham and Frieden (2002) echo many of the concepts put forth by other researchers. Their success factors focus around the primary areas of content, communications, support, preparation, performance, and small class size. Content should be developed based on knowledge already possessed by an instructor. This may include the conversion of a traditional course to online delivery. Preparation is work that needs to be accomplished by the instructor as well as the student. The instructor may visualize the delivery of the course or its conversion from traditional methods. Communications in an online course are vital and should be easy as well as accurate. Brevity and clarity are also traits that should accompany successful online delivery.

Piercy (2000) studied the concept of teaching gerontology through distance education and found several successful strategies in this educational endeavor. These successful strategies centered on preparation, rapport, communications, and technical support. Piercy (2000) along with many other educators found that significant and different preparation was involved in developing and conducting an online class. Detailed syllabi, review of technological tools, and extended support materials all were needed. Communications are key again but Piercy (2000) emphasizes the two-way nature of communications, as well as timely feedback. Finally, for the course to be successful the technology must be successful and this includes ease of use, reliability, and accessibility of support.

Hillesheim (1998) recognizes three problem areas for distance education and proposes strategies for improvement. These problem areas are student issues, student/faculty relationships, and technology itself. Some of the areas of student issues include student attitudes and expectations, time management, and need for feedback. The author suggests that many of these personal issues can be dealt with through proper acceptances and then proper orientation. Faculty issues include responsibility, support, and encouragement. Faculty need to be encouraged to get students' attention, foster feedback, and successfully guide learning through proper presentation among other suggestions. Technology issues suggest the need for a proper environment to conduct the distance education class.

Wang (1994) reviews the literature of the time on distance education and suggests two key factors for distance education support, instructional materials and technological environment and support.

Meyen, Tangen, and Lian (1999) suggest that online courses have two significant areas that need to be addressed namely instructional features and support features. The instructional features include items such as lectures, notes, readings, activities, projects and exams. The support features include syllabi, technical support, and rosters. The authors suggest that the unique nature of online courses requires special detail in each of these areas.

Hara and Kling (2000) surveyed students and their problems with distance education and found that the major problems were lack of instructor feedback, ambiguous instructions and lessons and technical problems.

There are a variety of delivery methods for distance education but as suggested in this review, technology stability and support as well as interactive course design are both critical to course success. Beldarrain (2006) suggests interaction should be used as the "foundation of effective education practices."

Synchronous Delivery and Adobe Connect Literature Review

In general there are two primary categories of distance education delivery: Asynchronous and synchronous.

Asynchronous delivery is the traditional form of distance course delivery and began nearly a century ago with correspondence course delivered via the US mail system. A student would be sent study materials and exams and return completed work for review and grading. A student could review and study materials at a time convenient to them and return materials when completed. This method had limited market penetration and was confined primarily to trades and crafts. Some expansion of this approach included videos and/or audio tapes when these technologies became common. With the introduction of the Internet however, course design and delivery became more flexible and popular. Traditional online asynchronous courses are delivered via the Internet to students across the globe and as with all asynchronous instruction, students can review materials at their convenience and submit work, test, or projects via the Internet.

By contrast, synchronous distance education is a relatively new phenomenon. With the development of video and audio conferencing tools, students at a distance can now receive live real time feed of instruction simultaneous with resident instruction at a specific location. This generally requires a student to be present with a computing device at a specific time and place.

There are advantages and disadvantages to each of these distance education approaches. Brannon and Essex (2001) found advantages and disadvantages for both asynchronous and synchronous technologies for distance education. "Reasons for using synchronous communication included: holding virtual office hours, team decision-making, brainstorming, community building, and dealing with technical issues. On the other hand, distance educators have found asynchronous communication to be helpful for encouraging in-depth, more thoughtful discussion; communicating with temporally diverse students; holding ongoing discussions where archiving is required; and allowing all students to respond to a topic. Both types of communication have their disadvantages, however. Disadvantages of synchronous communication include: getting students online at the same time, difficulty in moderating large-scale conversations, lack of reflection time for students, and intimidation of poor typists. Educators also cited the limitations of asynchronous communication: lack of immediate feedback, students not checking in often enough, length of time necessary for discussion to mature, and students feeling a sense of social disconnection."

Much study has been specifically done on asynchronous education implementations but less work has been accomplished on synchronous distance education.

A literature review was accomplished on the use of synchronous distance delivery and the most common tool used for synchronous delivery, Adobe Connect.

Dammers (2009) suggests the use of synchronous video conferencing tools is a new but growing area for distance education. Prior to this time these video conferencing tools were primarily used for business and other organizational meetings.

Wang (2008) performed a qualitative study and found that general levels of satisfaction with synchronous webinar delivery tools such as Eluminate and Adobe Connect. He found advantages of social presence and multi-level interaction. He noted advantages of synchronous online webinars as reduction of travel time, students learn in their own environment, and "near face-to-face interaction with the instructor and other participants." Wang (2008) also found technical issues such as delay or transmission interruption as one of the major issues in using online synchronous teaching tools.

Blackwell (2009) saw some of the advantages of Adobe Connect as ability to record classes for later review. Blackwell (2009) also noted the need to accept minor technical glitches and that students need to be active participants to get the most from online synchronous courses. Karabulut and Correia (2008) suggest Adobe

Connect as one of the highly recommended tools for online synchronous course delivery. Some of the advantages they suggest include rich multi-media abilities, cross platform compatibility, ease of use, and level of customization. Davidson (2007) notes the growth of online education at New Mexico Tech due to the incorporation of Adobe Connect synchronous tools in their online course delivery.
Falloon (2011) suggested positive benefits to Adobe Connect virtual classrooms including promotion of quality dialogue among students.
Armstrong, Morris, and Solomita (2008) also suggest areas for success include faculty training, student training, available technical support, training for all technical individuals, and good audio, video, and systems infrastructure. Bos (2011) performed a study and found that Adobe Connect can be successful and flexible environment for learning in the 21st century. The author performed a study based on Masters level elementary education students. Advantages included flexibility, interactivity, collaboration opportunities, and freedom to speak their mind from their own environment. Disadvantages noted were mainly focused on technical issues.

Fuest (2007) developed a six month project on the use of Adobe Connect in the classroom. He suggests some specific guidelines for success including tool training, content preparation, standard course layouts, clear agendas, and assurance of technical support. Buchman and Murray (2013) studied the use of Adobe Connect for teaching rural Appalachian students. There were generally favorable results but some limitations noted were network issues, microphone echoing, and the possibility of audio interference. All these were technical issues.

Though not much work has been done comparing the two options, Offir, Lev, and Bezalel (2008) found higher levels of achievement in their study of synchronous versus asynchronous distance education.

3. COURSES DELIVERED

There was a desire on the part of our University to explore the use of distance education technologies to address low enrolled classes at a campus location as well as to provide a cross-regional educational experience for our students. As noted Offir, Lev, and Bezalel (2008) found higher achievement via synchronous course delivery. They also found Adobe Connect to be successful and flexible. Based on this and our full literature review, it was decided we would use Adobe Connect for two upper level classes at our campus location. The courses would be taught live in the Fall of 2012 and simultaneously broadcasted via Adobe Connect at least two other campuses. The courses decided upon were IST 331 and IST 412. Course descriptions are as follows.

IST 331: **Organization and Design of Information Systems: User and System Principles** (3) Interdisciplinary survey of topics related to the use and usability of information systems.

IST 412: **The Engineering of Complex Software Systems** (3) Introduction to the engineering of complex software systems including software system specification, design and implementation, integration and test, and evolution.

Two different instructors delivered the courses over the fall semester. In general the courses were a success. Some general issues that rose up over the semester included the following.

- Technical stability is paramount. Adobe Connect can be a finicky application. Many times during the semester and often during each class, Flash would crash requiring a reopening of the Adobe Connect interface. Though this takes little time, it proved to be a frustrating experience for students as well as the instructor.
- Be careful with scrolling through presentation documents while using Adobe Connect. This rapid video change seemed to exacerbate the Flash crashes.
- There is a significant time lag on audio, therefore for those at a distance the inclusion of headsets as a key component of the student setup is essential.
- Wireless Internet access on the part of the students appeared to be less stable than wired Internet.

But more importantly, after our course we performed a detail survey to determine what variables affected the overall acceptability of this type of course by our students. The model we developed examined a variety of variables and their possible effect on overall suitability of Adobe Connect for the course and subsequent interest in future usage of Adobe Connect. The model is shown in Figure 1 (See appendix).

4. HYPOTHESES

The specific variables in the model were based on literature review. Our independent variables are the tools or environment in which our online teaching tool worked. Our dependent variables all related to acceptance and preference for the technology. As noted, the online teaching tool we studied was Adobe Connect.

Hypothesis 1: Ease of use of online teaching tools will significantly influence overall suitability of the tool for instruction.

Hypothesis 2: Technical reliability of online teaching tools will significantly influence overall suitability of the tool for instruction.

Hypothesis 3: Perceived quality of online teaching tools will significantly influence overall suitability of the tool for instruction.

Hypothesis 4: Perceived substitutability of online teaching tools versus face to face teaching will significantly influence overall suitability of the tool for instruction.

Hypothesis 5: Perceived interaction via online teaching tools will significantly influence overall suitability of the tool for instruction.

Hypothesis 6: Overall suitability of the online teaching tool for instruction will significantly influence future usage.

Overall then, we examined ease of use, technical reliability, perceived quality of the tool, perceived substitutability to classroom instruction, perceived interaction, overall suitability, and future usage.

A survey was developed and administered to all students near the end of the class semester.

5. RESULTS

Overall the courses offered were deemed a success. Success was defined as a positive response to the suitability and usage rate questions. There were 20 respondents to the survey and the overall suitability rate and future usage rate were good as shown in table 1. On a scale of 1-5 with 1=strongly disagree and 5=strongly agree, overall suitability rated a 4.05, above agree and enrolling another course using Adobe Connect rated a 3.8, only slightly less than a 4.0 agree. We found this result to be strong given this was our first effort with this delivery mode.

	Mean
I feel this course is suitable for the interactive video medium using Adobe Connect.	4.05
I would take another course that was delivered via Adobe Connect (assuming the course is of interest).	3.80

Table 1 Overall Acceptance of Adobe Connect

As our next step, Regression analyses using SPSS 20.0 was performed on the survey results to determine variables affecting overall suitability and the suitability impact on future use. We wanted to find out what was important to our students and where we might need to focus and/or improve. The specific questions answer were as follows.

The software used in these courses (Adobe Connect and ANGEL, *which is our University's Course Management System*) allows sufficient opportunity to interact with my instructor and course mates. In general, the quality of the audio reception for the students' voices is clear, Rate the reliability of the course delivery system used in this Adobe Connect course (reliability is the probability that the software will perform its prescribed duty without failure for a given time)., , In general, the volume level of the audio is satisfactory, In general, when viewing presentation material from the instructor (shared screen, PowerPoint, other documents), the clarity of the video is satisfactory., In general, the quality of the audio reception for the instructor's voice is clear., This medium (Adobe Connect) is a suitable substitute for having an instructor physically present at my site.

The responses to the questions were used to test each research hypothesis. For each of the first five variables, the dependent variable was: I feel this course is suitable for the interactive video medium using Adobe Connect.

Hypothesis 1: Ease of use of online teaching tools will significantly influence overall suitability of the tool for instruction.

There were two questions asked that addressed ease of use: I am able to connect to the Adobe Connect course meeting room easily. The Adobe Connect software is easy to use. As shown in Tables 2 and 3, neither of these ease of use variables had a significant impact on use and future use at $p < .05$. We therefore suggest that ease of use is not a factor in acceptance of the technology and reject research hypothesis 1.

Model		Unstandardized Coefficients	
		B	Sig.
1	(Constant)	3.168	.001
	The Adobe Connect software is easy to use	.218	.293

Table 2 Easy to Use

Model		Unstandardized Coefficients	
		B	Sig.
1	(Constant)	4.017	.000
	I am able to connect to the Adobe Connect course meeting room easily.	.008	.963

Table 3 Connect Easily

Hypothesis 2: Technical reliability of online teaching tools will significantly influence overall suitability of the tool for instruction.

Model		Sig.	
		B	
1	(Constant)	2.326	.000
	Rate the reliability of the course delivery system used in this Adobe Connect course (reliability is the probability that the software will perform its prescribed duty without failure for a given time).	.442	.003

Table 4 Technical Reliability

We next tested for the importance of the reliability of the software. Buchman and Murray(2013) and Wang (2008) suggested that technical reliability was an important variable. As shown in table 4, we also found that technical reliability was a significant factor for suitability at $p < .003$. Hypothesis 2 was accepted.

Hypothesis 3: Perceived quality of online teaching tools will significantly influence overall suitability of the tool for instruction.

Perceived quality of audio and video were studied via 4 questions and none of the variables showed significance at $p < .05$. This may be because the quality in both cases was not an issue. Hypothesis 3 could not be supported.

Model		Unstandardized Coefficients	
		B	Sig.
1	(Constant)	1.838	.033
	In general, when viewing presentation material from the instructor (shared screen, PowerPoint, other documents), the clarity of the video is satisfactory.	.253	.365
	In general, the quality of the audio reception for the instructor's voice is clear.	.442	.068
	In general, the volume level of the audio is satisfactory	.171	.465
	In general, the quality of the audio reception for the students' voices is clear	-.329	.073

Table 5 Quality

Hypothesis 4: Perceived substitutability of online teaching tools versus face to face teaching will significantly influence overall suitability of the tool for instruction.

If individuals viewed the online tool to be suitable versus face-to-face, they viewed the course as being suitable at p < .015. Hypothesis 4 was accepted.

Model		Unstandardized Coefficients	
		B	Sig.
1	(Constant)	2.669	.000
	This medium (Adobe Connect) is a suitable substitute for having an instructor physically present at my site.	.373	.015

Table 6 Tool Suitability

Hypothesis 5: Perceived interaction via online teaching tools will significantly influence overall suitability of the tool for instruction.

Those that Abobe connect provided sufficient interaction clearly correlated with overall suitability at p < .001. Hypothesis 5 was accepted.

Piercy (2000) noted that interaction is a key component of successful instruction.

Model		Unstandardized Coefficients	
		B	Sig.
1	(Constant)	1.180	.085
	The software used in this course (Adobe Connect and ANGEL) allows sufficient opportunity to interact with my instructor and coursemates.	.727	.000

Table 7 Interaction

Hypothesis 6: Overall suitability of the online teaching tool for instruction will significantly influence future usage.

Finally, as expected those that viewed Adobe Connect as suitable are more likely to take another course via this technology. The dependent variable here was level of agreement with "I would take another course that was delivered via Adobe Connect (assuming the course is of interest)." Hypothesis 6 was accepted.

Model		Unstandardized Coefficients	
		B	Sig.
1	(Constant)	.187	.793
	I feel this course is suitable for the interactive video medium using Adobe Connect.	.892	.000

Table 8 Suitable

The Adobe Connect software is easy to use	**Not significant**
I am able to connect to the Adobe Connect course meeting room easily.	**Not significant**
Audio/Video	**Not significant**
Rate the reliability of the course delivery system used in this Adobe Connect course (reliability is the probability that the software will perform its prescribed duty without failure for a given time).	**Significant**
This medium (Adobe Connect) is a suitable substitute for having an instructor physically present at my site.	**Significant**
The software used in this course (Adobe Connect and ANGEL) allows sufficient opportunity to interact with my instructor and coursemates.	**Significant**

Table 9 Summary of Results

Discussion of results

From our limited study, there are three questions that our student to have a significant impact on overall suitability of Adobe Connect for the courses delivered. In addition, there were three areas that did not show a significant correlation with suitability. The question with the largest impact was that Adobe Connect allows sufficient opportunity to interact with the instructor and coursemates. This suggests that the communication interchange is an essential component for successful distance education alternatives. The second significant variable was technical reliability. If the system or software crash, then the students soured on Adobe Connect suitability. Up-time is a key component of successful delivery. Finally, the view that a live instructor delivered remotely via Adobe Connect was a suitable substitute for a physical presence was a significant factor in overall suitability. This is a variable that may be strongly affected by age and gender and further study should be explored breaking down these demographic groups. The three areas that were found not to be significant were ease of use, audio/video, and ease of connection. It is postulated that these areas were not a problem for our students and as a result did not calculate to be significant.

Limitations

There are many limitations to this study. First, the study is a convenience sample of only two courses at our University. The study is meant as an initial attempt to explore possible issues and concerns involved in Adobe Connect distance education delivery. Further study is required to generalize these results across a larger population. Likewise, larger sample sizes are needed to attempt to develop a statistically valid model for Adobe Connect course delivery. The courses were upper level and should be expanded to freshman and sophomore courses. Additionally, there should be work done to compare results with on ground control delivery.

6. CONCLUSION

Our experiences with online distance education have been very positive and our results compared with my traditional undergraduate instruction appear to be similar. Student evaluations are similar as well. Overall, the experience of teaching online synchronous education has been interesting and worthwhile and results appear to be similar to classroom instruction. Our 20 students who responded to the survey and took the course generally agreed that the courses were suitable for Adobe Connect and that they would take another course via this medium. The variables that were found to be significant to suitability were technical reliability, interactivity, and the perception that an online presence was an acceptable substitute for a live physical presence. Though not without its challenges and issues, synchronous online course delivery via Adobe Connect can be a successful endeavor for both students and faculty.

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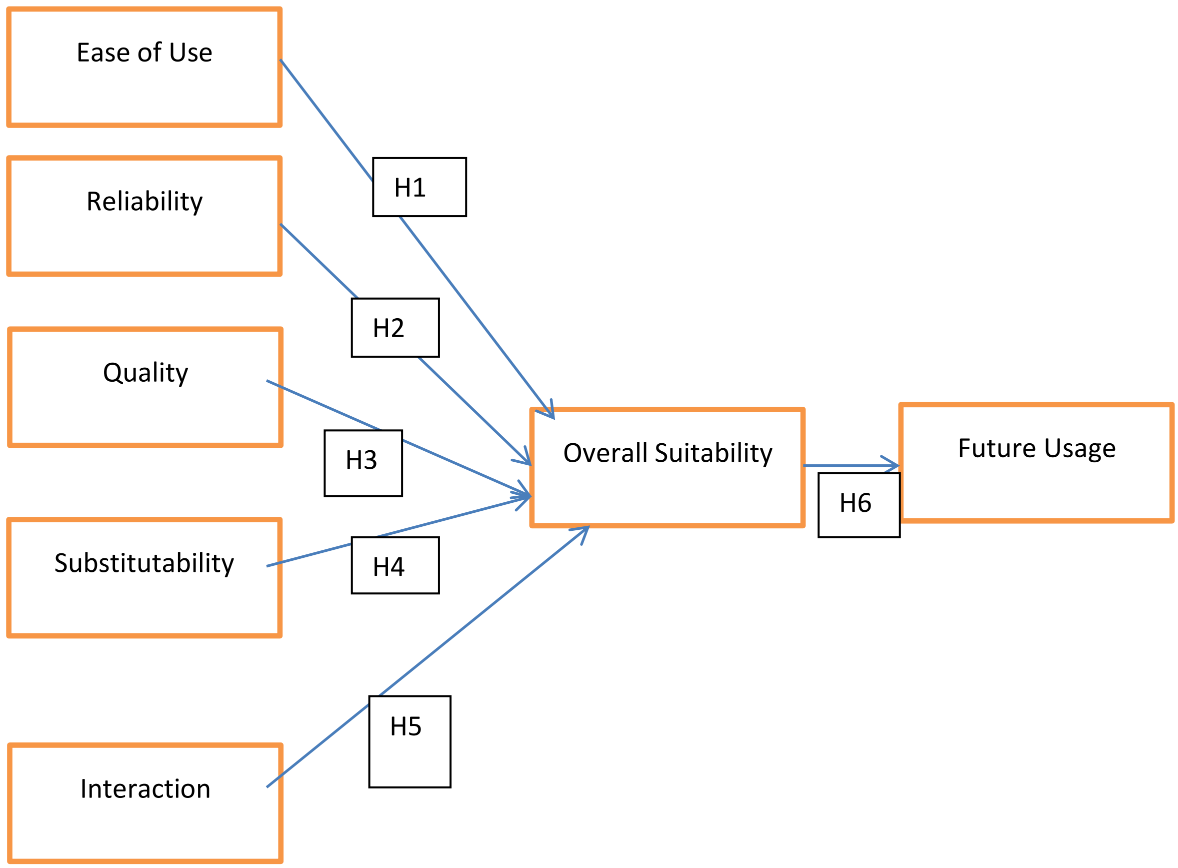
Appendix

Figure 1 Synchronous Course Delivery Suitability Hypotheses



Evaluating Effectiveness of Pair Programming as a Teaching Tool in Programming Courses

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Abstract

This study investigates the effectiveness of pair programming on student learning and satisfaction in introductory programming courses. Pair programming, used in the industry as a practice of an agile development method, can be adopted in classroom settings to encourage peer learning, increase students' social skills, and enhance student achievement. This study explored students' perceptions on effectiveness of pair programming and the influence of student's level of experience with this activity and perceived partner involvement on effectiveness outcomes. Findings suggest that the more students are involved in this activity, the more they enjoy it and the more they learn by collaborating with their partners. When comparing different effectiveness measures, their perceived learning, quality of work, and enjoyment during pair programming was found to be at a higher level than increased productivity outcome.

Keywords: Pair Programming, Teamwork, Collaborative Learning, Programming Course.

1. INTRODUCTION

Software development is typically a process that requires the coordinated efforts of the members of one or more teams. As such, it is important that computer programming courses provide students not only with technical knowledge, but also with the skills required to work in real-life projects. It is not sufficient for IS graduates to be technically competent. Social competence, such as teamwork and communication, are also important (Figl, 2010).

Pair programming is one of the collaborative leaning activities that has found support in academic environments as a promising strategy to approach learning programming. This paper presents a study on the implementation of pair programming as a team-based activity in information systems courses. It discusses what was learned about the impact of this type of collaborative activity on students' attitudes and learning. The following section provides a review of existing research on pair programming, collaborative learning and research questions and hypotheses. Next, the description of the study's methodology, results of data analyses and discussion are presented.

2. PAIR PROGRAMMING AND COLLABORATIVE LEARNING

Pair programming is the term used to describe the process in which two programmers work side by side, on the same task at one computer designing and coding the same algorithm. It is suggested that there are typically two roles in pair programming: the "driver", who has control of the mouse and the keyboard and the "navigator", who observes the work of the driver, offers suggestions and corrections to both algorithm and code. Each programmer takes a turn at being the "driver" and the "navigator". The two programmers collaborate in designing, coding and reviewing. Pair programming is one of the key practices in Extreme Programming (XP) (Beck, 2000). XP is one of the most popular agile software development methodologies with a strong focus on personal interactions among software developers. Benefits of pair programming include ability to notice more details when working in pairs, encouragement of best programming practices and sharing expertise (Wray, 2010).

Collaborative learning involves groups of students working together. Pair programming can be considered a model of collaborative learning. It incorporates the critical attributes of a collaborative learning activity: 1) common task; 2) small group learning; 3) cooperative behavior; 4) interdependence; and 5) individual accountability (Preston, 2005). There has been a significant amount of research on pair programming used as a collaborative learning tool in the traditional classroom. More recently, pair programming has been adopted in distance education, also known as virtual pair programming or distributed pair programming (Hanks, 2008; Edwards, Stewart & Ferati, 2010; Zacharis, 2011).

Studies on pair programming in the classroom have sought to capture both students' attitudes towards pair programming, as well as measure the actual benefits of pair programming such as improved learning and academic performance. Most of the previous research that has explored students' perceptions suggests that students have a positive attitude toward collaboration and communication that takes place during pair programming (Howard, 2007) and that they perceive that pair programming helped them develop teamwork skills (Cliburn, 2003; Edwards, Stewart & Ferati, 2010). It has been reported that students enjoyed working in teams (Williams & Kessler, 2001; Cliburn, 2003; McDowell et al., 2006; Howard, 2007; Chigona & Pollock, 2008; Mentz at al., 2008; Zacharis, 2011). In addition, students who worked in pairs reported higher confidence in the correctness of program solutions compared to individual programmers (Williams & Kessler, 2001; Werner, Hanks & McDowell, 2004; McDowell et al., 2006; Braught, Wahls & Eby, 2011). Several studies indicate that pair programming reduced student frustration (Howard, 2007; Simon & Hanks, 2008; Braught, Wahls, & Eby, 2011). Collaborative learning is considered one of the main benefits of pair programming in both professional and educational setting. Several studies indicated that students perceive they learned more by working with a partner than they would have by working alone (Cliburn, 2003; Carver et al., 2007; Edwards et al., 2010).

Other studies have focused on the impact of implementation of pair programming on academic performance and learning. The findings of these studies are not consistent. Some of them report higher assignment grades for pairs compared to solo programmers, greater likelihood of course completion and higher pass rates (Williams et al., 2002; McDowell et al., 2006; Mendes et al., 2006; Chigona & Pollock, 2008). These findings are not supported by all studies. A study by Zacharis (2011) showed that assignment grades for pairs were not significantly different from solo students. Individual exam grades (a measure of their knowledge of course material) were not different for those who used pair programming vs. those who did not (Williams et al., 2002; McDowell et al., 2006). There were cases when students felt that they understand their programs better when they work by themselves (Simon & Hanks, 2008).

In addition to academic performance, previous research has focused on other potential benefits of pair programming in the classroom, such as program quality and productivity. Many studies showed that pair programming improves the quality of the programs. Studies by Williams & Kessler (2001), McDowell et al., (2006), Chigona & Pollock (2008) and Zacharis (2011) report findings that students working in pairs produced better programs and higher software quality. Muller (2007) also showed that for simple problems, pair programming lead to fewer mistakes.

However, previous research does not provide the same support for the impact on productivity. Zacharis (2011) and Salleh et al., (2011) found that paired students were more productive than individual programmers and they completed tasks in a shorter amount of time. On the other hand, Simon and Hanks (2008) found that pair programming may or may not take less time. Another study by Williams & Kessler (2001) found that time for pairs and individuals was the same. This is in line with research findings on pair programming in general that indicate that collaborating pairs do not exceed the performance of its best member working alone (Balijepally et al., 2009).

Outcomes of the adoption of pair programming have not been the only areas examined by previous research. The review of the literature on pair programming in computing education revealed other areas that have been of interest to educators and researchers. Several studies focused on the pair formation approach. In some studies, pairs were assigned randomly (Mendes, Al-Fakhri & Luxton-Reilly, 2006; Muller, 2007; Hahn, Mentz & Meyer, 2009). Some other studies used matching pairs, based on criteria such as academic performance (Williams & Kessler, 2001; Choi et al., 2009; Zacharis, 2011). Van Toll, Lee & Ahlswede (2007) suggested that pair programming works best when programmers in a pair are of slightly different skill level. Bevan et al., (2002) also suggested pairing based on the skill level. Based on their experience of using pair programming in the classroom, disparity between the experience levels of students in a pair was one of the sources of intra-pair stress. Another factor of interest in team design was pair rotation versus same partner throughout the semester. Pair rotation was reported as an approach used by many studies (Carver et al. 2007; Braught et al., 2011). In some other studies students worked with the same partner during the semester (McDowell et al., 2006).

While research described above has provided theoretical and practical contributions to this area, adoption of pair programming as a teaching method can be further investigated using models and theoretical concepts from research on collaborative learning and teamwork effectiveness in educational settings. Little has been done to date to associate these two areas. The purpose of this study is to contribute in this direction by examining students' perceptions of effectiveness of pair programming as a learning activity and some of the factors that might influence these perceptions.

Based on the review of previous research, this study considered these factors of the effectiveness of pair programming as a teamwork activity: confidence in quality of work completed in pair, perceived productivity, enjoyment, and perceived learning. One approach to examine these perceptions would be to analyze which of the outcomes were considered to be more strongly impacted by the use of pair programming. The following research question will be addressed in this study:

Research question 1: What is the relative importance of perceived outcomes of pair programming by students?

Despite significant amount of research conducted on pair programming as a collaborative teaching method, there is still a need to investigate the factors affecting pair programming's effectiveness (Salleh, Mendes, & Grundy, 2011). As indicated in the previous literature review, most of the previous research has focused on factors such as the optimal pair formation approach, or level of complexity of the task. Literature on teamwork in educational settings suggests that previous experience with teamwork and task experience may have a beneficial effect on satisfaction with the teamwork activity. Littlepage, Robison & Reddington (1997) found that both group and task experience leads to better group performance. Wong, Shi & Wilson (2004) found that previous experience with teamwork influenced teamwork satisfaction. Hamlyn-Harris (2006) also looked at this relationship, but their study did not show a significant relationship between these two factors. This factor has yet to be investigated in the context of pair programming. In the reviewed studies, pair programming was implemented in a varying number of course activities ranging from a few labs or assignments to all labs and/or assignments. However, none of them has explored the effect that experience or the number of pair programming activities the students participates might have on their satisfaction and learning.

As such this study will test the following hypothesis:

Hypothesis 1: Students experience with pair programming activities is positively related to their perceptions of pair programming effectiveness.

Like any other team activity, one concern educators have about using pair programming is unequal participation of pair members. Cliburn (2003) suggested changing partners throughout the semester as an approach to deal with "free-riders". A known phenomenon in teamwork activities is that of social loafing, which occurs when individuals working together in groups put less effort than when they work individually (Balijepally et al., 2009). Hasan and Ali (2007) considered perceived loafing in the context of IS education. Perceived loafing is the perception that one or more other group members are contributing less than they could to the group. In their study, perceived loafing was found to have a significant impact on the success of the project, but not on the student learning from the team project. So the learning was not affected by other members' efforts. Jassawalla, Sashittal & Malshe (2009) explored students' perceptions of consequences of social loafing in group work. They found that the quality of work of the social loafer in the team does not directly affect team performance, because the rest of the team works harder to compensate for the poor work of a loafing team member. Instead, it is the distractive effect of having such a team member that affects the performance.

In the context of this study, it would be of interest to explore how the partner's collaborative effort might influence the outcomes for the other member in the pair programming team. Pair programming approach as a method can help alleviate this issue since students have to switch roles periodically. Based on this and previous research findings, it can be assumed that partners will put a similar effort during pair programming activities and perceptions of partner's effort will not impact the students' perceptions of effectiveness of pair programming activities.

Hypothesis 2: Perceived partner's effort will not influence students perceptions of effectiveness of pair programming.

Next section describes the methodology used in this study to answer the research question and test these two hypotheses.

3. METHODOLOGY

The study was conducted in the context of an introductory programming course for computer information systems students in a midwestern university during the time period of four semesters. The purpose of the course is to introduce principles and practice of software development using the object-oriented programming approach and develop problem solving skills necessary to develop software solutions to problems.

The first semester served as a pilot semester for the implementation of the pair programming approach. The survey was not administered during this first semester to avoid any confounding effect of implementation issues. A total of 82 students were enrolled in the different sections of the course during the three subsequent semesters. The number of students completing the survey was 64 and the number of valid responses was 63.

There were 8-9 hands-on or lab sessions during the course of the semester. In some of the sessions students were asked to work in pairs. Before the first pair lab session, students were introduced to pair programming through a short presentation and a video that demonstrated how pair programming works. In addition to explaining the rules of this class activity, it was important that students understood that this was a component of an actual software development method. Each session covered a different activity. Following the guidelines for implementing pair programming in the classroom by Williams et al., (2008), students were assigned into pairs by the professor instead of letting students choose their partners. Students had different partners during the semester. During the lab sessions where pair programming was used, pairs were closely monitored to ensure that they were using the pair programming method, such as the use of a single computer and role switching, to ensure that both students in the pair had a chance to be in both roles during the session. At the end of the semester students were asked to complete a survey about their experiences with the pair programming activities during the semester. The survey was completed anonymously.

The survey items and the constructs they measured are presented in the Appendix. In addition to questions related to the four effectiveness outcomes, the survey included questions about the partner involvement during pair sessions and the number of pair lab sessions the student participated during the semester. Participants responded to statements using Likert scales anchored by (1) Strongly Agree to (5) Strongly Disagree.

In this study, confidence in quality represents the strength of the student's perception of the quality of the pair's programming solution. Productivity represents student's perception of the time used to complete the exercise, and perceived learning represents student's perceptions of the learning that took place during the pair activities compared to individual ones. Most of the items were adopted by Chigona and Pollock (2008) and the last item was adopted by Howard (2007).

4. RESULTS AND DISCUSSION

A summary of students' responses for effectiveness items is presented in Appendix, Table 1. Data showed that except for the productivity, the majority of students either agree or strongly agree with statements that compare benefits of pair programming over working individually. Reliability analyses were initially performed on the items used to measure students' perception of pair programming activities. The alpha scores were within the acceptance range. Cronbach's alpha for confidence in quality was 0.74, enjoyment was 0.93, and perceived learning 0.84.

The first research question aims at exploring the relative importance of perceived outcomes and benefits of pair programming by students. Table 1 shows descriptive statistics for the variables that represent the various outcomes of pair programming activity.

Variables	Mean	Standard deviation
Perceived learning	2.22	0.82
Confidence in quality	2.37	0.88
Enjoyment	2.38	1.10
Productivity	2.70	1.12

Table 1. Descriptive statistics for effectiveness outcomes

Results show that the mean for perceived learning is the lowest among the four outcomes measured in this study, which means that the students have a higher level of agreement with statements that represent enhanced learning during pair programing activities. Perception of productivity, as measured by the time to complete the activity, has the highest mean. This indicates that students do not perceive that their productivity was increased during pair programing at the same level as the other effectiveness measures. In order to draw any conclusion about these differences in perceptions about the outcome measures and their ranking, paired samples t-tests were performed to determine whether these mean values are significantly different. Results of these analyses are shown in Table 2.

Effectiveness measures comparisons	Mean diff.	t	df	Sig
Perceived learning vs. Confidence in quality	-.15	-1.81	62	.074
Perceived learning vs. Enjoyment	-.16	-1.64	62	.106
Perceived learning vs. Productivity	-.48	-3.92	62	.000*
Enjoyment vs. Confidence in quality	.02	.20	62	.843
Confidence in quality vs. Productivity	-.33	-2.99	62	.004*
Enjoyment vs. Productivity	-.32	-2.56	62	.013*

Table 2. Results of t-tests for the differences among outcomes

These tests showed that students' perceptions of learning, their enjoyment and confidence in the quality of the program developed during the pair programming activity were significantly higher than their perceptions of productivity. Results of the tests also indicate that there are no significant differences among perceived learning, enjoyment and confidence in quality. Based on these analyses we can conclude that in this study students' perceptions of increased learning, improved quality of their work and enjoyment during the collaborative work in the pair programming activities are at similar levels. However, their perceptions of improved productivity due to working in pair are significantly lower than the three other outcomes. This finding does not necessarily diminish the benefits of this activity. Compared to industrial settings where productivity and quality are the main concerns associated with the adoption of pair programming, it can be argued that in educational setting productivity is of a lesser importance relative to learning and student engagement outcomes.

Another purpose of this study was to examine the role of students' level of experience or exposure to pair programming on the effectiveness outcomes. Hypothesis 1 states that this experience would be positively related to their perceptions of pair programming activities. Experience with pair programming was measured by the number of pair programming sessions students completed during the semester. In the sample used in this study, 7 students or 11% attended only one session, 28 students or 44% attended 2 sessions and 28 students attended 3 sessions. To test this hypothesis, regression analyses were conducted. The independent variable in these analyses was number of sessions attended. The dependent variables for each of the analyses were the effectiveness outcomes. Summary of results for these analyses are presented in Table 3.

Test	Outcome variables	β	t	p
1	Perceived learning	-0.27	-2.20	.032*
2	Confidence in quality	-0.17	-1.35	.183
3	Enjoyment	-0.27	-2.19	.032*
4	Productivity	-0.08	-0.62	.539

Table 3. Summary of regression analyses with number of sessions attended as independent variable

Results showed that the number of sessions completed has a significant effect on students' perceptions of learning and their enjoyment during these sessions. In other words, the more session they attended, the more they perceived to have learned more during pair programming and the higher the level of enjoyment. The results also indicate that the number of sessions does not have a significant effect on the confidence in quality and productivity. One explanation for these findings might be the fact that this study used pair rotation. Attending more sessions provided more opportunities to work with different classmates with different levels of skills. Also, as they became more familiar with the procedures of the pair programming activities they were able to enjoy the activity more.

In addition to the role of experience, this study considered the role of perceived partner effort. The second hypothesis stated that the perceived partner effort would not impact effectiveness outcomes. To test this hypothesis, regression analyses were performed. Summary of these analyses are presented in Table 4.

Test	Outcome variables	β	t	p
1	Perceived learning	0.37	3.08	.003*
2	Confidence in quality	0.42	3.65	.001*
3	Enjoyment	0.46	3.99	.000*
4	Productivity	0.40	3.35	.001*

Table 4. Summary of regression analyses with partner effort as independent variable

Results indicate that perceived partner effort had a significant effect on the effectiveness outcomes. This leads to the rejection of hypothesis 2. In this study, students' perceived partner effort has a positive significant effect on all effectiveness outcomes. The greater the student perceived their partners were equally contributing to the group activity, the greater was their perceived learning, confidence in work quality, enjoyment and productivity. These findings contradict those of some of the previous research where social loafing did not affect learning from the group activity or the quality of work. In this study, lack of partner contribution affects both learning and confidence in the quality of work. As for the other relationships, it is understandable that lack of participation from the other pair member would reduce the level of enjoyment and increase the time the complete the work.

5. CONCLUSIONS

Educators are always trying to find way to incorporate activities that would increase student engagement, learning, and foster their collaborative skills. Despite good intentions, these activities may not always have the desired outcomes of encouraging peer learning, increasing students' social skills, and enhancing student achievement. The objective of this study was to examine effectiveness of pair programming as a collaborative learning activity in IS education, as perceived by students.

Several factors that represent the effectiveness of this collaborative activity were considered and two main research questions were addressed. First, students' perception for each effectiveness factor was considered in order to determine which outcome had the higher level of achievement. Second, the study focused on the effect of two factors identified by the teamwork literature, experience with the activity and partner involvement on the effectiveness outcomes.

Findings provide some useful insights on the adoption of pair programming as a classroom activity to encourage collaborative learning and foster teamwork skills. Participants in this study perceived participation in this activity as beneficial in several areas such as learning, confidence in the quality of their work and being able to accomplish work faster than they would be working individually. They also enjoyed this type of teamwork in the classroom.

This study also showed that the more students are involved in pair programming exercises, the more they perceive they learn through it more than they would if they worked individually, and the more they enjoyed it. This has important implications for educators interested in adopting this activity in the classroom. To increase the benefits to students, they should plan for several programming activities, to allow for student to become familiar with the procedures and some of the unique aspects of this type of collaboration work. Also, educators should implement measures to ensure that pair members contribute equally to the team activity. This study indicated that this aspect has a significant impact on the outcomes of this activity. It is important to enforce role switching and incorporate peer assessments as a motivation for student to be involved. Pair rotation, having different pair assignments for each session, could contribute to mitigation of social loafing. On the other hand, this could prevent bonding between team members, also known as "pair jellying" in pair programming.

Future research can examine which approach might be more beneficial for student learning. This study focuses on effectiveness of this collaborative activity from the students' perspective. Future studies can examine the impact of the factors analyzed here on more objective measures of effectiveness such as academic performance and work quality as assessed by the instructor.

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APPENDIX

Items used to measure effectiveness outcome and frequencies of student responses.

Outcome	Items	Strongly agree	Agree	Neither agree or disagree	Disagree	Strongly disagree
Confidence in Quality	I find that pair programming develops better projects than programming by myself.	21%	33%	27%	14%	5%
	More errors were found and fixed when we pair programmed.	16%	56%	14%	14%	0%
	I was more confident in the work when we pair programmed.	22%	46%	11%	18%	3%
Perceived Productivity	The work was finished quicker because of the pair programming.	13%	37%	25%	19%	6%
Enjoyment	I enjoyed programming with a partner more than programming alone.	21%	35%	17%	22%	5%
	If I had the choice I would work in a pair programming team again.	30%	30%	23%	11%	6%
	I liked using pair programming during the in-class labs.	30%	33%	19%	16%	2%
Perceived learning	I learnt more from doing the work because of the pair programming	21%	36%	27%	16%	0%
	It was helpful to discuss programming problems and solutions with a partner.	33%	52%	10%	5%	0
	I think that using pair programming during the in-class labs helped me better understand the concepts.	21%	36%	24%	19%	0

The Google Online Marketing Challenge: Real Clients, Real Money, Real Ads and Authentic Learning

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Abstract

Search marketing is the process of utilizing search engines to drive traffic to a Web site through both paid and unpaid efforts. One potential paid component of a search marketing strategy is the use of a pay-per-click (PPC) advertising campaign in which advertisers pay search engine hosts only when their advertisement is clicked. This paper describes a class exercise utilizing the Google Online Marketing Challenge (GOMC) to teach search marketing and PPC concepts. The GOMC is a global collegiate competition in which student teams utilize a $250 budget provided by Google to design, implement, and monitor a PPC campaign for an actual small business client. This paper argues that the GOMC is an effective exercise to teach search marketing and PPC terminology, skills, and techniques and demonstrates many of the characteristics present in authentic learning environments.

Keywords: Search marketing, pay-per-click advertising, search engine, authentic learning

1. INTRODUCTION

Search marketing is the process of gaining traffic and visibility from search engines through both paid and unpaid efforts (Sherman, 2006). Under search marketing, unpaid efforts generally fall under the category of Search Engine Optimization (SEO). Individuals and organizations alike apply both onsite and offsite SEO techniques in an effort to have their site display high within the search engine results pages for certain desirable keywords (Sullivan, 2010). Normally, SEO techniques alone are not sufficient to provide the requisite visibility within search engines and are often augmented with paid search marketing campaigns. Paid efforts within search marketing generally follow a form of advertising known as pay-per-click (PPC) advertising. This form of advertising, also commonly referred to as cost-per-click (CPC) advertising, is an internet-based advertising model in which advertisers pay online hosts, typically but not exclusively, search engines, only when their advertisement is clicked by a potential customer (Sullivan, 2010). One of the most successful and widely used pay-per-click search marketing programs in the world is Google's Adwords (Kiss, 2010). In 2012 alone, Google generated over $43 billion globally in advertising revenue primarily from its Adwords program (Google, 2013a). Utilizing the Adwords program, advertisers create simple text-based ads that then appear beside Google search results or beside web content on the thousands of Google partner websites that comprise the Google Network (Google, 2013a).

Since 2008, Google has sponsored the annual Google Online Marketing Challenge (GOMC) to provide collegiate students real-life experience designing and implementing an online PPC advertising campaign using its Google Adwords product for an actual business client. This program has proved to be very popular. According to Google, since the inception of the program "over 50,000 students and professors from almost 100 countries have participated in the past 5 years" (Google 2013b). The nature of the GOMC makes it well-suited for an authentic learning assignment in which the learning environment is similar to a real-world application and produces a product that is "valuable in its own right" (Lombardi, 2007, p.4).

This paper describes the use of the GOMC as a course-embedded authentic learning exercise to teach search marketing and specifically PPC advertising. Over the course of 6 weeks of a semester, students enrolled in an undergraduate e-commerce and e-marketing elective course offered at a small liberal arts university worked in groups through the GOMC to implement an Adwords campaign for four separate small business clients. This paper describes the assignment, the learning outcomes achieved, and lessons learned through the process.

2. SEARCH MARKETING IN THE IS CURRICULUM

The use of search marketing has continued to increase among organizations attempting to get their products and services noticed by a market that is continuing to spend more time online. According to Search Engine Marketing Professional's (SEMPO) Annual State of Search Survey 2012, the compound annual growth rate for search marketing in North America since 2004 is a staggering 26% with revenue exceeding $17 billion annually. Further, approximately 86% of this spending is through the use of pay-per-click advertising campaigns (SEMPO Institute, 2012).

While industry has embraced search marketing and pay-per-click advertising as an effective mechanism, the teaching of the concepts at the university-levels appears to lag. A survey of programs conducted by McCown (2010) showed that while courses covering search concepts were becoming more prevalent within the curriculum of computer science and management information systems programs, the search courses tended to focus on search algorithms, search information retrieval, and search architecture.

Search marketing is also not explicitly listed as a topic within IS 2010: Curriculum Guidelines for Undergraduate Degree Programs which serves as a model for the curriculum of many information systems undergraduate programs (Topi, Valacich, Wright, Kaiser, Nunamaker, Sipior, & deVreede, 2010). Nevertheless, there are several references within the model curriculum which may provide evidence to its usefulness as a topic within an information systems program. The foundational course of the curriculum, IS 2010.1 - Foundation of Information Systems, suggests the inclusion of Web 2.0 topics, specifically citing other internet-based marketing techniques such as crowd-sourcing and viral marketing. Further, the suggested elective course, IS Innovation and New Technologies, in the model curriculum recommends the inclusion of a module understanding the search space including search monetization and the strategic importance of search to organizations (Topi et al., 2010).

As well, other educators have noted the growing importance of search marketing concepts and have successfully integrated various learning exercises into their courses. Frydenberg and Miko (2011) embedded a hands-on SEO contest in both an introductory-level and upper-level information systems course to teach search marketing concepts. During the first year of the GOMC, the GOMC was integrated into an MBA-level Management Information Systems course the researchers concluded that it was an effective tool in teaching search and search marketing concepts (Rosso, McClelland, Jansen & Fleming, 2009). Since that original competition, the GOMC has matured and Google offers additional educational resources that wrap-around the GOMC. Namely, Google now offers an asynchronous digital marketing course. In both of these studies, student feedback showed that the hands-on, real-life nature of projects stimulated student interest in technology and marketing (Rosso et al., 2009; Frydenberg & Miko, 2011).

According to Connolly (2009) search engines are now the main portal into most public Web sites and it is increasingly important that students learn how search engines work and how sponsored link systems such as Google's function. Given the importance and continuing growth of search marketing and in particular, PPC advertising within industry, the skills of designing and implementing an effective PPC campaign would appear to be valuable for students to acquire.

Further, the highly-applied nature of the GOMC, designed to supply students hands-on experience working with actual small business clients utilizing the industry-leading PPC program, seems to fit a model of learning known as authentic learning. Under authentic learning exercises, students work on open-ended, applied projects that result in the creation of a tangible real-world product (Lombardi, 2007; Lavin, 2010; Reeves, Herrington, & Oliver, 2002). Several researchers have found authentic learning to be an effective pedagogy in which learners not only enjoy the applied process but gain a deeper, more individual understanding of the material (Herrington, Reeves, & Oliver, 2006) Ramsden, 1992; Watagodakumbura, 2013). Given the practical, real-world nature of the GOMC and the importance of SEM in the curriculum, the following research questions emerged:

- How is participating in the GOMC an authentic learning experience?
- How does participating in the GOMC impact student learning about search marketing and PPC advertising as part of an organizational strategy?
- How does participating in the GOMC impact student confidence in their ability to effectively design, implement, and manage a PPC advertising campaign?
- How does participating in an authentic learning assignment with real clients impact student's enjoyment of learning search marketing and PPC advertising?

3. IMPLEMENTATION OF THE GOOGLE ONLINE MARKETING CHALLENGE

Since 2008, Google has sponsored the Google Online Marketing Challenge (GOMC) to provide students an opportunity to learn search marketing, particularly pay-per-click advertising in a real-life, hands-on environment. While the challenge has grown since its original offering to include more educational resources for the students and optional competitive social media and non-profit impact components, the core of the challenge has remained the same (Google, 2013b).

Student teams of three to six students are provided a $250 Google Adwords credit to develop and implement a three-week, pay-per-click advertising campaign for a small business client of their choosing. Student teams are required to submit two reports as part of the challenge. A pre-campaign report, submitted prior to the running of the campaign, provides an overview of the selected small business client and details regarding the Adwords campaign strategy designed by the students. The post-campaign report, submitted after the three-week campaign concludes, requires students to reflect on the effectiveness of the campaign, the learning aspect of the challenge, and lessons learned including future recommendations for the client (Google, 2013b).

After the conclusion of the campaign and the submission of the post-campaign report, student teams are then judged on three components. Statistics generated as part of the campaign including impressions, clicks, and click-through-rate are automatically assessed by Google. The structure and design of the campaign are examined by Google employees to determine if the student teams followed best practices. Finally, an academic panel of experts examines the campaign reports submitted by the student teams for evidence of learning and the overall clarity and readability of the reports. While student teams competing in the GOMC must have a professor as a team sponsor, the implementation of the challenge is fairly open as students can be from any major and the challenge itself does not have to be embedded in a course or an academic club (Google, 2013b).

This paper describes the implementation of the GOMC as a course-embedded exercise within an elective e-commerce and e-marketing course at a small liberal-arts based university. Further, this paper examines attributes of the GOMC as an authentic learning environment and perceptions of students about the exercise.

Prior to the exercise, all students in the course were given a survey which asked them to rate their knowledge of terminology, skills, and techniques associated with search marketing and pay-per-click advertising. As well, each student reported their confidence level in their ability to design and implement a pay-per-click advertising campaign. The students in the course were provided two 50-minute lectures explaining the growing importance of search marketing and a review of both search engine optimization and pay-per-click marketing theory, terminology, tools, and techniques within the context of a broader marketing strategy.

The eighteen students enrolled in the course were then randomly assigned to one of four

GOMC teams (2 teams of 5 students and 2 teams of 4 students). Each team was then randomly assigned a GOMC client. Clients for the GOMC were recruited through the regional, state-funded small business development center which provides free consulting to new and existing small businesses. Four separate clients were recruited through this method. The clients included: a company that had developed and wanted to market an ink-saving font, a regional waste disposal business, a manufacturer of a sports training aid, and a regional structural engineering firm. The diversity of the clients and their unique marketing goals insured student teams would be developing unique campaigns as a solution for their client.

The professor then introduced the GOMC as a required course assignment providing the three-week window for the campaign which was to begin two weeks from the introduction of the assignment. Students did not receive any specific instruction on the use of Google Adwords. Instead, the instructor directed student teams to the educational resources provided by Google and available through the student dashboard.

To gather the initial information required to design the campaign and complete the pre-campaign report, student teams utilized two separate methods. Every team designed its own questionnaire which was sent to the client for completion. An example of a questionnaire produced by one student team can be found in the Appendix of this paper. The questionnaires were designed to gather basic client background information such as company name, location, website url, years in existence, and number of employees. As well, each team set up a face-to-face meetings with its client. These meetings were used to discuss the GOMC itself, explain the purpose of Google Adwords, and for the students to gain an understanding of their client's specific marketing goals and strategy. These meetings allowed teams to design some of the more detailed components of the campaign including: establishing ad groups to target various markets, selecting keywords and key phrases, and determining geotargeting and bidding options for the campaign.

Using the information gathered, student teams worked to build the campaign on the Google Adwords platform. During this same timeframe, student teams documented all of this within the pre-campaign reports which were uploaded to the GOMC student dashboard, an online portal Google provides. Once the pre-campaign reports were uploaded, Google credited the Adwords accounts with the $250 that funded the three-week campaigns. At this point, campaigns were built and were ready to be activated but were paused until the instructor-provided campaign start date.

During the three-week campaign period, student teams monitored campaign performance by analyzing impressions, click-through rates and ad positioning for various keywords and keyword phrases. As a result of this analysis, student teams were encouraged to make changes to the campaign which included pruning non-performing ads, tailoring ads, altering bidding options, and adding and deleting keywords and keyword phrases. Every Friday during the three-week campaign period, each student team was required to give an oral report in class on the performance of the campaign and to explain any modifications that they had made or were planning on making to the campaign. These oral reports provided both the professor and the other students in the class the opportunity to make suggestions for each team and also provided an additional learning opportunity for the students.

At the conclusion of the campaign, student teams worked to complete the post-campaign report. The post-campaign report is a reflective exercise with two major sections: the industry component and the learning component. The industry component of the post-campaign report serves as an analysis of the effectiveness of the campaign in the context of the marketing goals of the client. This section details all of the measureable outcomes of the campaign including: impressions, clicks, click-through rate, average cost-per-click, and overall performance of the various ads and keyword phrases (Google, 2013b). This information is gathered through the use of the Google Adwords program.

Figure 3 in the Appendix shows overall metrics for the Adwords campaign for the student team that was working with the client who had developed an ink-saving font. The figure shows that this particular student-developed campaign generated 211,158 ad impressions which led to 580 "click throughs" for a click-through-rate of .26%. While the overall click-through-rate of .26% is low, it can be used to relatively assess the performance of each ad group. As can be seen from the metrics, the "saving money printing" ad group outperformed the others significantly. The total cost of these clicks was $293.98. The metrics also indicate that the average position of these displayed ads was position 2.3. Figure 4 displays similar metrics for the same campaign for a specific ad group under the campaign that was targeting customers interested in printing software. Along with requiring students to report all of the major campaign metrics, the industry section of the post-campaign report also forces student to critically analyze the performance and evolution of the campaign noting lessons learned throughout the campaign.

As they completed the learning component of the post-campaign report, student teams documented the learning that they perceived they gained from the challenge. As well, students were asked to elaborate on the interpersonal aspects of the campaign including the dynamics of the team and the relationship with their client. Each student team uploaded their post-campaign report to the GOMC student dashboard. Student teams also sent this report to their client along with a note of thanks for participating in the GOMC.

At the conclusion of the assignment, students were administered a second instructor-designed survey asking them to again rate their knowledge of terminology, skills, and techniques associated with search marketing and pay-per-click advertising. Additionally, the student answered questions on the survey about the nature of the GOMC assignment itself as a learning experience. To answer the research questions formulated earlier, the two instructor-designed surveys and the characteristics of the assignment itself were analyzed.

4. THE GOOGLE ONLINE MARKETING CHALLENGE AS AN AUTHENTIC LEARNING EXPERIENCE

A general preference for learning-by-doing is often expressed by students (Lombardi, 2007; Lavin, 2010). As well, the IS 2010 model curriculum recommends teams projects with actual clients using applications packages as a way to teach IS skills and demonstrate applied learning (Topi et al., 2010). The Google Online Marketing Challenge is a competitive program in which participating students design and implement a pay-per-click advertising campaign for an actual client. The exercise has real-world relevance, provides for collaboration and a diversity of competing solutions, and culminates in the creation of a product that has worth in its own right. These are some of the characteristics of a model of learning-by-doing termed "authentic learning" (Reeves, Herrington, & Oliver, 2002).

Lombardi (2007) describes authentic learning experiences as those that focus on "real-world, complex problems and their solutions" (p. 2). They are inherently multidisciplinary and can be applied to any subject matter. Reeves, Herrington, and Oliver (2002) provide 10 design characteristics that provide the framework for authentic learning activities. While Table 1 in the Appendix lists each of these characteristics and how each is manifest in the GOMC, there are core elements of authentic learning exercises that were explicitly observable in this implementation of the GOMC.

First, the primary tenet of authentic learning is that it involves real-world relevance and "matches the real-world tasks of professionals in practice as nearly as possible" (Lombardi, 2007, p. 3).

The nature of the GOMC seems to demonstrate this real-world characteristic. Students performed a task for their client, the development and implementation of a pay-per-click advertising campaign using Google Adwords. This type of service is readily performed by vendors and business professionals alike. Further, students themselves were well aware that they were learning a skill that is needed in industry. Every student in the class reported on the post-assignment survey that they either "agreed" or "strongly agreed" with the statement that the GOMC was relative to the real-world. One student remarked in the comments section of the survey:

> I thought it was great to work with a group on a business project which I felt went closely along with something we could possibly have to do after college. I also feel confident now that I could successfully do this for a client (Anonymous, GOMC Post-Assignment Survey, April 24, 2012).

Second, authentic learning experiences are based on open-ended problems that require sustained investigation, collaboration, and allow for multiple perspectives and alternate solutions (Reeves et al., 2002). As noted earlier, the GOMC required student teams to meet with their clients to understand their marketing strategy and goals prior to the development of a pay-per-click advertising campaign. While the campaign itself only ran for three weeks, the formulation of a strategy and the creation of the reflective post-campaign report extended the total duration of the exercise to 6 weeks.

Since each client was very different in nature, each campaign was also necessarily open and unique as student teams attempted to design campaigns matching the goals of their client. On the post-assignment survey, students indicated that the assignment provided ample opportunity for teamwork and collaboration. The post-assignment survey revealed that 89% of the students felt that the GOMC allowed for collaboration and provided the flexibility and openness for the group to formulate a unique solution for their client. One student stated:

> I learned that teamwork is key and that one member's input can make a big change in the campaign and its results for our client (Anonymous, GOMC Post-Assignment Survey, April 24, 2012).

Last, authentic learning activities terminate in the "creation of a whole product, valuable in its own right" (Lombardi, 2007, p. 4) Further, this creation of a product allows assessment to be integrated seamlessly into the task as it reflects real-world evaluation processes.

As noted earlier, the design and implementation of the Adwords campaign utilizing the $250 budget provided by Google was a useful service for the students' clients. The professor assessed the performance of student teams by examining the pre- and post-campaign reports required in the GOMC. The campaign reports documented the actual results of the student-designed campaigns including impressions and clicks generated through the campaign. This information was not only used for assessment by the professor but was also a useful mechanism for the client as it directly demonstrated the results of the campaign in the context of the client's unique marketing goals.

Cleary, the applied nature of the GOMC where student teams utilize the industry-leading pay-per-click advertising program to design a live, $250 ad campaign for an actual client makes it ideally suited to be an authentic learning experience. The characteristics of the GOMC that align with authentic learning experiences are further enforced by student data and comments which indicated that they perceived the assignment to closely emulate a real-world task performed by professionals in the field.

5. LEARNING, CONFIDENCE, AND ENJOYMENT

Obviously, the primary measure of success for any course exercise is the amount of knowledge and skills gained by the participating students. The evidence suggests that this implementation of the GOMC was successful in this regard as the data indicated students' perception of their own knowledge and confidence level with search marketing and pay-per-click advertising improved through the application of this exercise.

Prior to the exercise student were asked to rate their level of agreement with the statement "I am familiar with and understand the basic terms associated with search marketing and pay-per-click advertising campaign" on a 5-point Likert scale. Prior to the exercise, 17% of students "agreed" or "strongly agreed" with this statement. After the GOMC exercise, this measure improved significantly to 89%. As well comments received from students generally supported the GOMC as a useful learning tool. One student remarked:

> Everything we did was new to me. I learned a lot about the terms associated with pay-per-click campaigns that professional use (Anonymous, GOMC Post-Assignment Survey, April 24, 2012).

Students were also asked to report their level of agreement with the statement, "I am familiar and understand the techniques and processes used to design, implement, and monitor a successful pay-per-click campaign." The percentage of students indicating agreement with the statement increased dramatically from 6%, or 1 of the 18 students, to 94%, or all but 1 of the 18 students. Figure 1 shows student perception of their knowledge and understanding of search marketing and PPC advertising before and after the exercise, demonstrating a perception of learning.

Figure 1. Familiarity and understanding of search marketing and PPC before and after the GOMC exercise. This figure demonstrates the change in students' perceptions of their knowledge level before and after the exercise.

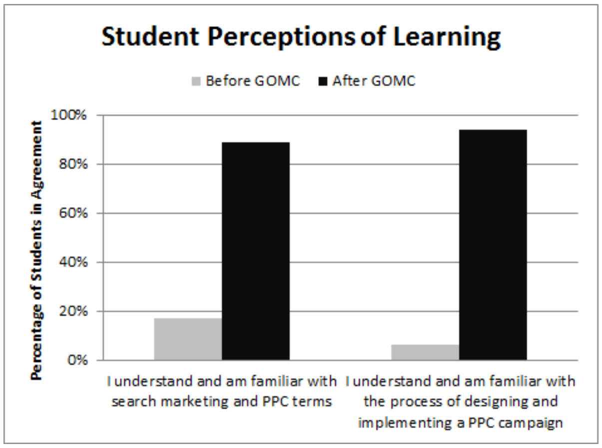

Figure 1

Not surprisingly, the learning that was evidenced after the campaign also instilled a sense of confidence in the students to use this knowledge in a professional environment beyond the classroom. The percentage of students who rated themselves as either "confident" or "very confident" in their own ability to design and implement a pay-per-click campaign for an actual client increased from 11% to 89% of the class (See Figure 2). One student said:

> I wasn't too sure how to design and implement a pay-per-click search engine, but from what I learned, I could do it now. Once I became more familiar with it, it was interesting to see just how well we made improvements each day (Anonymous, GOMC Post-Assignment Survey, April 24, 2012).

In fact, another student in the class planned to immediately put his or her new found skills to work:

> I learned how to utilize a pay-per-click program as part of a marketing effort. I am glad I did because I plan on using it for a non-profit foundation that I work with in the very near future to help them get traffic to their site and get some much needed donations (Anonymous, GOMC Post-Assignment Survey, April 24, 2012).

Figure 2. Student confidence level in implementing a PPC campaign before and after the GOMC exercise. This figure demonstrates the change in students' confidence level in implementing a PPC campaign before and after the exercise.

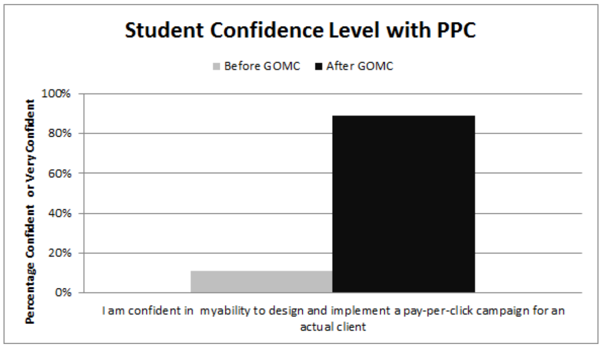

Figure 2

As noted earlier, the instructor only provided two 50-minute lectures explaining search marketing and pay-per-click marketing theory, terminology, tools, and techniques within the context of a broader marketing strategy. The instructor however did not provide any hands-on instruction on the use of Google Adwords or designing and implementing a PPC campaign. Therefore, the instructor believes that the gains in knowledge and confidence in designing and implementing PPC campaigns can be attributed to participating in the GOMC exercise itself.

Further, students seemed to enjoy the applied nature of the GOMC. Supporting the claim of proponents of authentic learning exercises, every student in the class either "agreed" or "strongly agreed" with the statement that they enjoyed the assignment. As well, 89% of the class reported being proud or very proud of the work they completed for their client. One student stated on the post-assignment survey:

> What I liked the best was working with a client and trying to help him with his product instead of completing a made-up case study. I felt I learned how to conduct business professionally with an actual businessperson (Anonymous, GOMC Post-Assignment Survey, April 24, 2012).

As a result of the GOMC exercise, student learning seemed to go beyond just learning the terms and theory of search marketing and PPC. The GOMC as an authentic learning exercise placed student teams in the role of business professionals implementing a solution for an actual client. The results of this highly-applied exercise showed that students perceived a high level of learning, gained confidence in designing and implementing a PPC campaign, and enjoyed the experience.

6. CONCLUSION AND LESSONS LEARNED

Search marketing and pay-per-click advertising are relevant topics for information systems and marketing students alike. Students see the value of pay-per-click advertising as part of a larger marketing strategy for organizations. The Google Online Marketing Challenge is a viable tool to provide students an authentic learning experience applied to learning search marketing and PPC terminology, skills, and techniques.

Additionally, the GOMC provides students the opportunity to work with real clients, real money, and the industry-leading PPC program, Google Adwords. The nature of the GOMC also provides students the chance to hone their teamwork and interpersonal skills as they work together to meet the needs of an actual client.

While the instructor was satisfied with the outcomes of this assignment, there are some aspects of the assignment that he would change in the future. The instructor of the course designed the exercise over a six-week period of the course with two weeks reserved to gather information from clients, design the campaign, and write the pre-campaign report; three weeks for the actual campaign; and one week allotted for the creation and submission of the post-campaign report. While the three-week timeframe for the campaign is prescribed by Google and the one week allotted to write the post-campaign report seemed appropriate, the first two weeks seemed rushed as students struggled to both learn the Adwords program and to meet with their clients. In retrospect, the instructor would have allotted more time for this portion of the assignment.

Additionally while the student teams sent the post-campaign report to each of their clients, both the clients and students themselves expressed a desire for a final face-to-face meeting to discuss campaign results and to perhaps transition the Adwords campaign to the client. The implementation of this suggestion would be a valuable addition to future iterations of this exercise.

The GOMC has matured greatly since its first offering in 2008. One of the newer features of the GOMC that was not utilized for this exercise is a client center that allows professors to oversee the active campaigns of students participating in the GOMC. Using this feature could prove very useful to monitoring team progress (Google, 2013b). Although the GOMC is now in its sixth year, educators must also be aware that utilizing it as an authentic learning exercise inherently places an external dependency in the course as there is no guarantee that Google will continue to offer future iterations of the GOMC.

Google has also increased the educational resources surrounding the GOMC. Google now offers a free, online, asynchronous digital marketing course. This course contains nine separate modules including modules on search marketing and the use of Google Adwords. After the completion of this course, Google recommends students take the Google Adwords Certified exams which when passed earn students the Google Adwords Certification. According to Google, this certification The Google AdWords Certification is "a globally recognized stamp of approval which showcases your knowledge of the latest AdWords tools and best practices as well as your ability to effectively manage AdWords campaigns" (Google, 2013b). Earning this certification could be a differentiating factor for students hoping to enter the search marketing field.

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Appendix

GOMC Client Survey

Please complete as much of this survey as you can and e-mail to XXXXXXXX. Thank you.

1. So that we have a brief profile of your organization, please provide the following information (if there is confidential information that you do not want to provide, please indicate that):

   - Contact Name, e-mail, phone number
   - Organization Name, brief profile
   - Sales and number of employees
   - Goods and services offered
   - Age of the company
   - url, website age, website management
   - Company presence and sales via online and offline channels
   - Other relevant information

2. So that we have a brief profile of the market in which you compete, please provide the following information:

   - Current and potential competitors
   - Overview of the industry (key characteristics, competitive/saturated/mature)
   -- Market position/specialties
   - Unique selling points of the goods/services offered
   - Seasonality of goods/services or seasonality that the company has identified
   - Other relevant market information

3. So that we have an understanding of your current marketing, please provide the following information:
   - What kind of current marketing do you perform to promote your business?

4. What kind of “keywords” or “keyphrases” would your potential use or type into a search engine that you would want to be associated with your website. Please list as many as you can think of.

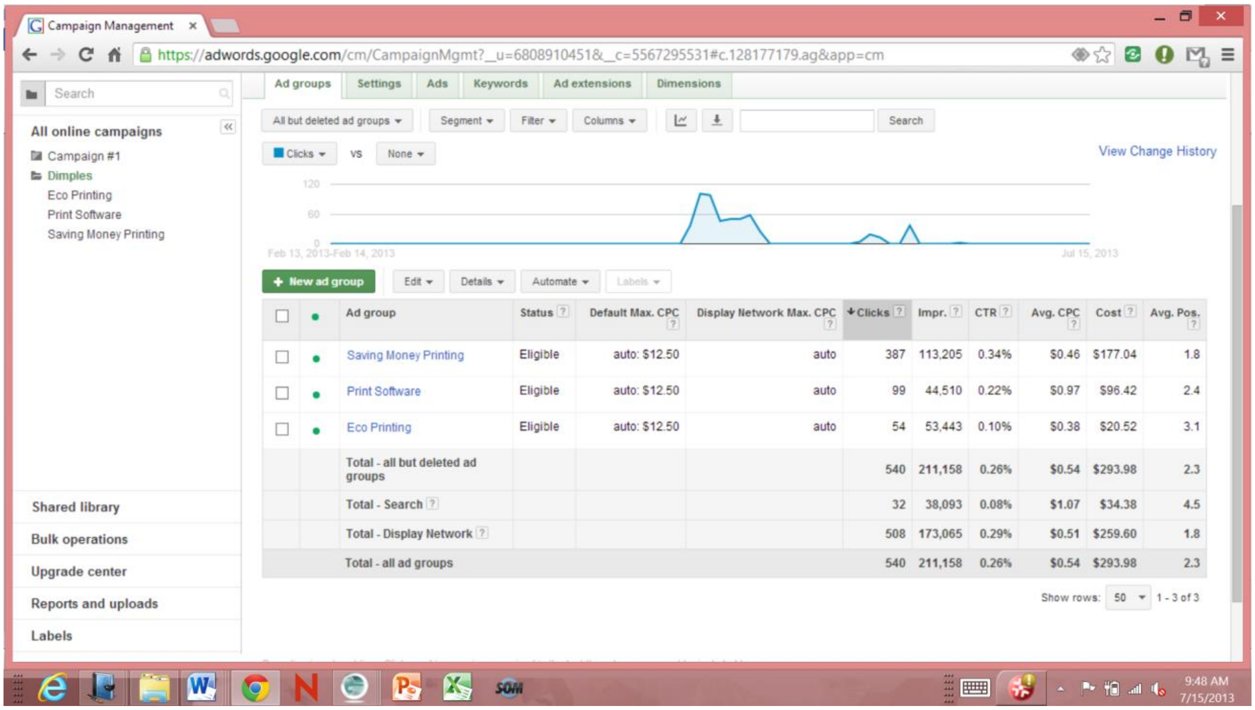

Figure 3. Google Adwords Campaign Metrics for a GOMC Campaign. This figure displays metrics from Google Adwords for one of the clients that participated in the exercise.

The figure above indicates that this particular campaign generated 211,158 ad impressions which led to 580 "click throughs" for a click-through-rate of .26%. This is an overall satisfactory rate however as can be seen from the metrics, the "saving money printing" ad group outperformed the others significantly. The total cost of these clicks was $293.98. The metrics also indicate that the average position of these displayed ads was position 2.3.

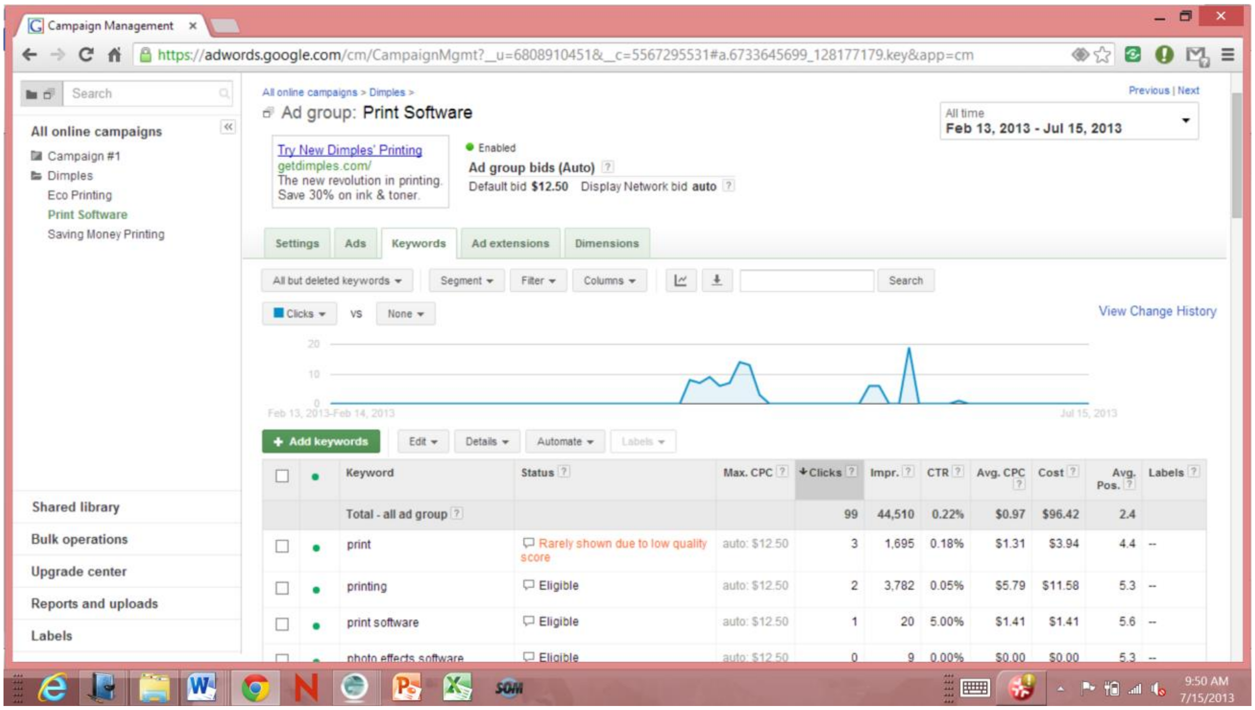

Figure 4. Ad Group Performance. This figure displays performance metrics from Google Adwords for a particular Ad Group for one of the clients that participated in the exercise.

The figure displays ad group level metrics for the campaign referenced in Figure 4. Specifically, this figure displays keyword metrics for the ad group "Print Software".

AUTHENTIC LEARNING CHARACTERISTIC	MANIFEST IN THE GOMC ASSIGNMENT
Problem has real-world relevance	Students research, design, and implement a live PPC advertising campaign for an actual small business client utilizing a $250 credit provided through the GOMC.
Problem is open-ended	While all student teams implement a PPC campaign using Google Adwords, student teams were each assigned unique clients. The uniqueness of each client and their marketing needs challenged each student team to design, implement, monitor, and improve a distinct campaign utilizing different approaches, ad groups, geo-targeting, and keyword targeting.
Task to be investigated over a sustained period of time	A requirement of the GOMC is that campaigns last no longer than three consecutive weeks. However, student teams are tasked with interviewing clients and determining the needs of their client before designing the campaign. These efforts were structured over 5-weeks of a semester.
Allow for exploring a task from different perspectives	The students participating in this exercise were from various majors with about half of the team members having technical majors of either management information systems or computer science while the other half were either management or marketing majors. This resulted in a different focus as students collaborated on designing, implementing, and monitoring PPC campaigns for their clients.
Provide for Collaboration	Students worked together in teams of 4 to 5 to complete the assignment. Students were required to use Google Docs and Apps (Google Drive) to collaborate on the pre-campaign and post-campaign report deliverables. As well, students met with clients in a group setting and collaborated on the design of the campaign in structured time within the classroom.
Provide an opportunity to reflect on the experience	The design of the GOMC requires student to monitor the performance of the campaign that they have designed and to tweak parameters if it is not meeting goals. As well, the GOMC requires the creation of a post-campaign report which asks student to reflect on the strengths and weaknesses of their campaign.
Activities encourage interdisciplinary perspectives and diverse roles of participants	In order to complete the GOMC assignment, student teams were required to complete various tasks including understanding the marketing needs of their client, learning the Google Adwords system, and designing an effective campaign. These tasks required different skills sets including the ability to communicate with the client, the ability to synthesize information, and the creativity to design effective ads and an effective campaign utilizing a structured information system. Students gravitated toward various roles on the exercise and applied different lenses and perspectives in completing the exercise.
Seamlessly integrate with assessment	Students were graded based on the effectiveness of their campaign and the quality of the GOMC-required pre-campaign and post-campaign reports.
Create polished products in their own right	Students created a live PPC advertising campaign using Google Adwords for actual small business clients. Clients received the benefit of a $250 Google Adwords advertising credit and the work associated with designing, implementing, and maintaining a PPC advertising campaign. This type of a work is a service that is readily available for a fee through third-party vendors. The actual product of this exercise however may be the learning the student experienced by participating in the challenge.
Allow competing solutions and a diversity of outcomes	Students designed PPC campaigns that utilized various ads for their clients. Students monitored the results for each of these ads including their click-through-rates. Ads which received lower click-through-rates were pruned.

Table 1. *The GOMC and Authentic Learning Characteristics*

Information Technology Job Skill Needs and Implications for Information Technology Course Content

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Abstract

As the demand for Information Systems (IS) and Information Technology (IT) graduates remains strong, it is imperative that the curriculums in IS and IT programs meet employer needs. IS and IT educators encounter a continuing challenge to ensure that their courses and curriculum stay up to date with new and evolving technological changes in the field as well as being relevant to the business community. This research summarizes the results of an employer survey of IS/IT professionals. It is similar to other employer surveys in querying job-hiring expectations, but unique in that it drills down to identify the detailed job skills required for specific occupations. The article also compares the results of employer surveys conducted in 2008 and 2003. The survey indicated the growth of new occupation areas for IT/IS professionals in Big Data and its many components. There was also increased demand for IT/IS professionals possessing project management skills.

Keywords: IT employment, IS curriculum, IT curriculum, employer needs

1. INTRODUCTION

The demand for Information Technology (IT) professionals continues to be one of the highest in the United States. According to the US News Jobs Report, IT occupations comprise four of the Top Ten Best Jobs for 2013, with healthcare workers the other major occupation group in the top ten (US News, 2013). Additionally, the US Bureau of Labor Statistics estimates an expected growth of 22% in the field for the period of 2010 – 2020 (US Bureau of Labor Statistics, 2011). These are just a few of the recent reports to point out the continued need and demand for IT professionals.

The challenge faced by faculty in computer information systems is to design a curriculum that is relevant to the evolving needs of employers. Educators face a rapidly changing industry, highlighted by a dynamic environment where today's technology quickly becomes tomorrow's legacy system (Gallagher et. al. 2011). This can have a significant impact on faculty who constantly try to cope with this environment by adjusting course content. There are resources available to aid faculty in designing curricula including the IS 2010 model curriculum (Topi et. al., 2010) and the ABET curriculum. However, these models often are limited as they have difficulty staying abreast of technological changes.

To make this challenge even more difficult, many business schools that are accredited by the AACSB (Association to Advance Collegiate Schools of Business) have restrictions placed on the number of courses required within the business school and often results in restrictions on the number of courses required in a major, such as information systems. (AACSB, 2013) Thus, IS (Information Systems) content in major courses must be designed efficiently in order to effectively cover the growing knowledge and skill set within limited course offerings. Knowing the relevant skills and technologies required by hiring employers can help to improve the overall curriculum within current IS programs.

Compounding the problem is rapid technological change which makes it even more important for IS curriculum to remain relevant to employer needs (Legier, Woodward, Martin, 2013). There are several problem areas for developers of IS programs that need to evolve as technology and industry needs change. These problem areas are:

- How to meet employer needs in the changing IT and IS professions;
- How to determine what knowledge should be included in basic Information Systems courses;
- How to balance training and certification desires of students with foundation knowledge of a topic area; and
- How to incorporate frequent advances in technology into the same number of courses

This research is a follow-up study of similar surveys conducted in 2003 and 2008 (*xx – reference will be added after review*). The goal is to report the current state of employer skill needs and also highlight changes in occupations and skills demanded by industry since the last employer survey.
It also offers a unique perspective in two ways. First, it attempts to "drill–down" to understand the employer needs for an occupation. For example, it is helpful to identify the mix of knowledge and skills needed for database professionals, not just that a database course is necessary in the curriculum. Second, this survey was built from an employer perspective (of job skills needed) versus many surveys that are built from the academic side (what courses should be delivered).

2. LITERATURE REVIEW

There are numerous research efforts in the area of matching curriculum content to employer needs. These surveys generally revolve around two areas. The first matching technical skills and IT knowledge content needed to those taught. The second is more general and relates to the interpersonal skills today's employers expect from IT professionals.

The needs surrounding IT content knowledge have been researched from a variety of perspectives. Richards et al. (2011) examine a specific IT role by evaluating the needs for Business Analysis skills by all IT graduates. Other researchers examine the broader demand for skills. Studies conducted by Woratscheck & Lenox (2002) and Cappel (2002) report that the top skill set desired by employers was systems development life cycle knowledge. Likewise, Medlin, Schneberger and Hunsinger (2007) completed a study of employers and found these skills in demand: Knowledge of standard software applications, ability to design user-friendly graphical interfaces, knowledge of programming languages, knowledge of databases, knowledge of networking and knowledge of computer hardware. Additionally, Janicki et.al (2008) reported that employers expected a working knowledge of system documentation, security, IT ethics and privacy, problem identification, specific programming language and process analysis.

The audience surveyed has also varied to include the perspective of different populations. For example, He and Guo (2011) interviewed IT recruiters who reported that database, spreadsheet, general IT skills and project management were their leading reasons for hiring IT professionals. Dilion and Kruck (2008) did a similar study of employer needs with a focus on Accounting IS and the needs for AIS graduates. Their survey reported a high degree of auditing, operating systems and database knowledge. Research conducted by Legier, Woodward and Martin (2013) discuss the needs from the perspective of recent graduates as they entered and worked in the field.

Research in this area has not been limited to the examination of technical skills for professionals. For example Legier, Woodward and Martin (2013) detail the need for students to gain thinking and communication skills plus the desire to learn as the key components in their careers as IT professionals. This matches a previous study by Lee et al. (2002) where they rated interpersonal, team, and communication skills higher than technical knowledge and skill sets. Another recent study by Van Auken et al. (2011) also stressed the importance of communication skills in addition to possessing business acumen. Tesch et al. (2008) reinforce the need for additional interpersonal skills for all graduates

A study by Gallagher et al. (2011) summarizes much of the previous research in employee needs and curriculum needs by stating that "essential skills will remain a main focus of IT programs, improvements could be made in laying a foundation in non-technical skills" (p.9)

3. METHODOLOGY

To build on the results of previous research, we built our survey to provide a more detailed examination of the job skills and knowledge (technical and non-technical) needed for indicated current or anticipated "hot" jobs across both undergraduate and graduate degree students. We sought to answer three key questions:

a) what are the technologies currently in use and projected to be in use in the near future by corporations?
b) what are the IS skills required for specific jobs as well as IS skills are needed by all IT graduates?
c) What is the projected demand for graduates by job category.

The survey instrument was developed in four phases as shown in Figure 1.

Phase One

During phase one, 25 professionals from various IT professions and responsibilities (members of a corporate advisory board, met with faculty to develop relevant job titles, areas and responsibilities important to IT professionals. This advisory board consists of representatives from a variety of employers ranging from those with more than 500 employees down to employers with 20 or more employees.

Roundtable discussions occurred in which the group was given the job titles from the 2008 survey and asked to delete, modify and add titles to represent today's IT professionals. For example, the job titles of programmers, web developers and app developers were all consolidated into software developers. Changes from the previous surveys are noted at the end of Section 3.

A second task was to develop a detailed list of job skills necessary for particular job area. For example, the job skills for a database professional were considered to be knowledge of SQL, reporting services, normalization and fine tuning performance.

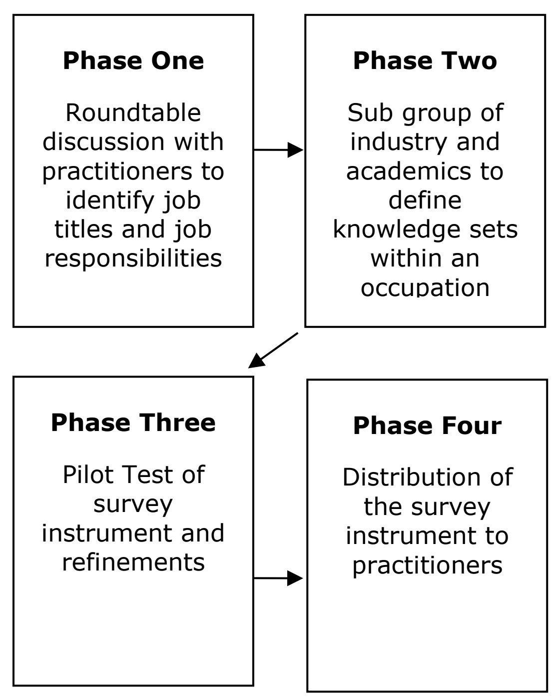

Figure 1: Survey Methodologies Stages

Phase Two

Working with academicians, a sub group of these professionals helped to define the job knowledge areas required for each occupation. These job categories went through several iterations and included pilot testing with other industry professionals to ensure the proper job skills were defined.

This resulted in the development of eight potential job categories as shown in Table 1.

Big Data / Data Analyst
Business / System Analyst
Database Admin/Analyst
IT Managers / Strategy Analyst
Networks / Security
Project Manager
Software Developer

Table 1:
Job Categories for IT Workers

To understand employer needs, the job categories shown in Table 1 were further defined into skills questions to help with course development. This provides a 'drill down' capability to enable faculty to design their syllabi around specific topics needed by industry.

To illustrate this 'drill down' by knowledge area, the following list details the sub category questions for the Business / System Analyst job category:

- Data Modeling
- Object Oriented Modeling
- Process Analysis
- Process Modeling
- Requirement Analysis
- Software as a Service Knowledge
- Structured Design
- System Design
- UML/Object Modeling
- Web Services

Respondents were asked to indicate the level of knowledge desired for each sub category as 'none, fundamental, working or expert'. To minimize the length of the survey, the respondents would only be asked 'sub category' questions for either their occupation or for one occupation they supervised.

During this phase, the survey instrument was also further developed. Questions were included to ask about general demographics (age, gender, location, company size, industry, job title) and if they were responsible for hiring or supervising IS/IT professionals. Based on the answer to the hiring/supervising questions, the survey would branch off to either Branch A (if they answered yes) or Branch B (if they answered no). Branch A was for participants who managed or hired IT professionals while Branch B was for those participants only working in the field (not involved in managing or hiring). The following provides the question areas asked for each branch:

<u>Branch A: Hired or Supervised IS/IT professionals</u>:

- Anticipated Hiring for IT professionals in the next 24 months for jobs found in Table 1.
- Drill down skills needed for the job with the highest number of employees they supervised

<u>Branch B: Worked as an IT professional</u>

- Detailed expectations for the skills they should possess for their respective occupation
- Various technological knowledge areas expected for this occupation

Phase Three

A pilot study was conducted to ensure that the survey would be clear to the participants with an average completion rate of 5 minutes or less. The survey request was emailed to twenty five industry professionals who were directed to a web site to complete the survey. They were asked to record the time to complete the survey and to print any pages that were misleading and reply back with any suggestions. Fourteen of the twenty five requests were completed.

Following completion of this pilot test, the survey instrument was revised and ready for distribution.

Phase Four

The request to complete the survey was emailed to 3578 individuals in either the IS/IT field or those known to potentially hire IS/IT professionals. The distribution email came from three sources: a) the membership roster of the Association of Information Technology Professionals (AITP) members), b) 653 IT professionals that had attended at least one IT conference hosted by the university and c) 575 IT alumni from the institution. All information collected was confidential as no identifying information was gathered by the respondents.

3.1 Changes to Job Categories

It is interesting to note the changes to job categories from the last survey in 2008. From the industry professionals the following job titles were dropped or consolidated prior to distribution of the 2013 survey:

- A consolidation of web developers, programmers and graphic design development was merged into software development

- Networks and Security which were two different categories was merged into one category as the need for security is needed for any network administrator was related by the industry professionals.

New job categories also appeared in the 2013 survey. These included:

- Big Data / Data Analysis
- Project Management was separated from overall IT Management and Strategy in previous surveys.

3.2 New Sub Category Questions

Within job categories major job responsibilities evolved for the 2013 survey. Shown are the key new job skills needed for today's IT professionals that were not in the previous surveys. These are not the only skills needed but the new ones added to the survey. These job skills should assist in course development.

Big Data / Big Data Analyst
- Analytic Tools (SSIS/SSAS/SSRS)
- NoSQL / Object Storage
- R Knowledge
- Raw, Unstructured Data
- SQL Query
- SQL Reporting

Business / System Analyst
- SaaS (Software as a Service)
- Web Services

Database Admin/Analyst
- Big Data Analytics
- Big Data Storage Concepts
- Data Cleansing / Integration
- SAN
- Virtualization

Network / Security
- BYOD (Bring Your Own Device)
- Cloud Computing
- Virtualization
- Wireless Admin

Software Development:
- Graphics / Visualization
- CSS 3
- HTML 5
- jQuery
- Mobile Device Development
- .Net MVC

4. SUMMARY STATISTICS

As stated the survey was emailed to 3578 IT professionals. 352 started the survey, and 225 completing all nine pages of the survey. This represents a 6.3% response rate. Of the over 100 professionals who started the survey, but did not complete all pages, 40% of them listed their job as 'Other IT' for which we did not ask any job detail questions beyond the first 4 pages of the survey.

The summary statistics presented represent those respondents who completed all pages of the survey. Overall, 49% of the respondents worked in corporations, while 19% worked for educational institutions. The remainder worked for government, sole proprietors or LLCs. The size of the organization varied from 24% working for companies with 100 to 499 employees while 25% and 21% worked for 1000+ and 10000+ employee firms respectively.

Women represented 20% of the survey respondents, with men comprising 80%. The education level varied for the respondents with 30% having a BS in an IT related field and 16% with a BS in a non IT related field. 19% had a master degree in IT while 16% had a master degree in a non IT master degree field.

The median number of years at their firm was 6 years, while the median number of years in the IT profession was 15.5 years. Interestingly, 30% of respondents held at least one certification. Popular certifications included:
- A+ (general technical certification)
- PMP (project management professional)
- CDP (certificate in data processing)
- CCP (certified computing professional)

As for various job categories, the respondents represented 8 different categories of IT/IS professionals. Their job categories and percentage of the overall respondents is shown in Table 2.

IT Management	16.8%
Software Development	16.8%
IT Strategy	14.6%
Networks/Security	9.3%
Business / System Analysis	8.4%
Project Management	7.5%
Database Admin/Analyst	4.9%
Big Data / Business Intelligence	2.2%
Other IT Jobs	19.5%

Table 2:
Job categories of Survey Respondents

More details on summary demographics may be found in Appendix A.

5. HIRING EXPECTATIONS INCLUDING NEW JOB CATEGORIES

To assist faculty in course development and students as they prepare for the job market, a section of the survey concerned future hiring expectations by position. Table 3 summarizes hiring expectations for 2013 and 2014 periods. The "Growth Rank" columns represent the number of employees expected to be hired in each category with 1 being the highest.

Job Categories	***Total Current Employees Rank***	***Growth Rank***	***Growth Rank in 2008 Survey***	***Growth Rank in 2003 Survey***
Big Data / Analyst	*6*	*1*	*	*
Business / Systems Analyst	*3*	*3 (tie)*	*3*	*5*
Database Admin / Analyst	*7*	*3 (tie)*	*5*	*3*
Networks / Security	*5*	*5*	*2*	*2*
Project Management	*4*	*2*	*	*
Software Development	*2*	*6*	*1*	*1*
Other IT Skills(Primarily Help Desk)	*1*	*7*	*4*	*4*

Table 3:
Occupations and hiring expectations for 2013 and 2014 periods
(*new category for 2013 Survey)

Table 3 details the responses from respondents who stated they were either responsible for hiring employees or supervising employees. These respondents reported supervising a total of 1119 employees in all of the categories. As shown in Table 3, Other IT Skills have the majority of IT professionals however it demonstrates the lowest growth job categories. Leading the new growth job categories for 2013 and also 2014 was Big Data Analysts. This growth rate is projected at 39% and 50% for 2013 and 2014 respectively. Another new job category in the 2013 survey was Project Management. This area details the second highest growth rate for IS/IT professionals. Project Management reported a growth rate of 32% and 27% in 2013 and 2014. Both of these job categories were not in previous surveys as they are relatively new job skills sets for IS/IT professionals. This is an interesting finding since only 2.2% and 7.5% of the current respondents worked in Big Data or the Project Management areas. Thus these areas and skills are seen to be increasingly important for future IT/IS professionals.

Dropping significantly was the projected demand for software developers. It was the highest demanded in previous surveys but it now rates as sixth place for job growth across all job categories surveyed. Even though it is in sixth place, the growth rate each year averaged 20%. Overall, survey respondents estimated a growth rate of 22% in 2013 and 21% in 2014.

Implications from the survey indicate that IS/IT programs should increase their emphasis of Big Data Concepts including storage, reporting and analysis along with additional Project Management concepts. Furthermore, IT managers will need to have foundation knowledge in these emerging areas.

6. TECHNICAL SKILLS DESIRED BY JOB CATEGORIES

Knowledge desired by occupation

The goal of the drill down by knowledge set is to help provide developers of curriculum an understanding of the current industry needs and to offer a wide range of knowledge sets in the curriculum.

Table 4 details the knowledge / technical skills reported for each IT/IS job categories. The top five skills for each job category are listed in order of importance. Additional details on skills by job category may be found in Appendix B.

Desired Knowledge By Job Category	
Big Data Analyst	
	SQL Query
	SQL Reporting
	DB Design Concepts
	Tools (i.e. SSIS, SSAS, SSRS)
	Raw/Unstructured Data
Project Management	
	Team Management
	Resource Scheduling
	Risk Management
	Leadership
	Planning and Scheduling
Business System Analyst	
	Requirement Analysis
	Process Analysis
	Structured Design
	System Design
	Software as a Service (SaaS)
Database Admin/Analyst	
	SQL
	DB Programming (tie)
	Database Administration (tie)
	Data Cleansing / Integration
	Backup / Restore
Network / Security	
	Data Security
	TCP/IP
	Network Security
	Security Policies
	Desktop Support
Software Development	
	Data Structures
	Structured Programming
	Object Oriented Programming
	ASP.Net
	Design Patterns
	Note: A breakdown of languages and platforms may be found in Appendix B

Table 4: Desired knowledge for IT/IS Job Categories

Finally the survey asked what overall knowledge about IT/IS should all IT/IS professions possess. Table 5 details the level of overall IT knowledge desired in order of importance. It should be noted that all of the knowledge categories were from the Fundamental Knowledge area, implying IT/IS professionals should possess basic knowledge of the concepts for the IT/IS categories.

Business / Systems Analysis
Project Management
Networks / Security
Database Skills
System Admin
Software Development
Data Analytics
Cloud/Virtualization

Table 5:
Desired knowledge of IS/IT topics for a 'all IT/IS professionals.
Scale: 1=None; 2=Fundamental; 3=Working; 4=Expert

6. DISCUSSION

The IT/IS profession continues to evolve with ever increasing and changing skills and knowledge areas demanded for today's IT/IS professionals. The two new job categories that were added to the 2013 survey included both Big Data and Project Management. These areas were added at the recommendation of a corporate advisory board and the survey results indicate that both Big Data and Project Management positions will be the highest growth areas in the next two years. Implications for course curriculum indicate additional emphasis should be added for Big Data handling, storage, and analysis as well as increased concentration on Project Management topics.

Another change to the demand for IT/IS professionals from prior surveys was the reduction in emphasis on software developers. In the 2008 survey, software developers were projected as the highest growth area, while in 2013 they are reported as the sixth highest growth area. It should be noted, that although software developers were listed as the sixth highest growth area, the highest total of employees supervised were reported for the software development area. The growth rate was projected at 20% for software development even though it was ranked sixth.

The survey reported, in order of growth, the following areas as having the largest growth in positions: Big Data, Project Management, Business / System Analyst, Database Analyst, Networks & Security and Software Developers, with all categories in double digit projected increases.

Within job categories, the skill set demanded by employers has also changed between 2008 and 2013. Several new skills emerged as topics that IT/IS professional should possess: Business Analysis, Database Analysis and Networking. These include skills such as SaaS for Business Analysts; Big Data Storage Concepts, SAN, and Data Cleansing for Database Analysts; and Cloud Computing, Virtualization and BYOD (Bring your Own Device) concepts for Network professionals. Again, the implication for courses is the need to constantly stay in touch with industry trends and adjust curriculum to match industry needs and new concepts.

For all IT/IS professionals, respondents indicated the need for IT/IS to possess business/system analysis skills. This was the highest overall skill required in previous surveys and indicates the need for students to understand problem solving, interviewing clients and developing solutions to problems involving technology. Project Management skills increased to second place as the survey indicated that all IT/IS professionals manage projects of varying sizes and need skills ranging from resource management to team leadership. Also added to the knowledge set from the 2008 survey was the need for fundamental knowledge of data analytics and cloud/virtualization concepts.

7. SUMMARY

Several new areas requiring curriculum attention arose from our survey which are Big Data Concepts including storage, reporting and analysis along with additional Project Management concepts. This is not limited to those working directly with the technology. IT managers in all areas of IT will need to have fundamental knowledge in these areas as well.

The 2010 Model Curriculum (Topi et al., 2010) does include a module for Project Management; however not present in the model curriculum is the growing field of Big Data Analysis. While there is a core course on Data Management currently in the curriculum model, it is more related to the building of relational database models. While the curriculum model sufficiently covers many of the skills needed, changes to future models are needed for universities to effectively utilize the curriculum.

Also not present in the 2010 model curriculum are concepts or a course in software development. The survey results indicated growth rates in excess of 20% for these skills for future employees. Faculty responsible for curriculum development need to consider the inclusion of software development languages and principles in their course offerings.

In summary, the survey indicates the need for IT/IS academicians to stay current in the field. It is evident that it is increasingly difficult to add new concepts to the curriculum while maintaining the need for basic concepts in the areas of system analysis, database, networking, security and software development all remain strong. Especially difficult is to incorporate changes quickly into the model curriculum model.

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Editor's Note:

This paper was selected for inclusion in the journal as a ISECON 2013 Distinguished Paper. The acceptance rate is typically 7% for this category of paper based on blind reviews from six or more peers including three or more former best papers authors who did not submit a paper in 2013.

APPENDIX A

Demographic Summary Tables

# of Employees	*2013 (%)*	*2008 (%)*
< 11	*8.7*	*12.9*
11 – 20	*2.2*	*6.1*
21-100	*9.5*	*19.1*
101-499	*25.5*	*10.4*
500-999	*8.2*	*25.6*
1000-9999	*25.1*	*23.6*
>10000	*20.8*	*2.3*

Table 6: Size of the organizations

Organization Type	*2013 (%)*	*2008 (%)*
Corporation	*47.6*	*58.3*
Education	*20.8*	*10.0*
LLC	*8.2*	*8.4*
Government	*6.9*	*12.3*
Healthcare	*5.6*	*-*
Sole Proprietor or Partnership	*5.6*	*5.2*
Non or Not for Profit	*5.2*	*5.8*

Table 7: Organization Type

Company Location	*2013 (%)*	*2008 (%)*
NC	*40.7*	*50.2*
IL	*7.4*	*-*
CA	*6.9*	*1.8*
WI	*6.5*	*-*
MO	*3.9*	*-*
SC	*3.5*	*-*
GA	*3.0*	*-*
NB	*3.0*	*-*
PA	*1.3*	*16.5*
OH	*1.7*	*12.5*
MI	*.9*	*9.0*
Others	*21.6*	*11.0*

Table 8: Company Location

APPENDIX B

Summary of knowledge areas expected for
IT/IS Professionals by Job Category
(Ranked in order of importance)

Big Data / Business Intelligence

Fundamental Knowledge
- SQL Query
- SQL Reporting
- DB Design Concepts
- Tools (SSIS, SSAS, SSRS)

Some/Minimal Knowledge
- Raw/Unstructured Data
- R Knowledge
- SPSS, SAS

Business / Systems Analyst

Fundamental Knowledge
- Requirements Analysis
- Process Analysis
- Structured Design
- System Design
- Software as a Service (SaaS)
- Object Oriented Design
- Process Modeling
- Data Modeling
- Web Services

Some/Minimal Knowledge
- UML/Object Modeling

Database Admin / Analyst

Fundamental Knowledge
- SQL
- DB Programming (tie)
- Database Administration(tie)
- Data Cleansing / Integration
- Backup/Restore
- Virtualization
- Data Modeling
- Performance Tuning

Some/Minimal Knowledge
- Data Warehousing
- Big Data Analytics
- SAN
- NAN

IT Management / IT Strategy

Fundamental Knowledge
- System Analysis
- IT Strategy
- Human Resources
- System Architecture
- Presentation Skills
- Ethics/Privacy Policies
- Team Leadership
- Project Management
- Supervisory Skills
- Negotiation Skills
- Vendor Relations

Network / Security

Fundamental Knowledge
- Data Security
- TCP/IP
- Network Security
- General Security Policies
- Desktop Support
- Network Admin
- Firewall Admin / Security
- Windows Admin
- Wireless Windows Admin
- Virtualization

Some/Minimal Knowledge
- Cloud Computing
- BYOD (Bring Your Own Device)
- Linux Admin
- Network Programming

Project Management

Fundamental Knowledge
- Team Management
- Resource Scheduling
- Risk Management
- Leadership
- Planning and Scheduling
- Project Management Software
- Inter-Organizational Relationships

Some/Minimal Knowledge
- Reporting Software

Software Development

General Development Concepts
- Data Structures
- Structured Programming
- Object Oriented Programming
- ASP.Net
- Design Patterns
- Algorithms
- User Interface Design
- Web Services
- Graphics/Visualization

Languages
- PHP
- HTML 5
- C#
- JavaScript
- XML
- ASP.Net MVC
- jQuery
- Java
- Python
- CSS 3
- C++
- JSP

IT educational experience and workforce development for Information Systems and Technology students

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Abstract

This study involves an analysis of a cohort of student's during their pursuit of a Bachelor of Science degree in Information Systems Technologies (IST) at a Midwestern university. Demographics and analysis of this cohort include basic demographic information, student home-life and personal responsibilities, employment and work experience, and their academic experience while attending a 4-year public institution. Fifty-three students in an IST program provided responses and perceptions to this survey. Over three quarters (> 75%) of the respondents identified that they were working during their degree with a high percentage on non-traditional students identified in this study. Program content and preparation for employment in the Information Technology (IT) field/profession were assessed. Findings and conclusions of the perceptions of this cohort's responses to the survey are provided.

Keywords: Information Technology (IT), IT experience, workforce development, IT/IS undergraduate students, non-traditional students.

1. INTRODUCTION

This paper aims to investigate potential personal, academic and professional factors that may influence the non-traditional students' choice to learn IT skills beyond the classroom instruction. In addition, we want to investigate opportunities for offering outside of classroom activities that can help prepare students with IT skills in demand for the job market. We will also discuss the students past, current and future IT related jobs and the skills (or the lack thereof) needed for their jobs.

The world of employment in applied Information Technology (IT) and Information Systems (IS) is continually reshaping educational curriculum and the workforce. Preparing graduates to meet these demands for present and future workforce skill sets are pushing educators to increasingly understand the constantly evolving demands of the IT/IS profession *and who the student is* that is pursuing an IT/IS degree through higher education.

Present projected employment trends in the computer and mathematical occupations identified in the U.S. Department of Labor's (DOL) *Occupational Outlook Quarterly (OOQ) for the 2010 – 2020 job outlook in brief* (2012), identified that computer occupations will grow at an overall average rate of 22% through 2020, faster than average for all other occupations.

This report identified eight computer occupational categories and their occupational growth through the year 2020. Table 1 below provides this information with estimated growth potential.

Occupational Category	Percent Growth
Computer and Information Research Scientists	19%
Computer Programmers	12%
Computer Support Specialists	18%
Computer Systems Analysts	22%
Database Administrators	31%
Information Security Analysts, Web Developers, and Computer Network Architects	22%
Network and Computer Systems Administrators	28%
Software Developers	30%

Table 1: Computer Category Occupational Growth through 2020, (DOL, 2012, p. 12)

CompTIA (2012) further performed an international study of 1,061 IT businesses involved with managing IT or IT staff within their organizations. The purpose of the study was to identify IT skills gaps presently facing the profession. Respondents of this study identified 15 technical skills or skills gaps that will be needed to meet the demands of increasing technology and the profession. These IT skills gaps are provided in Table 2 below in order of priority and percent response.

2. BACKGROUND

The increasing number of non-traditional students in undergraduate programs is changing the student demographics in higher education (Cantwell, Archer, & Bourke, 2001), and is pushing universities to offer academic activities inside and outside of classroom that addresses the students need to balance their personal, academic and professional life while pursuing their degrees (Forbus, Newbold, & Mehta, 2010).

According to Horn (1996), the most common definition of "nontraditional" is based on age, whereas, students of an age of 24 and older are considered nontraditional students.

Industry Technical Skill Gaps	Percent Response
Cybersecurity	88%
Data Storage/Backup	88%
Updating of aging Computers/Software	82%
Network Infrastructure	82%
Disaster Recovery/Continuity	81%
Automating Business Processes	73%
Web Online Presence/e-Commerce	64%
Collaboration	63%
Telecommunications	62%
Virtualization	61%
Business Intelligence/Data Analytics and Mining	59%
Cloud Computing	50%
Social Networking Technologies	41%
Green IT	38%

Table 2: CompTIA IT Skills Gap , (2012, p. 5)

Figure 1 shows the enrollment of students in Title IV institutions in United States in the fall 2009. Out of 20,966,826 students enrolled, 39.3% are students of age 25 or older, which are considered the non-traditional students (Ely, 1997).

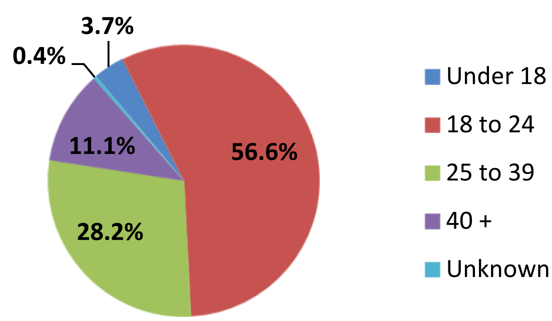

Figure 1: Percentage of enrollment in Title IV institutions by student age in United States, Fall 2009 (chart created with data from Knapp, Kelly-Reid, & Ginder, 2011, p. 10)

Gilardi & Guglielmetti (2011) argue that employment and job security can represent limitations for non-traditional students investing time in person development within the university and that the type of employment contract can have an impact on retention. Forbus et al. (2010), nonetheless, contend "that working does not have a negative effect on learning (grade point average), but also shows that working hinders involvement, which has a positive effect on learning" (p. 71).

Aud et al. (2012) reported that "in 2010, about 40 percent of full-time and 73 percent of part-time college students ages 16 to 24 were employed" (p. 92). As traditional students are working too (Forbus et al., 2010) for of any kind of reasons (e.g.: loans, living expenses, etc.), they may be also in need for opportunities to learn and practice their IT skills outside of formal classroom interactions. Students can find several extra-curricular activities within their School and Departments, such as attending guest lectures, joining a student club, participating in workshops, or volunteering for community services within their area of expertise. Nonetheless, in many cases these are synchronous activities and required not only a time commitment but also the need for physically being in a certain place, which is unfavorable for many working students.

Indeed, students are becoming more connected and ubiquitous. According to the ECAR Study of Undergraduate Students and Information Technology, 2012 (Dahlstrom, 2012, pp. 13-14), a large number of students have portable devices. Laptops, in first place, represent 86% of the students with devices (i.e., almost 9 out of 10 students), and Smartphone comes in second place with 62% of the students. Tablets and e-readers combined account for 27% of the student devices. These devices combined with a plethora of social networks and tools can generate opportunities for continuing education beyond the classroom settings and beyond restrictions of time and location.

With the increasing availability of digital devices and the opportunity of educational activities, these technologies may be able to enhance a nontraditional student's persistence and attainment of their educational goals. Thus, potentially minimizing the impact on work, education, and life balance.

The ECAR Study (Dahlstrom, 2012, p. 11) shows that students wish instructors used more open educational resources, simulations or educational games, course or learning management systems, E-books, Web-based videos, Video-sharing websites, podcasts and webcasts and more. In addition, some of the key findings from the ECAR Study also reveal that:

- "Blended-learning environments are the norm; students say that these environments best support how they learn" (p. 7)
- "Students expect their instructors to use technology to engage them in the learning process" (p. 9)
- "Understanding which technologies are more or less effective for students can translate into strategic pedagogical investments" (p. 10)
- "Students believe technology benefits them, especially with regard to achieving their academic outcomes and preparing for future plans" (p. 19)

Information Technology is a field that is constantly changing. By the time students are learning something in class, the technology may have already advanced. For example, the software installed in classroom computers may be a few versions behind the current version. It is almost impractical to go back to school every time we need to update or learn new technologies as well as for schools to teach everything that students need to know before they graduate. Therefore, a professional in the IT field must "learn how to learn" for an effective lifelong learning (Neame & Powis, 1981) and to keep up with the changes in the field.

Relating to the factors contributing to an IT skills gap as reported in the CompTIA (2012) study, 46% of the respondents believed that the fast changing technology makes it difficult for IT workers to stay current with their skills, 39% reported that IT training/education does not sufficiently translate to workforce performance, and 15% responded stating there was insufficient focus on Science, Technology, Engineering, and Mathematics (STEM) education (p. 16). Further, this study asked how the organizations plan to address IT skills gaps through investing in training for existing staff. Of the companies reporting, 57% stated they will train or retrain their existing staff, and only 6% stated they should contribute or support programs designed to boost STEM education to increase the pool of students entering these technical fields (p. 21). Given the responses provided above from this study, it would seem imperative that industry and education work closely together to develop educational curriculum to meet the needs of this IT skills gap.

Legier, Woodward & Martin (2012) suggest that "a steady supply of IT professionals to the business community is necessary for our nation to remain competitive in the global market, and educators must train and support the next generation of IT specialists" (p. 1-2). Their study lists the graduates' primary IT job focus and how well their curriculum prepared them for their jobs. Sanchez-Morcilio (2012) also reports the alumni competencies in relation to technological skills.

3. METHODOLOGY

The survey included 31 questions about individual student demographics, home-life while enrolled in the Information Systems Technologies (IST) program and attendance at the university, present and past work experience in the IT profession, and academic experience. All questions pertain only to the time students spent attending the university. The subject population was composed of 200 students enrolled in an IST program of a Midwestern University in spring 2011, with a response rate of 26.5% (i.e., 53 respondents).

The study was approved by the Office of Research and Development at the university. Faculty members in the IST program were provided information about the study and were asked to distribute the information to all IST students in their classes.

The survey was developed and administrated through the online survey application, LimeSurvey. All respondents were informed of their confidentiality and were provided with a confidentiality agreement statement prior to beginning the survey.

4. Results

Student Demographics

Questions 1 through 5 addressed basic student information to include gender, age, employment status, year in college, and current Grade Point Average (GPA). Figure 2 shows the percent gender in this study.

This disproportionate percentage of males to females in the IT profession is consistent with the results identified by Aud et al. (2012) study.

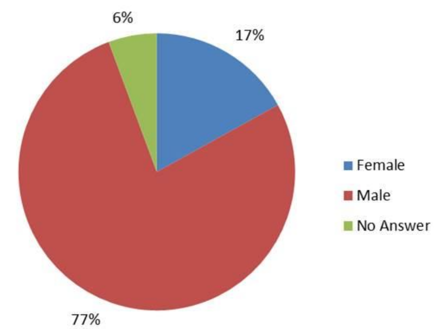

Figure 2: Gender Percentage

Question 2 asked the age of each respondent with an average age reported of 28 (*SD* 10.97). The maximum age provided in the survey was 62, with the minimum age provided as 19.

Additionally, the survey asked for respondent present employment status (Figure 3).

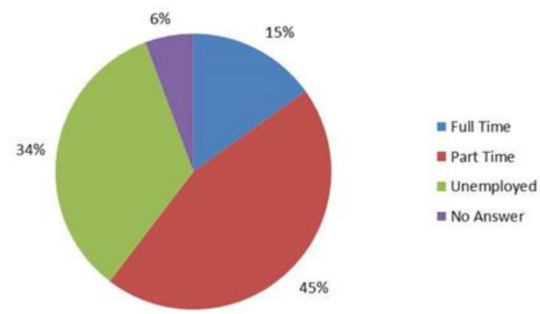

Figure 3: Employment Status

Question 4 asked for respondents to provide their present year in the IST program/college. Approximately 57% of the respondents were Seniors, 26% were Juniors, 9% were Sophomores, and approximately 2% of the respondents were Freshman. Approximately 6% of the respondents did not provide their year in college.

As part of the student demographics, GPA was requested of each respondent. Ninety-four percent (94%) of the respondents provided their GPA. Of the 53 respondents, the mean GPA was

3.26 (*SD* 0.52). The maximum GPA reported was 4.00, with a minimum GPA reported of 2.30.

Student Home-Life while attending College
Questions 6 through 11 were designed to evaluate what students face outside the educational environment that may impact on their performance during their program/college experience. These questions included marital status, spouse employment, number of children and any other responsibilities related to other dependents.

Approximately 68% responded as single. Nineteen percent (19%) responded as married. Six percent (6%) were divorced and approximately 2% were in a domestic partnership. Approximately five percent (5%) did not provide an answer to the question.

Twelve percent (12%) of the respondents stated that their spouses are either employed full or part time. Two percent (2%) identified that their spouses were full time students and approximately 4% of spouses stay at home.
Further, respondents were asked to provide the number of children they have. Nineteen percent (19%) of the respondents to this survey stated they have children. Of those responses, respondents identified that they have between 1 and 5 children, with 25% of the responses stating that they are responsible for "other dependents".

The final question in this category asked "*Are you the primary source of income for your family*?" Of the responses, approximately 42% answered Yes, and 53% answered No.

Student Employment and Work Experience
Questions 12 through 18 addressed the student's employment while attending the IST program/university.

Question 12 asked the respondents to provide their average hourly wage at work while attending school. Of the 53 respondents, 38 (72%) reported earnings between $8.25 per hour (minimum wage) and $10.00 per hour. Six (approximately 11%) of the respondents reported earnings between $10.00 per hour and $15.00 per hour, and 6 or approximately 11% reported earnings greater than $15.00 per hour. Additionally, respondents were asked how many hours per week did they work while attending school. Table 3 below provides the responses to the question.

As identified in table 3, approximately 77% or over three-quarters of the students responding to this survey, stated that they worked while attending school. This information further leads in to the question of what were the reasons you worked while attending school.

Amount	Count	Percentage
I did not work	9	16.98%
< 10 Hours	7	13.21%
10 to < 20 Hours	13	24.53%
20 to < 30 Hours	15	28.30%
30 to < 40 Hours	1	1.89%
> 40 Hours	5	9.43%
No Answer	3	5.66%

Table 3: Average number of hours worked

Table 4 below provides the responses for the main reasons a student chose to work while attending school (*respondents were asked to check all that apply*).

Reason	Count	Percentage
Tuition	15	28.30%
School Supplies	25	47.17%
Living Expenses	38	71.70%
Travel/Vacation	6	11.32%
Phone/Computer	19	35.85%
Clothing	20	37.74%
Vehicles	14	26.42%
Social Events	22	41.51%
Support of Family Members	10	18.87%
Other	9	16.98%

Table 4: Reasons for working while attending school

Further, the survey asked respondents "*While pursuing your degree, how many IT related jobs have you had*?" Fourteen or 26.42% responded that they have held 1 IT related job, 11 or 20.75% stated they have held 2 IT related jobs, 2 or 3.77% identified having 3 IT related jobs, and 1 each or 1.89% each responded that they have had 4 to 5 IT related jobs while pursuing their degree. Additionally, 21 or 39.62% responded that they have not held an IT related job during their degree pursuit.

Position	Count	Percentage
Phone Support / Troubleshooting	16	30.19%
Programming	3	5.66%
Database Management	5	9.43%
Systems Analysis	7	13.21%
Consultant	1	1.89%
Web Design	7	13.21%
Web Development	2	3.77%
Networking	17	32.08%
Information Security	6	11.32%
Other	21	39.62%

Table 5: IT job description/position held

Of the respondents that stated that they had held an IT related job, question 16 provided a list of IT related jobs for respondents to choose which of the job descriptions/positions they have held. Table 5 below provides the responses (*respondents were asked to check all that apply*).

As noted above, Phone Support/Troubleshooting and Networking provided the largest number of responses to the question. The "Other" category or 21 responses (39.62%) identified positions as Technicians, computer setup and support for family and friends, and the largest amount of responses stating that they have not held a job under the list of positions provided.

Additionally, this portion of the survey asked the respondents if they were going to pursue an IT related job upon graduation. Of the respondents, 44 (83.02%) answered Yes, 6 (11.32%) answered No, and 3 (5.66%) did not provide an answer.

The final question in this section relates to the responses given in the paragraph above, asking what kind of IT related job do you plan on pursuing. Table 6 below provides the responses to the kind of job the respondents were interested in pursuing (*respondents were asked to check all that apply*).

Position	Count	Percentage
Phone Support / Troubleshooting	10	18.87%
Programming	10	18.87%
Database Management	12	22.64%
Systems Analysis	14	26.42%
Consultant	6	11.32%
Web Design	12	22.64%
Web Development	11	20.75%
Networking	27	50.94%
Information Security	22	41.51%
Other	4	7.55%

Table 6: Type of IT job position pursing after graduation

The data above shows that the most sought after IT related job positions by the respondents include: Networking, Information Security, Systems Analysis, and Database Management and Web Design, respectively. For the "Other" category, respondents listed jobs such as Network/Systems Administration, IT Management, and Project Management.

Student Academic Experience(s)

Questions 19 through 31 of this survey deal with a student's academic experience while pursuing their degree and attending college.

Questions 19 and 20 asked the respondents for the semester and year entering the IST program and their expected graduation dates. The purpose of this question was to evaluate the time to completion of the degree for any anomalies in completing degree requirements. Analysis of this data did not find any anomalies.

Question 21 asked the respondents if they transferred into the IST program from a different program. Figure 4 below provides the results of this question:

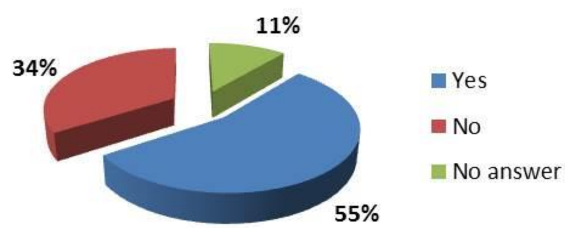

Figure 4: Percent of Students that transferred into the IST program

Respondents were then asked "*What program did you transfer from?*" Twenty-nine or 54.72% provided a response to this question. Twenty-four or 45.28% did not provide an answer. For the "Yes" answers provided, Table 7 below provides the responses for where students transferred from (*with count*):

Transfer Program	Count
Community College IT/IS Associates	6
Computer Science	4
Computer Engineering	3
Workforce with classes	3
Telecommunications	2
Communication Design	1
Engineering	1
Pre-Physical Therapy	1
Electrical Engineering	1
Education	1
Accounting	1
School of Art and Design	1
Basic Studies	1
Pre-Major	1
Electronic Systems Technology	1
Communication Design	1
No Response	1

Table 7: Count of Transfers

Respondents were further asked "*Why did they transfer to the IST program*?" Table 8 below provides the responses to this question (*respondents were asked to check all that apply*).

Reason	Count	Percentage
IT related classes in HS/College	7	13.21%
Know someone in the IT industry	7	13.21%
Worked with IT before	8	15.09%
Changing Careers	8	15.09%
Interested in the field	21	39.62%
Want to make money	9	16.98%
Want to learn more to help with a current job	2	3.77%
Previous Major Requirements	3	5.66%

Table 8: Reason for transferring to the IST program

Additionally the survey asked if the respondents have or currently are participating in any IT related extracurricular activities. Four or 7.55% responded that they attended guest speaker lectures, 6 or 11.32% responded that they have participated in workshops, 10 or 18.87% stated they have attended job fairs, 11 or 20.75% of the respondents stated that they are involved in student organizations/clubs, and 29 or 54.72% stated "Other". Of the responses provided in the "Other" category, all 29 of the respondents stated that they are not involved in any IT related extracurricular activities.

Question 23 of the survey requested information from the respondents concerning what skills they have acquired while enrolled in the IST program and which of the listed skills have assisted them in IT related tasks. Table 9 below provides the responses to the selected list of skills (*respondents were asked to check all that apply*). It shows that the highest skill sets acquired in the IST program as reported by the respondents include: Programming, Troubleshooting and Networking, equally, Systems Analysis, and Database Management. Responses in the "Other" category include: IT Management, Team Management, and Desktop Publishing.

Skill	Count	Percentage
Troubleshooting	29	54.72%
Programming	34	64.15%
Database Management	23	43.40%
Systems Analysis	27	50.94%
Consulting	5	9.43%
Web Design	14	26.42%
Web Development	8	15.09%
Networking	29	54.72%
Information Security	19	35.85%
Other	6	11.32%

Table 9: Skills acquires in the IST program

As a follow-up to the previous question above, respondents were asked "*What IT skills did you need in the work place that you did not find in this program or at this university*?" Six of the respondents stated that they are unsure at the time this survey was taken, 13 of the respondents stated "none", 8 respondents identified additional skills in programming, mobile applications and comprehensive VoIP, data integration, IT related curriculum to transportation and health care, IT forensics, Linux servers, and OS and software upgrades. Two respondents stated that there needs to be additional emphasis on "soft skills" such as, social skills and dealing with people. All other respondents felt the curriculum required minimal to no changes.

Questions 25 and 26 addressed whether the IST program prepares students to find a job in the IT field and have the students received enough information concerning potential careers in the IT profession. Both questions were developed using a 5-point Likert-type scale where responses include: Strongly disagree, Disagree, Neither agree nor disagree, Agree, and Strongly agree as choices. Table 10 and Table 11 below provide the responses to these questions.

Response	Count	Percentage
Strongly disagree	5	9.43%
Disagree	10	18.87%
Neither agree nor disagree	8	15.09%
Agree	17	32.08%
Strongly agree	7	13.21%
No answer	6	11.32%

Table 10: Received enough information about potential IT careers

Response	Count	Percentage
Strongly disagree	1	1.89%
Disagree	4	7.55%
Neither agree nor disagree	6	11.32%
Agree	27	50.94%
Strongly agree	9	16.98%
No answer	6	11.32%

Table 11: IST program prepared you for a job in the IT field

Excluding the "no answers", approximately 45.29% of the respondents either agreed or strongly agreed that they received enough information about potential IT careers, versus approximately 28.3% either disagreed or strongly disagreed that they had received adequate information about IT careers. Of the respondents to this question 15.09% responded to neither agree nor disagree.

For the question as to whether the IST program has prepared individuals for jobs in the IT field, approximately 9.44% of the respondents either disagreed or strongly disagreed that the IST program has prepared them for a job in the IT field, versus 67.92% of respondents either agreed or strongly agreed that the IST program is preparing them for employment in the IT field. Of the respondents to this question 11.32% responded to neither agree nor disagree.

As a final question to this survey, respondents were asked how they are financing their education. Responses to this question are provided below in Table 12 (*respondents were asked to check all that apply*). The data shows that for this cohort of respondents, the vast majority of the combination in financing their education comes from State and/or Federal support, Scholarships/Grants, and Student Loans. A large percentage is "paying out of pocket" including parental assistance. Those that provided "Other" responses included: military tuition assistance and employer provided tuition assistance.

Method	Count	Percentage
Family Assistance (Parents)	14	26.42%
State/Federal Financial Support	25	47.17%
Scholarships/Grants	20	37.74%
Student Loans	32	60.38%
Out of Pocket	17	32.08%
Other	5	9.43%

Table 12: How are you paying for your education?

5. DISCUSSION

This study identified a significant disproportion in male and female gender pursuing a degree in applied IS/IT. Approximately 77% of the respondents were male and only 17% of the respondents reporting identified themselves as female. While Aud et al's study (2012) supports our findings, Hussar & Bailey's (2011, p. 21) study presents a projection that the number of enrollment will increase 8% for men and 16% for women between 2009 and 2020. Future recruiting of female students needs to be addressed at both the High School and transfer student (Community College) level when marketing applied IS/IT degree programs.

Forty-two (42%) of the respondents reported that their age was 24 or greater, thus identifying high-level of non-traditional students seeking a Bachelor of Science degree in IS/IT. Being a four-year degree program and with the present economic employment conditions in U.S., it is likely that more non-traditional students are seeking higher education degrees for mobility and increased advancement in their professions. In fact, according to Hussar & Bailey (2011, p. 21) the number of enrollments in postgraduate degree-granting institutions between 2009 and 2020 is projected to increase 21% for students that are 25 to 34 years old, and 16% for students of age 35 or older.

The increasing number of non-traditional students will require institutions to revisit their education practices and will trigger the need for innovative ways for delivering curricular and extra-curricular activities both in and out of the classroom settings to accommodate the student's work, education and life balance.

Approximately 64% of the respondents reported that they were working anywhere from 10 to greater than 40 hours per week while trying to achieve their degree. As noted in Table 4, the vast majority of reasons for why a student needed to work while attending school included (ranked by count in decreasing order): 1) Living Expenses, 2) School Supplies, 3) Social Events, 4) Clothing, 5) Phone/Computer, 6) Tuition, 7) Vehicles, 8) Support of Family Members, 9) Other reasons, and 10) Travel/Vacation. Although tuition ranked 6th by the number of counts, living expenses and school supplies account for a significant number of responses (counts) as a major reason for working while attending school.

For many students working is not optional, but a necessity, especially when they are the primary source of income for their families or when they have to finance their education by paying out of pocket. Working students is already a reality in many classrooms and can impact how instructors and institutions offer academic activities. Bosworth (2007) cautions that "employees who study were at particular risk of leaving postsecondary education in their very first year" (p.13).

Approximately 54% of the students in this cohort transferred from another degree program which may suggest that they were not introduced to the applications/opportunities of the IS/IT field prior to enrolling into an educational program at a university. The data shows that the vast majority of the respondents chose to transfer to the IST program from another educational program or industry due to their interest in the field of IT. However, one of the lowest reasons for transfer was due to previous major requirements.

Approximately 68% of the respondents in this cohort felt that the skills/education they have received at the time of this survey prepares them for employment in the IT field/profession. Yet, 8 respondents identified additional IT skills that they did not find in the program or at the university. These skills could be incorporated into the existing courses or could be taught as extra-curricular activities. However, the activities should be carefully planned to take into consideration the increasing number of non-traditional and working students (e.g., remote, asynchrony and self-paced activities).

Every semester students have the opportunity to learn more about the IT field by attending guest lectures, career fairs, and panel discussions with representatives of technology companies, or by simple talking with faculty or academic advisors. Despite all the opportunities available, 28% of the respondents disagree that they have received enough information about potential IT careers. In addition, almost 55% of the respondents reported not being involved in any IT related extra-curricular activities. This situation raises an important issue of engaging students in learning activities beyond the classroom settings. However, it would require further investigation to identify the main factors for such disregard.

Based on the present curricula evaluated by students in this program, 68% of the respondents believed the IST degree program was preparing them for employment in the IT/IS field. Further, respondents in this study were asked "what changes would you make to the program to better prepare yourself for the IT job market?" Respondents suggested that the curriculum keep up with the changes in technology, more hands-on labs, and continue to update the hardware and software applications.

Presently, the average total cost of an undergraduate public 4-year degree which includes housing, tuition, fees, books, supplies, and other expenses is $20,100 (Aud et al, 2012, p.98). In working towards degree attainment and the cost of a 4-year degree, our study identified that approximately 64% of the students responding to this survey reported working between 10 and greater than 40 hours per week while attending college. Aud et al's study (2012) supports our findings, in that, their study reported for full-time college students, approximately 17% of college students worked less than 20 hours per week, approximately 17% worked between 20 – 34 hours per week and approximately 6% worked 35 hours or more in 2010, respectively (p. 93). Further, our study reported that of the expenditures and costs students are facing to attain a degree, the largest reasons for working while attending college included paying for tuition, school supplies, and living expenses (see Table 4).

Additionally, a large amount of respondents in our study reported that they were financing their degrees through State and/or Federal assistance, student loans, and paying out of pocket. With the rising costs of a public 4-year degree, first-time undergraduate students receiving financial aid has increased from 75% to 85% from 2006 to 2010 (Aud et al, 2012, p. 100). Thus, for the relatively high percentage (42%) of non-traditional students identified in this study, the costs of degree attainment and balancing home life, work, and pursuing an education may have its trade-offs, more so, extending the time to degree completion.

During the analysis of the survey data, we identified some variables that would help the discussion of education for non-traditional and working students. The first was the failure to ask the cohort of this study their Ethnicity, and the second was not asking about Housing (e.g., living in the dormitory halls, renting or owning a place). In addition, as there were respondents who stated that they would not pursue an IT related job after graduating, the survey should have a follow-up question to help identify the reasons for not continuing in IT the field.

Brown (2002) developed seven strategies to contribute to a nontraditional student's development and persistence. These strategies include:

- Recognizing the unique characteristics of the nontraditional student;
- Establish a number of services to meet the needs of nontraditional students;
- Empower professional student services to advise these students in various types of educational backgrounds;
- Employ, for the purpose of recruiting and pre-enrollment student services that assist in setting realistic goals;
- Develop orientation and first-year experiences that empower the students to manage the culture of higher education;
- Design career counseling and directed internships, service learning, and volunteer experiences; and
- Encourage faculty members who teach in nontraditional settings to develop inclusive learning environments (Brown, 2002, pp. 72 – 74).

6. CONCLUSION

With the increasing amount of nontraditional students entering technical degree programs, curriculum design and program educational activities will require re-evaluation for student access. Many students may not be able to participate in educational activities beyond the regular classroom settings because of restrictions of their work-life-education balance. Students may even struggle to find time for the expected academic activities such as to study the material, complete homework assignments or meet for team work.

As cited by Brown (2002), this cohort of student's make up at least 50% of enrollments continues to grow in higher education. With this cohort, comes a myriad of variables that can unfortunately lead to a student's attrition in completing their educational goals. These variables include (*not all inclusive*): supporting a family, working greater than 30 hours a week, financially being able to obtain a degree in reasonable amount of time, and balancing these responsibilities with coursework.

In a longitudal study (Horn, 1996) of nontraditional undergraduate students' persistence and attainment in postsecondary education, the author states that intervention, assistance, and providing support to nontraditional students has to take place within their first year of college. As a comparison to more traditional students, one in three nontraditional students stopped attending school and left without a credential in their first year versus one in five for traditional students.

With the data from this study identifying the lack of participation of nontraditional students involved in extra-curricular program activities and with the growing number of nontraditional students in higher education, it is imperative upon staff and faculty to develop and provide a stronger and more inclusive learning environment for nontraditional students.

The results of this survey identified opportunities to improve the students learning while taking into consideration their work-life-education balance. For example, the use of podcasts would allow students to listen important topics while driving to and from work or doing other activities. When representatives from companies are invited to speak with students, we should record the presentations or, if possible, make it available in a synchronous mode so students that cannot attend the presentation can still participate in the discussions. Another issue to be addressed is that lab equipment is not available outside of the school environment. However, several technologies can be used to remotely connect to the lab equipment or to simulate them, such as NetLab+ and IBM Academic Skills Cloud. In addition, this research shows that 39.62% of participants did not hold an IT related job and 26.42% held only one IT job while attending school. As many students need to work, we could help them to find IT related jobs that will contribute to their experience learning IT skills beyond the classroom environment. For example, students could rotate jobs to be exposed to different technologies and IT activities.

As the non-traditional becomes the new traditional, we should consider blending pedagogy with andragogy to better serve the future student population and to accommodate their work-education-life balance.

7. ACKNOWLEDGEMENT

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The Document Explosion in the World of Big Data – Curriculum Considerations

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Abstract

Within the context of "big data", there is an increasing focus on the source of the large volumes of data now stored electronically. The greatest portion of this data is unstructured and comes from a variety of sources in a variety of formats, much of which does not conform to a consistent data model. As business and government organizations become "paperless", the system of "record" in these documents (including text messages, social media postings, tweets, and email messages) becomes more important. The job of "records management" is becoming more significant in the information systems discipline, as businesses and government agencies struggle to control and manage their electronic resources for regulatory, compliance, legal, and business analytics purposes. Records management has risen to be a separate discipline with its own certifications and job classifications. Many of the principles in the discipline were developed in the time of paper records but still apply in this electronic age, and are now considered part of the responsibilities of the information technology worker. As this is a potential large job market, it is time to consider whether electronic document management (in addition to database management) should be included in the college-level preparation of undergraduate students who will join the workplace in the time of "big data" and its exploitation. This paper looks at the field of electronic document (records) management and its insertion in the undergraduate information systems curriculum.

Keywords: big data, records management, electronic documents and records management, information systems curriculum, document management

1. THE BIG DATA CONTEXT

"Every day, we create 2.5 quintillion bytes of data — so much that 90% of the data in the world today has been created in the last two years alone." (IBM).

This data comes from everywhere: documents created in the course of doing business, posts to social media sites, digital images and videos, emails, web pages, e-commerce transaction records, security cameras and logs, cell phone transactions, and text messages to name a few. As business and government activities become "paperless", much of this data is only available in electronic form and this digital form is the only permanent record of important events (Franks, 2013; Ganz et al., 2007).

Much of the data is "unstructured" or "semi-structured" with no underlying data model or consistent format such as a social media comment. A recent study shows that 95 percent of information in business today is unstructured objects such as messaging logs, call history, usage trends, and weather information (Yu, 2012). This lack of a standard format makes it difficult to fit much of the "big data" into the conventional relational data model, which relies on data items that are consistent in form and format (data type and size). Unstructured data such as text documents is typically stored as a "blob" in a database that limits its usefulness. It can be retrieved and displayed though. In the big data context we are looking for insights above and beyond what traditional, structured data and content analysis techniques can provide. For example, in order to see into the text and find words or phrases that correlate with similar words in other text documents, techniques such as customer sentiment analysis need to be applied. Text analytics techniques such as "word clouds" can be employed to provide visual representations of unstructured data. Furthermore, the techniques that enable people to trace the origins of parts of documents are important as new documents are formed which include data from other sources. Technology exists today for this type of analysis but using them gets complex as the volume and variety of data is exploding.

2. ELECTRONIC DOCUMENTS AND THE ISSUES THEY PRESENT

Where is this unstructured data coming from? Electronic documents are everywhere. The traditional and most common document format include MS-Word "doc (or docx)" or Adobe "pdf". However, many different forms of documents now are commonplace in business- spreadsheets, email messages, SMS messages, Facebook comments, Twitter tweets- are now all components of a big data solution.

It has been reported that one in three business leaders do not trust the information they use to make decisions (IBM). How can you act upon information if you do not trust it? Establishing trust in big data presents a huge challenge as the variety and number of sources grows. While there are many techniques to verify and validate discrete data (e.g., the age of a person can be validated against their birth date), the nature of electronic documents makes them more difficult to validate. Specific issues associated with managing and safeguarding "unstructured" electronic documents include:

1. Version control. The key question is which version of document is counted as the "official version". In a typical business environment, a document may exist in many places as it goes through the draft, review and approval processes. How do we keep track of that workflow leading to the final "document"? Which version is the "system of record"? Is it located in a central repository?

2. Duplication. Even if a document is not revised, it may occur multiple times in many forms, including in someone's email, on someone else's private hard drives, on a variety of corporate servers, in the "cloud", on flash drives, etc. Which documents do we need to archive and store as permanent records and which do we discard? How do we remove known copies? Duplicated data can invalidate results or present bias in a data analysis leading to the lack of trust in the data.

3. E-discovery. When it comes to a legal dispute or a criminal investigation, documents and records are an important part of the discovery process and are the subject of evidence in civil and criminal trials. Amendments to the US Federal Rules of Civil Procedure (U.S. Courts, 2010) codified the requirement to provide electronic documents in the discovery process, using the term electronically stored information (ESI). E- discovery includes not just looking at the content of the documents themselves, but also an analysis of the "metadata" attached to such files (who created them and when, for example).

4. Security and privacy. There have been considerable "hacking" activities in today's networked computer environment, with "rogue states" and criminals stealing everything from trade secrets to business plans to individual identities. The more documents available electronically, the more risk of a security breach and the increased possibility of "reputation damage" as such breaches impact the privacy of individuals and businesses.

5. Information leakage: The 2011 CyberSecurity Watch Survey revealed that 46% of the respondents thought that damage caused by malicious insiders was more severe than damage from outsiders (Silowash et al., 2012). Confidential information can be compromised by employees and contractors who have uncontrolled access to important documents. Insider threats are well known since the advent of the WikiLeaks scandal. Wikileaks (wikileaks.org) is an international organization whose sole purpose is to publish confidential information from anonymous sources through its web site, so disclosing such information to the public (Karhula, 2012). How do companies prevent one of their confidential documents from appearing on a website like Wikileaks or being sold to a competitor in the U.S. or overseas?

These are just some of the major electronic document issues that face businesses, government agencies, and other organizations in today's digital world.

3. ELECTRONIC DOCUMENT MANAGEMENT

Document management is becoming increasingly important in the "big data" world, not just for the role of a document as a "record" of a transaction but also for the content that the document contains, in relation to information in other documents and when aggregated in a larger context.

One important consideration is the difference between a document and a record. ISO (International Organization for Standardization) 15489 is the key international standard on records management. It defines records as "information created, received, and maintained as evidence and information by an organization or person, in pursuance of legal obligations or in the transaction of business" (International Organization for Standardization, 2001).

According to the above definition, a record plays the role as "evidence", which implies that it must be complete and unchanged. Furthermore, the definition implies that organizations keep records in order to fulfill "legal obligations" or "transaction of business". A specific document "may or may not meet the definition of a record" (Department of Defense, 2007). ISO 15489 defines a document as "recorded information or Standardization, 2001). This definition is relatively generic compared with the definition of records. It does not specify whether and how the documents need to be kept and managed. Therefore, one major distinction between documents and records lies in that documents may or may not become records. Once a document becomes a record, it must be managed and controlled against change.

In today's digital world, however, the distinction between records and documents becomes vague as documents may be retrieved and then become evidence. In this sense, any document can be considered a record and any piece of its content can be extracted and used in a context different from the original intention of the document.

A document was originally considered to be text on paper and the term records management was used to describe a profession that manages physical documents (Franks, 2013). It was also more frequently associated with the traditional library catalogue and archive management. However, advances in technology (e.g., cloud computing, big data, etc.) and emergence of communication tools (e.g., social media) have completely changed the traditional view of records management as a discipline. Furthermore, how records are created and used in organizations is also fundamentally reshaped as a response to those developments (Bailey, 2013). More and more organizations today are overwhelmed by the volume of electronic documents and records and are searching for more efficient ways to store, manage, and maintain documents and records, and more importantly, to ensure compliance of the records with policies and standards (Franks, 2013).

One of the technical solutions is the implementation of an EDRMS (Electronic Documents and Records Management System), defined as "a system designed to manage electronic content, documents, and records and support four key functions: input (creation/capture); management (content, documents, records); collaboration/process management; and output/delivery" (JISC InfoNet, 2012). An EDRMS includes software tools that can be used to manage all kinds of records and documents and enforce retention and disposition rules and policies (Smallwood, 2012). However, it should be noted that EDRMS is only one piece of the puzzle. A successful document and record management program requires a seamless integration of different components including the EDRMS, records management policies and procedures, content management techniques, effective information governance strategies, as well as well-trained personnel (Franks, 2013; Smallwood, 2012).

In her book Records and Information Management, Franks summarizes several adverse impacts on organizations which do not have a comprehensive document and record management program in place (Franks, 2013, p33):

- Damage to the organization's reputation;
- High costs for information management and storage;
- Lost files and risk of spoliation;
- Legal discovery penalties or sanctions; and
- Audit and compliance violations.

The above adverse aspects further reinforce the importance of implementing document and record management programs in organizations and the need for personnel to support them effectively.

4. DOCUMENT MANAGEMENT IN THE IT/IS CURRICULUM

Having established the importance of effective electronic document (record) management in the workplace, we next need to consider how to train young professionals to support the implementation and management of such systems.

As mentioned in the prior section, documents in business today can be rendered in a myriad of electronic forms. What poses challenges for managing these documents is the increasingly growing amount of unstructured information and the increasing need to analyze the data inside these documents, sometimes in ways not envisaged when the document was first created. In contrast with a database that stores and manages structured content (numbers in columns and rows), unstructured content is more difficult to capture, classify, maintain, and search than its structured counterpart (Franks, 2013).

Most contemporary undergraduate IT/IS programs include at least one required course on relational databases and the processing of structured data. The role of "big data" in the IS curriculum is currently under discussion (Topi, 2013), the focus being to manage big data technologies. However, there appears to be a lack of courses offered on managing, retrieving processing, and maintaining unstructured data (or documents containing such data) in undergraduate IT/IS programs. The ensuing question that we as IT/IS educators are facing currently is whether it is the right timing to incorporate electronic document management topics into the existing curriculum. And if so, how do we justify such a decision? Where does it fit into the curriculum? Is it a separate discipline or part of the database realm? In order to answer those questions, we apply an existing model as the framework to analyze the scenario.

The "holistic" model was proposed to help IT/IS educators make a valid decision as for "when" to incorporate new technology topics into the curriculum and the "tactical model" was developed for "how" to insert new courses into the existing curriculum (Liu & Murphy, 2012). In the model, several "forces" (i.e., factors) were integrated as a foundation for making "when" decision. These factors are summarized in Appendix: Figure 1.

We primarily examined three of these factors (i.e., impetus for the new topic, technology certification status, and avoiding curriculum bloating) to inform our decision on when and where to place electronic document management in the curriculum.

Impetus for the new topic

In our model, a new topic is considered to be a higher priority if it is recommended by industry or a curriculum advisory board.

As Franks pointed out in her book Records and Information Management, "… records professional must be a specialist when it comes to records management but a generalist when it comes to understanding the core business responsibilities of the organization and possessing the skills and abilities to interact with professionals from other domains, including legal, compliance, business units, information technology, and security/risk management." (Franks, 2013, p289). Most of these general topics are already covered by other courses in the IT/IS curriculum. In our institution, all IT students take courses in project management, computer security, and general business. Students who take the information systems (IS) specialty also take business law and organizational management. The missing element is therefore electronic document record) management.

Although the document (record) management field was underrepresented in the past (US Office of Personnel Management, 1979; US Office of Personnel Management, 1965 (revised 2005)), employers are starting to recognize the important value of well-trained records management professionals to the business and organizations (Franks, 2013). This is also echoed by OPM in the memorandum Managing Government Records which states that the goal of establishing the records management occupational series is "to elevate records management roles, responsibilities, and skill sets for agency records officers and other records professionals (Executive Office of the President, 2012, p.6)."

Our institution is in the Washington DC metropolitan area and so government jobs are significant possibilities for our students. We felt that this job market was important for our students and could justify adding a course to the curriculum.

The technology certification status
The availability of a certification in the technology by a reputable organization is also considered as an important factor in our holistic model. (Liu & Murphy, 2012). The following are some of the current certification available in documents and records management and its related fields by reputable organizations:

- AIIM ERM: The Association for Information and Image Management (AIIM) is a global, non-profit organization that provides independent research, education and certification programs to information professionals. AIIM offers the Electronic Records Management (ERM) certificates. The certificates include two tracks: ERM Practitioner and ERM Specialist. The former covers major concepts and technologies for ERM while the latter focuses on implementing ERM.

- CompTIA CDIA+: CompTIA is the leading provider of vendor-neutral certifications and is well known globally. CDIA+ (Certified Document Imaging Architect) "covers major areas in technologies and best practices used to plan, design, and specify a digital imaging and content management systems.

- ARMA International ERM: ARMA International (formerly the Association of Records Management and Administrators) is a not- for-profit professional association and the authority on governing information as a strategic asset. ERM covers electronic document systems, related standards, and legal requirements.

Based on these technology certifications we concluded that the field was mature and that our students would be more marketable in the regional job market because of taking this course.

Avoiding Curriculum Bloating
The core curriculum for our B.S. in Information Technology degree is very full and designed to be cohesive and compliant with accreditation requirements. We looked at our specialty areas as having the most potential for application of document management skills and identified two areas: the information systems (IS) specialty (focusing on business) and the health information technology (HIT) specialty (focusing on healthcare). The course could be added to both of these areas: HIT was not a problem as this was a new curriculum. For IS, we decided we could move a decision analysis class to the core curriculum (as an option for the second quantitative course) and so could add the electronic document management course without "bloating the curriculum".

In conclusion, we decided that it was timely to introduce a course on electronic document (record) management into the curriculum and that it would serve students well in today's competitive job market.

5. CREATING AND IMPLEMENTING THE ELECTRONIC DOCUMENT MANAGEMENT COURSES

The "tactical" model (Liu & Murphy, 2012) suggests that, in general, there are four insertion approaches for a new technology topic: offer a "special topics" course which students can take as an elective, offer a new course outside of the department/program without "bloating" the IS/ IT curriculum, introduce a new course or make extensive revisions to an existing course, or develop a new specialization in IT program. Considering the factors of timeframe for implantation and the complexity of required approval processes, we originally took the approach of introducing a new course to the curriculum and created a new course - Electronic Documents and Records Management as an IS/IT elective. This approach involved a formal curriculum review process at our institution.

As digital documents become the system of records in the world of big data, whether medical records or real estate transactions, the need for organizations to manage as well as analyze documents and other electronic records becomes paramount. The new course addresses this growing need, and supports the growing trend of e-discovery in litigation. It was an elective in the BS in IT program and in the IT minor, and a required course in the new BS in Health Information Management program. The broad purpose of the course is to ensure that students understand what is required to establish a sound documentation function within their work area, how electronic documentation systems work and what is needed to keep them compliant with regulations and policies. The course discusses how to go from a paper system to an electronic system and provides students with practical experiences at creating and using document and records management systems. It also discusses what documentation must be in place to support the company's systems and processes. The course objectives are listed below:

- Define electronic document management and records management systems and describe the importance of managing them, as the systems of record, in business and government;
- Explain the business and legal benefits of establishing a comprehensive records retention program and the need for vital records protection and disaster recovery planning;
- Identify factors that help reduce the scope and time for a document search and identify general criteria for indexing systems for effective identification, search and retrieval of records;
- Recommend solutions for common filing problems, for uniquely identifying records and for safeguarding the security and confidentiality of documents, particularly those containing personally identifiable information (PII); and policies, and the regulations for e- discovery in the legal environment; and
- Describe and evaluate document and record management software and how it is used in business, including legal and medical environments;
- Understand the common ground in all regulations, including the International Organization for Standardization (ISO), the HIPAA regulations for electronic medical records, the National Archives regulations and policies, and the regulations for e-discovery in the legal environment; and
- Create or acquire and manage a cost-effective electronic document management system to meet a specific business need government.

We ran this 300-level course as an elective and a pilot conducted in summer 2012 as an online course. There were only six students enrolled but their feedback was positive. Now we are moving to also offer it as a required course for students taking the information systems specialty (the largest subset of our students) beginning in the fall of 2013. The course is running as a hybrid one and has eighteen students. We will closely follow the outcomes (including employment opportunity, learning gains, etc.) from those students.

6. CONCLUSIONS

Big data has in its roots a variety of electronic document formats and, if the results of analytical process on this data are to be "trusted", it is important that the electronic sources of data (structured and unstructured) are managed effectively. It is our belief that as "big data" becomes more prevalent, qualified professionals will be needed to collect, manage, and retain documents in a structured way to meet industry and government requirements. One of these fields is obviously heath care, but there is also a variety of other business needs. While there is a high demand for the "data scientist" (Woods, 2012) to do the analysis and interpretation of the data, there is also a need within the IT profession for the "data custodian" role to manage the data. We believe that an undergraduate course in electronic document (record) management is essential to understanding the role of the data custodian and making our information systems students more marketable in this fast growing field.

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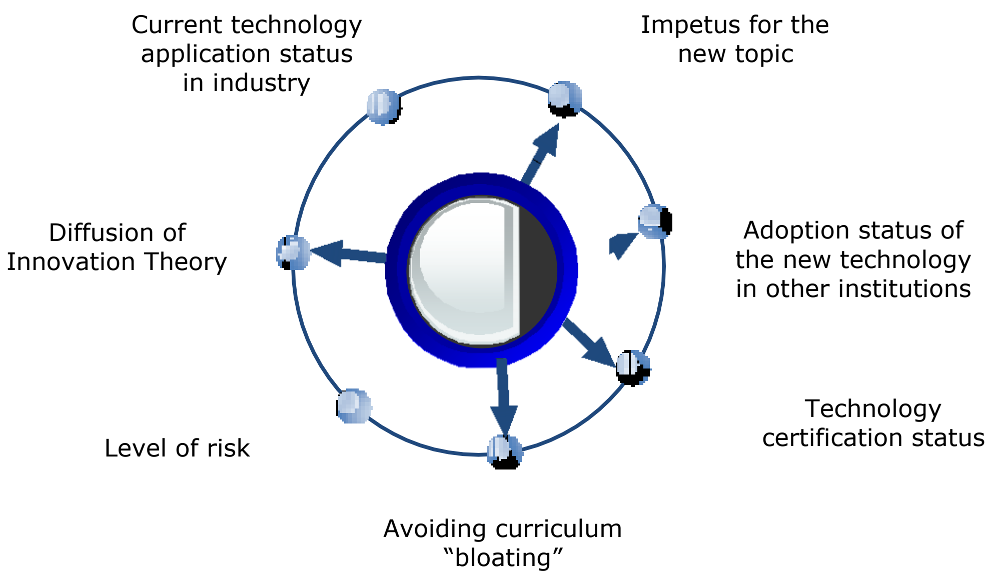
Editor's Note:

This paper was selected for inclusion in the journal as the ISECON 2013 Best Paper The acceptance rate is typically 1% for this category of paper based on blind reviews from six or more peers including three or more former best papers authors who did not submit a paper in 2013.

Appendix


Current technology
application status
in industry
Impetus for the
new topic
Diffusion of
Innovation Theory
Adoption status of
the new technology
in other institutions
Technology
certification status
Level of risk
Avoiding curriculum
"bloating"

Flipping Introduction to MIS for a Connected World

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Abstract:

It has been increasingly challenging to provide an introductory coverage of the rapidly expanding fields in Information Systems (IS). The task has been further complicated by the popularity of web resources and cloud services. A new generation of technically savvy learners, while recognizing the significance of information systems, expects connectivity to current and meaningful information technology. Internet accessible information far outpaced those packaged in a typical textbook, triggering a fresh look into learning resources. Compliance to institutional and accreditation expectations for measured learning outcomes also requires careful revision of course design. This paper presents an approach to deliver a broad scope of Information Systems topics to introductory students with heterogeneous backgrounds and career interests, by "flipping" the overall design of the Introduction to MIS course. This approach has been refined over the last 5 years with promising results. Free tools and web-based sources support the low cost delivery of the course. Assessment tools have been developed to better monitor individual student learning outcome.

Keywords: MIS, Flip learning, assessment, learning resources, knowledge construction, rubric grading

1. Introduction

A course in introduction to MIS (refer to as the MIS course from this point forward) has traditionally served as a foundation course for students seeking careers in IS fields. As information systems become more prominent in organizations, the course evolves to serve as a core course in many business study programs. Gradually, technical and operational topics yield to organizational issues, strategic considerations, global management challenges, and shortening technology development cycles. Indeed, increasing number of MIS textbooks defer technical topics to the optional supplement sections to accommodate the expanding topics. At the same time, several disruptive forces pressure the reinvention of the MIS course. First of all, the inclusion of IT topics in non-IS courses and the indiscriminate usage of the term "MIS" confuse students on the value of the MIS course. Unfortunately, many students begin to see the MIS course as merely an unwelcomed requirement for graduation. Secondly, a new generation of students comes to the MIS course with new attitudes and expectations. These students have been pampered by intuitive consumer information technology (IT), and expect hands-on experience in the MIS course. In addition, the relevancy and affordability of textbook create unavoidable political pressure from students. Dissatisfied students expect "useful" information from an expensive textbook, and found even richer information from the Internet. Other students rely on older versions of the textbook and complain about the lack of "full guidance" from the instructor in testing. Increasingly, students also pressure the instructor to provide class notes; PowerPoint slides, and reviews prior to taking test. Combination of these events adds to the chaos of instruction for the MIS course. Moreover, rapid shortening of technology cycles and proliferation of information technology compete for student interests in the traditional contents of the MIS course, threatening the sustainability of the MIS course, especially in an environment of declining enrollment, and abundant substitution. Lastly, new institutional expectation to practice assessment and demonstrate learning outcomes forces the critical review and redesign of all courses, including the MIS course. This paper reports lessons learned from experimentation and modification of the MIS course over the past 5 years.

2. Reexamination of the MIS Course

The MIS course faces an identity crisis as increasing number of non-IS students enroll in the course, while selected IS topics are being incorporated into non-IS courses. Table 1 shows recent distribution of the declared majors of students enrolled in the MIS course. It is clear that a majority of the students in the MIS course will be non-IS majors. The handful of Computer Information Systems (CIS) students actually came from a different program from the Science College. Since it is unlikely that a human resource management student will be concerned about an inventory system, nor for a tourism student to be interested in a supply chain management system, a course design consideration is whether to require all students to study all IS topics. At the same time, many accounting students take Accounting Information Systems, a course that potentially overlaps topics with the MIS course. The CIS students, while enrolling in the MIS course, often avoid the non-technical topics in the MIS course. Immediately, there is a need to motivate students to attend class. Another dilemma emerges when considering the inclusion of hands-on experience, when some students may learn similar materials in a non-IS course. Time constraints and the drastically different IT backgrounds of the students make it almost impossible to squeeze in any meaningful technical training. An even greater challenge is in the task of assessing student learning outcomes, with the spread of student prior knowledge. The rapid adoptions of IS topics in non-IS courses further undermine the value construction of the MIS course. Table 2 shows a sample of IS topics in non-IS courses. The MIS course must justify its unique value contribution by going beyond merely coverage of definitions and basic concepts. The constantly changing mix of students makes it extremely difficult to select and address topics potentially of interest to a class of students with diversified backgrounds and career interests.

Major	Count
Accounting	5
Chemistry/Accounting	1
Computer Information Systems	5
Finance and Economics	11
Finance and Human Resources	1
HR Management	5
HRM and Entrepreneurship	1
International Tourism	3
Tourism and HR	1
Undeclared	1
Total:	34

Table 1: Majors Distribution

IS Topic	Non-IS Course
Excel	Accounting
E-Business	Marketing
Systems Development	Accounting IS
Simulation	Business Strategy
Website Construction	Marketing
Business Analytics	Business Statistics, Finance
HRIS	HR Management
Government IT	Public Administration
Healthcare IS	Nursing
Multimedia Systems	Education
GIS	Geography, Urban Planning
CRM	Marketing
ERP	Accounting

Table 2: Sample of IS topics in non-IS course

3. Flipping Learning Objectives for Richer Experience

Initially, the adoption of a textbook with an update topic list was considered as a solution to draw student interest. Table 3 presents a sample of updated topic list in a recent textbook. However, the expanded topic list with overwhelming details seemed to add frustration to the non-IS students, most of whom have yet to develop interest in IS topics. A revised course design with core topics and elective topics seems to be more effective for the new generation of students.

Business Information Systems Overview
Strategic Uses of Information Systems
Functional Information Systems
Business Information Technology
Information Systems Architecture and Networks
E-Business
Data and Knowledge Management
Decision Support Systems and Intelligence Systems
Information Systems Development
Information Project Management
Integrated and Global Information Systems

Table 3: Sample updated textbook topic list

Today's students are computer and Internet savvy, skilled in online information search, and crafty in the assembly of information report from web excerpts. They learn just-in-time, love learning by exploration, and expect relevancy in their learning experience. They study hours before test, seldom read the textbook before class, and use study notes and PowerPoint slides instead of textbook. They are fast to sift through volumes of information, but sorely need guidance to select and digest information. They love and expect accommodation of their own individual learning styles. The Grasha-Reichmann learning style questionnaire (GRLSQ) categorizes students as either dependent, collaborative, or independent learners (Reichmann & Grasha, 1974). Thus while some students expect structured lectures and course activities, some expect interactivity with the instructors, others may rebel against planned learning activities. This is a consistent challenge when working with students with heterogeneous career aspirations. Keirsey-Bates (Keirsey & Bates, 1984) classified learners through the Myers-Briggs Type Indicator (MBTI) using four personality scales: Introvert/Extrovert, Sensing or Intuitive, Thinking or Feeling, Judging or Perceiving. Frequently, non-IS students have drastic different learning styles from IS students. This explains difficulties in delivering lessons to non-IS students using contents and pedagogical methods initially designed for IS students. It is particularly difficult when selecting hands-on experience and class projects. What is fun and challenging for one group of student appears as boring task for other students. More significantly, the new generation of learners does not consider hard work a factor of learning, but expect learning to be fun. They avoid mundane, repetitive works, but immerse themselves into meaningful, challenging tasks (Law, 2011).

Keeping in mind the traits of current students, the core topics are timeless, and applicable to broad organizational and global settings. Instead of requiring students to memorize a selected set of definitions and concepts, they were assigned to explore the expanding scopes of information, management challenges and solutions relevant to the core topics. Table 4 presents a list of core topics. The core topics account for approximately 16 hours out of 45 contact hours. For example, the topic "information Resources and IT roles" allows the coverage of any hardware, software, data, infrastructure or personnel issues. The "System Development" topic allows coverage of all in-sourcing or out-sourcing software projects, as well as contracted services. Further details on revised instructional strategy will be presented in a later section.

Information Resources and IT Roles
IT and Business Strategy
Systems Development (in-source or out-source)
Information Systems in Business
E-Business

Table 4: Sample Core Topics

In addition to the core topics, elective topics are also included to ensure student awareness of important IS/IT trends and developments. The elective topics are determined together by the instructor as well as students enrolling in the MIS course. The instructor selects the elective topic list for each course, and the students bid for the topics as teams. Each student team is then allowed to define the scope of the topic, based on the interest of the team and the available online resources. The elective topics account for about 17-20 contact hours, with the remaining contact hours reserved for class administration and experiential, hands-on activities. Table 5 shows a list of potential elective topics, which will be refreshed periodically according to current trends, available resources, and student interests. For example, while the students learn about general information security issues in a prerequisite course, mobile information security presents new challenges with a shift of IT applications to mobile devices and mobile platforms. The students have the option to propose and negotiate an elective topic to work on.

Ethics, Compliance, and Information Policy
Customer Relationship Management
Mobile Commerce (GPS, GIS, LBS, payment system)
IT Infrastructure
ERP
Cloud Computing
Supply Chain Management
Global Information Resources Management
Database and Data Warehouse
Networks, Telecommunications and Wireless Computing
Collaborative System
Project Management
Mobile Information Security

Table 5: Sample Elective Topics

After the presentation of each student team, the instructor fills in knowledge gap by correcting misconception, further explaining difficult concepts, and presenting omitted information as permitted by class time. This is similar to reported "Flipped Learning" (Frydenberg, 2013; Lage, Platt, & Treglia, 2000. The students responded positively to this arrangement that allows them to explore IS topics that are potentially relevant to the personal experience of the students.

4. Flipping Learning resources in a connected world

The proliferation of information through the Internet, and alternative educational resources and channels challenge the value of instruction centered on a textbook. The acceptance of an electronic future in higher education relaxes the expectation on tying a course to a textbook. As the cost of textbook spirals to the point of being unaffordable for many students, maddening revision cycles of textbook make it exhausting for the instructor to keep up with course preparation. To save cost, students secretly utilize multiple versions of textbook, creating unpredictable behaviors in the learning process. Some students even attempted to borrow a textbook from the instructor to study for a test!
In fall 2012, a free online e-book was adopted in place of a regular textbook as a required textbook, with the expectation for students to utilize the e-book for their studies. Chapters of the e-book were included among the elective topics. Surprisingly, very few students selected topics from the e-book, and instead, found their own online information sources to present topics of their choices. As a matter of fact, very few students utilized the free e-book as reference source for their research assignments.

In spring 2013, the online e-book was relabeled as an optional textbook, and there was no official textbook for the course. A Google Site was created to provide students with notes, PowerPoint slides and web links on core and elective topics. PowerPoint set found online, along with PowerPoint submitted by previous student teams were made available to the students. The learning resources were given to the student with no guarantee for the quality or completeness of the information. The student teams were expected to make a presentation on a selected topic with critical analysis of available information. The students were encouraged to utilize online resources, using information placed in the Google Site as starting references. All student teams must share their presentation media through the Google site to the entire class of students. The student presentations were impressive, including nice graphics and video. Many presentation media were superior to those provided by textbook publishers, and including current information not found in textbooks! At the end of the semester, students were asked in a survey question whether they recommend using a textbook in the course, 100% of those who took the survey responded "No, I do not really need a textbook to learn". This suggested that structured information, like a textbook, is not an important factor of learning for the new generation of students.

5. Flipping Memorization of facts to the Construction of Knowledge

The elimination of a textbook requires modification of assessment approach. Students seem to prefer learning by exploration over learning by memorization. Since each student team utilized different learning resources for their learning, it was no longer meaningful to assess learning through standardized tools such as written tests. When given a choice, students voted to construct knowledge bases in place of written tests. The Knowledge Bases were designed as continuing efforts of the topic presentations, but students were given the option to work as teams or individual. While students must provide critical summaries of key concepts in their presentation, they must organize detailed information in the Knowledge Bases. Table 6 shows the groups of information that students may earn credits on. Many student teams presented incredible collections of information. The Knowledge Bases provided the core reference sources for students to create enriched information in the class wiki project for digital storytelling (Bromberg, Techatassanasoontorn, & Andrade, 2013), while practicing their skills in team collaboration and project management. When surveyed at the end of the class, 100% of students indicated "Yes, I learned from the Knowledge base project" over "No, I rather just take tests", even though the Knowledge Bases required more works.

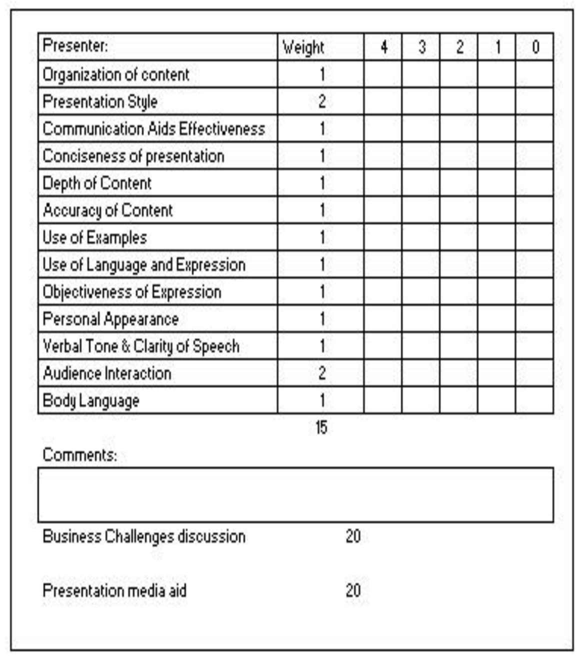
List of key concepts
List of key terms
List of key software products
List of key web-based services
List of key data management issues
List of key technology
List of key supports/users
List of key reference sources
Key concepts with 10-30 words description
Key terms with 10-30 words description
Key software products with 10-30 words description
Key web-based services
List of relevant video

Table 6: Knowledge Construction Credits

6. Flipping evaluation to document learning and critical thinking

The most important change in the course design has been a new learning evaluation and assessment method. This is a direct response to the institutional mandate on learning assessment. Recent institution accreditation requirements expect demonstration of learning outcome of core competencies including, but not limited to, written and oral communication, quantitative reasoning, information literacy, and critical thinking (WASC 2013 Handbook of Accreditation Penultimate Draft- March 2013, p. 28). The MIS course now pegs its existence on providing evidence of learning outcomes to support the program and institutional learning objectives. Therefore, it is insufficient to show the test score distribution of students in written tests, the adoption of a popular textbook, or the completion of assignments by students. Instead, it is necessary to report that students demonstrate critical thinking and problem solving through class activities. Kolb (Kolb, 1981) pointed out the different learning styles in handling information. Instead of measuring percentage completion toward a few goals, student learning is continuously monitored throughout the course. Students earn credits on class attendance, as well as class contribution, including peer evaluation tasks. Evaluation tools have been designed to measure student works against a targeted level, as well as allowing bonus opportunities when a student exceeded the expected learning target. In short, students have been relieved from the pressure of failed efforts, and provided ample opportunities to make up for credit shortfalls, as well as making advance progress toward their targeted course grade. Table 7 presents a sample of the grading scheme used for the MIS course. Figure 1 shows the tool for presentation assessment and Figure 2 shows the e-forum assessment tool.

Figure 1 Sample presentation assessment tool



Presenter:	Weight	4	3	2	1	0
Organization of content	1					
Presentation Style	2					
Communication Aids Effectiveness	1					
Conciseness of presentation	1					
Depth of Content	1					
Accuracy of Content	1					
Use of Examples	1					
Use of Language and Expression	1					
Objectiveness of Expression	1					
Personal Appearance	1					
Verbal Tone & Clarity of Speech	1					
Audience Interaction	2					
Body Language	1					
	15					

Comments:

Business Challenges discussion 20

Presentation media aid 20

A. Acquire Core Knowledge	
Core Knowledge demonstration	20%
Topic presentation	10%
Discussion/e-forum	20%
B. Understanding and Critical Analysis	
Business IT research/project	32%
Special class project	18%

Table 7: Sample Grading Rubric

Figure 2 Sample E-Forum assessment tool

Eforum Evaluation						
	Weigh	0	1	2	3	4
Core Knowledge	2					
Structured Presentat	2					
Managerial Analysis	3					
Response Completer	1					
Persuasiveness	2					
Unique Perspective	2					
	12					

The major course assignment is an individual research assignment, where students competitively bids for a topic from a list of approved research topics. The research assessment rubric is provided to the students upfront to ensure that they prepare the research report according to the evaluation criteria. Figure 3 shows the research evaluation rubric. The key design of the rubric is to measure the critical thinking of students, include their ability to collect, digest, and organize information, and persuasively present a critical review based on the collected information. The instructor clearly explained the use of the rubric and its relationship to assignment grade. For example, level 7 on the rubric scale of 10 has been chosen to reflect approximate 100% score on the assignment. Thus students are assured that outstanding effort will be recognized. All assessment tools are designed to measure strength and weakness of students in their submitted works. For example, poor performance on the individual research assignment does not automatically disqualify a student from a "A", as long as the student performs "beyond expectation" in most the other class activities. The top ends of the measurement scales indicate "beyond expectation" performance. Hence, a student only has to demonstrate sufficient "outstanding performance" to qualify for a good course grade, and it becomes pure experience and fun beyond that point. Once a student accumulated sufficient credits for a course grade, the student is no longer obligated for further class works. Amazingly, many students performed the extra work, just for their "pride".

Figure 3 Sample Research assessment tool

	Name												
	Weight	Basic Quality of Report					Superior Report Quality						
		0	1	2	3	4	5	6	7	8	9	10	Total
Background:	2												
Significance of Issue:	2												
Affected Organization/Users:	2												
Changes Management:	2												
Geographic location:	1												
Promoters:	1												
Economics:	2												
Cultural and Social Factors:	2												
Legal and Ethical Factors:	1												
Performance	1												
Reference List	2												
Downloaded Home Page	2												
Research Depth and Quality	4												
Critical Thinking	4												
Mastery of research topic	3												
Webpage Design/organizatio	2												
Writing Style / Presentation Quality	2												
	35												
Comments													

7. Flipping Learning Progress to nurture Deep Learning

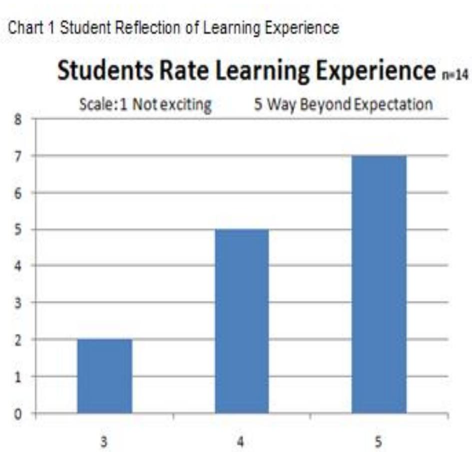
To encourage serious efforts on the course materials, students were allowed to participate in making the course schedule. The instructor handled the first few weeks of the course, to provide orientation and background information on information systems management, including a timeline discussion of events and developments up to the current year. This also provided sufficient time to finalize schedules for various course activities. Students proposed and scheduled presentations, and voted on due dates for various assignments before the course schedule being finalized and distributed to the students. Once the course schedule has been finalized, a class policy governed the extent that students may swap presentation dates and request changing of due dates. Students were given total freedom to join class activities, each of which provided credit opportunities. Success was measure solely on the total credit points, regardless of how the credit is earned. This method seemed to encourage students to make more thorough preparation for their assigned tasks. There was also a virtual component of the course once students have completed all preparatory and in-class activities. Instead of attending regular class meetings, students were then allowed to meet in groups in time and place of their choice to work on class projects. The instructor served as a consultant on demand for student teams and individual students. It was interesting to observe student activities on the class wiki project. Often students show little activities for weeks, and suddenly propagated the wiki with rich contents, days, and even hours before the project deadline.

8. Results and Conclusion:

The current format of the MIS course is the outcome of years of experimentation and innovation. The most immediate observation is improved student motivation towards learning IS topics, especially with the recent adoption of dynamic course contents to match interests of the non-IS students with diversified backgrounds. There is evidence of high student satisfaction, through comments written in course evaluation and feedback survey (Table 8 & Chart 1). This is a very satisfactory achievement since the MIS course has been considered by students as one of the most difficult courses in their college experience. A side-product of the revised MIS course is heightened technical skills of students through the courses. All students can construct a website using offline web building tools, and learn to operate wiki, and many consider these the most valuable learning experience in the MIS course.

Had a wonderful experience
The website was hard but very necessary learning experience
I learned a lot in this class
On hand learning experience was great!
…encouraging students to be active learner
The class got interesting, fun, & exciting
Stress how students should learn the key concept, ensures student think critically
This course is very interesting…I find it very convincing and interesting in learning more in not only this course, but from the whole similar area as well

Table 8: Sample Positive Comments from Evaluation



The individual research assignment has been plagued by plagiarism for a long time, partially due to the ease of copying information directly from web sites. Many students were packaging just sufficient information in their research reports to please the instructor in order to receive a passing course grade. When each student is assigned a different research topic, and encouraged to properly quote online information, incidence of plagiarism in submitted work declined close to zero. Grading is simplified since there is no need to look for unique information. Instead, the focus is on how a student collects and utilizes information to support a managerial position in critical analysis. The ability to work with "real time" information adds meaning and relevancy to class activities.

The MIS course is evolving to become an effective platform for introducing IS topics to students. The end of course survey requested students to indicate interest in elective IT courses. Table 9 summarizes healthy student responses on elective IS course. This is significant considering that many students postponed the enrollment in the MIS course until the graduating semester, merely to fulfill program requirement. It is worth noticing how non-IS students are interested in technical topics. This insight hints at the feasibility of organizing advanced IS courses for non-IS students.

What kind of elective IT course will you take? n=14, 13 responded to this question	
Elective IT Courses	**# Positive Responses**
Database applications	7
Current IT trends and cloud computing	7
Develop mobile apps	9
Business data analysis (Business Analytics)	7
Practical business applications with iPad	6
E-business development	8
Mega IT global trends and business IT readiness	4

Table 9: Student Vote on IT Elective Courses

The MIS course has established systematic assessment of learning outcomes, and is one of a few courses that has closed the loop of assessment through progressive improvement of course delivery according to student feedback and performance. In doing so, the MIS course is currently suitable for students of all majors; potentially opening new opportunities for IS training. Enrollment demand consistently exceeds supply of available instructional resource.

However, more data is required to confirm these preliminary observations. There are many questions pending further investigation. The following are a sample of questions that may command general interest:

Have we assured that student learned all the basic IS concepts? The answer is no, but neither could we assure the learning outcomes by sampling knowledge through testing. However, we have evidence of learning when students successfully assimilated scattered information and concisely articulated key IS concepts. There are further evidence of the effectiveness of the Flipped design when student indicated interests in elective IS courses. The course format outlined in this paper may not be suitable to ensure that students command a specific body of knowledge, such as the requirements for certification. On the other hand, students interested in certification can utilize online tutorial.

Have student learned sufficient basic skills in software design? The answer is probably not, but students gain sufficient perspective on factors revelant to IS decisions, as well as relationship between existing IS and emerging technology and information management practices. In this case, software design topics are really irrelevant learning experience for non-IS students in the MIS course. However, this may be an attractive format if the students have the option of taking a "Systems Design and Analysis" course. Helping non-IS students to appreciate the IS perspective could be beneficial to the long term relationship between IS and other functional areas.

Have we covered most of the topics in a typical Introductory textbook? The answer is no because the course design objectives are focused on learning outcomes rather than information packaged in any textbook. Student responses indicate that they place low value in a textbook. We are assured that students have been exposed to more IS topics than a typical textbook, and there are some evidence of depth learning through the quality of student research projects and the class project. However, this can create inconvenience for students planning to transfer credits between institutions.

Is the Flipped design scalable? This MIS course design seems to work very well for small size class. The development of additional team project management tool can easily support scaling to class size of 40 to 60. This flipped design was initially prepared for 20 students, but was modified to accommodate up to 40 students. As in the case for any highly interactive course, the increased number of student definitely will increase the instructor workload, which is manageable through various web-based services. The key is to carefully design learning resources and team assessment tools, including the design of roles in a team.
This reported "Flipped" MIS course is considered a "stabilized "class format that will require further refinement. Two areas that will require immediate improvement are scaling, and assessment. The streamlining of learning resources and improving design for student roles should support class size up to 60 students. The improvement of assessment tools will hopefully lighten the increased grading workload with large class size.

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