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Information Systems Education Journal

Will Computer Engineer Barbie® Impact Young Women's Career Choices?

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Abstract

Controversy and fanfare accompanied the announcement in 2010 by Mattel, Inc. of the Barbie® doll's 126th career - computer engineer. Even though women have been and still are in a minority in the information technology (IT) and computer science (CS) fields, enough women voted for the computer engineer as the next career for Barbie® on Mattel's website that it won the overall vote, while the winning choice voted for by young girls was news anchorwoman. The discrepancy resulted in Mattel producing Barbie® dolls in both careers. This paper reports the results of a survey completed by women in the IT and CS fields regarding their attitudes about and purchases of Computer Engineer Barbie®.

Keywords: women in computing, women in IS, recruiting women, enrollment, recruiting

1. INTRODUCTION

Although women have been involved throughout the history of computers and information technology, they have always been in the minority in those fields. Numerous articles and books have been written about the lack of women in the computing and information technology fields. Researchers have looked into why women do not choose computer science (CS) or information technology (IT) in college and why those that do often leave for other majors. Some of the reasons why young women do not choose CS/IT majors overlap with those cited by young men as those majors have experienced low enrollments of both genders in the past decade. The reasons given by both genders for not choosing these fields include the negative "geek" image of people working in the various areas of computer and information technology, and the perception that jobs are being outsourced and off-shored.

While recruiting both genders has recently been difficult, recruiting women has been and remains more problematic.

A number of programs have been developed at CS/IT departments at institutes of higher education aimed at recruiting and retaining young women. These programs often produce positive local results, but overall, the numbers of women in CS/IT fields has not improved.

Figure 1 Computer Engineer Barbie

One reason may be that young women are ruling out this career choice early, before those recruitment programs reach them in high school. If this is the case, one could argue that young women's exposure to possible CS/IT careers should begin earlier. Thus, it was of interest that toy manufacturer, Mattel, began producing Computer Engineer (CE) Barbie® dolls in the fall of 2010. (Fig. 1).

The release of CE Barbie® was preceded by some controversy surrounding the voting on Mattel's website. Even though women have been and still are in a minority in the IT and CS fields, enough women voted for the computer engineer career for Barbie® on Mattel's website that it won the overall vote, while the winning choice voted for by young girls was news anchorwoman. The discrepancy resulted in Mattel producing dolls representing both careers. This paper reports the results of a survey completed by women in the IT and CS fields regarding their attitudes about and purchases of Computer Engineer Barbie®.

2. CONTRIBUTIONS OF WOMEN TO COMPUTING IGNORED

One of the mysteries about the current low representation of women in computer and information technology is that women have a long history of contributions to the field. From Ada Augusta Lovelace in the late nineteenth century to the 2008 Turing Award recipient, Barbara Liskov in the last decade, women have made important contributions in the areas of programming, searching, sorting, compilers and human computing interaction (Gürer, 2002; The Ada Project, n.d.). One of the possible explanations is that until relatively recently, the contributions of women to the field of computing were largely overlooked. As Jean Bartik, one of the group of women hired to program the ENIAC computer during World War II, was quoted "We had worked hard to get it ready to go. We couldn't believe we were ignored." (Todd, Mardis & Wyatt, 2005) Even current computer science texts that recount the history of computers often fail to mention these early female pioneers (E.g., Savitch, 2009; Russell & Norvig, 1995).

3. WHY WOMEN DO NOT CHOOSE A COMPUTING CAREER

Even though enrollment in computer related programs has increased over the last three years and the percentage of women has increased 2.5% (Thibodeau, 2011), women remain a distinct minority at 13.8%. According to the National Center for Women & Information Technology (2010), the percentage of women enrolled in computer programs peaked in the mid-1980's, ~~and~~ declined sharply in the mid-1990's and has remained low. When women do pursue careers in CS or IT, they change careers at twice the rate that men do.

There have been many studies on the reasons women do not choose a CS/IT career path. The most notable examination of this phenomenon was published by Margolis and Fisher in 2002. In their book, "Unlocking the Clubhouse", Margolis and Fisher note that men and women surf the web to the same degree and make the same amount of online purchases, but that women are not learning to invent, create and design computer technology nor do they contribute in other ways. A recent NY Times article notes the small percentage of women who contribute to Wikipedia (Cohen, 2011). As to why this matters, Margolis and Fisher note that women are missing out on a promising career choice and that experience in information technology contributes to many fields. The result is that computers and software end up being designed for males, just as early voice recognition software, car airbags and artificial heart valves were and women cannot benefit from the new developments.

Margolis and Fisher indicate that the gender differences are the result of early exposure to subtle and not-so-subtle biases. As an example, they quote a children's book entitled "I'm glad

I'm a Boy! I'm glad I'm a Girl" (Darrow, 1970) which states "boys invent things and girls use things that boys invent." Girls grow up with the father being the one who brings the computer into the house, and the male siblings joining him in using it. Later, in middle and high school, the boys are the ones who gravitate to the computer lab and in college, females described the culture in the computer science major as "insular, isolating and out of balance."

Throughout Margolis and Fisher's book, females' lack of confidence in their knowledge and abilities is pointed out. They report that females seem to be full of self-doubt and they worry about being perceived as "stupid", whereas males with similar experience and knowledge did not have these fears. This seems to be an extension of the lack of confidence in math and science that many females experience at the onset of puberty. Others report similar findings relating to females' self-confidence regarding computer and technical ability. For example, Hunsinger, Holt & Knight (2009) found that a large majority of females surveyed agreed with the statement "Majoring or double-majoring in CIS before graduating from college would be difficult for me." Colyar & Woodward (2008) and Irani (2004) reported that females and males had the same level of confidence in mathematics, but women's confidence was lower than men's confidence in the areas of programming, networks and cryptography.

Efforts Aimed at Recruiting and retaining Female CS/IT Majors

Efforts at attracting and retaining females into computer-related majors have met with success at the institutions where concerted efforts have been made. These efforts have included outreach activities, enhanced recruitment, scholarships, course and curriculum re-design, tutoring, and mentoring (e.g., Margolis & Fisher, 2002; Beck, 2007; Gerhardt-Powals & Trail, 2008; Mento, Sorkin & Prettyman, 2008; Mathis, 2008; Craig, 2009; Leitherer & Tupper, 2009; Alvarado and Dodds, 2010; Sorkin, Gore, Mento & Stanton , 2010; Tupper Leitherer, Sorkin & Gore, 2010). For the most part, these efforts require significant financial resources and time investment, though Barker et al. (2010) claim a good strategy is more important than the financial investment.

Post College Career Change Rates

After college, women in IT careers leave the field at twice the rate of men even though there are several organizations, such as the Anita Borg Institute, the National Center for Women and Information Technology (NCWIT) and Women in Technology International (WITI) that encourage and support women in computer related fields. As in college, the women who do change careers mention the culture as a issue. Anita Borg is quoted as saying "I really believe women bring incredible richness and diversity of thought, perspective and new ways of looking at problems…But to get to that, first you have to create an environment where women are really comfortable contributing." (Bentsen, 2000). In a 2011 article, Vijayan confirms the difference in culture by saying "they <women> need to not only constantly push themselves forward but also find someone who can help them" as he advocates that women find one or more mentors in their organization to sponsor and recognize their achievements.

4. TOYS AND CAREER CHOICES

One of the assumptions made by the authors of this paper is that Computer Engineer Barbie purchases that were made for a young girl indicate a belief that the doll may encourage the girl to pursue a career in a computer-related area. There is some evidence that supports the belief that a toy might influence the choice of career (e.g., Cooper & Robinson, 1989; Miller, 1996).

More to the point of this paper, there is research that indicates that the toys available for girls reinforce societal and parental messages about the careers available for girls. In a report done for the Department of Health, Education and Welfare in 1977 (Riley & Powers, 1977), the authors studied pre-school age and elementary age children who were exposed to non-sexist toys and games for four months in a classroom setting. An example of the non-sexist toys and games supplied to classrooms is "Our Helpers Play People" by Milton Bradley (Trademarkia.com), which consists of cardboard cutouts of people depicted in a number of both stereotypical and non-stereotypical occupations. For example, it includes both female and male construction workers and both female and male doctors, all with mixed ethnicity. For the most part, Riley and Powers found that the toys had only a limited impact on the personal career aspirations of the children overall, but the toys did have an impact on perceptions on what are acceptable occupations for both sexes. Kacerguis and Adams (1979) reported that "girls, almost two decades prior to the time of actual vocational decisions, are acutely aware of the limited vocational options available to them" and stated "toys may be viewed as offering experimentation with future roles and present an opportunity to rehearse a future occupational opportunity on the child's level."

Given that research, the Barbie doll series is an interesting conundrum. By many, the doll is reviled as the ultimate sexist toy, with her impossible physical dimensions sending unhealthy messages to young girls by promoting negative body images (Stone, 2010; Dittmar et al, 2006). On the other hand, the Barbie doll has become a "rite of passage" for many young girls in the United States. According to Stone (2010), in America, girls between the ages of three and six own an average of twelve Barbie dolls and 90% of girls between the ages of three and ten own at least one. Although the sales of Barbie dolls declined after dolls like the Bratz® were introduced in 2001 (Ferrell & Hartline, 2008), Stone (2010) reports that the doll was still the number one most famous doll internationally.

Reid-Walsh and Mitchell (2000) argue that the Barbie doll "does not occupy one unified space within women's lives" and that women recount conventional and unconventional "Barbie-play". The conventional accounts include staging Barbie's dates, weddings and fashion shows. The unconventional accounts include girls who constructed houses, churches, schools and stores that Barbie lived and worked in and one woman who constructed her own Barbie house out of left-over construction materials from the re-modeling of her parents' house. She even added an alarm system to keep her little sister out of it.

The objective~~point~~ of the Barbie dolls' creator, Ruth Handler, was to present an alternative to the toys available for girls in the 1950's (Parker, 2008; Valis, 2010; Stone, 2010). The toys available for girls of that time period were baby dolls, kitchen sets, and little vacuum cleaners. These toys reinforced the notion that girls would grow up and become mothers and housekeepers. Barbie promoted imagination of a different sort and fairly early on, presented the image of a career woman, rather than a housekeeper. In fact, many believed that the doll led young girls astray from traditional female roles by promoting the image of a woman who ventured into unconventional (for the time) careers (Valis, 2010).

5. MOTIVATION FOR THE STUDY

Despite the many efforts at recruiting and retaining women in computing majors by many institutions, their representation remains low. It might be assumed that these efforts are not enough to overcome the fact that females rule out a career in computing very early on. The reasons include

- the lack of well-known female role models in the field of computers and information technology,
- the male-dominance of computers at home and at school,
- the male "geek" stereotype of those working in computing fields

These reasons are pervasive throughout society and therefore affect females' views of computing and technology careers from their early years.

In addition, research has shown that the major influences on women's career choices are parents, teachers and guidance counselors. Unfortunately, many parents, teachers and guidance counselors are not knowledgeable about the variety of careers one could pursue that involve computers and information technology. (Hunsinger et al., 2009; Woratschek et al., 2009; Saunders et al., 2008; Tillberg and Cohoon, 2005; Adya and Kaiser, 2005)

It is against this backdrop that in January of 2010, Mattel set up a website where people could vote for the Barbie® doll's next career. The choices on the website were architect, news anchorwoman, computer engineer, environmentalist and surgeon. The voting was open for one month. (Zimmerman, 2010 and 2010a). Zimmerman (2010) reports that women in the computing and engineering fields began encouraging others to vote for the computer engineer career. Twitter logged 1840 tweets on the subject and a number of technology-related websites mentioned the voting. At the end of the voting period, Mattel reported that the career that won the popular vote was computer engineer, but that the career that was most popular with young girls was news anchorwoman. Mattel diplomatically started producing Barbie® dolls in both careers later in 2010.

When one of the authors of this paper tried to order a Computer Engineer Barbie® in early October of 2010, she found that it was on backorder and did not receive it until mid-December. This prompted her and her co-author to consider whether other adult women were purchasing the doll and whether the purchases were for themselves as display items in an office as was the case for one of the authors of this paper, or if the purchases were for young girls. We also were curious whether women in computing and IT careers think the dolls might encourage girls to consider computer and IT careers.

6. METHODOLOGY

An online survey was developed, with eleven brief questions, which participants were encouraged to complete anonymously. Females in academia as well as industry were contacted via email. The email list was developed by researching other institutions in Western Pennsylvania. Females in industry were contacted via the Pittsburgh and Johnstown chapters of Association of Information Technology Professionals (AITP).

7. RESULTS

Overall Survey Results

A total of fifty-two responses were received. (Table 1) The results of the survey indicate that only twenty-one of the fifty-two respondents (40% of the total.) were aware that Mattel had released the Computer Engineer Barbie® in fall of 2010, prior to the survey. Six of the twenty-one (29%) respondents who had prior awareness of the doll had voted for the Computer Engineer Barbie, on Mattel's website. Of those respondents who had voted, three out of the six (50% of those who voted) had encouraged other women to vote as well.

Table 1.
Overall survey results

Question	Yes	No	Maybe
Aware of CE Barbie®?	40%	60%	
Voted for CE Barbie®?	12%	85%	
Purchased CE Barbie®?	8%	92%	
Owned Barbie® dolls as a child	65%	35%	
Will CE Barbie® influence career choices?	17%	25%	56%

Only four of the total respondents (8% of the total; 19% of those with prior awareness) had purchased a Computer Engineer Barbie. Two had purchased it for themselves, one respondent purchased it for another adult, and two people made the purchase for a child other than their own. None of the respondents who purchased the doll said the purchase was for their own child.

Thirty-four of the respondents (65%) owned one or more Barbie® dolls as a child, but only twenty-eight (54%) actively played with the dolls as a child.

Only nine respondents (17% of the total) answered "yes" to the question about whether Computer Engineer Barbie® would influence a young woman's decision to choose a career in some area of computer or information technology. Twenty-nine respondents (56%) answered "maybe" and thirteen (25%) answered "no".

A vast majority of the respondents (83%) said that they do mentor and/or encourage young women to enter a computer science or information technology fields. Additional demographic data collected can be found in Appendix B.

The last question in the survey asked what influenced the respondents' career choices. The most popular answers to this question were teachers, parent or other relative and job opportunities. Of the remaining choices that were provided, guidance counselors had the least impact (6%) on career choices.

More Detailed Analysis

Table 2.
Comparison of Opinions Regarding Possible Influence on Career Choices between Owners and Non-owners of Barbie® dolls.

		Will CE Barbie® influence girls' career choices?		
		Yes	**Maybe**	**No**
Owned Barbie® dolls	**Yes**	7 (20%)	19 (56%)	7 (20%)
	No	2 (11%)	10 (56%)	6 (33%)

There appears to be a difference between the respondents who owned Barbie® dolls as a child and those who did not. (Table 2) As shown in the table, those respondents who owned Barbie® dolls in the past were more likely to answer "yes" to the question about whether CE Barbie® would have an influence on girls' career choices. Statistical tests were not performed due to the low number of those who did not own Barbie® dolls as children and who also answered "yes" to the influence of CE Barbie.

Further analysis of the survey results indicates that of those six respondents who had voted:

- Two purchased dolls for a child who was not a relative
- Three owned Barbie® dolls as a child, but only two actively played with them
- All said "maybe" to influencing a career choice
- The ages ranged from 30 to over 60
- All had over 15 years of experience
- All had doctorates
- All were in education

Of the four respondents who had purchased the Computer Engineer Barbie® doll,

- Only two owned Barbie® dolls as a child
- One said no to CE Barbie® influencing career choice

Given the small number of respondents overall and the very low number who voted for the computing engineer career and who purchased a CE Barbie, no statistical analyses can be made. However, it does appear that prior ownership of Barbie dolls does not seem to affect the number who voted, the number who purchased CE Barbie dolls, nor the opinions of the possible influence of CE Barbie on young girls' career choices.

Respondent Comments

The comments made by survey respondents reveal reasons for their answers to the question about the possible influence on careers choices. Those who answered "yes" to that question say that simply bringing attention to careers in technology and potential role-playing will be beneficial. Those who responded "no" to that question feel that Barbie is merely a fashion icon. Please note the respondent comments in this section for the most part, have been copied verbatim from the survey except that minor typographical errors have been corrected.

Those respondents who said "**yes**" to CE Barbie® influencing career choices, made the following comments:

- I think "role models" are very important. Just bringing attention to computing careers period -- disregarding any gender issues -- will be a plus for both genders to consider computing as a career option. To what extent it might influence females vs. males will be interesting to try to discern. (Also please note below I am currently an educator but formerly worked as a computer systems analyst, project manager, and senior consultant.)
- It's a simple matter of getting the 'idea' that women can choose technology planted in little girls' minds.
- I personally do not feel that Barbie (the way she is built) is a good role model. However, if a girl has a Barbie I prefer that it is Computer Engineer. It will influence some girls in that direction.
- Role playing with dolls was a popular activity when my friends and I got together as children. Barbie was one of our favorites since she was more "realistic" than just baby dolls. We were able to simulate situations of parties, luncheons, weddings, dates, etc. Having dolls that lead girls to project career situations also is critical to opening doors for girls to consider all types of careers.

Those who said that **"maybe"** to CE Barbie® influencing career choices, made the comments listed below:

- Depends on the age of the child, and the "play" setting or group the child participates in or with.
- I think it's a positive step, but a very small one. There are so many influences on girls that don't encourage them to pursue careers in computer science, engineering, mathematics ...
- My daughter is a huge fan of Barbie dolls. She often gets ideas about careers from them, so having computer engineering represented is important.
- I would rather see a "barbie" created by a computer modeling program based on 'normal' female physical parameters.
- The degree of influence will depend on the popularity of this version of the doll.
- I don't think it will cause young women to avoid a computing career. The media attention of this new career may bring computing careers into a young woman's awareness.
- A Computer Engineer Barbie does, at least, make it clear that women (including beautiful and young ones) may choose a career in computer engineering. It allows a girl to consider herself in that role.

Those who said **"no"** to CE Barbie® influencing career choices, made the comments listed below:

- Not anymore than owning a fire truck encourages someone to become a firefighter.
- I don't think that girls associate Barbie with careers. Instead their focus is on her as a fashion icon.
- My impression of how kids play with Barbies is that they usually take the clothes off.
- I think the obstacle to CE Barbie making any impact it that it has virtually no shelf space. In traveling the US and Canada, I've only seen this "I Can Be" option available in 2 locations of about 50 visits to large retail stores. As far as her ability to inspire girls for computing careers, I don't hold much hope. CE Barbie has gadgets, but there's virtually no depiction of her solving problems, taking care of others, etc. There's no "verb" to go with her name. Her box is a cubicle. There are no other living beings with her (cats, dogs, kids). She has a laptop and a phone. She types all day, alone in a cubicle.

8. LIMITATIONS AND DISCUSSION

Two questions were flawed in the way they were constructed and given the small sample size, no statistical analyses were appropriate. The two flawed questions are the ones that asked respondents about their age and number of years in the field. In both, the choices included overlapping ranges.

Additionally, the sample size was small, the response rate was rather low and it was not a random sample. The number of requests that were sent out is unknown, since some requests were made through professional organizations. However, given that most of the respondents were in education and the number of requests to educators is known. The response rate was less than 17%.

Given the limitations, there is a general consensus in the responses that the CE Barbie® doll itself may have some influence in the career choices of young girls. When the "yes" and "maybe" answers to the questions are added together, both prior owners and non-owners of Barbie® dolls tend to believe that CE Barbie® may have an influence (>70%).

But this influence can only happen if they are exposed to the doll. In June of 2011, a quick computer search showed that Target.com was out of stock of the doll. Both Walmart.com and ToysRUs.com did not list the doll at all. If the dolls are not on store shelves and websites, they will not have any influence at all. The careers from the Barbie® "I can be" series that were available on Walmart.com were:

- Lifeguard
- Doctor
- Vet
- Ballet teacher
- Pizza chef

On ToysRUs.com, those careers were available as well as the following:

- Movie star
- Cheerleader
- Preschool teacher
- Nurse
- Newborn baby doctor

A subsequent search for "Computer Engineer Barbie" performed a week later produced no results on Target.com.

We would be remiss ~~in noting~~ if we did not note that organizations and groups that encourage girls to pursue careers in science, technology, math, and engineering suggest toys for girls such as puzzles and construction sets. (E.g., Halpern, Aronson, Reimer, Simpkins, Star, & Wentzel, 2007)

9. CONCLUSION

In general, most respondents believed that a Computer Engineer Barbie® doll may bring awareness of CS, IT and engineering careers to young girls. This corresponds to the research mentioned in section 5 which found that exposure to careers in which women are a minority influences the careers that children believe are acceptable. However, if girls are not aware of the doll, they may not be aware of the career choice, and a search of the websites of three major retailers in June of 2011 produced no results when the term "Computer Engineer Barbie" was entered.

Another issue with CE Barbie®, as some of the respondents commented, is that there is no indication of what CE Barbie® does during her workday. It is not surprising that young girls voted for the news anchorwoman career choice because they can see at least some of what that career entails on television. The other careers presented as choices on Mattel's website are unlikely to have a presence in the lives of young girls. Young girls are likely to imitate careers with which they are familiar. They are exposed early in life to doctors, nurses, teachers and television personalities and their exposure to the other career choices presented on Mattel's website (computer engineer, architect, and environmentalist) is probably quite limited. One might conclude that the only reason that CE Barbie® was produced was due to the ground-swell of voting that came from women in computer science, information technology and engineering fields.

It is also not surprising that major retailers are not stocking the CE Barbie® because they will stock what customers want. Girls aren't likely to be familiar with any computer-related career unless it is a career held by a close family member. Awareness of the doll and ordering one directly from Mattel may be the only way one could purchase the doll.

An interesting follow-up for the future will be to survey females entering computing and engineering majors to see if any owned a Computer Engineer Barbie® as a child.

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APPENDIX A

Survey Questions

1. Are you aware that Mattel® released "Computer Engineer" Barbie in the fall of 2010? (Yes/No)
2. Prior to the release, did you vote on the Mattel® website for "Computer Engineer" to be Barbie's next career?(Yes/No)
   a. If you voted, did you encourage other women to vote? (Yes/No)
3. Have you purchased at least one Computer Engineer Barbie? (Yes/No)
   a. If so, was it (check as many as apply)
      i. For yourself
      ii. For another adult
      iii. For your own child
      iv. For a child other than your own
4. Did you own one or more Barbie doll when you were a child? (Yes/No)
   a. If so, did you actively play with Barbie dolls when you were a child?(Yes/No)
5. Whether or not you purchased one, do you think that Computer Engineer Barbie will have an influence in a young women's decision to choose a career in some area of Computer Science/Information Technology/Information Systems/Computer Engineering? (Yes/No/Maybe)
   a. Please enter any comments about the potential influence of Computer Engineer Barbie here. (text area for comments)
6. Do you mentor/encourage young women to enter the computer science/information systems/information technology fields? (yes/no)
7. What is your age range?
   a. 20-25
   b. 25-30
   c. 30-40
   d. 40-50
   e. 50-60
   f. Over 60
8. Are you currently employed in some area of Computer Science/Information Technology/Information Systems/Computer Engineering?(Yes/No)
   a. If so, how many years have you been in the field?
      i. 0-5
      ii. 5-10
      iii. 10-15
      iv. 15-20
      v. Over 20
   b. What is the highest educational level obtained?
      i. High school
      ii. Associate's degree
      iii. Bachelor's degree
      iv. Master's degree
      v. Doctorate
9. What most closely describes the industry in which you are employed?
   a. Government
   b. Healthcare
   c. Education
   d. Consulting
   e. Other (text box for input)
10. What most closely describes your job title?
    a. Project manager
    b. Computer Engineer
    c. Software Engineer
    d. Systems Analyst
    e. Database Administrator
    f. Network/Systems Administrator
    g. Computer Support
    h. Educator
    i. Software Trainer
    j. Other (text box for input)
11. Which of the following influenced your career choice? (check as many as apply)
    a. Parent or other relative
    b. Friends
    c. Guidance counselor
    d. Teacher or professor
    e. Research done by yourself
    f. Job opportunities
    g. Opportunity for a good salary
    h. Other (text box for input)

Thank You for your time and participation in this research endeavor!!!

APPENDIX B
Survey Demographics

Age of survey respondents:

Years	20-25	25-30	30-40	40-50	50-60	Over 60
No. of respondents	0	3	7	12	21	9

Educational level of survey respondents:

Education level	Bachelor's degree	Master's degree	Doctorate degree
No. of respondents	5	10	37

Job titles of survey respondents:

Job title	Educator/Professor	Other
No. of respondents	41	11

Years of experiences of survey respondents:

Years of experience	5-10	10-15	15-20	Over 20	Blank
No. of respondents	8	3	12	25	4

Developing an Introductory Level MIS Project in Accordance with AACSB Assurance of Learning Standard 15

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Abstract

As part of the introductory level management information systems (MIS) course, faculty are asked to introduce the students to MIS concepts as well as to help them develop technology-related skills benefitting them in their course work and beyond. However, with a vast array of MIS topics that could be covered and class time at a premium, it is difficult to determine which MIS topics to address and which ones to forego. Ensuring that the appropriate topics are addressed and adequately covered is tremendously important to the learning process as well as abiding by the learning standards of accrediting institutions. In this study, the author describes a project and survey that was administered to undergraduate junior and graduate MBA students in the core MIS classes in the College of Business undergraduate and graduate level curriculum. The purpose of the study was threefold: to introduce the students to collaborative technologies, determine whether or not students were already familiar with the technology assigned, and evaluate the perceived value of the projects in relation to learning objectives and the projects' use of class time.

Keywords: Collaboration Tools, Learning Taxonomy, Assurance of Learning Standards, Curriculum Management

1. INTRODUCTION

Developing meaningful projects that illustrate course concepts as well as provide a significant and new learning experience for the students can, at times, be challenging. This is especially true for introductory core major classes in which topics are addressed from different perspectives, i.e. Customer Relationship Management (CRM) may be addressed in both the "Introduction to Marketing" class as well as "Introduction to Management Information Systems" (MIS). Structured coordination between course sections can be difficult and time consuming. Attempting to coordinate projects across multiple disciplines can be creatively limiting, if not impossible. Thus, some topics may be covered in multiple classes, but from a different perspective. Establishing the educational value of projects covering material that could be addressed in other classes may prove beneficial to maximizing the learning experience. In this study, the author examines the process of introducing a topic to students at both the undergraduate and graduate levels, developing projects to facilitate topic learning using learning taxonomies as an educational guideline, and attempting to evaluate the value of the topic in relation to the overall educational experience from the students' perspectives.

2. LITERATURE REVIEW

Developing strategies for providing valuable learning experiences for students has been an ongoing concern of educators across a variety of disciplines for years (Lee et. al, 2007; Lucas, 2001; Ramburuth & Mladenovic, 2004; Shariff, Hasan, Mohamad, & Jusoff, 2010) noted that the approach taken by faculty members teaching information systems quality would be determined by the nature of the course and topics to be covered. Similar findings regarding course structure arose for entrepreneurship courses and students' interest and intentions in becoming entrepreneurs (Shariff et. al, 2010). Strike and Posner (1985) indicated that students learn new accounting concepts when they are able to relate and apply what they are learning to their current ideas and processes. In addition, students' preconceived conceptions of disciplinary topics may also affect students' learning (Lucas & Mladenovic, 2009).

The 2007 Interpretation of the Assurance of Learning Standards published by The Association to Advance Collegiate Schools of Business (AACSB) emphasizes the importance of learning goal setting, outcomes assessment and continuous improvement. The increasing emphasis on compliance with assurance of learning standards, like those established for business schools by AACSB, emphasizes the importance of curriculum management initiatives. AACSB Standard 15 specifically addresses curriculum management as it states, "The school uses a well-documented, systematic process to develop monitor, evaluate and revise the substance and delivery of the curricula of degree programs and to assess the impact of the curricula on learning" (AACSB, 2007; p. 3). The process should incorporate all aspects of development and span from program and course development through the ongoing process of continuous improvement and evaluation.

The first step in the AACSB Assurance of Learning process is the development of learning goals (AACSB, 2007). The interpretation indicates that, although "faculty should lead the development of learning goals and subsequent learning objectives, … the standards call for input from a variety of stakeholders including alumni, students, and employers" (AACSB, 2007; p. 6). The interpretation of the AACSB standards goes on to provide examples of learning goals and corresponding initiatives including the following example (p. 7):

Learning Goal: Our graduates will demonstrate problem solving skills, supported by appropriate analytical and quantitative techniques.
Corresponding Objective:

- In a case setting, students will use appropriate analytical techniques to identify a business problem, generate and compare alternatives, and develop a solution.
- In a case setting, students will recognize and analyze ethical problems, choose, and defend a solution.

Thus, with these considerations in mind, as faculty initiate a formal process from goal setting to evaluation, application of existing models may prove beneficial to the process. In the next section, the author describes two cognitive learning taxonomies that were used to develop undergraduate and graduate level projects on collaborative technologies. The assigned projects and their implementation are described in sections 4 and 5. Section 6 describes the survey results.

3. COGNITIVE TAXONOMIES

Most faculty probably do not have the time to meticulously walk through the process of examining each exercise and assignment to determine whether or not each fully meets learning taxonomy specifications. However, many probably develop their exercises and assignments with learning objectives in mind that closely mirror accepted learning models. With the increasing emphasis on compliance with assurance of learning goals, faculty may need to find proven learning models to assist them in the development process.

In developing this study, two learning taxonomies were used to evaluate the project: a localized learning model and an established model. The first model used came from the general studies learning objectives of the author's institution. The second model that was used in the study was developed by Anderson and Krathwohl (2001), a continuation of Bloom's taxonomy (1956).

University Studies Learning Objectives

The project was developed in accordance with the learning objectives of the University Studies Program at the author's institution. With the increased emphasis in assurance of learning at AACSB accredited business colleges, it is important to consider how well classroom projects meet the learning goals set forth by the University. Although the course is part of the core business curriculum, the general learning requirements of the University Studies program provide a good general outline of quality learning objectives. The fundamental purpose of courses fulfilling the University's general education requirements is to "…equip students to integrate acquired knowledge in order to produce interconnections of thoughts and ideas." The underlying goal of the program is to "…provide students with the information, ideas and skills they need to have in order to live a happier and more intellectually rewarding life" (University Studies Handbook, 2005-2006). Based upon the stated purpose and goals, the University Studies program has developed a series of nine objectives for courses in the program to address. From these courses, students should be able to:

- Demonstrate the ability to locate and gather information;
- Demonstrate capabilities for critical thinking, reasoning and analyzing;
- Demonstrate effective communication skills;
- Demonstrate an understanding of human experiences and the ability to relate them to the present;
- Demonstrate an understanding of various cultures and their interrelationships;
- Demonstrate the ability to integrate the breadth and diversity of knowledge and experience;
- Demonstrate the ability to make informed, intelligent value decisions;
- Demonstrate the ability to make informed, sensitive aesthetic responses;
- Demonstrate the ability to function responsibly in one's natural, social and political environment.

The project focused upon collaborative technologies and was developed with consideration made for the University Studies' learning goals and objectives. Once the project was finalized, several of the learning objectives had been addressed. The learning objectives that this project addressed are described in the following subsections.

Demonstrate the Ability to Locate and Gather Information

Both groups of students were briefly introduced to the technologies and then asked to individually view the application tutorial materials provided on the sites. Once students became personally familiar with the collaborative technologies, they could then complete the project. One of the desired results of the exercise was to equip students with another technology tool that they could use to gather data, and then later, further develop into a completed project.

Demonstrate Capabilities for Critical Thinking, Reasoning and Analyzing

The project, that students were asked to complete, required them to gather and analyze data and then synthesize the results as a virtual group. The online collaborative resource provided an excellent interface for students to build their project asynchronously.

Demonstrate Effective Communication Skills

Students in each class were assigned to groups and asked to complete an assignment as a virtual group. Both the online undergraduates and the graduate classes were asked to keep their face-to-face interactions to a minimum with the majority of their work being conducted online. The goal of learning the new collaborative technology was to enhance the virtual team experience through improved virtual communication and collaboration.

Demonstrate the Ability to Integrate the Breadth and Diversity of Knowledge and Experience

The online collaborative technologies had similar interfaces and logic structures as the productivity-based applications with which the students were familiar. Little instructional assistance was provided beyond the application-based online tutorials and answering the few questions raised by the students. Students were able to easily draw from their prior web-based and productivity application experiences to learn and utilize the new technology.

The project was developed with the University Studies learning objectives of the author's institution in mind. To refine the project and examine the learning objectives in light of a more universal model, Anderson and Krathwohl's learning model was applied to the project.

Anderson and Krathwohl's Learning Model

The second learning taxonomy used to evaluate the projects was Anderson and Krathwohl's 2001 extension of Benjamin Bloom's (1956) highly referenced learning taxonomy. Bloom's model consisted of cognitive (mental), affective (emotions/ feelings), and psychomotor (physical skills) domains (Bloom, 1956). In revising Bloom's Model, Anderson and Krathwohl noted that, "The revision emphasizes the use of the Taxonomy in planning curriculum, instruction, assessment, and the alignment of these three (2001, p 305). (See Figure 1.) The primary focus of Anderson and Krathwohl's model, compared to the Bloom model, was the shift in focus from assessment to the teaching process. The model was extended, in part, to provide faculty with a tool they could use to help classify and identify project objectives.

Anderson and Krathwohl's Cognitive Process model (2001) extends Bloom's work by re-evaluating the pyramidal progression of learning. Both models classify the learning progress from a state of memorization of facts, to eventual application of concepts in a distinct functional domain.

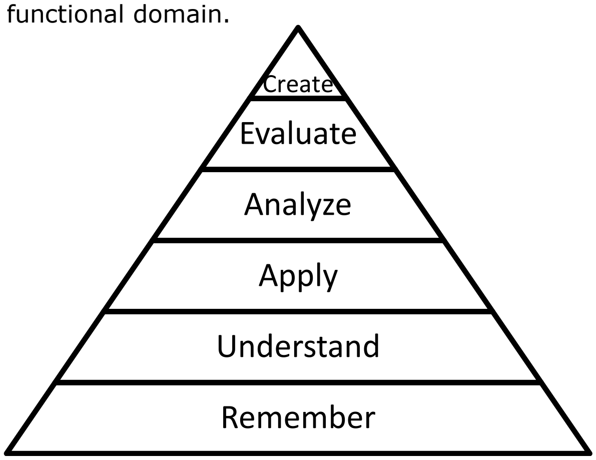

Figure 2 - Anderson & Krathwohl's Cognitive Model

As students progress through their academic programs, courses and assignments will likewise progress from activities oriented toward remembering facts and definitions, to application of facts, definitions, and concepts (Figure 1). Essentially, students just starting their programs of study would see more academic work oriented toward the base of the pyramid while students nearing the end of their programs should see projects and assignments oriented toward using their acquired knowledge to create new solutions.

This study was conducted in two business core classes in the College of Business: one at the undergraduate level and the second in the MBA program. Both courses contain elements of all of the steps of the pyramid with short units of study moving quickly from the "Remember" level to "Create." In the graduate level course, greater focus is placed on assignments with characteristics toward the top of the learning pyramid.

4.0 PROJECT BACKGROUND

The focus of the learning unit in both the undergraduate and graduate level courses was on virtual teams and collaboration technologies. The undergraduate students were given a project to develop as a virtual group using Google Docs, a free online suite of office productivity tools consisting of word processing, spreadsheet, and presentation applications. The graduate students were given a project to develop as a virtual group using Zoho.com. Zoho is a comprehensive online suite of tools for small business consisting of productivity applications as well as tools directed towards assisting with customer relationship management, accounting information systems, and supply chain management. Although Zoho.com is targeted toward providing a comprehensive business solution for small businesses, most of the applications can be used by individuals for free.

Subjects

Similar projects, using different collaborative tools, were assigned in the MIS core class at both the undergraduate and graduate levels in the College of Business. Both groups of students were asked to complete a survey following the project; however, the surveys differed slightly based upon the technology covered during the project.

Junior Level MIS Core

The junior level MIS class is taken by all majors in the College of Business as part of the core curriculum. The prerequisites for this course include an introduction to the Microsoft Office suite course, junior level standing, and concurrent enrollment in a management concepts course. Thus, students enter the course with a general understanding of productivity software and basic business concepts. By the time students are eligible to enroll in this course, they should have taken at least eight courses from the College of Business core curriculum and selected a major field of study. A breakdown of the respondents by major is provided in Table 1. The course was administered online during the Fall 2010 semester. The class contained 27 students with 17 students participating in the survey for a response rate of 62.96%.

Table 1. Breakdown of Majors

Majors	UG #	MBA #
Accounting	2	8
Administrative Systems Mgt	1	NA
Business Administration	2	NA
Entrepreneurship	0	1
Finance	0	3
General	2	7
Health Care Administration	NA	4
Human Resource Management	1	1
International Business	2	2
Management	1	0
Marketing	1	0
Organizational Administration	4	NA
Sports Management	1	1
Total number of respondents	17	27
Total number of students in class	27	27

In light of the pervasiveness of technology in the current college students' life, it is very possible that students will be introduced to, or familiar with, several technology concepts before entering the course. Thus, the possibility of covering topics addressed in other courses can be of concern.

Graduate Level MIS Core

The graduate level MIS course is part of the College of Business' MBA core curriculum. In order to enroll in the course, students must have taken the undergraduate junior level MIS course or its equivalent, either as part of their undergraduate curriculum or as a background prerequisite for those not having a College of Business undergraduate major. The course was taught in a face-to-face format with 27 students both taking the course and participating in the survey administered at the end of the project. Table 1 provides a breakdown of the MBA students according to concentration.

5. IMPLEMENTATION

Both groups of students participated in a project emphasizing collaboration technologies, followed up by a survey focusing upon their opinions of the technology and its perceived usefulness. The project and survey differed slightly between the graduate and undergraduate courses based upon the technology addressed.

Online Undergraduate Student Project

The online undergraduate students were provided with a short introduction to Google Docs and divided into instructor-formed teams. The teams were created based upon student location and technical experience. Each team consisted of three group members. Since the class was taught online, at least one student on the team was local. This student could come to the instructor's office on behalf of the team should questions arise during the project. Each team also had at least one student located a distance from campus so that no group contained all distant students. Although not possible for all teams, as many teams as possible contained at least one student who indicated, on a self-evaluation survey, a strong background of computer experience. This student was assigned in hopes of providing a technical lead and could also meet one of the distance characteristics as well.

Groups were assigned a project that they had to complete, by a specified deadline, using all elements of Google Docs. Upon completion of the project, they were asked to share their files with the instructor by the assigned deadline. After the Google Docs portion of the project was completed, the students were then given a short exercise to become familiar with the tools and capabilities of Zoho.com. Again, students were provided with a brief overview of the application and directed to view the online tutorials associated with the tool.

Once the students completed the Zoho.com portion of the project, they were asked to complete a short survey about their experience and opinions about the applications and the value of the exercise.

Graduate Student Project

Since several of the graduate students had also completed their undergraduate program at the University, it was assumed that most of the students already had experience with Google Docs. Unlike the undergraduate students whose project centered upon learning Google Docs, graduate students were expected to develop a more in-depth understanding of Zoho.com.

Students were briefly introduced to Google Docs and Zoho.com in class. Google Docs was discussed as an introductory example of collaborative technologies while the focus was placed on Zoho.com. Students received a quick overview of the Zoho.com web site and resources. Students were allowed to form their own teams of three or four students. Due to the large number of applications provided by Zoho.com, teams were asked to select two of the business tools to learn, explain and demonstrate to class at a later date. (This provided the class with a more comprehensive examination of the Zoho.com resources available.) Teams were asked to use the office functions within Zoho.com to perform their collaborative work and develop their presentations.

6. FINDINGS

Once the exercises were completed, students in both classes were asked to complete a survey. Survey questions focused on determining whether or not the students had used the technology prior to the assignment, if the project was a valuable use of course time, and whether or not the students could see a use of the technology in the future. Overall, responses for both classes were similar.

Undergraduate Outcome

In regards to the exercises' learning objectives, the results of the survey were very informative (Appendices A and B). One of the main learning objectives for the project, from the perspective of the online class, was to "introduce the students to collaborative technologies" and provide the students with a tool that they could use in the remainder of the online course as well as future coursework. The survey indicated that none of the undergraduate students had used Google Docs in any other class and that only a couple had used it for work. The two students who had used the technology for work used either SharePoint or box.net. Thus, in regards to determining whether or not students were already familiar with the technology assigned, the survey indicated that this tool was new to them.

For survey questions asking the students whether or not they thought that Google Docs would be helpful to use in future group projects and if they would use Google Docs on future projects, all respondents indicated that it was useful and would be used in the future. All of the respondents also thought that collaborative technologies, like Google Docs, would be beneficial to businesses.

The third project objective focused upon the value of the project from the perspective of class time appropriation. In examining the responses from the survey, it appears that the project was a valuable use of class time. None of the students had used the software before, so they were provided with a new resource. The students' attitude towards the difficulty of the software changed from approximately 54% thinking that the software was "Difficult" or "Very Difficult" before the exercise, to 94% of the class thinking that the software was "Very Easy" or "Easy" after the exercise.

The undergraduate students were expected to learn Google Docs and then become familiar with the office applications in Zoho.com after learning Google Docs. When asked, "Was it helpful to use Google Docs before using Zoho?" 82% of the students indicated that using Google Docs prior to working with Zoho was helpful. In addition, 88% of the students indicated that the

Google Docs exercise should be assigned prior to the Zoho exercise if the assignment would be assigned again in the future (Appendix B). One of the students, who did not think that Google Docs should be included in the exercise in the future, indicated that since Zoho was more comprehensive, it had everything that was needed for the assignment and more.

Graduate Outcome

The graduate students' project required that the students learn and use Zoho.com without an introductory assignment in Google Docs. Similar to the undergraduate assignment, the main learning objectives were met at the graduate level as well. (See Appendices A and C.) As expected when the assignment was created, more graduate students had used collaborative technologies than undergraduate students with approximately 11% of respondents using the resource for work and 22% using a technology in another class. Finance students were the only student major who had used the technology in other classes. For those students who had previously used the technology for work, the collaborative technology used was Google Docs. Only one student felt that collaborative technologies would not be beneficial in future class group projects or for businesses given the state of the economy. Although 98% of the students felt that collaborative technologies could help them in future group projects, only 81% of the respondents indicated that they thought they might use the technology on future projects.

Since the students were not assigned a small project in Google Docs to introduce them to collaborative technologies prior to the Zoho.com assignment, students were asked, "Would it be helpful to use Google Docs or a smaller collaborative tool before using Zoho?" and "Zoho is a more advanced business tool. When the exercise is assigned again, do you think it important to include Google Docs in the assignment?" The responses were similar for both questions with approximately 56% and 52% of the students respectively not feeling that a smaller Google Docs assignment was necessary prior to the assignment of the Zoho.com project. In regards to students' opinions of the difficulty of the software, pre and post improvements were similar to those of the undergraduates; however, the graduate students did not initially view the collaborative software to be as difficult as the undergraduates.

When asked their impressions of the difficulty of the software when the assignment was first started, 52% of the students thought the software was either "Difficult" or "Very Difficult." By the end of the project, 92% of the students thought that the software was either "Very Easy" or "Easy" to use. Their impressions of the office applications' ease of use were higher as 89% thought they were "Very Easy" or "Easy" to use at the beginning of the project with 98% feeling that way by the end of the project. Thus, all three learning objectives for the project were achieved as:

- a majority of the class had never used a collaborative technology prior to this project;
- 92% of the students felt that the technology was easy to use by the end of the project; and,
- 56% of the class did not feel that an introductory project in Google Docs would have been beneficial to the learning process and thus, a valuable use of class time.

As MIS faculty develop and evaluate projects for inclusion in their courses, not only must they consider university and course learning objectives, but they must also consider the relevancy of the material given the advancements in the field. In highly dynamic fields in which the landscape is continuously changing and is heavily integrated with everyday life, faculty may wish to consider surveying their students to determine their level of familiarity with the technology at hand. Based upon their findings, they may wish to adjust the approach that they take on the topic, consider replacing the topic, or depending upon the results of the survey, provide supplemental materials to assist students who are less familiar.

7. FUTURE RESEARCH

After examining the results of the surveys for both classes, it seems as if the project provided a beneficial tool for students, was a valuable use of class time, and met the learning objectives proposed for the assignments. Although the project and survey could be administered again to multiple sections, greater value, especially in regards to assurance of learning initiatives, could come from moving on to other assignments. The learning taxonomies could be applied to the development of the learning objectives of other projects. The simple survey instrument could be modified to collect data regarding students' perceptions of these assignments and determine whether or not their perceptions are in line with those of the instructor. Should the process and survey instrument be used to collect results on future projects, it would be interesting to compare the results of face-to-face and online sections across one course.

8. CONCLUSION

When developing exercises to enhance classroom learning, it is important to keep in mind accrediting body considerations, the learning goals and objectives of the university, as well as the goals and objectives of the project. Examining projects during the process of development as well as evaluating the students' opinions of the projects, provides valuable instructional insights as well as possible evidence towards abiding by assurance of learning standards. When technologies that may be addressed in previous coursework are being considered for inclusion in a course, faculty may want to survey students' opinions to determine the value that the exercise provides to the students' overall learning experience.

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Appendix A

Survey Question – Both Undergrad and Grad.	Undergraduate		Graduate	
	Yes	No / NA	Yes	No / NA
Before this class, had you used Google Docs, Zoho, or some collaborative technology for **other classes**?	0	17 100%	3 11%	24 89%
Before this class, had you used Google Docs, Zoho, or some collaborative technology **at work**?	2 12%	15 88%	6 22%	21 78%
Did your previous experience help you with this assignment?	3 18%	11/3 82%	7 26%	18 / 2 67% / 7%
Do you think **Google Docs/Zoho** or other collaborative technology could help you on future class group projects?	17 100%	0	26 98%	1 2%
Do you think you will you use **Google Docs/Zoho** or other collaborative technology on future group projects?	17 100%	0	22 81%	5 19%
Keeping in mind the state of the economy and use of technology, do you think that businesses will increase or decrease their use of collaborative technologies?	17 100%	0	26 98%	1 2%
Was it helpful to use Google Docs before using Zoho?	14 82%	3 18%	NA	NA
Would it be helpful to use Google Docs or a smaller collaborative tool before using Zoho?	NA	NA	12 44%	15 56%
Zoho is a more advanced business tool. When the exercise is assigned again, do you think it important to include Google Docs in the assignment?	15 88%	2 12%	13 48%	14 52%

Appendix B

Survey Questions – Undergraduate Students Only	Very Easy	Easy	Difficult	Very Difficult
When you **first started** the exercise, how difficult did you think **Google Docs** was?	0	8 47%	8 47%	1 6%
By the **end** of the exercise, how difficult did you think **Google Docs** was?	9 53%	7 41%	1 6%	0
When you **first started** the exercise, how difficult did you think **Zoho** was?	0	6 35%	9 53%	2 12%
By the **end** of the exercise, how difficult did you think **Zoho** was?	4 24%	12 70%	1 6%	0

Appendix C

Survey Questions – Graduate Students Only	Very Easy	Easy	Difficult	Very Difficult
When you **first started** the exercise, how difficult did you think **Zoho** was?	0	13 48%	13 48%	1 4%
By the **end** of the exercise, how difficult did you think **Zoho** was?	9 33%	16 59%	2 8%	0
When you **first** used the basic features of Zoho (word processing, spreadsheet, slide show) for this exercise, how difficult did you think the basic features were?	4 15%	20 74%	3 11%	0
By the **end** of the exercise, how difficult did you think the basic features of **Zoho** (word processing, spreadsheet, slide show) were?	15 56%	11 42%	1 2%	0

Adapting to Change in a Master Level Real-World-Projects Capstone Course

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Abstract

Our mission of capstone computing courses for the past ten years has been to offer students experience with the development of real-world information technology projects. This experience has included both the hard and soft skills required for the work they could expect as industrial practitioners. Hard skills entail extending one's knowledge structure with technical know-how, specifically using the latest software and hardware tools for building applications of genuine utility. Soft skills include the ability to work in a collaborative setting (e.g., to participate in team coordination and governance), the ability to interact with a customer (e.g., to establish product requirements and achieve acceptance), the ethos of creating value, and a facility for technical communications (written, oral, and electronic). Significant changes in the instructional environment have taken place in the ten years since the capstone class was first offered. This paper describes the adaptation to changes in the course's delivery so that its mission continues to be fulfilled successfully.

Keywords: capstone computing courses, project-oriented courses, distance education, collaborative and teamwork skills, online student assessment

1. INTRODUCTION

The aim of our capstone is to familiarize students with how their trade is plied in organizations, so that the master program delivers "the practice" part of the promised "theory and practice." The projects are "real world" in every respect. They entail the development of an application desired by a real world customer. As in industry, applications are developed by a small, collaborative team which needs to communicate with the customer, coordinate its activity, attend to internal decision-making, and, as observed by Denning and Dunham (2001), be sensitive to delivering value. The applications press into service current technology. This is technology with which the students are usually unacquainted inasmuch as it may be specialized, new, or at least new to them. Students learn about real-world technology through their own group's experiences as well as through reports from other groups. A soft skill of transcending importance, emphasized by activities throughout the capstone, is the ability to communicate on technical concepts and issues; orally, in written reports, and via Web media; to peers and lay people.

Capstone courses that provide real-world projects for actual customers are not new. They are available in one or two-semester courses at both the graduate and undergraduate levels. Novitzki (2001), in describing a one-semester graduate course, focused on the administrative issues and found that the most consistent shortcomings of the students related to their working with functional managers, their group skills, and their communication skills. Two papers (Gorka, Miller, & Howe, 2007; Green, 2003) described one-semester undergraduate courses that provided projects in conjunction with industry. Goold (2003) described how a one-semester undergraduate course evolved from small student teams of 4-5 students to relatively large teams of 10-12 students. Bruhn & Camp (2004) described a two-semester undergraduate course that required the full two semesters to provide an in-depth coverage of the phases of the systems development life cycle. A series of papers has described real-world information technology projects in masters-level capstone computing courses (Tappert & Cha, 2004; Tappert, Stix, & Cha, 2007; Tappert & Stix, 2009; Tappert & Stix, 2011).

In the ten years since the capstone class assumed its project-based form, the most significant change has been in its presentation. In 2001-2002 the class spanned the fall and spring semesters and was face-to-face. In 2006 it was condensed into a one semester offering. For projects, this meant that requirements elicitation, building the application, and the testing regimen were accelerated. We responded with agile methodology. In 2006 the class's delivery also shifted from face-to-face to "hybrid": online but with a meeting at the beginning of the semester for orientation, a meeting at the middle of the semester for team reports to the class, and a meeting at the end of the semester for final system presentation. By 2009 the format was entirely online for portions of the class for whom attendance was geographically infeasible. This included 15 students taking the class from India.

What has not changed over time is the essence of the course. Groups are still required to maintain a Website for project tracking, have a single spokesperson for interacting with the customer, and attend to the division of labor. Projects must still be delivered. And a professional paper, about the project, must still be written by the group and presented at our annual internal conference that provides students and faculty with the opportunity to present their research and project work.

The remainder of this report goes into the details of each aspect of the course touched upon above. It explains how the course is currently managed and presents a comprehensive review of the projects completed over the past ten years.

2. TEAM-ORIENTED CAPSTONE COURSE

We use team projects modeled on real-world development practice to provide students with the educational experience of collaborative efforts, similar to what is done in industry, in order to design, build, and test computer information systems. We also discuss the pedagogical issues of managing information technology development projects conducted by geographically distributed student teams in an online course.

Effective teamwork requires the division of responsibility, the coordination of efforts, communications to expedite coordination, and group governance for collective decision making, conflict resolution, and the control of deviance. Denning and Reihle (2009) draw attention to both the importance of group dynamics to software engineering and the traditional failure to accord them proper regard in project development courses. To pique the interest of students in "teamwork dexterity," which is even more critical to the functioning of distributed teams, we are capitalizing upon their enthusiasm for the television reality game shows such as *Survivor* and *The Apprentice*. Individuals in groups (tribes or teams) on these reality shows, as in the course, are: working toward common goals; acquiring and sharing new knowledge about the problem, the solution, and cooperative processes; harnessing the different skills of the different teammates; adjusting to the different personalities of the different teammates; exhibiting initiative but without disruptiveness; and learning to shoulder group obligations responsibly. The settings differ in significant interpersonal ways as well. For example, our project students don't get eliminated from the course, as participants can be eliminated from the game shows – like "voted out" on *Survivor* or "you're fired" on *The Apprentice*. Other differences are that reality show participants compete against each other, competitiveness is encouraged, and devious behavior on the part of participants against other participants is accepted as part of the game.

Beginning with the Fall 2006 semester, we migrated our highly successful, project-centered class from a traditional face-to-face format to an online format. While we had found mechanisms for overcoming the challenges that threatened the effective governance and achievement of traditional student development teams, in 2006 we were confronting uncertainties about how these mechanisms port to teams working in the context of an online class and the new mechanisms that might need to be created. The online format precludes automatic, weekly assemblages that act as a safety net to the teams' interaction and smooth functioning.

As the ability for impromptu team discussions before and after class disappeared and online communication became dominant, the internal dynamics of the development teams became more complicated. In addition, we needed to revisit the way we graded the performance of team members (see section 6).

It is well known that projects undertaken by groups lacking co-presence presuppose a higher level of organizational and process skills among their members (Cusumano, 2008). The present paper describes procedures that enabled the successful functioning of student development teams in a largely online course.

3. PROJECT-ORIENTED CAPSTONE COURSE

The current capstone course is a project-oriented, one-semester, web-assisted course for masters-level computing students in which student teams develop real-world computer information systems for actual customers. Students learn the importance of a systematic approach in the process of developing robust systems, the management of projects, how to interact with customers and conduct requirements analysis, how to build and test systems, and the related technical and soft skills. Emphasis is placed on developing skills and knowledge in technical areas that have practical value in the workplace. In addition to technical skills, students develop problem-solving, critical thinking, communication, and teamwork skills. By working on real-world systems with actual customers, the students learn the appropriate skills – both technical and soft skills – for filling meaningful roles in the professional IT workplace.

Team Project Categories and Publications

The team project focuses on developing a computer information system that meets an actual customer's real needs. Although the requirements for the projects come from the customers, the course instructor is the "boss" or "Chief Information Officer" of each project team, and, as such, the person who makes all the major decisions. The project customer knows what he/she wants as an outcome but may not know the technical aspects of the project work (algorithms, program code, etc.). Some projects have subject matter experts who are knowledgeable about certain domain related aspects of a project. The customer, the subject matter experts, and the instructor can give advice to help guide the teamwork but are not expected to make major contributions to the actual project development effort.

Table 1 presents the 102 projects conducted over the last ten years together with the resulting 185 publications. Table 2 lists the project sources, Table 3 the publication categories, and the Appendix provides a detailed list of the publications. Of the 185 resulting publications, 142 were directly project-related, and 43 were similar in kind and designated "offshoot publications" (Table 1).

Table 1. Summary of projects and publications.

Project Category	Number Projects	Project Semesters	Project Related Pubs	Offshoot Pubs
Web Applications	21	25	21	
Pervasive Systems	15	25	18	
PC Applications	11	18	13	
Artificial Intelligence	9	11	12	
Pattern Recognition	9	12	34	19
Biometric Systems	32	35	39	19
Quality Assurance	5	9	5	5
Totals	**102**	**135**	**142**	**43**

Table 2. Project sources.

Project Source	Number
Faculty Ideas or Research	42
Student Ideas or Research	36
External Community	13
Internal University Needs	11
Totals	**102**

Table 3. Publication categories.

Publication Type	Number
External Conference Papers	53
Journal Articles	7
Book Chapters	2
Doctoral Dissertations	17
Masters Theses	4
Internal Conference Papers	98
Internal Technical Reports	4
Totals	**185**

Sample Projects and Websites

In a recent semester we had seven projects as shown on the Projects page of the course website (Figure 1). Most of the project customers that semester were doctoral students enrolled in our Doctor of Professional Studies (DPS) program. The Projects page lists the projects and contains, for each project, the project ID number, the project customer(s) with links to detailed contact information (SME = Subject Matter Expert), a link to a detailed project description, and the student team (listing the team leader first). The project ID number is also a link to the student team website for the project. The team website for the "Keystroke Biometric" project is shown in Figure 2.

Project Information

ID	Customer	Project	Student Team
1	Robb Zucker, DPS Dmitry Nikelshpur, DPS	Human Visual System Neural Network	Alexander Cipully Stamatios Cheirdaris Roberto Rodriguez Rohit Yalamanchi
2	John Stewart, DPS	Stylometry System	Edyta Zych Omar Canales Vinnie Monaco Thomas Murphy
3	Sadia Ismat, DPS Alex Alexandrou, DPS Dr. Narayan Murthy (SME)	Biometric Product Investigation	Juan Amadiz Jia Tian Lin Giovanni Lugones ShashankaTripuraneni
4	John Stewart, DPS Dr. Robert Zack (SME)	Keystroke Biometric: Data Collection & System Testing	Vinnie Monaco Tyrone Allman Mino Lamrabat Mandar Manohar
5	Ned Bakelman, DPS	Keylogger Keystroke Biometric System	Horace Henry John Deluca Pierre Folkes Dwight Worley
6	Brenda Lyons Jack Freeman Jenny Li, DPS (SME)	Social Network Business Site	Nancy Raffaele Yogita Ahire Jenifer Neubauer
7	Steve Kim, DPS	Social Network Forensic Tools	Andrew Kambad Vishal Almeida Palak Shah David Wilkins

Figure 1. Project information on course website, spring 2011.

A continuing line of research, and one that brought forth many projects, is on the keystroke biometric, one of the less-studied behavioral biometrics. Keystroke biometric systems measure typing characteristics believed to be unique to an individual and difficult to duplicate. Over the last five years, long-text-input keystroke biometric systems for identification (one-of-n response) and for authentication (accept/reject response) have been developed. In this keystroke biometric area we have had about ten semesters of masters-level project work, four doctoral dissertations, three external conference papers, a book chapter, and a journal article.

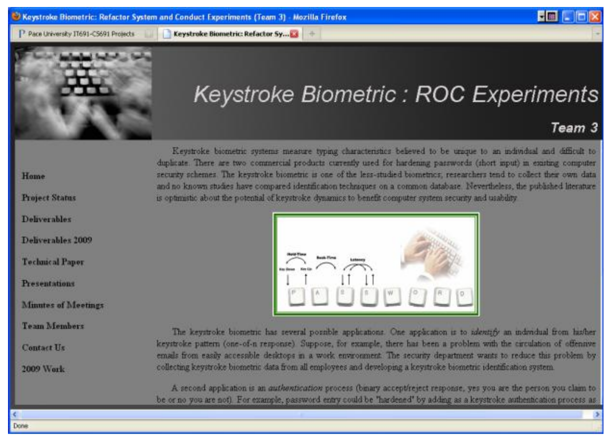

Figure 2. Example team website.

Teams, Roles, and Methods of Work

A team is a group of individuals having the responsibility to jointly accomplish an objective, and in this course the objective is to successfully complete a project. It is widely accepted that work in teams enhances learning by creating an "active learning process." Student teams have been found particularly effective when the students actually need each other to complete the project. It is also the norm for employees to work in teams, and teams are used in all kinds of organizations, such as in industry, education, and government.

Most of the systems involve one or more of the following: programming, a database, a computer network, a Web interface. Java is the preferred language for projects that require programming. Non-programmers or weak programmers can contribute in many ways other than programming. A team usually consists of 3-5 students – an Architect-Designer, one or two Implementers, a Quality Officer, and a team

Coordinator-Liaison. For small teams several team member functions can be combined. At least one team member, usually the Coordinator-Liaison, must be a good communicator for customer and instructor interactions. Once the project is underway, teams should interact at least once a week in addition to project work time, and interactions can be through a variety of communication modes, such as conference calls, email, online chat, comments affixed to work-related materials, and virtual or actual face-to-face.

For project development work we use the agile methodology, particularly Extreme Programming (XP) which involves small releases and fast turnarounds in roughly two-week iterations (Beck, 2000). Each team delivers a prototype system that performs the basic required functions to their customer at the halfway point of the semester. This is possible since, according to the 80-20 rule (Pressman, 2010), 80% of the project can be completed in 20% of the time it would take to deliver the complete system. A complete system is delivered at the end of the semester.

4. PROJECT AND RESEARCH INTERPLAY

Another aspect of this course is the interplay of student projects and research done by students and/or faculty. One of the novel approaches we use is to support student dissertation and faculty research to create research-supporting projects in several of our courses. We teach our dissertation students how to conduct research in a number of areas of computing, and our student project teams how to develop real-world computer information systems. In recent years, we have experimented with the interplay of dissertation research and projects created specifically to develop the supporting software infrastructure for that research. Some of the project customers are faculty members or dissertation students who need supporting software infrastructures to conduct their research. Thus, there is interplay between the project and research activities.

We have found this interplay between research and project activities to be exciting and productive. The main benefits have been to increase faculty research productivity, to facilitate the completion of the doctorate program for gainfully employed information technologists, and to strengthen capstone classes in the masters program. The mechanism has been using research problems to provide projects, and using projects to supply computing infrastructure. We term this symbiotic relationship the research/project interplay.

The Doctor of Professional Studies in Computing program enables computing and information technology professionals to earn a doctorate in three years through part-time study while continuing in their professional careers. In contrast to project work which uses known technology to develop systems according to specified customer requirements, research is original, rigorous work that advances knowledge, improves professional practice, and/or contributes to the understanding of a subject. To graduate, each doctoral student is required to complete an original investigation presented as a dissertation. Masters students also have the option of a research thesis. Research methods depend upon the nature of the inquiry: controlled experiment, empirical studies, theoretical analyses, or other methods as appropriate. We require research work to be of sufficient strength to be able to distill from it a paper worthy of publication in a refereed journal or conference proceedings.

5. COURSE MANAGEMENT

Currently about two-thirds of the capstone students live or work in the greater NYC area. The remaining third come mostly from more distant regions of the east coast but some have been from as far away as California and Europe. Beginning in 2009 the course served cohorts from India – first a group from AOL and later a group from IBM. The distributed team issue is handled by a number of mechanisms and guidelines.

To facilitate communication among the project stakeholders, we insist that, except for extenuating circumstances, communication between a team and instructor, and between a team and a customer, be through the team leader, with all team members copied on communication email and given summaries of face-to-face meetings. This reduces communication to the instructor from individual students and keeps all stakeholders updated on project activities. Although we had the same guideline when the course was conducted in the classroom with local students, this guideline is even more critical for distributed teams. Also, the instructor creates and uses email distribution lists for the whole class, for each project team including the customer, and for all the customers.

Project team leaders must be local, either living or working in the greater NYC area. This allows for easy communication and meetings between the project team leaders and the project customers, who have, so far, all been local. It also allows for similar contact between the project team leaders and the instructor, enabling the instructor to keep informed of the progress of the project work.

The course website efficiently presents all the course information as described above for convenient centralized access. Most importantly, it contains the project-related information and links to the student-developed team project websites that are frequently updated with postings of project deliverables and other information. To ensure that the students read and understand the material on the course website, the first quiz contains questions on the course operation as described in the website material.

The three 3-hour classroom meetings are important to bring the local students together so they can meet many of their teammates and form some face-to-face bonding. The first meeting occurs after the first week of the semester. By this time:

- the students have introduced themselves online through a Blackboard forum, reviewed the course website, and submitted the project preference information form to the instructor
- the instructor has received the students' project preferences and associated information, formed the student project teams, assigned teams to projects, chosen project team leaders, and posted the information on the project's page of the course website

At this meeting the instructor and students introduce themselves face-to-face (half hour), the instructor gives a lecture on the nature and value of conducting real-world projects in a capstone course (one hour), the instructor reviews the specifics of the course material and describes each of the projects (one hour), and the students group themselves into their project teams and begin planning project activities (half hour). Some customers attend the first meeting to introduce themselves and to meet the members of their team.

At the second (midterm) meeting the students make PowerPoint slide presentations of their project prototypes. Material covered in these presentations includes, as appropriate and as time permits, a subset of the following items: brief description of project, summary of project specifications, frequency of meetings with customer/stake-holders and usual method of communication, plans to address changes in customer requirements, summary of user stories collected (if any), analyses accomplished (object-oriented might include defined classes and API's), design decisions and the trade-offs encountered, work breakdown structures, PERT chart, and/or Gantt chart, components built/planned, testing strategy, what was accomplished to complete the prototype, what will be added in the remainder of the semester, what has been easy/difficult during this half of the semester, and a prototype demonstration. Many customers attend the second meeting.

At the third (semester-end) meeting the students present their final project system. This meeting is similar to the second meeting, and most of the customers attend the final presentations.

Successful Teamwork at a Distance

Although this is essentially an online course, we have three face-to-face meetings in a classroom during the semester: one near the beginning, one near the middle, and one at the end of the semester. These contacts, presence at which is highly recommended but not required, are typically attended by about two-thirds of the students – those who live or work in the greater New York City area. The first contact is important because it introduces communication standards and the archiving of course information. An extensive course website presents all the course information, with links in the left menu area providing access to the sections (pages) of the website:

- Homepage – includes the instructor information, textbooks, course description and goals, course requirements, and grading system.
- Syllabus – lists the weekly readings and assignments.
- Projects – contains a table of the semester's projects, and provides for each project the

customer's name and contact information, the description of the project, the names of the students on the development team assigned to the project, and a link to the project team's website.

- Students – contains photos of the students so students know their classmates and the instructor can recall a student (possibly years later) when providing a letter of recommendation.
- Project Deliverables – lists and describes the project deliverables.
- Grades – contains a table of the graded events and the current student grades indexed by the last 4 digits of their university ID number.
- A link to the Blackboard educational software system (Blackboard, 2012) used for quizzes, discussions, and collecting digital assignments.

The instructors solicit and interact with potential customers to set up new projects, work with the university computer support personnel to assure the presence of the required project development software and computing infrastructure, and monitor the systems' development process. Projects come from faculty and dissertation students interested in developing systems to further their research, from other departments or schools of the university needing computer information systems, from non-profit community institutions such as local hospitals, from local research institutions, and from interests of the project students. The instructor sizes and shapes each project to be an appropriate systems development experience for the students, forms the student teams, and assigns each team to a project.

From the project descriptions posted on the course website the students complete a project preference form during the first two weeks of the course. They list their current company and job title, number of years of work experience in information technology, work and home locations, whether they can attend the three classroom meetings, preferred communication mode (email, phone, online chat, Skype, Facebook, Twitter, etc.), top five project choices, top five availability time choices for project communication (day of week plus morning, afternoon, or evening), project skills (requirements engineering, system design, programming, databases, web design, networking, communication/leadership, etc.). The instructor uses this information to form teams, to select team leaders, and to assign teams to projects.

Blackboard Educational Software

The Blackboard educational software system (Blackboard, 2012) is used for quizzes, for collecting digital deliverables, and for discussion forums. There are discussion forums for archiving all instructor email to the whole class for easy reference, for student introductions (students are asked to introduce themselves online during the first week of the semester), for discussions related to the textbook and other course material, and for discussions relating to each of the projects. The project forums are used to discuss project-related material, and each project team is required to post a weekly project status report on their project forum. It might be mentioned that previously student teams gave their status reports verbally in the classroom and students could benefit by learning about the other projects and hearing the instructor feedback, whereas now they are posted on the project forums (and simultaneously on project websites) where they are less likely to be reviewed by students in other projects.

6. STUDENT ASSESSMENT

Student assessment is currently as follows: individual quizzes (20%), initial team assignment (10%), team project midterm (20%), team project final (20%), and team project technical paper (30%). Thus, 80% of a student's grade is based on their contribution to the team effort with the quizzes (based primarily on the textbook material) providing the only direct individual assessment. Mid-term and final exams used in a previous two-semester course were eliminated allowing the students to focus on the project work in this one-semester course. The team has the ultimate responsibility for the project work and is graded accordingly. Grades on team events are determined by first assigning a team grade and then adjusting an individual student's grade up or down based on evaluations of the student's contribution from the instructor, the project's customer(s), and the student's teammates.

Because this is a project-oriented course with no midterm or final exams, student grades depend mostly on their contribution to the project work. The usual expected time commitment per student for a 3-credit course is 3 hours per week in class and twice that outside of class, for a total of 9 hour per week. However, because this is an online course where students save commuting time, we expect a time commitment of about 10 hours per week, and this additional time commitment is one of the advantages of a distance-learning course.

Self and Peer Evaluations

Finally, we use peer evaluations to assess the project contributions of each team member. Although used when the course was conducted in the classroom, peer evaluations are even more critical for distributed teams because some team members have minimal, if any, direct contact with the customer and instructor. Obtaining individual student grades on teamwork has been reported in the literature. For example, Clark, Davies, & Skeers (2005) created an elaborate web-based system to record and track self and peer evaluations, Brown (1995) has a system similar to ours but which uses more granular numerical input, and Wilkins & Lawhead (2000) use survey instruments.

The students are required to provide self and peer evaluations three times during the semester – once after the initial assignment primarily to acquaint the students with the process, at the midterm checkpoint, and at the end-of-term checkpoint. They evaluate each team member, including themselves, by assigning "=" for average contribution, "+" for above average contribution, and "−" for below average contribution. Multiple "+" or "−" signs can be used to indicate extra strong or extra weak contributions, but the total number of plus and minus signs the evaluator assigns must balance out (i.e., be equal in number). A team grade for a particular deliverable or time interval is first determined, and then grades for individual students are adjusted relative to the team grade based on the peer evaluations along with additional input from the customers and instructor. For example, a typical peer evaluation summary chart with associated grades is shown in Table 4 for a four-member team. Each of the four evaluation columns shows the evaluation of a team member evaluating him/herself and the other team members. The summary column shows the sum of each row of evaluations, and the grade column shows the student grades. Here, a team grade of 85% is first determined and then individual grades are adjusted relative to the team grade, in this case up or down 2% for each "+" or "−" sign. For simplicity, this table shows only the peer evaluations, but customer and instructor evaluations are usually included as well. Team leader and instructor evaluations can be given extra weight, and self evaluations that appear overly inflated are usually eliminated.

Table 4. Team peer evaluation and grade chart.

Team Member	Eval 1	Eval 2	Eval 3	Eval 4	Summary	Grade
1	+	=	+	++	+ + + +	93
2	=	=	−	− −	− − −	79
3	−	=	+	−	−	83
4	=	=	−	+	=	85
Average	**=**	**=**	**=**	**=**	**=**	**85**

Students are also asked a number of general questions for the time interval in question – the number of hours per week spent on project work, their specific contributions, their strengths and how these were used, their areas needing improvement, and what has enhanced and/or handicapped their team's performance – and the responses might influence the instructor evaluation of a student's contribution to the team effort. For additional input the instructor can discuss team member contributions with the team leader.

Customer Evaluations

At the end of the semester we survey the students using the Survey Monkey (2012) web-based survey system to obtain feedback on the team-customer interactions during the semester: whether the customer's initial project specifications were clear and understood, whether the amount of contact/interaction was adequate, whether the speed of response to questions was adequate, and whether the continued guidance and direction on the project work was sufficient. This information is used to determine the team satisfaction with a customer and, for example, whether to continue or not continue a project with a particular customer.

Pedagogical Evaluations

At the end of the semester we survey the students to obtain feedback on the course methodologies and procedures, such as what has worked well or not well from the students' point of view. We use these pedagogical evaluations to change our methodologies and procedures from time to time, and to keep informed on the technologies and methodologies the student teams are using. We find, for example, that student teams use many modes of communication.

7. OVERALL BENEFITS

There are many benefits of the research and project activities. The real-world projects provide valuable systems for the customers, allow the students to develop technical and value skills, utilize student-centered team learning, foster interdisciplinary collaboration, encourage student involvement in the university and local communities, support student and faculty research, and enhance relationships between the university and local technology companies. Overall, these projects result in a beneficial outcome for all concerned.

A side benefit is the presentation and publication activities that enhance communication skills. We have both the research and project students produce papers for publication, which is a novel aspect of our teaching approach. For the dissertation student we encourage publication, even if only for an internal conference or workshop, soon after the student obtains preliminary results. Our yearly internal conference, complete with a review process and proceedings, is for this purpose. We have found this helpful because it is much easier to begin by writing a small paper than a large dissertation, it solidifies the problem statement and general approach with some preliminary results, it ensures that the student and advisor have a common understanding of the problem and methodology and that the advisor buys into the process, and it generates ideas and motivation for extending the work into a significant research study acceptable as a dissertation. We have found that working to produce publications is a strong motivating factor for the students. The publications also enhance the external image and identity of our programs.

The various customers benefit from the systems created for them by the students, sometimes receiving systems they might not obtain under ordinary circumstances. The customers include the research students, the faculty, the internal and greater university communities, and the community non-profit and technology organizations. The work with other universities, such as the Rensselaer Polytechnic Institute, extends our collaboration to the greater university community. The projects also extend into the local community, involving three local hospitals, the IBM speech and pen computing groups, and a small company, to provide the students with off-campus experiences and to foster an extended community for learning and growth.

8. CONCLUSIONS

The online course format necessarily means a reduction in the face-to-face contact time of student teams jointly working on projects inasmuch as weekly class assemblages no longer exist. All courses with a collaborative component requiring groups to complete a task requiring cooperation and coordination over an extended time will find that the students are forced into working in a distributed context. For projects' success, and therefore course success, effective techniques for managing distributed student teams are required. We confronted this pedagogical issue head-on in a masters-level, capstone course in which teams of students in computer science and internet technology develop real-world systems for actual customers. This course had been in successful operation for over five years in the face-to-face mode when it shifted to online. Here we experienced success as well.

Our success in the online mode rests on much of the same management infrastructure that had facilitated effective communications among "traditional teams," notably the website that comprehensively centralized access to project information and Blackboard for organizing digital deliverables and discussion forums. The new pedagogy consists of an initial face-to-face contact offering a rigorous introduction to the usage of the information dispensing and communication channels, the requirement that the team leader live locally and be amenable to in-person meetings with the customer and the instructor, and rigid requirements about circulating communications and archiving documents.

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Market Basket Analysis for Non-Programmers

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Abstract

Market Basket Analysis is an important topic to cover in a Management Information Systems course. Rather than teach only the concept, our philosophy is to teach the topic using hands-on activities where students perform an analysis on a small but non-trivial data set. Our approach does not require knowledge of SQL, programming, or special software. Students use simple Microsoft Access functionality to find frequent itemsets and association rules. We believe this approach is a rigorous and engaging way to teach Market Basket Analysis that is most appropriate for an introductory course. Our follow-on Business Database course revisits the topic in a more technical manner where students write SQL queries. Thus, students are introduced to various SQL features through a fundamentally important topic that they have already seen in the prerequisite course. This paper describes the cognitive support structures used to introduce Market Basket Analysis, the details of how the activities are performed without SQL, and how we reinforce the topic with SQL in our Business Database course.

Keywords: management information systems, database systems, laboratory-based learning, association rules, market basket analysis, business intelligence

1. INTRODUCTION

For many businesses, understanding and acting upon purchasing patterns of customers using transaction data is a critical success factor. Students are accustomed to receiving "recommendations" for additional purchases of music, books, clothes, etc. How exactly are these "recommendations" generated and why are they often so relevant? The data mining technique called Market Basket Analysis (Julander, 1992) plays a critical role in many of the marketing strategies that students see every day. Our goal is to improve students' analytical and critical thinking skills by using an in-depth study of the concepts and algorithms behind Market Basket Analysis. Data mining is a suggested topic for both the introductory MIS course and the business database course according to the IS 2010 Curriculum Guidelines published by AIS and ACM (Topi, 2010). Market Basket Analysis is a form of data mining that fulfills this requirement and can be relatively easily understood.

How can we motivate students to learn about this important and complex methodology using simple tools? In our Management Information Systems (MIS) course, we introduce our business students to Market Basket Analysis

(MBA) using case studies and a hands-on approach. The novelty of our approach is that students generate association rules (Agrawal, 1993) without directly using SQL or special software. Students implement the basic Apriori (pruning) Algorithm (Agrawal & Srikant, 1994) using the query design view in Microsoft Access. In our Business Database course, students revisit the topic but use SQL, which broadens their perspective and reinforces concepts from a more technical point of view.

Our goal is to go beyond textbook concept coverage and provide hands-on exercises without requiring special software that can obscure fundamental processes, and without programming in a language such as Java (Witten, 1999) or requiring advanced knowledge of algorithms (Zaki, 2000), which is inappropriate for an introductory course.

Our institution, courses, and labs

We are a liberal arts college of approximately 3000 students with an AACSB accredited School of Business. Our MIS course, a required core business course, is taught within the Computer Science department, which offers a BS in Computer Science and a minor in Information Systems. MIS is an introductory level course that requires only spreadsheet proficiency as a prerequisite. The course consists of two hours of lecture and two hours of lab each week. Lab sections are restricted to a maximum of 16 seats where students typically work in pairs at a computer with dual monitors. Our business database course, which has MIS as a prerequisite, is taught in a 16-seat classroom in which each student has a computer; the format is a mix of lecture and workshop activities.

The remainder of this paper will briefly trace the evolution of our MIS labs, describe the MBA lab activities and expected student outcomes in more detail, outline the approach to MBA taken in our business database course, and draw some conclusions based on our experiences teaching MBA to business students.

2. EVOLUTION OF OUR MIS LABS

The value of a hands-on approach to learning computing concepts has been recognized in the IS 2010 Curriculum Guidelines (Topi, 2010) and elsewhere; we also provide specific evidence of its utility for learning MBA in the Conclusions section of this paper. The material presented in labs is the driving force for integrating content and experience for all sections of the course. We implemented a collaborative approach to scaling our MIS course by creating a shared repository of lab and lecture materials in Blackboard that fosters collaboration among faculty teaching the course. A faculty member can contribute new lab ideas and corrections using an editing review system, where at least two other faculty members must review the suggested changes and perform the lab in its entirety to ensure continuity and cohesiveness (Breimer, Cotler, & Yoder, 2009).

Our labs have a "triad" structure that incorporates (i) theory from the textbook or lectures and (ii) practical case studies with (iii) information technology, such as Excel, Access, Geographic Information Systems, and Radio Frequency ID readers. All labs have pre-lab reading assignments and an online quiz to introduce the lab. The in-lab experience is fast paced, where students are paired in teams to use technology and learn basic concepts to solve problems and to work through examples. Lastly, students individually complete a post-lab assignment to synthesize material and to reflect on the lessons learned in the lab. A web-based lab delivery and assessment system is under development.

3. OUR MARKET BASKET ANALYSIS LAB

The MBA lab, inspired by a chapter from Larose's (2005) data mining text, presents a complete analysis of transaction data for a farmer's vegetable stand. We added specifics on how to accomplish a market basket analysis using only the graphical interface of Access (no programming or explicit SQL). The dataset presented in the book is non-trivial but easy to understand. We show students a bottom-up approach to generate frequent itemsets (groups of items purchased together) and how to compute measures of Support and Confidence for the association rules derived from these itemsets. The next section provides definitions of these terms. A good introduction to MBA can be found in Berry & Linoff’s text (2004).

Students learn that finding frequent itemsets requires computing cross products of sets, which increases the size of the problem exponentially. It becomes obvious that removing (pruning) non-frequent itemsets of size N before moving on to itemsets of size N+1 makes the analysis much more tractable. The Apriori principle is introduced as a theoretical justification for removing non-frequent itemsets without affecting the solution. Thus, students gain the valuable experience of actually performing a market basket analysis, using theory that can be applied to a real business problem.

Pre-lab activities (20% of lab grade)

In order to smooth the presentation and understanding of Support and Confidence during the lab session, we provide students with a worksheet to review the concepts of probability and conditional probability. We also provide a set of PowerPoint slides, to be presented before the lab session, that introduces the concepts of Transactions, Itemsets, Association Rules, Support, and Confidence:

Transaction: the purchase of a collection or "basket" of items by a customer in a shopping cart.

Itemset: a subset of items selected for purchase in a single transaction for analysis purposes. We evaluate itemsets of size 1 (singles), 2 (doubles), and 3 (triples).

Association Rule: the itemsets that occur frequently in transaction data (Support), and items that often occur together in individual baskets (Confidence) are good candidates for appearing in general Association Rules. As an example, the association rule A→B means "if item A is purchased in an itemset, then item B is also purchased in that itemset".

Support: this is the percentage of transactions containing all items in the itemset compared to the total number of transactions (baskets). For example, if 432 baskets contain both Asparagus and Beans, and we have 1000 baskets, then the support is 432/1000 = 0.432 (43.2%). Support is the probability that the items occur together in baskets, and is a measure of how frequent the itemset occurs within our transaction data. The association rules Asparagus→Beans and Beans→Asparagus will have the same support (43.2%).

Confidence: this measure applies only to rules, not to itemsets. Support by itself is an imperfect measure of the quality of a rule. We need a way to further measure the predictive accuracy of the candidate association rules that takes into account how strongly items are associated with each other. This measure is called Confidence, the probability that an item B is in the basket given that item A is already in the basket. You may recognize this as Conditional Probability (Bayes' theorem). Confidence can be computed by Support(A&B) / Support(A). Note that the Confidence for A, given B is in the basket is different than the Confidence for B, given that A is in the basket. The assertion "All people who buy Peanut Butter also buy Bread" does not necessarily imply that "All people who buy Bread also buy Peanut Butter."

The pre-lab activities introduce Market Basket Analysis as a form of unsupervised data mining, which is in turn a form of business intelligence.

We ask students to read the brief introduction in the MIS course textbook (Kroenke, 2010), followed by a short (7 page) white paper on the benefits of MBA from the perspective of a business (Megaputer.com). The paper reviews MBA terminology and describes actions businesses can take based on these rules, such as product placement or pricing strategies.

Finally, the pre-lab introduces students to the data that will be used during the lab. The raw data are stored in a table with two columns: transaction (basket) number and item name (Figure 1).

Veggie

Basket	Item
1	Broccoli
1	Corn
1	Green Peppers
2	Asparagus
2	Corn
2	Squash
3	Beans

Figure 1: Market Basket data format

The pre-lab guides the student through the process of creating a query to count, for each item, the number of baskets that contain that item. An online quiz concludes the pre-lab activities. All of our pre-lab activities are due by the start of the lab session.

Because of the complexity of the subject, this pre-lab is the most intensive of any of our labs. It is important that students carefully complete the pre-lab material beforehand.

In-lab activities (50% of lab grade)

The in-lab activity focuses on performing the steps in the MBA algorithm shown in Figure 2. During the lab, students answer questions on their worksheet that test their understanding of crucial steps and verify their progress. Students create tables containing all possible single, double, and triple itemsets; create queries to calculate the candidate association rules; prune the rules table of non-frequent itemsets (those with less than 25% support); and copy only the frequent itemset rows from the transaction data that will participate in the next round.

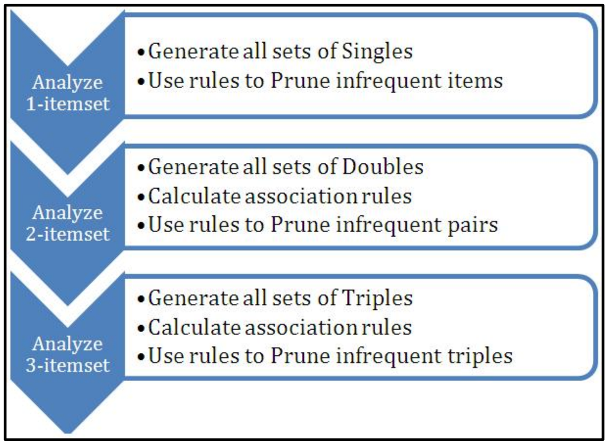

Figure 2: The MBA Algorithm

There are some nuances to making the tables and action queries that will be described here. We have designed the lab so that students can recover from mistakes easily without performing large sections of the lab over again. The detailed design for each query mentioned below is shown in the appendix.

For Single itemsets

The students complete the following steps:

- Copy the original transaction data, the "Veggie-Table," to a new table called Singles.
- Compute the Support for every single item: Using the Access query wizard, create a make-table query named Make-SingleRules that creates the table named SingleRules that includes Support as a calculated field by dividing *ItemCount* by *NumBaskets* (Figure 3). *ItemCount* is the number of baskets containing the item and *NumBaskets* is the number of transactions in the dataset. (Note that we call this table "SingleRules" for consistency with the upcoming "DoubleRules" and "TripleRules", even though technically these single itemsets do not give rise to association rules.)
- Remove infrequent items: create a *delete* action query named Prune-SingleRules to prune the SingleRules table by adding a criterion of < 0.25 to the Support column in the query design.
- Retain just the item names and basket numbers for these frequently-purchased items: create a new query named Make-FreqSingles that makes the FrequentSingles table by selecting rows in the Singles table that have frequent items in them, effectively pruning the Singles table.

SingleRules

Item	ItemCount	NumBaskets	Support
Asparagus	6	14	42.86%
Beans	10	14	71.43%
Broccoli	5	14	35.71%
Corn	8	14	57.14%
Green Peppers	5	14	35.71%
Okra	1	14	7.14%
Squash	7	14	50.00%
Tomatoes	6	14	42.86%

Figure 3: The SingleRules Table

For Double itemsets

This phase of the lab requires the students to build upon what was created before, by creating itemsets of 2 items, computing Support for both items together, and keeping only frequent itemsets of size 2, as follows:

- Generate all pairs of items purchased together: create a make-table query named Make-Doubles that joins the FrequentSingles table with itself to generate all combinations of two items and place it in the new Doubles table. Note that students are using the Apriori Principle here since they are only including frequent single items, not all items.
- Data cleaning and consistency: to avoid itemset duplicates, such as {corn, corn} or pair reversals of items from the same basket, such as {asparagus, beans} and {beans, asparagus}, we add the criterion that the second item column be less than the first item column (sorted order).
- Add support: create a query named Make-DoubleRules that includes the Doubles table in the query with additional calculated fields to compute Support as ItemCount divided by NumBaskets for both items together, creating table DoubleRules (Figure 4).

DoubleRules

FirstItem	SecondItem	NumBaskets	ItemCount	Support
Asparagus	Beans	14	5	35.71%
Asparagus	Broccoli	14	1	7.14%
Asparagus	Corn	14	2	14.29%

Figure 4: A portion of the DoubleRules table

- Remove infrequent itemsets: create a delete query named Prune-DoubleRules that prunes the DoubleRules table by removing the low-support pairs using a criterion of <0.25 in the Support column. Thus, the second and third rows would be removed from the table in Figure 4.

- Prepare final frequent pairs list: finally, we create a query named Make-FreqDoubles that copies only the item pairs with high support, by including the Doubles and DoubleRules tables in the query with the criteria that the first item in the Doubles table matches the first item in DoubleRules, and that the second item in Doubles matches the second item in DoubleRules. In this manner, only the frequent item pairs are selected from the transaction basket data to participate in the next round. The resulting table is shown in Figure 5.

FreqDoubles

Basket	FirstItem	SecondItem
12	Asparagus	Beans
9	Asparagus	Beans
6	Asparagus	Beans
13	Asparagus	Beans
5	Asparagus	Beans
6	Asparagus	Squash
9	Asparagus	Squash
2	Asparagus	Squash
13	Asparagus	Squash
12	Asparagus	Squash
3	Beans	Corn

Figure 5: A portion of the FreqDoubles table

At this juncture, students perform a little analysis based on the SingleRules and DoubleRules tables they created earlier: using a supplied spreadsheet, students calculate the Support, Confidence, and overall Quality measures for Doubles itemsets and their reverse, e.g., {Asparagus, Beans} and {Beans, Asparagus}. Since the Confidence measure is a conditional probability, the order of items matters. We combine (multiply) the measures of Support for both items (the proportion of baskets with those items in them) and Confidence (how strongly the items are linked with each other) into a single measure called Quality that expresses Confidence adjusted for how often the items are sold together. In the "Doubles Analysis" worksheet in the appendix, Quality is computed as the "Support for I1, I2" column times the "Confidence" column.

For Triple itemsets

The students first create a list of all the triples of items that are purchased together: they create a Make-Table query named Make-Triples that joins the FreqDoubles table to itself (as FreqDoubles_1) and creates a table named Triples. Note that the Apriori Principle is in play here again: they are using the "FreqDoubles" table as a starting point, not the "DoubleRules" table, which includes all pairs (not just the frequent ones). For Triples, the Basket ID and the first item from both tables must match. Thus, we are selecting rows from both tables that start with the same Basket ID (by a join) and first item, and generating all of their combinations, e.g., {4,Asparagus,*,*} in FreqDoubles with {4,Asparagus,*,*} in FreqDoubles_1. We also add a criterion that the second item name be less than the third item name to avoid duplication and to keep the triples in alphabetical order, as shown in Figure 6.

Triples

Basket	FirstItem	SecondItem	ThirdItem
6	Asparagus	Beans	Squash
9	Asparagus	Beans	Squash
13	Asparagus	Beans	Squash
12	Asparagus	Beans	Squash
13	Beans	Corn	Squash
3	Beans	Corn	Squash

Figure 6: A portion of the Triples table

We leave the task of making the TripleRules table and pruning it to make FreqTriples as a paper exercise for the post-lab. There are only a few rows remaining at this point, and we want students to focus on the process and not on the complexities of the queries for triple itemsets.

Post-lab activities (30% of lab grade)

The in-lab activities focused on the creation of itemsets of sizes 1, 2, and 3; including the creation of frequent itemsets of size 1 and 2 and on association rules involving itemsets of size 2. The post-lab first asks the students to extend the analysis of the triples (itemsets of size 3) by deriving the association rules (with support and confidence) for these triples by filling in the TripleRules worksheet table (Figure 7).

Students then prune the TripleRules worksheet table by drawing a line through rows with Support of less than 25%. Lastly, using the Triples table from the in-lab session and the pruned TripleRules table, students manually create their own FreqTriples table, as shown in Figure 8.

TripleRules					
First Item	Second Item	Third Item	Triple Count	NumBaskets	Support
Asparagus	Beans	Squash	4	14	28.6%
Beans	Corn	Squash	2	14	14.3%
Beans	Corn	Tomatoes	3	14	21.4%
Beans	Squash	Tomatoes	2	14	14.3%

Figure 7: The TripleRules worksheet

FreqTriples			
Basket	First Item	Second Item	Third Item
6	Asparagus	Beans	Squash
9	Asparagus	Beans	Squash
12	Asparagus	Beans	Squash
13	Asparagus	Beans	Squash

Figure 8: The Frequent Triples worksheet

In the post-lab, we limit the student to rules in which the left-hand side contains two items: i.e., we are interested in rules of the form

A,B → C

but not rules of the form A → B,C. In the post-lab exercise, students are asked to fill in the "Triples Analysis" worksheet containing the Frequent Triples and their Support, Confidence, and Quality values (shown in the Appendix).

Using the results from the in-lab and post-lab activities, students are asked to make recommendations to the business owner based on the association rules they discovered.

The post-lab also includes some questions that invite the student to consider the importance of the Apriori rule when generating frequent itemsets. The Apriori rule states: *if an itemset is not frequent, then adding another item to the itemset will not make it more frequent*. This is the driving principle that permits pruning of non-frequent itemsets to reduce computational complexity while maintaining correctness.

4. MBA WORKSHOP IN OUR BUSINESS DATABASE COURSE

Our business database course has MIS as a prerequisite, so most students have already performed the lab described in the previous section. The database course textbook (Kroenke & Auer, 2010) contains just 2 pages on MBA and using SQL to derive rules, so the in-class workshop we describe next comprises the bulk of the students' learning materials for this topic.

After basic concepts are briefly reviewed in a mini-lecture, the worksheet is distributed to students. The worksheet begins with a short pencil-and-paper exercise that presents some market basket data and asks the students to list all the itemsets that have at least 60% Support and, based on those itemsets, all the association rules that have at least 60% Confidence.

The remainder (and the bulk) of the exercise focuses on generating itemsets of size 2, then computing Support and Confidence for association rules based on those itemsets. Extending these techniques to triples and beyond is fairly straightforward and could be incorporated into a homework assignment or other activity.

The first task is to complete an SQL query that will generate all pairs of items purchased together (i.e., itemsets of size 2). The raw transaction data are in a table named *Order_Data*, with columns *OrderNumber* and *ItemName*. In the following query, the students are given the portion in **bold** and must complete the portions in *italics*:

SELECT O1.ItemName AS FirstItem,
O2.ItemName AS SecondItem
FROM Order_Data AS O1, Order_Data AS O2
WHERE *O1.OrderNumber = O2.OrderNumber* **AND**
O1.ItemName <> O2.ItemName;

This query works well as an introduction to the concept of self-join (joining a table to itself) in SQL. If the students have already seen that concept, then they can be asked to write the entire query from scratch. The intuition behind the WHERE clause is that you want two items that were (a) purchased in the same transaction (the "=" comparison) and (b) are not the same item (the "<>" comparison). The students then save this query as "TwoItemSets", in effect creating a view (in Access, a named query can be used in subsequent queries just as if it were a table). The result of this query is shown in Figure 9. Note the duplication of some pairs (which are purchased together more than once)

TwoItemSets

FirstItem	SecondItem
Tent	Fork
Tent	Cup
Cup	Tent
Cup	Saucer
Saucer	Cup
Fork	Saucer
Tent	Saucer
Saucer	Fork
Tent	Fork
Fork	Tent
Saucer	Tent

Figure 9: Pairs of items ("TwoItemSets") using SQL (partial result).

The next step is to create and save a new query called "Rules" that will be used to compute the Support and Confidence for each entry in TwoItemSets. This is done in two steps, first by simply counting the number of occurrences of each itemset, then by converting that count into a percentage. The students are first asked to complete the Rules query (given portions in bold, to complete portions in italics):

SELECT FirstItem , SecondItem , *COUNT(*)* **AS SupportCount**
FROM TwoItemSets
GROUP BY *FirstItem, SecondItem***;**

This is a fairly standard GROUP BY query, but it is a nice introduction to the concept of using a query as the basis for another query (outside of Access, these stored queries are called views). Now that the students have every itemset of size 2 and the count of orders containing that itemset, they can enhance the query to convert the SupportCount into a more useful percentage format (SupportCount divided by total number of orders). The total number of orders can be computed by the following query:

SELECT COUNT(DISTINCT OrderNumber) FROM Order_Data;

Unfortunately, Microsoft Access does not support the standard COUNT(DISTINCT) syntax, so the following must be used instead (this is given to the students):

SELECT COUNT(*) FROM (SELECT DISTINCT OrderNumber FROM Order_Data);

The students are then asked to embed (nest) that query in the SELECT clause to help compute the support as a percentage; the Rules query now looks like this:

SELECT FirstItem , SecondItem ,
COUNT(*) AS SupportCount,
COUNT(*) / **(SELECT COUNT(*) FROM**
(SELECT DISTINCT OrderNumber
FROM Order_Data)) *AS SupportPercent*
FROM TwoItemSets
GROUP BY FirstItem, SecondItem;

Note that some of the nested query was given to the students -- the total number of orders in the database.

The last main task in the exercise is to add a column to the Rules query that will compute the Confidence of the rule. At this point it becomes useful to point out to the students that they may have noticed some repetition in the Rules query/table: There is a row in the table for items A and B as well as a row in the table for items B and A. But those rows represent the same itemset. Now, however, that repetition becomes useful, since while the two rows represent the same itemset, they represent distinct association rules: as indicated earlier in this paper, A→B is not the same rule as B→A. We interpret the "FirstItem" column as containing the left-hand side of the rule.

The Confidence column can be computed by dividing the SupportCount for the itemset by the number of times the left-hand side of the rule (FirstItem) is purchased overall (this is simply the definition of "Confidence" for an association rule). The new column in the Rules query thus looks like this, where again the portion in italics must be added by the student:

COUNT (*) / (SELECT *COUNT(*)* **FROM Order_Data WHERE ItemName =** *FirstItem***) AS Confidence**

The result of the Rules query is shown in Figure 10.

Rules

FirstIten	SecondIt	Sup	SuppPer	Confid
Cup	Fork	3	0.25	0.43
Cup	Saucer	3	0.25	0.43
Cup	Tent	4	0.33	0.57
Fork	Cup	3	0.25	0.75
Fork	Saucer	2	0.17	0.5

Figure 10: partial final result of Rules query

Now the Rules query contains all rules involving itemsets of size 2, plus the Confidence and Support for each. The final activity in the worksheet is to write an SQL query to retrieve only those rules that have at least a minimum level of support and confidence. For example, if we wish to see all rules with support at least 20% and confidence at least 50%, then we have the following query:

*SELECT **
FROM Rules
WHERE SupportPercent >= .2 AND Confidence >= .5;

Note that throughout this worksheet, the amount of "blank space" to be filled in by the student (i.e. the amount of italics in the SQL queries above) can be varied. What is shown in italics here probably represents a minimum of what the students should be expected to generate. If more time is available, or if the students are more experienced with SQL, then they should be expected to contribute a higher percentage of the query texts. Also, as mentioned above, extending these techniques to triples and larger itemsets can be incorporated into the course as well.

5. RESULTS and CONCLUSION

In the final exam for one of our sections of the MIS course, the score on the market basket question (which tested their ability to understand association rules and to reason about and compute support and confidence) was about 8 points higher (out of 100) than was the score on the exam overall, indicating that the approach we have taken is working.

Although we did not survey students about this lab specifically, students seemed to tolerate this lab well. Students received an average of about 84% for the lab score. Most students liked the labs overall and found them to be "*challenging*" and indicated that "*lab material will be very useful in the future*." Another student wrote: "*my favorite thing about the course was the labs. I was able to learn Microsoft Access through this course, which I know will be useful in many careers*". We plan to add assessment measures for each lab in the future.

There was one negative comment in our MIS course evaluations about this lab: "*some of the labs especially the market basket lab were too complicated"*. We recognize that the MBA lab takes a little extra time to prepare for than most of our lab activities. A few students needed a little help with the post-lab worksheet, but once we showed them how to compute one row of the table, they could easily do the rest.

In the Business Database course, student evaluations indicate that the hands-on approach is working, and there is no reason to suspect it is not working with the MBA topic in particular: Since changing to the hands-on approach, overall course ratings have risen (on a 10-point scale) nearly 1.5 points; the "are classes interesting" question has risen over 1.1 points, and the question about encouraging critical thought has risen over 0.6 points. In addition, student comments that the course material is sometimes "boring" or "dull" went from about 4 per section to 0 after the change.

Final exam scores in the Business Database course also indicate the benefits of our approach: on exams of roughly similar difficulty, scores rose by about 9 points when the approach changed to being more hands-on.

We want to encourage active learning that goes beyond lecture slides or text readings. We have to go the extra step. In an MIS course, we want students to use information systems to solve problems. We believe, based on our own experiences (anecdotal, student evaluations, and exams scores) that the best way to understand association rules, Support, and Confidence is through hands-on activities with actual data. Using database tools to perform a Market Basket Analysis achieves this goal. Students experience "mining" association rules by creating tables and queries using Microsoft Access. In our follow-on Business Database course, they experience MBA from a different perspective by writing SQL queries that generate the association rules. In both approaches, students learn MBA fundamentals and useful data analysis techniques in a hands-on fashion: they not only learn the concepts, but will be able to claim experience putting the concepts into practice, which is not possible without the hands-on experience we have provided for them.

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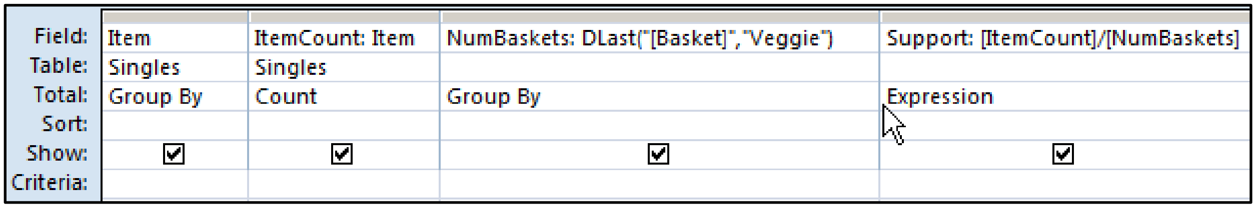
7. APPENDIX – Query design details and analysis worksheets



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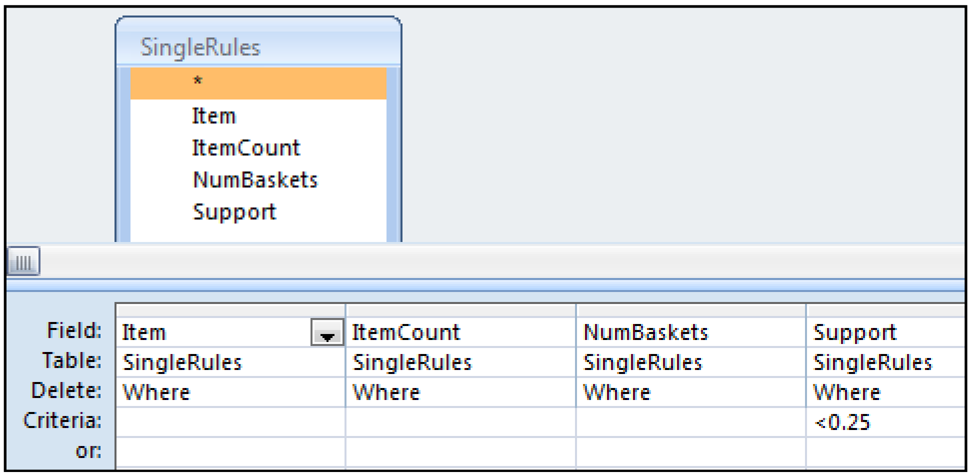
Show:	☑	☑	☑	☑
Criteria:				

Make-SingleRules Query Design



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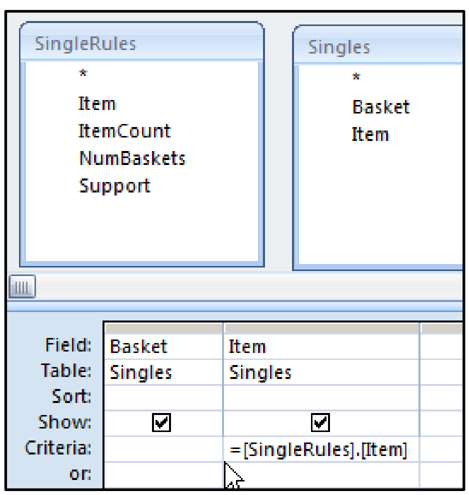
Prune-SingleRules Query Design



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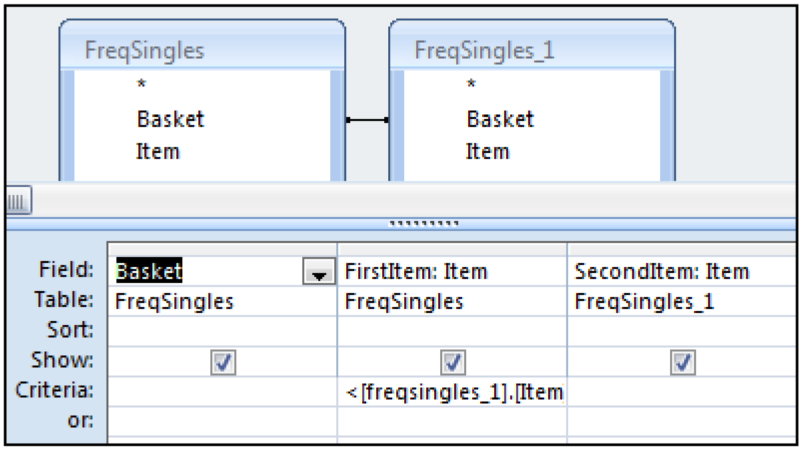
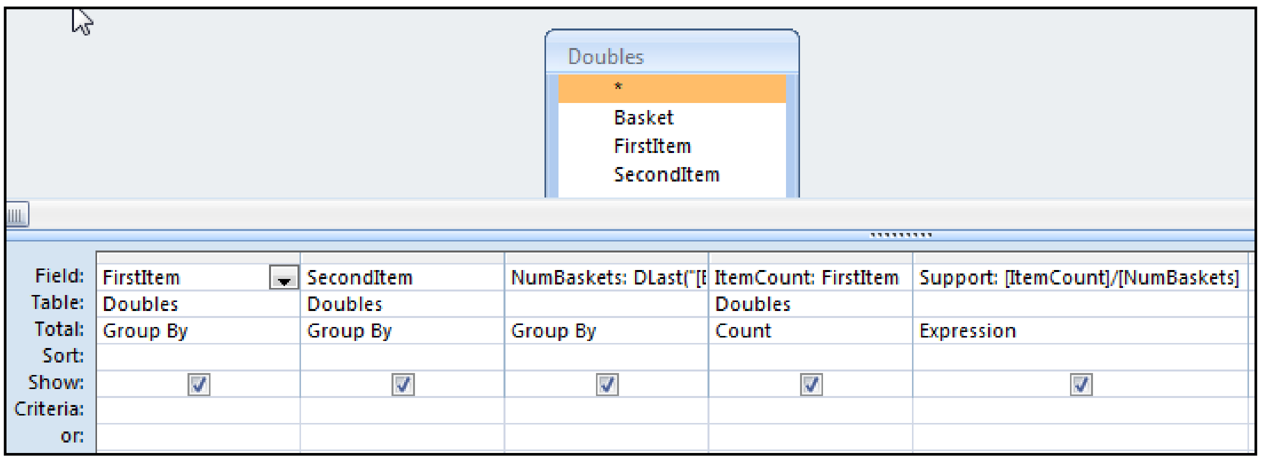
or:		

Make-FreqSingles Query Design



Make-Doubles Query Design



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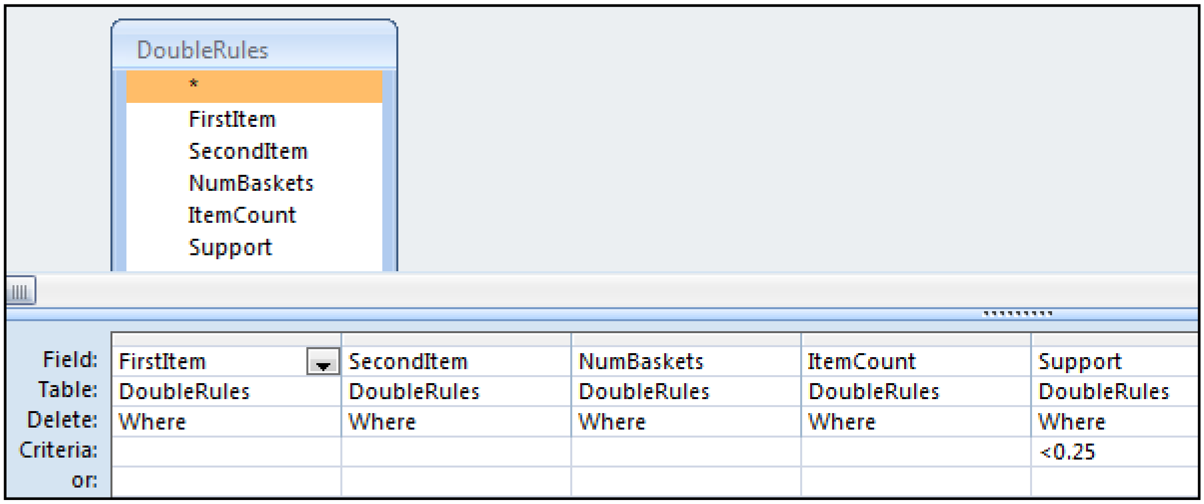

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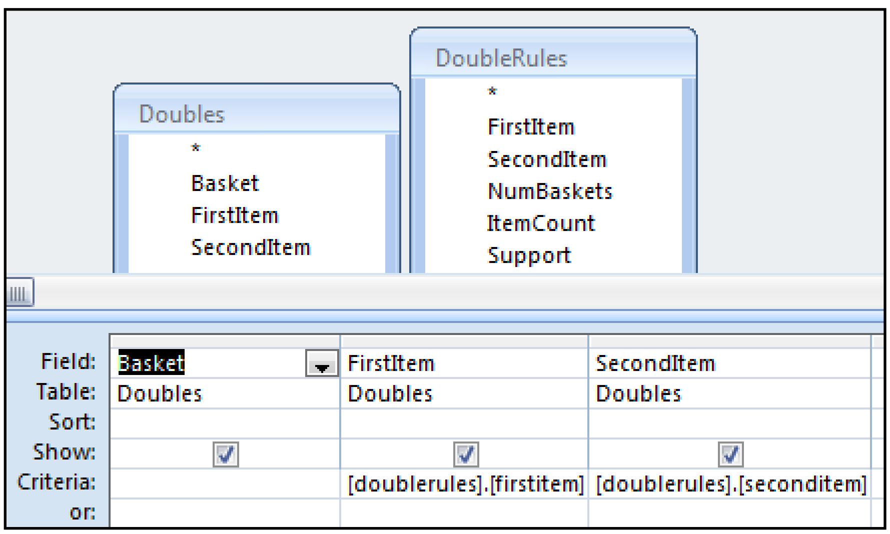

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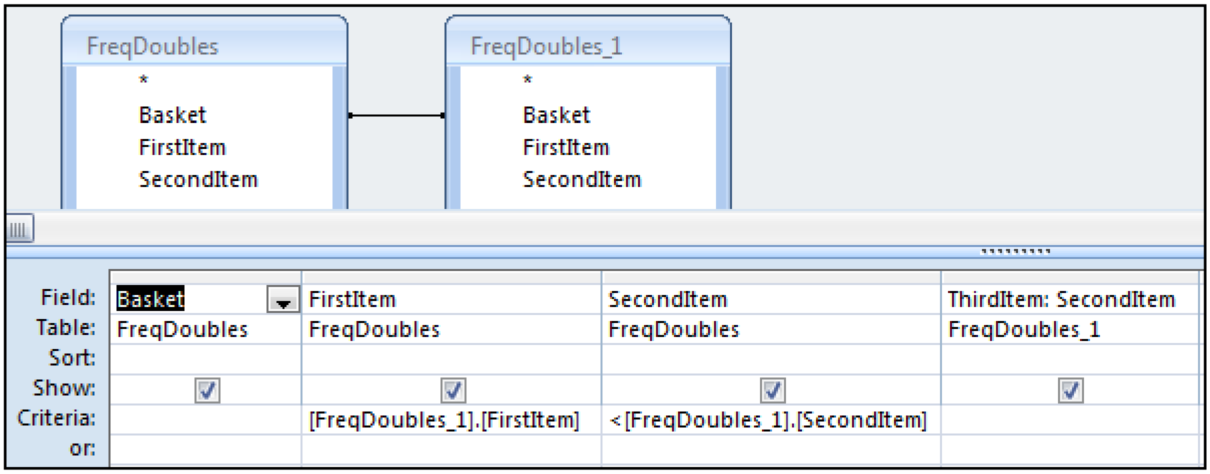

Make-Triples Query Design

Item1	Item2	Support I1,I2	Support I1	Confidence	Quality
Asparagus	Beans	35.71%	42.86%	83.33%	29.76%
Asparagus	Squash	35.71%	42.86%	83.33%	29.76%
Beans	Squash	42.86%	71.43%	60.00%	25.71%
Broccoli	Gr Peppers	28.57%	35.71%	80.00%	22.86%
Corn	Beans	35.71%	57.14%	62.50%	22.32%
Gr Peppers	Broccoli	28.57%	35.71%	80.00%	22.86%
Squash	Beans	42.86%	50.00%	85.71%	36.73%
Squash	Asparagus	35.71%	50.00%	71.43%	25.51%

Doubles Analysis Worksheet

Triples Confidence and Quality									
Fill in veggie names from 3-itemsetF here			Count {A,B,C}[1]	Num Baskets	{A,B,C} Support[2]	Count pair purchased first[3]	Support for Pair Purchased first	Confidence[4]	Quality[5]
A= aspar	B= beans	C= squash	4	14	4/14= 0.29	5	5/14=.36	.29/.36= .79	.28*.79= .224
A= aspar	C= squash	B= beans	4	14	4/14= 0.29	5	5/14=.36	.29/.37= .79	.28*.79 = .24
B= beans	C= squash	A= aspar	4	14	4/14= 0.29	6	6/14=.43	.29/.43=. 66	.28*.66 = .19

Triples Analysis Worksheet

Health Informatics as an ABET-CAC Accreditable IS Program

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Abstract

This paper builds on prior work defending innovative information systems programs as ABET-accreditable. A proposal for a four-year degree program in health informatics, initiated at the authors' university to combat enrollment declines and to therefore help information systems to survive and thrive, is described. The program proposal is then evaluated against ABET-CAC criteria for information systems degree programs. The results of the evaluation were used to refine the authors' program proposal and provide further evidence of the defensibility of innovative IS degree programs as ABET-accreditable.

Keywords: ABET, accreditation, Computing, Health Informatics

1. HEALTH INFORMATICS AS CURRICULUM INNOVATION

The co-authors of the paper are faculty members in an information systems (IS) program at a computing school, the University of South Alabama School of Computer and Information Sciences (SCIS), where students must choose among three separate, accredited degree programs: Information Systems (IS), Information Technology (IT), and Computer Science (CS). An era of enrollment decline has seen the pipeline of majors reduce to a trickle, and intensify the competition among the three competing programs.

While there has been a decline in computing enrollments, the need for computing professionals is still strong, especially in the domain of healthcare. The growth in the need for health information technology (HIT) workers has been fueled by recent legislative actions taken by the United States (U.S.) government. In order to remedy the slow rate of adoption of information technology by healthcare providers, the U.S. government enacted the Health Information Technology for Economic and Clinical Health Act (HITECH Act) as part of the American Recovery and Reinvestment Act of 2009. The HITECH Act encourages Medicaid and Medicare providers to implement an electronic health records (EHR) system and meet a set of meaningful use rules established by the government by providing incentive payments directly to providers. Medicare providers that that do not meet these requirements by 2015 will be penalized in their reimbursements by the government. Currently, Medicaid providers face no similar penalty (Lynn, 2011).

For many years the use of HIT has been limited, and the need for technology workers who understand health care has been met by traditional technology graduates learning on the job. However, the passage of the HITECH Act has caused demand for such workers to far outstrip the ability of healthcare organizations to supply these retooled workers. Leading up to 2015, there is a projected need for between 30,000 and 50,000 skilled HIT workers. These numbers are based on estimates by the ONC, Bureau of Labor Statistics, and HIMSS (http://www.himss.org/Content/Files/CSC_US_Healthcare_Workforce_Shortages_HIT.pdf). Providers need a workforce that is able to "hit the ground running" in the healthcare setting.

It is no longer sufficient for colleges and universities to produce students who have knowledge of only the traditional business environment since, as Hersh (2010) notes "a well-trained HIT professional should have knowledge not only of information technology, but also of health care, business and management, and other disciplines." To meet the needs of the healthcare industry, it is necessary to create a new curriculum that produces outcomes expected of a traditional information systems graduate, along with healthcare clinical environment training needed to understand the deployment and use of HIT in a modern healthcare organization (Longenecker et al., 2011; Campbell, et al., 2011).

HI: A New Pipeline

With the HIT workforce needs as a justification, a multidisciplinary health informatics (HI) certificate program was designed and implemented at South Alabama. The certificate program was the result of collaboration among faculty and deans of programs in information systems, nursing, the allied health professions, and health care industry representatives. Initially, HI course enrollments drew from students majoring in either health sciences or IS. We quickly found that HI students, with only a computer literacy background, could grasp the IS concepts; while the IS students, without clinical training or experience, could likewise pick up the healthcare context. Both sets of students would adequately produce healthcare systems analysis and design artifacts.

Building upon the success of the certificate program, a full degree program in HI was proposed. The expansion of the certificate program to a major is designed to attract students in three groups: those interested in a niche healthcare profession; those whose application for health science programs were declined because of program enrollment limits; and those attracted to the computing first but with a secondary interest in health care. Through the allied health/nursing pipeline, the program promises to attract more female students to high tech careers, as well.

The development of a health informatics (HI) degree program as an information systems program, while addressing a workforce need, both nationally and locally, is also seen as a strategy for the survival and growth of IS academic programs. By tapping into another market, i.e. another source of students, the HI degree program is a means for IS survival. Rather than competing within a computing school with a strategy of differentiation, the faculty in the IS program is expanding into new markets with its new product, the health informatics degree program. The program is will be interdisciplinary— program delivery will be a collaborative effort of faculty from three academic units: the School of Computer and Information Systems, the College of Nursing, and the College of Allied Health Professionals. The program will be administered by a curriculum chair who will oversee all aspects of the program. The program is expected to enroll between 30-100 students per year.

This paper is one of three papers on the proposed HI degree program appearing in the ISECON 2011 proceedings. The Campbell et al. (2011) paper provides the background of the program and its interdisciplinary design details, including curriculum areas. The purpose of this paper is to describe our efforts to define the HI program as an IS-accreditable degree program. As IS faculty experienced with ABET accreditation, we argue that health informatics is accreditable as an innovative IS program. For an analysis of the HI curriculum against model curricula in IS and HI, see Longenecker et al. (2011).

2. APPLYING ABET CRITERIA TO THE HEALTH INFORMATICS DEGREE

Prior work (Wood et al., 2010) has demonstrated that an innovative IS program can be argued to be an ABET-accreditable IS program, that is, meeting the Accreditation Board for Engineering and Technology, Inc. (ABET, Inc.) Computing Accreditation Commission's (CAC) criteria for accrediting computing programs, including the ABET-CAC general and IS program-specific criteria. In the prior work, a cyber forensics and security program was argued to be accreditable as an IS program. The authors defended the need for such professionals and illustrated how program and course outcomes could be mapped into the ABET-CAC program outcomes criteria for information systems programs (ABET-CAC, 2010). This paper builds upon the prior approach to demonstrate that our health informatics program, likewise, is accreditable as an IS program. We will address not only the program outcomes issues, but other key accreditation issues that apply to our situation.

Critical Accreditation Issues

Because the authors already have participated in the ABET-CAC accreditation process for our current undergraduate computing programs, portions of the ABET requirements will be less challenging to meet. ABET requirements are broken into eight general criteria, with additional IS-program-specific criteria specified in some of the general areas. The eight general areas are students, program educational objectives, student outcomes, continuous improvement, curriculum, faculty, facilities, and institutional support. The IS-specific criteria are in three areas: student outcomes, curriculum, and faculty. Assuming our experience with achieving our current accreditation can be leveraged, we will model the processes for continuous improvement for the health informatics program according to the current processes in our existing IS program. The authors' school already has the processes, polices, and procedures for monitoring student performance and progress, advising and career guidance, admission and transfer credit, and for documenting that graduates meet program requirements. Since the curriculum is composed of existing courses taught by IS faculty in facilities already vetted by the accreditation of the IS program, and since the program is a collaboration of deans of accredited programs, we expect the same assessment of faculty, facilities, and institutional support criteria for the health informatics program as for the existing IS program. The remaining three areas, program educational objectives, student outcomes, and curriculum, provide the newest and most challenging issues.

Program Educational Objectives

Program educational objectives are "broad statements that describe what graduates are expected to attain within a few years of graduation" and that should be "based on the needs of the program's constituencies." For the health informatics program to be ABET-accreditable, constituents of the program must be identified, and program objectives written that are consistent with their needs.

The health informatics program has the following constituencies, and their representatives. See Table 1.

After first engaging representatives of the local employers, consulting government healthcare IT workforce reports, establishing internships where our IS graduates worked in healthcare/clinical settings, and consulting the IS 2010 model curriculum (Topi et al., 2010), we developed the following broad statements, adapted from Campbell et al. (2011):
Within a few years of graduation, graduates of the health informatics program should be able to…

1. *use information technologies in the healthcare/clinical setting to improve the performance of healthcare providers*
2. *use information technologies in the healthcare/clinical setting to improve health care outcomes and reduce healthcare costs*

3. *use information technologies in the healthcare/clinical setting to improve patient safety (reduce medical errors)*
4. *establish a professional career in the healthcare/clinical IT workforce*

Table 2 - HI Program Constituencies

Constituency	Representatives
Local employers	a university hospital and local EMR vendor
National employers	government-defined health IT roles and the IS 2010 model curriculum
Alumni	IS graduates working for local employers (eventually, HI graduates working for local employers)
Faculty	IS/health informatics faculty

These programs collectively have been defined to meet constituency needs. Objective 1 has been crafted in a way that builds on the McNurlin and Sprague (2006) IS theme of improving the performance of people in organizations, but applied to a healthcare context. It therefore provides a mission for IS faculty and alumni familiar with the theme and its implications. Objectives 2 and 3 are closely aligned with the spirit of the government's national HIT vision, such as meaningful use. Both 2 and 3 serve the needs of local employers bound to creating meaningful use of health information technology. The focus on patient safety in Outcome 3 encompasses the ethical components of the program, including patient privacy. Finally, objective 4 is written to address the career needs of HI graduates.

Student Outcomes

Similar to program educational objectives, the student outcomes are broad statements of what students must be able to know or do, except that it is "by the time of graduation" rather than a few years out. As such, these broad statements reflect more of what the curriculum is producing, and less of what government, industry, and alumni need later on. They must, of course, relate back to the constituency needs as expressed in the program educational objectives.

In constructing an HI curriculum, we conceived of the HI program as an IS program with a healthcare environment. See Curriculum, below. As such, a combination of courses in the existing IS program, along with courses in the health sciences and business, were considered to make up the degree. We also explicitly considered the ABET general and IS program student outcomes criteria (ABET-CAC, p. 3), commonly referred to as the "a through j", which must be demonstrated to be enabled, in formulating these student outcomes, referenced from Campbell et al., (2011): *The program must enable students to attain, by the time of graduation, the ability to perform…*

- *Analysis: evaluate process workflows, perform process workflow redesign through user requirements analysis, and participate in implementation of redesigned process workflows*
- *Evaluation: assist in vendor and software selection, evaluate technology/software/ system alternatives, and assist in network planning and needs assessment*
- *Management: manage implementation project plans, act as liaison among healthcare providers, IT staff, and systems vendors, and communicate existing and emerging trends to healthcare providers and IT staff*
- *Data management: manage healthcare data and record structures, work with IT staff to ensure documentation/security/privacy requirements for medical records, and analyze and present data for healthcare decision making such as evidence-based practice*
- *Assessment: apply a working knowledge of biostatistics and epidemiology to assess healthcare outcomes and risks*

A mapping of the student outcomes to the ABET student outcomes criteria is shown in Appendix 1.

Critical Curriculum Issues

The general and IS program curriculum area provided five critical issues:

- covering the fundamentals of a modern programming language
- providing fundamental coverage of the five core areas
- providing advanced coverage that builds on the core

- covering mathematics beyond the pre-calculus level
- providing for an IS environment

Each of these issues are covered in the following sub-sections and summarized in Table 2.

Programming Language

We are proposing an innovative, yet potentially controversial, position regarding the modern programming language requirement for health informatics. ABET requires "coverage of the fundamentals of a modern programming language" (ABET-CAC, p. 6). To meet the modern programming language requirement, many schools and ABET evaluators might require a traditional programming course, taught in an object-oriented, standalone programming language, such as C++, Java, or Visual Basic. Requiring such a course would likely meet with resistance from faculty, however, who would find the course inappropriate for the major. The chosen professional focus of the HI program is not on the application developer role, for which programming fundamentals are critical. Instead, we are focusing on roles such as health information management exchange specialist (Hersh, 2010, p. 201) and the program's mission "to work closely with primary healthcare providers to select an appropriate vendor solution for electronic medical/health records (EMR/HER), integrate that solution into existing processes, policies, and technologies, and to utilize that solution to deliver 'meaningful use' that results in better medical and health outcomes"(Pardue, 2009). Application development has been removed as a prescribed core from the IS 2010 model curriculum (Topi et al., 2010, p. 27) underscoring that not all IS professional roles require application development skill. Recognizing that traditional programming skills is not required by HI professional roles, we are targeting, and receiving the support of the IS 2010 model curriculum, we decided not to require a traditional standalone programming language course.

In satisfying the fundamentals of a modern programming language requirement of ABET, we chose to use coverage of the structured query language (SQL) taught in the first data management course. Although it has been around for a long time, SQL is as relevant as ever, and meets the criterion of "modern." It is classified as a fourth generation programming language. In the coverage of SQL in our first data management course, students learn to write both data definition language (DDL) and data manipulation language (DML) queries in SQL. In the latter area, students learn all four create/read/update/delete (CRUD) operations; how to wrap a query inside of a stored procedure; and how to create triggers for event-driven actions. Through coverage of SQL, we are training students in 4GL data definition and manipulation, solving problems comparable in complexity to those solved by 3GLs. We assert that this depth of coverage in problem-solving with SQL meets the modern programming language requirement.

Core Area Coverage

ABET also requires coverage of "data management, networking and data communications, systems analysis and design and the role of Information Systems in organizations" and "advanced course work that builds on the fundamental course work to provide depth" (ABET-CAC, 2010, p. 6). We propose that the health informatics program meets this requirement, as well as the aforementioned modern programming language requirement. See Appendix 2 for a summary.

Advanced Coverage

ABET requires "advanced course work that builds on the fundamental course work to provide depth." The following courses build upon the foundation courses, providing advanced coverage.

- ISC 450 Health Information Systems Analysis and Design
- ISC 455 Health Decision Support Systems
- ISC 462 Information Systems Strategy and Policy
- ISC 475 Information Systems Project Management
- CIS 496 Computer and Information Sciences Internship

The ISC 450 course builds upon the fundamentals of health informatics covered in ISC 300 and ISC 410 to provide critical coverage of systems analysis and design skills applied to the healthcare context. However, the course significantly extends the scope of systems to the enterprise environment, and utilizes product automation to implement developed workflows.

This includes screen and reports design and implementation.

The ISC 455 is a combination of modern programming language and data management. ISC 455 focuses on "the design and management of electronic medical record systems and clinical decision support systems" including technical and management issues and tools for "extracting information from medical data". This course builds on the fundamentals of health informatics covered in ISC 300 and 410, as well as the practical experiences in ISC 450.

Both ISC 462 and ISC 475 provide advanced coverage that builds on prior course work. These courses cover information strategy and policy issues and project management in the IT context, respectively.

All health informatics students will be required to complete a relevant internship in their last semester: CIS 496. The internship duties will possibly draw upon the entire curriculum and all core areas. It will enable students to make a more significant immediate contribution when they enter the HIT workforce.

Together, seven courses are identified as providing fundamentals coverage and the five courses providing advanced coverage make up 36 credit hours, equivalent to the one year of curriculum coverage of IS areas required by ABET.

Math Coverage

Another curriculum requirement is the ABET-CAC general criteria requirement for coverage of "mathematics appropriate to the discipline beyond the pre-calculus level". In satisfying this requirement, we make the assumption that "mathematics" does not mean, literally, that the course has to have "math" in the title, i.e. offered by the mathematics department. For ABET, it is the course content that is important—if it is taught by mathematics faculty or not. Thus a course that covers the topics of discrete mathematics may be defended by a computer science program as satisfying the discrete mathematics requirement although it is in the catalog as a computer science course. Likewise a quantitative methods or quantitative analysis course that covers mathematics topics beyond pre-calculus can be defended as satisfying ABET-CAC's general criteria mathematics requirement.

A broader interpretation of mathematics "appropriate to the discipline" is supported by statements in two relevant curriculum guidelines. Under a discussion of "mathematical foundations" as one of five foundational knowledge and skill areas, the IS 2010 model recommends that "to support in-depth analysis of data, IS professionals should have a strong background in statistics and probability. For those who are interested in building a strong skill set in algorithmic thinking, discrete mathematics is important" (Topi et al., p. 22). The IMIA, in its curriculum guidelines for educating the biomedical health informatics (BMHI) professional, lists "mathematics" as a knowledge/skill domain area, comprised of "algebra, analysis, logic, numerical mathematics, probability theory and statistics, cryptography" (Mantas et al., 2010, p. 113).

We believe that statistics satisfies the foundational quantitative analysis skills requirement of HI professionals. In fact, ABET also requires, for IS graduates, that curricula cover "quantitative analysis or methods including statistics." Taking both the mathematics and quantitative analysis requirements into account, assuming a broad definition of "mathematics," and following the guidelines in IS 2010 and IMIA, we believe that requiring two courses in statistics or quantitative methods/analysis to be the discipline-appropriate preparation for HI. To be compliant with ABET, the first statistics course must be built on a foundation of pre-calculus algebra. A second, more advanced statistics or quantitative methods course that covers mathematic beyond pre-calculus is also required.

IS Environment

The IS environment is a requirement that the curriculum include "one-half year of course work that must include varied topics that provide background in an environment in which the information systems will be applied professionally." An environment does not and cannot constitute a single, focused knowledge area such as applications in mathematics, art, technology, law, statistics, or desktop publishing. Instead, an environment represents an *ecosystem* in which information systems are employed. The environment surrounds and impacts the systems and technologies that support it and whose inputs, processes or outputs are closely intertwined with their information systems. As we are conceiving the health informatics degree as IS applied in a healthcare context, we are defining our IS environment as 22 credit hours of courses in the health sciences, which collectively are viewed as an ecosystem of healthcare. We expect most of our HI majors to migrate from programs in nursing and the allied health professions. This implies that they will have a background by the junior year of biomedical sciences course involving a year in human physiology and anatomy. In their pre-professional studies we will request that they add courses in accounting and management principles. At the junior and senior level, what is important for HI majors is to have developed a broad awareness of the breadth and complexity of the healthcare environment. We call this the HI clinical environment.

Table 2 - Critical Curriculum Issues

Issue	Response
Programming language	SQL for DDL and DML appropriate for the HI professional experience
Core Areas	12 courses cover core areas
Advanced Coverage	Five senior-level courses; one as an internship
Math Coverage	Two statistics courses
IS Environment	Healthcare Ecosystem of 22 hours of health science courses

Therefore, we recommend that the students take preliminary coursework from nursing, clinical pharmacology, radiology, occupational and physical therapy, and cardiorespiratory therapy issues. To be sure, different universities will have access to a variety of different courses. Our course selection forms an ecosystem which provides a rich student exposure to healthcare. The importance of the clinical environment is to prepare students for the upper division health informatics courses that require students to use their knowledge of the healthcare domain. With a foundation in the clinical environment, students can begin to understand the issues surrounding EMR/EHR integration and apply analysis, data management, evaluation, assessment, and management skills towards delivering HIT solutions that provide meaningful use and positive health care outcomes. The details of the clinical environment are described in Longenecker et al. (2011).

3. CONCLUSIONS

In summary, we have shown that a health informatics degree program is defendable as an ABET-accreditable IS program. We have identified an ecosystem of healthcare as an IS environment. We have identified program objectives and outcomes that meet local and national constituency needs. We have defended an approach to meeting the modern programming language requirement without preparing the majors as application developers, per se. And, we have presented a proposed curriculum that meets the required core areas of coverage and has the required depth of coverage. For a computing school with an established, accredited IS program, these are the most challenging accreditation issues, in our view.

We must point out two important limitations to our claim that the health informatics program described in this paper is ABET-accreditable as an IS program. The first limitation is that the health informatics program has not yet been implemented. However, most if not all of the courses have been, a health informatics certificate program is currently in place, and the authors' have taught in an accredited IS program for several years. The second limitation is that our claim is just that, our own defense of the program against published ABET accreditation criteria, written in the spirit of a self-study. The approval of this defense would be up to the scrutiny of program evaluators in a future ABET review.

With our IS accreditation, however, we can use this experience as a basis on which to compare our approach towards accrediting the proposed HI program. We believe the approach taken with program objectives and outcomes is consistent with the approach used with past, accredited programs. We believe that our approach to defining core and advanced areas of coverage is similar to what we have done for accrediting our information systems (IS) program, with the notable exception of the modern programming language requirement. The approach taken with math is also different, in that our school has required one calculus (or discrete math) and two statistics courses in the past. Our elimination of calculus is a departure. A 15 hour business environment required for IS, justified for its preparing students in the organizational context, is similar to our approach in requiring the 22 hours of clinical environment for HI. We believe the riskiest areas for accreditation to be defending the modern programming language requirement.

Taking ABET-CAC program requirements into account early, in the proposal stage of the HI program, in fact, proved valuable. Familiarity with ABET requirements drove us to identify constituents early and identify outcomes to meet their needs. These outcomes, along with ABET curriculum requirements, were helpful in defining, refining and grouping courses. A poorly described "list of courses", as one faculty member described an early HI curriculum proposal, became an organized, mission-mapped, well-understood, and defensible program of study. We recommend that other faculty considering an HI degree program follow our example by adopting and considering the spirit of the ABET-CAC approach early, along with the IS model curriculum and health informatics program guidelines (Longenecker et al., 2011).

4. EPILOGUE: ISECON/CONISAR 2011

Interaction with colleagues while at ISECON/CONISAR 2011 has resulted in three issues for consideration. One issue is whether or not to omit the ISC 360 Systems Analysis and Design course. Arguably, each of ISC 360 Information Systems Analysis and Design and ISC 450 Health Systems Analysis and Design apply the same theoretical foundations to different, but similar application domains, and so requiring both is redundant. However, there is concern that some fundamentals concepts and experiences may be missed if the ISC 360 is omitted. A final decision has not been made.

A second issue revolves around our argument that coverage of SQL in the database course was sufficient to meet the modern programming language requirement. While most feedback was supportive, one reviewer cautioned that ABET might expect students to be taking a course using a standalone, object-oriented, programming language. Additionally, support for our position was specifically limited to our health informatics program, and not to all types of IS programs. We are moving towards the position that the strength of one's case for meeting the ABET modern programming language requirement depends on the goals of the program under review. Because the goals of the HI program are to prepare HI professionals who do not require the traditional programming skills, we believe our position, that coverage of SQL in the database course is sufficient to meet the modern programming language requirement, is defensible.

A third issue regarding the clinical environment arose from feedback from reviewers and colleagues at ISECON/CONISAR 2011, and colleagues in the College of Nursing and College of Allied Health Professions. We have began a review of the proposed collection of clinical environment courses to ensure that these courses satisfied the breadth-first overview expected of an IS Environment in an Information Systems curriculum.

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Appendices

Appendix 1 - Mapping of Health Informatics Student Outcomes to ABET Student Outcomes Criteria to Courses

Health Informatics Student Outcomes	ABET Student Outcomes Criteria	Courses
Analysis - evaluate process workflows, perform process workflow redesign through user requirements analysis, and participate in implementation of redesigned process workflows	b-An ability to analyze a problem, and identify and define the computing requirements appropriate to its solution c-An ability to design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs j- An understanding of processes that support the delivery and management of information systems within a specific application environment.	ISC 300 Health Informatics Clinical Environment ISC 360 Information Systems Analysis and Design ISC 450 Health Sys Analysis and Design
Evaluation - assist in vendor and software selection, evaluate technology/software/system alternatives, and assist in network planning and needs assessment	b-An ability to analyze a problem, and identify and define the computing requirements appropriate to its solution c-An ability to design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs i-An ability to use current techniques, skills, and tools necessary for computing practice. j- An understanding of processes that support the delivery and management of information systems within a specific application environment.	ISC 245 Information Systems in Organizations ISC 272 Systems Architecture CIS 321 Data Communications and Networking ISC 450 Health Sys Analysis and Design MGT 325 Operations Management
Management - manage implementation project plans, act as liaison among healthcare providers, IT staff, and systems vendors, and communicate existing and emerging trends to healthcare providers and IT staff	d-An ability to function effectively on teams to accomplish a common goal f-An ability to communicate effectively with a range of audiences h-Recognition of the need for and an ability to engage in continuing professional development i-An ability to use current techniques, skills, and tools necessary for computing practice. j- An understanding of processes that support the delivery and management of information systems within a specific application environment.	ACC 211 Principles of Accounting I MGT 300 Management Theory and Practice ISC 300 Health Informatics Clinical Environment ISC 410 Health Informatics ISC 475 Information Systems Project Management CA 110 Public Speaking CA 275 Small Group Communication
Data management - manage healthcare data and record structures, work with IT staff to ensure documentation/security/privacy requirements for medical records, and analyze and present data for healthcare decision making such as evidence-based practice	b-An ability to analyze a problem, and identify and define the computing requirements appropriate to its solution c-An ability to design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs e-An understanding of professional, ethical, legal, security and social	CIS 324 Database Design, Development, and Management ISC 410 Health Informatics ISC 455 Health Decision Support Sys ISC 462 Information Systems Strategy and Policy

	issues and responsibilities g-An ability to analyze the local and global impact of computing on individuals, organizations, and society j- An understanding of processes that support the delivery and management of information systems within a specific application environment.	
Assessment - apply a working knowledge of biostatistics and epidemiology to assess healthcare outcomes and risks	a-An ability to apply knowledge of computing and mathematics appropriate to the discipline j- An understanding of processes that support the delivery and management of information systems within a specific application environment.	BUS 245 Applied Business Statistics I BUS 255 Applied Business Statistics II BMD 210 Infectious Disease in Health Care Environments ISC 455 Health Decision Support Systems

Appendix 2 - Health Informatics Core Area Coverage

Course	Core Area(s) Covered	Advanced, builds on…
ISC 245 Information Systems in Organizations	Role of information systems in organizations	n/a
ISC 272 System Architecture	Networking and data communications	n/a
ISC 300 Health Informatics Clinical Environment	Role of information systems in organizations	n/a
CIS 321 Data Communications and Networking	Networking and data communications	n/a
CIS 324 Database Design Development and Management	Modern programming language Data management	n/a
ISC 360 Systems Analysis and Design	Systems analysis and design	n/a
ISC 410 Health Informatics	Role of information systems in organizations	n/a
ISC 450 Health Information Systems Analysis and Design	Systems analysis and design	300, 410
ISC 455 Health Decision Support Systems	Modern programming language Data management	300, 410
ISC 462 Information Systems Strategy and Policy	Role of information systems in organizations	245, 272, 321, 324
ISC 475 Information Systems Project Management	Role of information systems in organizations	245, 272, 321, 324
CIS 496 Computer and Information Sciences Internship	All areas	Entire curriculum

Factors Influencing Students' Decisions To Major In A Computer-Related Discipline

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Abstract

Too few students are entering the workforce with the technological skills required due to several factors, including under-enrollment in the computer-related disciplines by college students. Enrollment in these disciplines has made some progress since the precipitous decline of 2000 – 2007 and steps have been taken to attract more majors. However, we still do not fully understand the factors that influence students to choose to major in the computer-related disciplines. The purpose of the research described here was to: 1) explore, in-depth, specific factors that might influence a student's decision to major in a computer-related discipline and 2) determine if there were commonalities amongst these factors across the subject population.

Keywords: enrollment, recruitment, retention

1. INTRODUCTION

Preparing a technologically educated workforce is an important challenge facing the United States. The Bureau of Labor Statistics (BLS) predicts employment increases in many STEM-related disciplines and Congress has indicated concern that there will be sufficient workers to meet this demand (Stine & Matthews, 2009). Between 2006-2016, the BLS believes computer and mathematical occupations will grow the most quickly (0.8 million jobs; 24.8% growth rate) with other occupational groups related to science and engineering to grow as well, including architecture and engineering (0.3 million jobs; 10.4% growth rate), and life, physical, and social sciences (0.2 million jobs; 14.4% growth rate). Of the 30 fastest growing occupations, with a growth rate of 27% for all the occupations, many are science and technology-related; compared to the 10% average (Bureau of Labor Statistics).

There are three issues of concern: 1) The quality of preparation in science, technology, engineering and mathematics (STEM) for pre-collegiate students; 2) the low number of students majoring in the STEM disciplines in college; and 3) whether foreign students and workers are necessary to meet the workforce demands (Stine & Matthews, 2009). The second issue will be discussed in this paper.

2. LITERATURE REVIEW

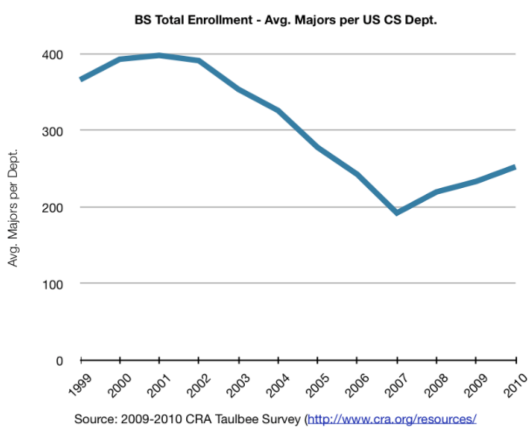

Figure 1: Enrollment Trends

From 2000 to 2007, collegiate enrollments in the computer-related fields steadily declined with a turnaround in enrollments the last three years (Harsha, 2011) (see Figure 1). This upswing in collegiate enrollment is encouraging, but insufficient to provide enough workers in STEM fields and problems are appearing in other parts of the educational system. In spite of the increase in enrollment, state budgetary cuts and low enrollment numbers of students intending to major in a computer-related discipline has jeopardized or eliminated many higher-education computer-related majors/ departments. Nagel (2009) reported that the number of students enrolled in computer science (CS) courses is declining in U.S. high schools and therefore, so is the number of advanced placement (AP) computer science courses offered. In a Spring 2009 survey of 1,100 high school computer science teachers, 65% reported that their schools offer introductory or pre-AP CS classes (2009 CSTA National Secondary Computer Science Survey). This number was 73% in 2007 and 78% in 2005. Additionally, AP CS was only offered at 27% of the schools in 2009; it was 40% in 2005 and 32% in 2007. The Commission on Professionals in Science and Technology (CPST) report commented on the decline of CS courses in high school, "One possible reason is computer science is not considered a core subject under the No Child Left Behind law, resulting in classes and resources being distributed to classes that are integral to school funding under the law. Unfortunately, this results in students growing up using computers more and more in their daily lives with no understanding of how the technology works" (STEM Trends, 2010).

Reasons For Under-Enrollment In CS Disciplines

A myriad of reasons have been hypothesized for the decline in computer-related disciplines enrollment from 2000-2007. These reasons have focused on the reported decline in the number of "good tech jobs" (Hoganson, 2004), the outsourcing of American IT jobs to foreign countries where labor costs are lower and skilled workers are plentiful (Holahan, 2007), the debate in Congress whether to increase the numbers of foreign skilled workers allowed into the country under the H-1B visa program, the dot com bust of the 2000-2001, the terrorist attacks of September 11, 2001 and their effect on the U.S. economy, and the budget cuts of many companies in the IT area.

Other researchers have offered non-economic possibilities. Morris and Lee (2004) argued that the decline in undergraduate CS enrollment might be because of the way we educate our students. "… our current approaches to computer science education fail to teach the science of computing. As a result, they fail to inspire the very best and brightest minds to enter the field … Computational methods are transforming an amazingly wide range of scientific, business, and artistic practices. Computer science enables science to be both fundamental and practical at the same time."

Ways to Attract Students

Just as there are many possible reasons why incoming students were not selecting CS as a major, there are many responses including ignoring declining enrollments (Herbert, 2004). Another response has been to create alternate methods to provide students with the "hot topic" skills they desire; for example, offer one credit courses/seminars on practical IT topics. Yet another response has been to start IT programs.

Mahmoud (2005) suggested that CS departments should consider implementing the following: 1) offer multidisciplinary and cross disciplinary programs; 2) change the image of computer science as just involving programming, Web site design and spam; 3) create more options in course selections and move towards a Bachelor of Arts program; 4) work to increase women's enrollment in CS; 5) train computing science high school teachers; and 5) make CS courses fun.

A final suggestion was for academia to work closer with industry to identify desirable skills (Chabrow, 2004; Ferguson, Henderson, Huen, & Kussmaul, 2005).

The idea of connecting the teaching and learning of CS to the broader world perspective/ multidisciplinary approach was discussed by various researchers. A 2004 NSF effort was focused on incorporating the history of computing in to computing curricula to broaden the focus of the field off of just narrow applications. Perez and Murray (2008) discussed the development of an information technology literacy course named *Computers and your World* as a service course to the institution. The learning objectives of the course included: 1) "Become a well-rounded, confident and curious user of computers and the Internet; 2) Use computer applications to solve common problems encountered at school, work, or home, and 3) Be familiar with how computers and the Internet are used in various professions" (p. 223).

Barr, Liew, and Salter (2010) reported on strategies used at Union College, Lafayette College, and Oberlin College to build bridges between CS and other departments/disciplines. At Union College, the CS faculty worked with faculty-student pairs in other disciplines developing some form of curricular component (complete course, lab, or module). This insured computation into the study of a specific discipline. The disciplines involved were Biology, Classics, Engineering, and Economics. The CS department at Lafayette collaborated with faculty from other departments to develop tools to assist them in research and teaching. Tools were developed with faculty from Art, Engineering and Public Policy, and Social Science. Oberlin College faculty in the natural and social sciences created The Oberlin Center for Computation and Modeling (OC-CaM). The goal for the Center was to develop a unified approach to introducing computation and modeling into the curriculum (Barr, Liew, Salter, 2010). Abernethy and Treu (2010) discussed instituting two new seminars at their University to address declining CS enrollments and demonstrate the multidisciplinary nature of computing and its connection to the world. The seminars are Alan Turing's work and life and cryptography.

Thibodeau (2011) stated that the Computer Research Associate survey done in Fall, 2010 found that men continue to dominate CS. The women who graduated in CS rose to 13.8% in 2010, but this was only an increase of 2.5% from the previous year. For the past decade the number of women who have entered CS has been dropping and many studies/reports have been done concerning the disappearance of women in the computer related fields. Some of these include: 1) National Science Foundation, 2) Women in Information Technology Project, 3) American Association of University Women Educational Foundation Commission on Technology, Gender, and Teacher Education, and Computing Research Association (CRA) Taulbee Survey (Geigner & Schamabach, 1999; Green, 2000; Irani, 2004, Sankaran & Bui, 1999). These studies agree that there are multiple dimensions regarding the under representation of women in the computer-related disciplines.

In 2006 Dann, Cooper and Pausch introduced the "Beginner Programming Languages" as a way to make it easier to learn the concepts and methods of programming through visual and interactive learning environments. Alice, developed by Carnegie Mellon University, is among the leading languages in this group with many researchers reporting on the pros and cons of using Alice as a programming language (Goulet & Slater, 2009; Courte, Howard, & Bishop-Clark, 2006). Bryn Mawr College and Georgia Tech introduced Artificial Intelligence and Robotics in the CS1 course in Fall, 2007 in order to make CS1 more fun (Kumar et al, 2008). Other universities like Northwestern, Kettering, and Drexel have introduced computer gaming in the CS curriculum to attract student interest.

Attitudes toward Computer Science-Related Majors

What factors influence students to choose a major in computing? O'Lander (1996) collected data from 4,127 New York high school students who were enrolled in a computer course concerning the factors that influenced their attitudes towards computing. He found that these factors included: 1) enthusiasm towards computing; 2) perceptions of computing ability; 3) apprehension about majoring in CS; 4) perceptions of degree of positive instructional influence towards computing received; and 5) perceptions of career and employment opportunities in computing.

Carter (2006) conducted research to test a number of hypotheses. Among them was that students, regardless of gender, do not pursue education in computing fields because they have no information or incorrect information about what the study of computing involves and what sorts of careers are available to computing professional. Surveying some 836 High School students from nine different schools in Arizona and California, she found evidence to support the beliefs: 1) students choose not to major in CS because they have incorrect or no perception of what CS is, and 2) one of the reasons for this ignorance is the lack of CS education available to or required of high school students beyond the realm of computer applications.

Pollacia and Lomerson (2006) attempted to determine the factors that influence a student's decision regarding a computer information system (CIS) major. They surveyed students enrolled in a first-year introductory computer courses. They found: 1) students have limited knowledge (inadequate and/or inaccurate) of the career opportunities in CIS; 2) many of the respondents choose their major using only self-developed information and did not rely on family, peers, the media or high school counselors; and 3) there are a wide variety of causes for disinterest in a computer career (Pollacia & Lomerson, 2006).

In 2009, DiSalvo and Bruckman examined the relationship between video games and interest in computer science. They found that gaming was weakly correlated with an interest in majoring in computer science.

Woratschek and Lenox (2009) replicated and enhanced the Pollacia and Lomerson study. Their findings confirmed that of Pollacia and Lomerson: students picked their major course of study via self-collected inputs; students seem to have limited knowledge of the fields of computer and/or career opportunities in these fields; students have stereotypes regarding the computer fields; more work needs to be done regarding student's school guidance counselor experience; and that students were not interested in technical careers.

Moore, Schoenecker, and Yager (2009) conducted a survey in Fall 2007 using School of Business marketing students. This survey collected data regarding why there are not more Computer Management and Information Systems (CMIS) students at their institution. Specifically, the survey gathered data about factors that influenced business students' choice of a major and the perceptions these students have of the CMIS major. In a different survey, introductory CMIS students were asked whether they were considering a major in CMIS, and why or why not. Results of these surveys revealed two themes. One theme suggested that there are misconceptions about the CMIS major. (Respondents believed that the employment market was poor for CMIS majors. They believed the CMIS majors and graduates worked with MS Office all day. The final misconception was that CMIS majors and graduates sit in front of a computer all day.) The second theme suggests that students may avoid the CMIS major because they doubt their ability to do well in it.

In a study performed by Serapilgia and Lenox (2010), six themes were identified as factors that affect the decision of women to enter into and complete, or leave a course of study in Information Science programs. These themes were: 1) Influence by male role models; 2) positive introduction to computers/technology in the home and school; 3) a natural affinity for problem solving; 4) early positive exposure to computers/technology; 5) meeting the challenges of a dynamic field; and 6) greater opportunity for higher salaries. One of the strongest themes found by the researchers was influence of a male role model; only 2 out 25 students mentioned a female influence. Many respondents mention that they enjoyed puzzles and solving problems. They also were influenced by an exposure to technology at home, school and/or in the workplace.

The under-enrollment in computer-related majors, the continuing retirement of baby-boomers, and the increasing use of computers in all fields is expected to create a substantial number of computer related jobs in the U.S. in the future. As already has been stated by a number of authors, the shortage of qualified graduates in the computer-related profession will be a significant problem.

While the research discussed has been by quantitative survey, little research has been done in the qualitative methodology to explore why students choose to major in the computer-related disciplines. The purpose of the research described here was to: 1) explore, in-depth, specific factors that might influence a student's decision to major in a computer-related discipline and 2) determine if there were commonalities amongst these factors across the subject population.

3. METHODOLOGY

Qualitative one-on-one interviews were conducted in the Spring, 2011 term across three Western Pennsylvania higher educational institutions. Instructor prompting, class fliers, and/or word of mouth recruited students. Students were declared majors in Computer Science, Computer Information Systems, Information Systems, or Information Technology. In all 36 students were interviewed.

The majority of interviews lasted 20 minutes. The interviewer took written notes on the student's responses. No recording of the interview was done. The interviewer's notes were transcribed, and Key-Words-in Context method was used to search the text files for key words and phrases to identify commonalities and differences in the data and a content analysis performed.

4. RESULTS

Six (16.6%) of the students interviewed were female and 30 (83.3%) were male. Eighty-three percent (30) are public schooled and 86% (31) are traditional students (ages 18-22).

Because respondents are from three different institutions, there are multiple categories of computer-related majors and not all majors are offered by all of the institutions. For example, one of the institutions does not offer a Computer Science degree. Another institution offers students the chance to double major in the discipline where the others do not (see Table 1).

DECLARED MAJOR (N=36)	
Computer Science (CS)	5
Computer Information Systems (CIS)	1
Information Systems (IS) or Management Information Systems (MIS)	21
Web Development	4
E-Commerce	1
Double: Web dev. & E-commerce	3
Double: CS & Web dev.	1
Double: Business Comm. & E-commerce	1

Table 1: College Major

ACTIVITIES	
Had computer when young	25
Video Games	13
Took apart things (may include computers)	5
"Messed" with computers	5
Played Educational Games	4
Problem Solving	4
Liked Puzzles	1

Table 2: Childhood Activities

As Table 2 indicates, the strongest themes that emerged in regard to the participant's childhood activities is that 69% (25) had a computer when they were young; i.e., before they were 13 years old. Thirteen of the respondents (36%) mentioned that they played video games as a child.

For 44% (16) of the respondents, interest in choosing a computer-related field as a collegiate major began in high school, specifically in a computer class. For all 16 of these respondents, that computer class was some type of programming. The respondents who chose a family member as a factor that influenced their college major decision spoke of a brother, father, or uncle – no female role models were mentioned (see Table 3).

INFLUENTIAL FACTORS	
High School Class	16
Family Member	4
Just liked it; learned how to program young & was good at it	4
College Class	3
Video Games	3
Liked problem solving & helping people	1
Saw it had a good future & job security	1
Friend	1
Taking the computer apart and fixing it at a young age -- it made me feel smart	1

Table 3: Factors Influencing College Major Decision

HUMAN INFLUENCES	
Family member other than parent	10
Parent	6
Teacher	4
Job	1
Advisor	1
Hollywood Film Maker	1

Table 4: Did any one person influence your decision?

INFORMATION RESOURCE?	
Internet	12
Family member other than parent	7
On-line forums	5
Professor	2
Parent	1
Other Students	1
HS Class	1
Placement Test	1
Aptitude Test on-line	1
Friends	1

Table 5: What one resource did you use to get more information about computer science?

Table 4 details the respondent's answers regarding the human influence on their decision to major in a computer-related discipline. Of the 36 interviewees, only two spoke of a female influencing their decision to choose a computer-related major. And, those two were both males. All teachers mentioned by the respondents were male. Thirteen (36%) of respondents stated that no one person influenced their decision to major in the computer-related disciplines.

On-line appears to be the way that the majority of respondents received answers to their questions regarding majoring in a computer-related discipline. Family members are the second most popular resource followed by on-line forums (see Table 5). Twenty-four (66%) of the respondents commented that their high-school guidance counselor was of no help to them in securing information regarding majoring in a computer-related discipline in college.

WHAT DID YOU SEE YOURSELF WORKING ON WHEN YOU FINISH YOUR COLLEGIATE EDUCATION?	
Not sure	15
Job	8
Programming	5
Networking	4
IT Security	3
Further education	3
Video Games	2
Military Work	1
Web Development	1
OS/UNIX	1
Hardware	1

Table 6: Future Plans

As Table 6 shows, 42% (15) of the students are not certain what their future plans are; however, the vast majority stated that some type of work/education in the computer-related disciplines was in their future plans.

Three final questions were asked of the respondents: 1) was the major what they expected, 2) did they have a family member currently working in a computer-related discipline, and 3) were they satisfied with the major. Sixty-one percent (22) said yes the major was what they expected. Twenty-eight percent (10) of the respondents have a family member who is currently working in a computer science-related job. And, 94.4% (34) of the students were satisfied with their major.

5. DISCUSSION

Mahmoud (2005) suggested that CS departments should offer multidisciplinary and cross-disciplinary programs to attract more students. College 1 offers degrees in Computer Science, Ecommerce, Management Information Systems, and Web Development. College 2 offers degrees in Computer Information Systems, Competitive Intelligence Systems, and Information Sciences. College 3 offers degrees in Computer Science and Computer Information Systems. Only College 1 offers interdisciplinary majors and students may have a double major such as web development and e-commerce (3 respondents), CS and web development (1 respondent), or business communications and e-commerce (1 respondent). (College 1 has 19 computer science majors, 6 ecommerce, 7 web development, and 3 MIS majors.)

Score	2010	2009	2008	2007
5	183	134	102	116
4	178	161	105	137
3	95	63	59	78
2	35	51	42	52
1	125	124	117	105
Total	616	533	425	488
Mean	3.42	3.24	3.08	3.22

Table 7: Pennsylvania Totals – School AP Grade Distribution for Computer Science A Exams

Mahmoud (2005), and many others, suggested training computing science high school teachers will improve collegiate enrollments. In the current study, 44% (16) of the students were influenced by a high school programming class, but only one student mentioned their high school class as a source of information about majoring in a computer-related field. Four students mentioned the influence of a high school teacher on their career choice. Carter's (2006) research showed that students have incorrect or no information about CS. She found that this was partly due to the lack of CS education available to high school students beyond the how to use computer applications. Unfortunately, Pennsylvania, where the colleges in this study are located, does not certify K-12 computer science teachers. It is difficult to find data on the number of high schools offering computer science courses (i.e., programming rather than application software), so we have examined the number of students taking the Advanced Placement Exam A in Computer Science as a measure of high school preparation. Table 7 below shows the past four years in Pennsylvania where the number of students has increased from 488 in 2007 to 616 in 2010 (http://www.collegeboard.com/student/testing/ap/exgrd_sum/).

The Computer Science Teachers Association (CSTA) looks at strong teaching certification requirements in each state and has used the state of Maryland as a positive example. (http://csta.acm.org/ComputerScienceTeacherCertification/sub/CertificationResearch.html). Maryland has instituted the stricter teaching certification requirements and has seen increases in the numbers of students taking the AP Computer Science A exam from 808 in 2007 to 1,352 in 2010 (see Table 8 below).

Score	2010	2009	2008	2007
5	352	215	149	162
4	301	202	138	180
3	177	128	86	118
2	84	84	54	61
1	438	266	148	287
Total	1352	895	575	808
Mean	3.03	3.02	3.02	2.84

Table 8: Maryland Totals – School AP Grade Distribution for Computer Science A Exams

Several studies (Woratschek & Lenox, 2009; Pollacia & Lomerson, 2006) found that students picked their major course of study via self-collected inputs. Table 5 shows that 19 of the 36 students (53%) used the Internet or an on-line forum as their primary source of information about majoring in a computer-related field. Other self-collected inputs appear to be (in decreasing order of mention): family member other than parent and professor; and with one mention each: parent, other students, high school class, placement test, aptitude test on-line, and friends. A follow-up study should examine the types of websites and on-line forums used as resources by potential majors.

Serapilgia and Lenox (2010) found that women were strongly influenced by male role models.

In the current study, only two of the 36 students spoke of a female influencing their decision to choose a computer-related major. Both those respondents were male. All teachers mentioned by the respondents were male also.

In 2009, DiSalvo and Bruckman found that playing video games was weakly correlated with an interest in majoring in computer science. In the current study, 13 of the 36 students (36%) mention playing video games; however, only three of the 36 (8.3%) stated that video games had an effect when selecting a major. Two of the students plan on careers in video game development.

6. CONCLUSIONS

Information about computer science-related majors and jobs is not found in the high schools. Early ideas about boosting interested in majoring in the computer-related disciplines suggested college/university departments sending newsletters to the high schools, professor visitations to the high schools, guidance counselor meetings, and collegiately run high-school computer science camps. Many of these ideas have been tried with mixed success. Recently, some colleges/universities have begun to explore high-school college partnerships. This idea may be a better way to educate K-12 teachers on technology careers and to better educate ourselves on how to build bridges between potential majors and ourselves.

In this study students stated that they found information about majoring in a computer-related discipline on-line. This begs the question of how accurate and complete is this on-line information? It is one thing to secure information from a collegiate web page, but quite another to secure information from social media or an on-line forum. Perhaps a collegiately controlled on-line forum for our discipline is in order. Regardless, as a discipline, we need to find better ways to disseminate information about our field to encourage students and understand the role of digital media in doing so.

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Beyond the Bake Sale: Fundraising and Professional Experience for Students Involved in an Information Systems Student Chapter

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Abstract

Fundraising traditionally involves selling. This paper explores the merits of selling technology services provided by a technology oriented student club to members of a campus community. This club activity puts into practice learning theories presented in the literature. Beyond fundraising, this activity yields many additional benefits to the students and the institution. Student benefits include an active learning experience, intellectual synthesis joining theory and applications, and practical work experience. Institution benefits include student retention, technology repair services for the campus community and increased learning by the students involved. This fundraising activity gives participating students real-world experience that merits inclusion on their resumes and practice applying recently learned classroom knowledge in a realistic business setting.

Keywords: student clubs, active learning, service learning, fundraising, professional experience

1. INTRODUCTION

Faculty advisors for student clubs with an academic focus have the responsibility to keep membership levels up, keep students motivated and on-track, and assist with activities (meetings, learning experiences, fundraising). As a cocurricular activity, student clubs augment the classroom environment through club activities (Kuh, Kinzie, Schuh, & Whitt, 2005) such as fundraising for the club. With professional conferences and competitions to attend, student clubs need funds for travel, lodging and conference registration. This paper describes how one information systems student club has started a business (The Computer Heroes) which applies classroom knowledge to real-world technology problems brought in by members of the campus community. The benefits are many: a quality learning experience for the student, practical business experience for the student, free or low cost technology solutions for the campus community, and fundraising for the student club.

2. LITERATURE REVIEW

The educational and cocurricular benefit of student clubs has long been known (Astin, 1985; Kuh, Pace, & Vesper, 1997). Astin (1985) believes that increased faculty-student contact increases learning and participation in the college environment. Boyer (1988) phrases these benefits as effectiveness of the undergraduate experience and the quality of campus life. He notes that these are directly linked to the students' quality of involvement in student activities (clubs for example) and time spent on campus. Boyer also states: "the college of quality remains a place where the curricular and cocurricular are viewed as having a relationship to each other" (p. 195). Kuh, Schuh, Whitt, Andreas, Lyons, Strange, Krehbiel and MacKay (1991) further clarify the cocurricular as: "A high-quality out-of-class experience is active participation in activities and events that are not part of the curriculum but nevertheless complement the institution's educational purposes" (p. 7).

More recently, Kezar and Kinzie (2006) state that "quality undergraduate curriculum requires coherence in learning, synthesizing experiences, on-going practice of learned skills, and integrating education with experience." (p. 149) This is one of the three principles in what Kuh (2001) terms "student engagement." Rob (2009) terms this involvement "active engagement" and applies the concept to a programming course, but active engagement can apply equally well outside the classroom. Kuh, Pace, and Vesper (1997) measure the effects of faculty/student contact and active learning, and report that the latter is one of the best predictors of educational gains in three types of institutions: baccalaureate, master's and doctoral granting.

Table 1. The Seven Keys to a Successful Student Club

Keys	Ideas to achieve the keys
Motivated students	Faculty and student members identify motivated students
Institutional support	Rooms for activities, financial support for activities Departmental support
Proactive advisor	Faculty interest
Dedicated alumni support group	Previous members assisting with presentations Graduates presenting at monthly meetings
Good ties to local professionals	Invite IT professionals to give talks at monthly meetings IT tours from local IT professionals
Good ties to local professional organizations	Attend and network at chapter meetings
Receptive community	Provide a service to the college community Participate in community activities as volunteers

Service learning can "strengthen the relationship that the college or university has within the community" (Ayers, Gartin, Lahoda, Veyon, Rushford, & Neidermeyer, 2010, p. 55). Ayers et al. also note that service learning differs from community service due to the educational component being incorporated. Building these learning communities (which have various definitions – see Zaho & Kuh, 2004) involves a partnership between faculty, students, and the institution (Barros & Verdejo, 2000). This partnership incorporates the first three of the seven "keys to a successful student chapter" listed in Table 1 (Evans, Evans, & Sherman, 2001).

The learning community surrounding a student club can also address the growth of the student members through the three theories of pedagogy as described in Astin (1999):

- The Subject-Matter Theory (SMT) – students learn best when exposed to the right subject matter, presented by an expert (the faculty member or a working professional).
- The Resource Theory (RT) – when enough resources are brought together in one place student learning and development will occur.
- The Individualized (Eclectic) Theory (IET) – emphasizes elective learning (rather than required coursework) by the student.

Lastly, Cross (1998) believes that learning communities use a constructivist approach to learning where students socially construct their knowledge rather than "discovering" it. As a result, learning is "deeper, more personally relevant, and becomes a part of who the student is, not just something the student has" (Zhao & Kuh, 2004, p. 117).

While these theories can be expensive to implement monetarily, they cost mostly time – admittedly the ultimate resource.

Most of the literature surrounding student clubs and organizations focuses on learning outcomes and intellectual development of the student group. (Astin, 1984; Kuh, Pace, & Vesper, 1997; Zhao & Kuh, 2004) These positive learning outcomes have been documented to be valid across cultures (Baker, 2008; Huang & Chang, 2004; Kuh, et al., 2005) and across genders (Busseri & Rose-Krasnor, 2008). Further, student clubs can be utilized as a recruiting and retention tool for the discipline, (Abrahamowicz, 1988; Kempken, 2010; Snyder, Slauson, Jackson, & Chaffin 2007) and a positive way to promote student/faculty interaction (Kezar & Kinzie, 2006). These reasons lend credence to creating, supporting, funding and being actively engaged with student groups.

Traditionally, IS students have raised money by hosting LAN parties and game nights (personal observation, Chundur and Zieleniewski, 2009) or having bake sales. While the former is germane to the profession, the latter is not. Some authors incorporate student projects or internships into their coursework as benefits for industry connections, (Watson & Huber, 2000) as funding sources for the program, (Weible, Shao, & Shao, 2009) or funding a laboratory space for an IS program (Henson, 2010). The literature on student clubs examines club benefits and components necessary for a successful student club, but does not examine ways in which one can fund the club as well as provide practical work experience for the students involved.

The remainder of this paper describes a program for a student club that accomplishes the goals of student/faculty interaction, student educational attainment via active and group learning, student business experience, business department goals, student professional development and fundraising for the student club.

3. FUNDRAISING AND PROFESSIONAL EXPERIENCE: THE COMPUTER HEROES PROGRAM

Fundraising for an information technology student club is a year-round activity. The fundraising activity presented in this section incorporates out of the classroom learning experiences, cocurricular learning activities, student engagement, team building activities, and student retention. This program also answers the question "Where can a student gain work experience while attending college?"

History

Fundraising for a student club has traditionally centered on activities such as bake sales, garage sales, art sales (art students), rock sales (geology students), internships (individual students), and student projects for business clients (personal observations; Henson, 2010; Watson & Huber, 2000; Weible, Shao, & Shao, 2009).

A trip to the campus library by the IS student club advisor yielded a usability study and a student club competition for best problem solution and design (Snyder, et al., 2007). After observing the voting in the meeting, a colleague suggested that this "idea" could be expanded to develop the students' professional skill set by applying knowledge gained in the classroom to solving issues ranging from hardware problems to software concerns. The program, Computer Heroes (CH), was thus born with a motivated student, some interested faculty, and a little bit of space in a computer laboratory that is dedicated to the CIS program. A brief history of the staffing of the Computer Heroes program is illustrated in Table 2.

Table 2. Staffing and Growth in the Computer Heroes Program

Year	Number of Students Involved	Number of Hours Committed per Week
2006 – 2007	1	by appointment*
2007 - 2008	3	by appointment
2008 - 2009	1	by appointment
2009 - 2010	2	6
2010 – 2011	4	20.75
Fall 2011	7	15

* Students involved would meet clients "by appointment" and accurate records were not being maintained

Servicing computers requires hardware and software tools. A listing of the hardware tools used by the CH program is given in Table 3, along with the initial justification for purchase and the cost.

Table 3. Hardware Used by the Computer Heroes Program

Year	Hardware	Cost	Usage
2006 – 2007	Monitor, Keyboard, Mouse, small PC repair tool kit	$0*	Diagnose problems with system unit brought in by client.
2007 - 2008	Monitor, Keyboard, Mouse, small PC repair tool kit	$0	Diagnose problems with system unit brought in by client.
2008 - 2009	Monitor, Keyboard, Mouse, small PC repair tool kit	$0	Diagnose problems with system unit brought in by client.
2009 - 2010	Monitor, Keyboard, Mouse, small PC repair tool kit	$0	Diagnose problems with system unit brought in by client.
	mini-fridge	$0	Donated to program, provide beverages to student group and clients
2010 – 2011	Monitor, Keyboard, Mouse, small PC repair tool kit	$0	Diagnose problems with system unit brought in by client.
	4 port KVM switch	$99.99	work on multiple desktops at a time
	8 port gigabit switch	$69.99	to have multiple computers connected to the Internet
	SATA/IDE to USB 2.0 adapter	$19.99	used for any data backups which would require the hard drive to be pulled out of PC
	2 TB external hard drive	$149.99	this external hard drive would be used for client backups and any Computer Hero storage needs
	USB 2.0 external DVD writer	$49.99	would be used in case a PC has a bad optical drive and software needs to be loaded
	PC repair tool kit with anti - static wrist bands	$49.99	necessary to perform any PC repair task
	Printer/scanner	$79.95	scan customer records, print jobs

* Provided by the college and/or department

Results of the program expansion over the years 2009 – 2011 include a larger work force for the program, more committed (and scheduled) hours for the program, more hardware and software (primarily open source tools), more client interactions, and more fundraising (the program works on a "by donation" basis with a suggested donation rate of $20 per hour). Some of the fundraising totals and number of clients helped are given in Table 4.

Table 4. Number of Clients Assisted and Fundraising Totals

Year	Number of Clients	Fundraising Totals
2006 – 2007	Unknown*	unknown*
2007 - 2008	unknown*	unknown*
2008 - 2009	unknown*	unknown*
2009 - 2010	15	$530
2010 – 2011	40	$1,111.50
*Accurate records were not being maintained		

Development of the Computer Heroes Program

Phase 1 (2006 - 2009)
The first phase of the program involved the recruitment of students to staff the initial launch of the program, to advertise the program and to meet with potential clients. As a screening process, students need to have completed and passed a sophomore level course in the curriculum, Information Technology Hardware and System Software. This course gives the student both theoretical and hands-on experience with the internal workings of a PC, including building a PC, trouble shooting skills, BIOS knowledge, and general system maintenance. The initial cohort consisted of one motivated student who would meet with clients on an arranged basis (the client would contact the Computer Hero and a meeting date, time, and place would be arranged). In the first phase, a lack of equipment kept the program constrained to performing repairs such as hardware swaps, software and driver updates, application software installs and operating system installs.

The college provided a small room with power, a network connection, as PC and a monitor in support of the program. Open source software tools were employed to trouble-shoot PC's. These tools were selected by the students based on their experience and familiarity with the tools.

The initial phase of the CH program incorporated three of the keys identified by Evans, et al. (2001), these being a motivated student, institutional support, and a proactive advisor (see Table 1). These keys are the fundamental set needed to start a program such as Computer Heroes and demand time rather than capital as an initial investment.

Fundraising: Donations accepted for services performed.

Phase 2 (2009 – 2011)
A significant increase in the amount of hardware and repair tools (see Table 3) along with an increase in staffing (see Table 2) increased the repair capacity of the program during this phase. Offering a one credit "special topics" course enabled consistent staffing of the program with a fixed schedule posted on the door to the CH room. This increased client traffic substantially and increased the number of students involved with the program.

The new hardware enabled the CH students to assist clients in data recovery and back-up, diagnosis of drive problems (resident and removable media drives), power supply errors, operating system errors, and other issues on client machines.

Maintaining accurate client records has been started; both paper and digital copies are being maintained. A file cabinet and free cloud storage technologies are being utilized for document management.

Fundraising: Donations accepted for services performed. Suggested donation: $20.00/hour.

Phase 3 (2011 – forward)
Plans for moving forward with the program include developing a database for work orders, standardizing business practices (client interaction, computer check-in for repair work, logging work performed), ensuring quality of work performed, labeling (keeping track of client hardware as well as condition of hardware upon entering the CH room), exploring liability issues, and generally establishing, maintaining, expanding, and improving the business practices of the CH program.

By bringing together the resources (hardware and software), personnel (students and a faculty advisor) and computer problems, two of the theories of Astin (1999) are put into play in the Computer Heroes program, the Resource Theory and the Individualized (Eclectic) Theory which contribute to student involvement and learning. This type of involvement can be a predictor of future success for the involved students (Kuh et al., 1991).

Activities

In the first years the program could be described as "students helping students with their computers." As the program has matured, the students have become more comfortable with wiping hard drives (after backing up data) and re-installing operating systems, extracting hard drives from non-functioning computers and retrieving important data (primarily school documents, pictures and music), trouble-shooting software issues (e-mail, Internet access, wireless support), and client interaction (an important part of any business). Additionally, a procedure manual is under development to standardize the CH operating procedures and to assist in training/mentoring students wanting to get involved in the CH program.

Liability

Liability (and repair documentation) has been a concern of the CH program. A business law professor assisted the CH students with the development of a liability release (see Appendix A) and the students augmented it to include information on the client computer (model, ID number, problem, initial condition of computer, diagnostics run, repairs completed) and a history of work completed while in the CH shop. Training in this arena for CH students includes issues concerning data privacy when backing up client's hard drive, to be complete with data back-ups for the client, logging the condition of the computer when it enters the CH program for repairs, and listing the operating condition of the computer as it leaves the program.

Problems

As with any business, problems occur. There have been bounced checks, dissatisfied clients, staffing issues, clients not donating after services performed, paperwork problems and client interaction concerns. Each of these issues had to be addressed as they arose, and a solution attempted. The accumulation of solutions (both good and bad) has helped in the evolution of business policies and business practices for the CH program. The issues surrounding business problems and their impact on business policies have been a learning experience for the students involved.

In addition to client problems, computer problems are dealt with on an (almost) daily basis. A list of problems, proposed solutions and solution results are presented in Appendix B. This appendix illustrates the types of hardware and software issues that are brought to the Computer Heroes program.

Technician notes keep computer repair jobs on track and student volunteers informed of what diagnostics have been attempted and the results of these diagnostics.

Student Presentations

Student clubs traditionally have monthly meetings. The CH program enables the students to assist with the meetings by giving presentations on creative solutions to a CH problem, their favorite software diagnostic tools or practice preparing for a special topics night (to be covered next). These presentations reinforce the skill sets applied by the students and enable them to practice their presentation skills in a friendly environment. Faculty and student comments can be used in improving these presentations which can be of a technical nature and involve a generalist audience. These presentations integrate education and experience, supporting the learning theories of Kuh, (2001) and Ayers, et al. (2010).

Special Topics Nights

In addition to the CH program, the students have begun to run "computer optimization nights" where campus members bring their computers to a pre-determined location at a pre-determined time and learn how to optimize system performance, install, set-up and run anti-virus software, or back-up their data. The students prepare an instruction sheet, provide software (open source), demonstrate installing and running the software, and assist the client group. These classes give students in the CH program experience with training user groups on how to operate a software tool. These training sessions give students in the CH program experience with training user groups on how to operate a software tools, employing the service learning theories of Ayers, et al. (2010), and Kuh, et al. (1997).

Fundraising: Suggested donation for attendance $10.00.

Succession Training

Keeping the CH program running year after year is an arduous task for the faculty sponsor as well as the continuing CH students. Each year, the most experienced CH students graduate and leave the campus environment. In the spring semester, a mentoring activity is attempted where the experienced CH students train new students in the procedures, policies and activities of the program. Interested students must be solicited to participate in the spring training program for the coming year. A notebook listing the major points of the program is available for new students to reference, and is under constant development and revision.

Computer Heroes Program Outcomes

Most schools of business have core curriculum goals that their coursework and faculty address. A list of the most common outcomes is presented here.

- communication skills – written, verbal and presentation
- quantitative reasoning skills
- technology competency
- information literacy
- critical thinking/problem solving skills

The Computer Heroes program exposes the students to real-world applications of these skills (with the possible exception of quantitative reasoning) via problem solving on clients' computers and training user groups. The students work individually or as a team and utilize discussion forums and other online knowledge bases to troubleshoot and repair client computers. The special topics nights give the students experience in preparing a written software/activity guide for the client, developing a PowerPoint presentation for the client group, and delivering a software training session for the client group as a team activity. These activities put into play many of the points made by many of the authors in the literature review section.

Most businesses have core competencies that they desire in new hires. The most common skills are presented here:

- communication skills
- customer relationship skills
- teamwork skills
- business experience

Again, the Computer Heroes program exposes students to various facets of each of these skills. The CH students work together as a team to tackle and solve computer problems while interacting with the (sometimes anxious) client. The most recent National Survey of Student Engagement states as one of the promising findings: "Students who engaged in learning activities with their peers were more likely to participate in other effective educational practices and had more positive views of the campus learning environment" (NSSE, 2010).

In general, students participating in the CH program are enhancing their academic experience as well as acquiring valuable job skills for inclusion on the resume and a discussion topic for a job interview.

The CH program is a business that functions (primarily) to fundraise for the students to travel and compete at conferences. One spin-off of running a business is that it provides a learning activity that benefits the students, their future employers, and the campus community. Overall, the Computer Heroes program integrates education with experience, incorporating an active learning environment into the college setting.

As the Computer Heroes program evolves and matures, outreach to the community at large (rather than just the college community) will be attempted. Expanding the CH program in this direction will enable the students to further experience the nuances of running a business and interacting with the general public. Expanding into the community will enable the students to network with possible employers. As Michael Umphrey (2007) states in his text on community centered education, "Teachers use the community as the subject of serious study," (p.93) and "Teachers look for chances for students to do real work" (p. 98). By opening the program up to the general public, the students benefit from running a discipline specific business and from gaining experience worthy of resume inclusion; the institution benefits by gaining stronger ties with the community in which it resides along with graduating well prepared students for the workforce.

4. CONCLUSION

Starting the Computer Heroes program was easy. Keeping it alive is hard. Each semester brings a new set of duties (scheduling, advertising, recruiting, training, bookkeeping) for the program as well as year-long oversight responsibilities for the faculty member(s) involved with the program. Motivated students and motivated faculty are required to keep the Computer Heroes program alive and healthy. This fundraising activity spans the entire school year and emulates a business more than a club fundraiser.

This activity also supports and encourages cocurricular, experiential learning experiences for the student, and provides a community service element to the students' educational pursuits. Branching out into the community will enhance student engagement with the off-campus community and begin to build the foundations of community centered education. Enabling this type of cocurricular activity benefits the students in many ways, and puts into practice many of the learning theories discussed in this paper.

While the workload can be daunting for the faculty and the students, the benefits of real-world problem solving activities, working as a team, community service hours, technology repair experience and fundraising gained by the student group is worth the effort.

Future directions include construction of a survey instrument for clients as well as an exit interview with the student volunteers. Both data sets could be utilized to improve the Computer Heroes experience for clients as well as students involved in the program.

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APPENDIX A

Computer Heroes Liability Release Form

This is a legally binding liability release, waiver, discharge and covenant not to sue, made by the undersigned to the State College Student Chapter of the professional society
Computer Heroes Program.

I, ___________________________________, recognize that there are risks associated
Releaser's Printed Name
computer repair and troubleshooting and I assume all risk arising from asking Computer Heroes to use their ability and knowledge to troubleshoot and repair hardware and software problems associated with my computer.

I therefore agree to assume and take upon myself the risks and responsibilities associated with any attempt to repair my computer. I, and any agent or assigns, release the professional society, its agents and members, from any liability arising from any attempts to troubleshoot or repair my computer and waive, release, discharge, and covenant not to sue for any such claims and indemnify them from any such claims brought by or through me.

____ ____________________
Releaser's Signature Date

____
Releaser's Contact Information (phone, e-mail)

Nature of computer problem: ____

Operating system: ____

Password (If client has one on computer): ____

Other notes (accessories, condition of computer, broken parts etc.)
____

Type of computer, identification number: ____

Solution proposed: ____
____

Solution result: ____
____

Computer operating condition at time of customer pick-up: ______________________________

Customer pick-up (signature): ________________________________ Date: _________________

Technician Notes Date Name

____

APPENDIX B

Client Computer Problems for Computer Heroes

Nature of Problem	Solution Proposed	Solution Result
Computer will not boot	Diagnostic	Data backed up off computer, computer shuts off immediately running stress test. Client wants to get new computer but will bring in external HDD for data.
Viruses!!! Can't access Internet	Remove viruses	OS damaged from viruses. Backed up data, restored OS, optimized, installed A/V, and installed MS Office
Clean install of Windows 7 and combine partition HDD into one	Win7 install, Open Office install, put data on from their external drive	Combined partitions on HDD, Installed/optimized Windows 7, installed Open Office and transferred data.
Pop-up virus	Diagnostic and removal of viruses	Removed infections, installed A/V, and optimized laptop
Virus infection	Virus removal	Virus/spyware removed and computer optimized
On boot PC will not start but prompts F1 for time settings. Virus warning pops up but Norton scan found nothing!	Diagnose software/hardware	Passed hardware tests, replaced faulty CMOS battery, removed 33 threats, and optimized PC.
Freezes, viruses, will not connect to Internet	Full diagnostic, laptop appears to have hardware issues	Fixed IE issue by running Norton removal tool. PC shuts off during tests and video display cuts in an out while on. Let client know it would be cheaper to replace than repair due to age of computer
WIFI does not work	Check wireless drivers and settings	The wireless was turned off on the computer. Showed client how to toggle on/off and connect to the school network
Need Microsoft Office for Macbook Pro	Installed Bootcamp Windows 7 and MS Office. Recommended due to user interface of Office in Windows opposed to Mac for taking classes	Installed Bootcamp partition with Windows 7 and Microsoft Office.
Computer getting BSOD	Diagnostic	Replaced bad module of ram

		with 2GB DDR2 provided by client and optimized PC
SLOW, mymathlab does not work all the time	Diagnostic, test all hardware and software, checking all IE/Firefox plugins (Flash, Java, Silverlight)	HDD tested bad. Replaced HDD, installed OS, transferred data from failing drive, installed appropriate applications, and optimized laptop.

Microsoft Enterprise Consortium: A Resource for Teaching Data Warehouse, Business Intelligence and Database Management Systems

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Abstract

Data is a vital resource for businesses; therefore, it is important for businesses to manage and use their data effectively. Because of this, businesses value college graduates with an understanding of and hands-on experience working with databases, data warehouses and data analysis theories and tools. Faculty in many business disciplines try to prepare students for this data-oriented business environment by teaching database and business intelligence concepts in their courses. However, many faculty may not be aware of various important online resources. For example, the Microsoft Enterprise Consortium (MEC) provides data and instructional resources to faculty in business colleges through access to several data sets that could be used for teaching a range of topics including fundamentals of database management, beginning and advanced SQL, data warehouses, and business intelligence (data mining, data cubes and dimensional reporting). The purpose of this paper is to introduce the Microsoft Enterprise Consortium, to discuss the various teaching resources it provides, to present an overview of the materials available through the MEC, and to give an example of successful implementation and utilization of MEC resources.

Keywords: data warehouse, business intelligence, database, data cube, dimensional reporting, data mining, teaching resources

1. INTRODUCTION

Businesses aim to maximize their data resource (Preston, R., 2010; Ferguson, R., 2008; Britt, P., 2006) and they value employees with data-related skills (Downey, McMurtrey and Zeltmann, 2008). Business faculty in many disciplines recognize that their students need to work with data and be familiar with software tools used to manipulate and analyze data (Jukic, N. and Gray, P., 2008). A comprehensive valuable data-related resource is available to faculty through the Microsoft Enterprise Consortium (MEC). It is worth noting that there is another data-oriented teaching resource called the Teradata University Network (Jukic, et al, 2008; Winter, R., Gericke, A., and Bucher, T., 2008). Both the MEC and the Teradata sites are valuable resources for teachers and students.

The MEC site in particular contains real-world data sets that are excellent for incorporating into business intelligence and database coursework. For fundamental database concepts, the MEC provides databases that range from fairly simple in terms of the number of tables, relationships and data rows to fairly complex with a large volume of data. For teaching data warehouses and business intelligence, the MEC provides very large data sets contributed by companies such as Sam's Club, Tyson Foods, and Dillard's. These companies have made "real" data available for instructional purposes through the MEC.

The MEC is hosted at the University of Arkansas Walton College of Business (http://enterprise.waltoncollege.uark.edu). Although the resources are free, faculty must register themselves and then add their students through a course management interface. The data sets are maintained in SQL Server 2008 and access is through remote desktop software.

The resources are organized by topic area and many topic areas include PowerPoint slides (Figure 1 in Appendix A), videos, assignment problems and solutions. The instructor-only material, such as instructor guides, assignments and solutions, will soon be housed in a password-protected section of the Microsoft Faculty Connection web site (http://www.microsoft.com/education/facultyconnection). Faculty who use the MEC site in their classes are encouraged to expand the reserve of teaching materials by contributing additional presentations and assignments.

The MEC is a valuable resource for IS educators because its utilization in IS courses facilitates teaching and provides students with an array of hands-on exercises using "real" and large data sets.

In what follows, there is an overview of the MEC site's available and soon-to-be-released data sets, instructional materials, and examples of how such instructional material could be utilized in various courses are presented**.**

2. Databases at the MEC

The MEC offers several data sets to educators. In addition to several small-scale databases, Dillard's Department Stores, Sam's Club and Tyson Frozen Foods have donated large data sets. These large data sets are particularly useful when covering topics in SQL tuning, data warehouses, business intelligence and data mining.

Microsoft's AdventureWorks

Microsoft's AdventureWorks is a sample data set that includes a transactional database and a data warehouse for analysis purposes. This database has numerous tables and provides examples of data in several business areas:

- Sales and marketing
- Product/inventory
- Purchasing
- Manufacturing
- Human resources

This sample data is based on a fictional bicycle manufacturer. (Note: There is an AdventureWorksLT database that is also available at the MEC. Though it is a smaller and simpler data set, it is <u>denormalized</u>.)

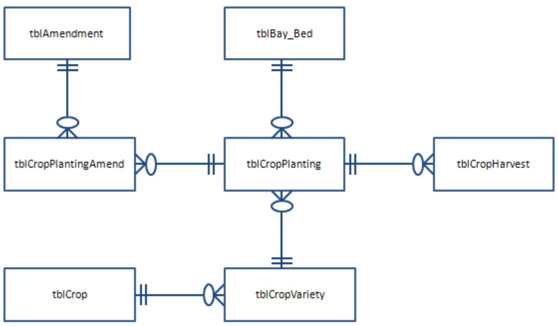
Hallux Productions

This data set is based on a music publishing and management company scenario (Hallux). There are 25 tables. This business scenario includes the sales order data model so often depicted in textbooks; however, it extends this model and tracks data about bands, band members, recordings, performances and more. The data spans several years and provides numerous ways to explore data modeling concepts and teach simple to complex SQL statements. See Figure 2 in Appendix A for the data model.

Greenhouse

The greenhouse database is based on a real greenhouse operation near New York City that is part of a non-profit farm and sustainable living education center. Like the Hallux Productions database, this data set provides teachers and students with a data model not typically found in textbooks. The database tracks information about different zones within a greenhouse, the crops planted, and the amendments used in the soil and the crop harvests. Figure 3 shows the greenhouse data model. This is a simple data model that could be used when teaching fundamental and advanced SQL. Some tables have only a few rows of data and others, such as harvests, have a few thousand rows.

Figure 3. Greenhouse ERD

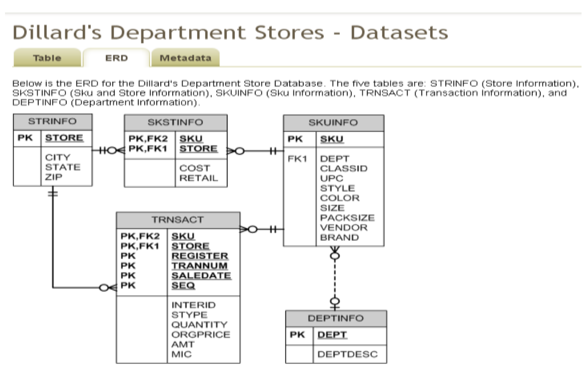


Dillard's Department Stores

The Dillard's Department data set contains sales transaction data for 453 stores during 2004 and 2005 (Dillard's). This database has several tables, one of which has over 120 million rows of data.

Figure 4 shows the Dillard's data model. This figure also shows the standard information about the large data sets provided at the MEC site. There is a general description of the business, some example table data, an ERD and metadata.

Figure 4. Dillard's ERD



Sam's Club

This is a data set of retail sales data. There are six tables related to sales, one of which has more than 48 million rows. The tables contain data from one month of transactions. The MEC server also has modified versions of the Sam's Club data set that are meant specifically for teaching data warehouses and data mining.

Tyson Frozen Foods

The Tyson data is a data cube with two years of sales transactions in a fact table linked to several dimension tables, including business division, pricing segment, and product. There are over 11 million rows of data. Figure 5 in Appendix A shows the Tyson data model.

3. Instructional Materials at the MEC

Each topic area has a set of videos and PowerPoint slides and most include exercises for students and solutions to the exercises. These materials were designed to give a short presentation on a specific topic. Each presentation is kept brief — 10 to 15 slides usually — and the videos usually run under 10 minutes. An instructor might choose to use the entire set of presentations within a topic area or take the one or two he/she finds useful.

Database Concepts

This subject area contains materials that cover the subjects listed below and includes a "test your knowledge" exercise that covers relational database fundamentals. Currently, the topics covered are:

- Data Models
- Relationships
- Logical & physical models
- Primary & foreign keys
- One-to-many, one-to-one, and many-to-many relationships
- Multivalued attributes

The videos for this subject area are also available on YouTube. A search for "MEC database" will list these videos.

SQL Fundamentals

The SQL fundamentals module uses two databases. A student-teams database is created and populated in the first couple of presentations, and it along with the Microsoft AdventureWorks2008 database are used in subsequent presentations. The SQL fundamentals include the following topics:

- Creating tables and populating them (SQL scripts included)

- Introduction to SELECT … FROM … WHERE
- Logical operators in the WHERE clause
- Using inexact criteria and ranges of values (inexact matching)
- IN and NOT IN
- NULL and NOT NULL
- Joining multiple tables either with JOIN or in the WHERE clause
- Organizing output: sorting, column aliases and dynamic columns
- Self-joins and table aliases
- Aggregate queries
- Traditional set operators

SQL Advanced Features

The advanced SQL materials use AdventureWorks2008, student-teams, and the greenhouse databases. Advanced SQL covers these topics:

- One-sided outer join and full outer join.
- One-sided outer join and a NULL criterion
- Nested queries: Type I & Type II
- In-line queries in the FROM clause
- Delete from a table using a subquery
- Difference problems
- Nested aggregates
- Division problems

Business Intelligence

The Microsoft Analysis Services software is used in this subject area. The instructional material covers:

- Building a data cube (one for Sam's Club and for Dillard's data)
- Using a pre-built cube (Dillard's data)
- Dimensional reporting using Microsoft Reporting Services (Sam's Club data)
- Data mining introduction
- Data mining with a decision tree
- Data mining with neural networks

4. Classroom Examples

The instructional materials at the MEC can be scaled and used as supplementary materials in introductory to advanced Information Systems courses, as well as in Supply Chain, Marketing and other business courses. For use in introduction to data bases courses, the EMC instructional materials can be scaled down to explain databases, tables, rows, etc., and to introduce data warehouses, data mining, and business intelligence concepts. At the other end of the spectrum, the instructional materials at the EMC can be fully utilized to build cubes, manipulate and analyze data and trend to devise strategic plans of action.

In fact, the MEC instructional materials can be easily aligned with a typical database textbook to complement coverage of various topics. For example, when teaching introductory database concepts—data models, database design concepts, relational database models, entity relationship modeling, normalizations of database tables, and advanced data modeling—a walk-through of MEC tables could be conducted and some or all of the instructional materials could be utilized. This practice would provide students a rich and "real" set of resources to draw upon when studying topics such as rows, columns, and populating tables. Later, when advanced database design and implementation concepts such as SQL, database performance tuning and query optimization topics are covered, more advanced topics covered in MEC instructional modules such as SQL advanced materials could be utilized, followed by a series of hands-on exercises. Finally, the MEC's Microsoft Analysis Services instructional materials could be used to introduce data warehouses, data mining and business intelligence, also followed by a hands-on practice when students would create data cubes, analyze data, identify trends, and devise strategic plans. In what follows, specific examples of possible uses of the EMC data models are presented.

Pre-Built Data Cube

In a long semester (15 weeks duration) database class, two to four class sessions could be set aside to cover data warehouse and cube concepts, and another two or to four sessions could be devoted to hands-on database manipulation exercises. Because of the short time frame, the instructor would use the pre-built cube from the Dillard's data set. In addition, to augment the learning process, one could use the MEC handouts that introduce students to Microsoft Analysis Services and use of the Dillard's cube to analyze the data. One teaching scenario could be that after going through the MEC handouts, students are assigned a set of questions that would require use of the data cube to obtain answers. Another teaching scenario could be that, once coverage of the materials on the MEC handout is completed, students are assigned open-ended questions that would require them to explore the pre-built cubes to find significant trends and present their findings in a short write-up. These types of exercises provide students with hands-on experience working with pre-built cubes while enhancing their critical thinking skills and effective business intelligence analysis.

SQL & Query Design

In a database class that spends several weeks covering SQL, the very large data sets can illustrate query performance. This is an advantage over small data sets, such as those typically provided with textbooks, where there's no discernible difference between "good" and "bad" queries because all queries run very quickly. As an example, the queries shown in Figures 6 and 7 have the same output, but their structure could be the basis of discussion about SQL query design using a subquery or "distinct."

Figure 6. Example 1 SQL

```
select distinct skuinfo.dept
  , deptdesc
  , vendor
  , skuinfo.sku
from ua_dillards.dbo.deptinfo
  join ua_dillards.dbo.skuinfo
     on deptinfo.dept = skuinfo.dept
  join ua_dillards.dbo.trnsact
     on skuinfo.sku = trnsact.sku
where saledate between '2005-08-01' and '2005-08-07'
order by skuinfo.dept, vendor;
```

Figure 7. Example 2 SQL

```
select skuinfo.dept
  , deptdesc
  , vendor
  , sku
from ua_dillards.dbo.deptinfo
  join ua_dillards.dbo.skuinfo
     on deptinfo.dept = skuinfo.dept
where sku IN
  (select sku
   from ua_dillards.dbo.trnsact
   where saledate between '2005-08-01'  and  '2005-08-07'
  )
order by skuinfo.dept, vendor;
```

There's another opportunity for teaching based on the two queries above due to the fact that they result in 253,715 rows of output. Students used to small databases and inclined toward lazy coding, such as SELECT * and no filtering in the WHERE clause, can learn from a large data set that careful planning and design are needed to make output practical and useful. Below is a modified query that reduces the output from over 253 thousand rows to 13 rows. The modified query shown in Figure 8 simplifies output by (1) counting the SKU items sold by vendor, rather than listing each sale, (2) showing sales in a particular department (ESPRIT) and (3) showing only the two stores in Tallahasee, Florida (stores #4302 and 4502).

Figure 8. Modified Query

```
/*
The WHERE clauses limits items sold to those in
the ESPRIT department in the Dillards
stores in Tallahassee, Florida (store # 4302, 4502).
/*

select skuinfo.dept
  , deptdesc
  , vendor
  , count(sku) as "SKU count"
from ua_dillards.dbo.deptinfo
  join ua_dillards.dbo.skuinfo
     on deptinfo.dept = skuinfo.dept
where deptdesc = 'ESPRIT'
and sku IN
  (select sku
   from ua_dillards.dbo.trnsact
   where saledate between '2005-08-01'  and  '2005-08-07'
   and store in (4302, 4502)
  )
group by skuinfo.dept, deptdesc, vendor
order by skuinfo.dept, vendor;
```

5. Summary

This paper has presented an overview of the instructional resources and data sets available at the Microsoft Enterprise Consortium. These resources cover a range of important topics that most business students and, certainly, students majoring in information systems should learn. The MEC is a free resource to higher education; however, faculty must register themselves and their students to gain access to its resources. Faculty who join the MEC are invited to compile and submit to MEC new course material they develop using these databases for possible inclusion in the MEC resources. A community of faculty could help the MEC continue to expand teaching materials provided to teachers and students.

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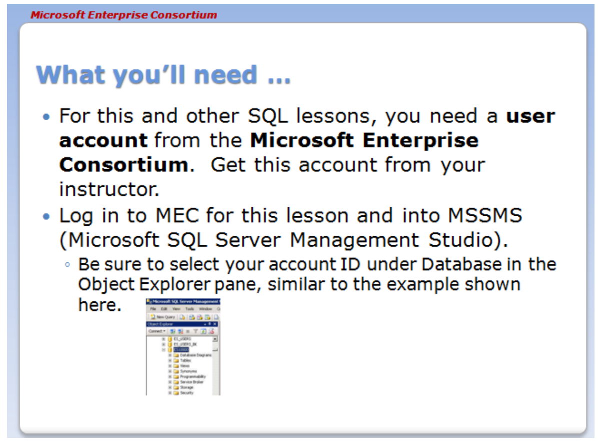
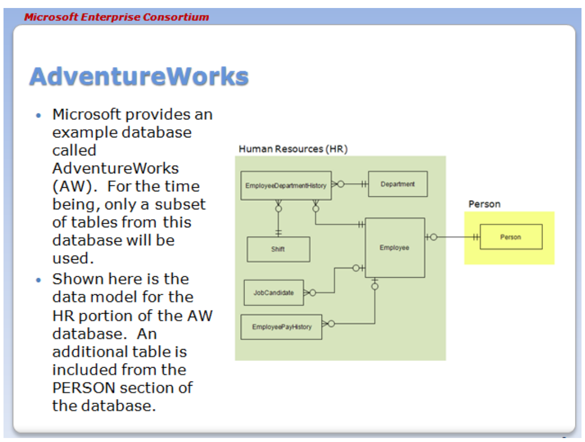
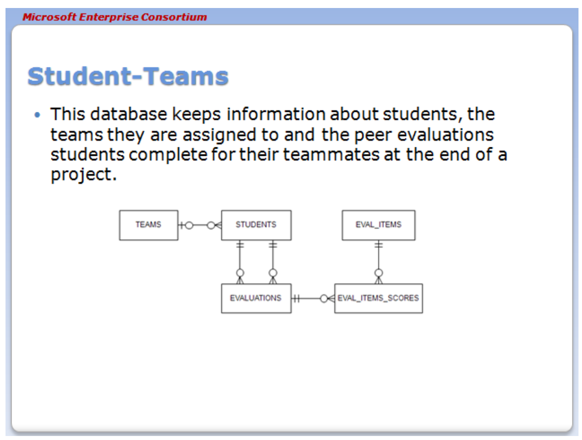
Appendix A

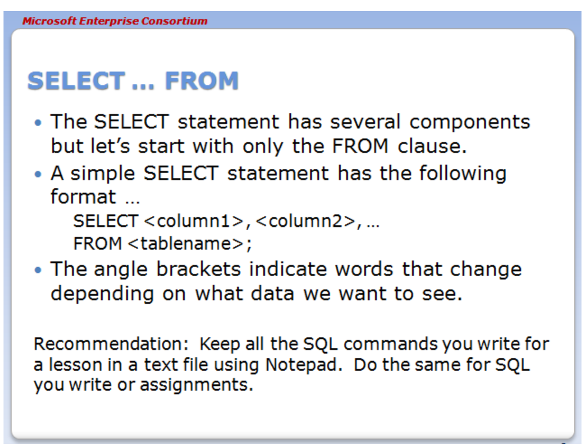
Figure 1. Example of PowerPoint slides

(6 of 11 slides are shown)









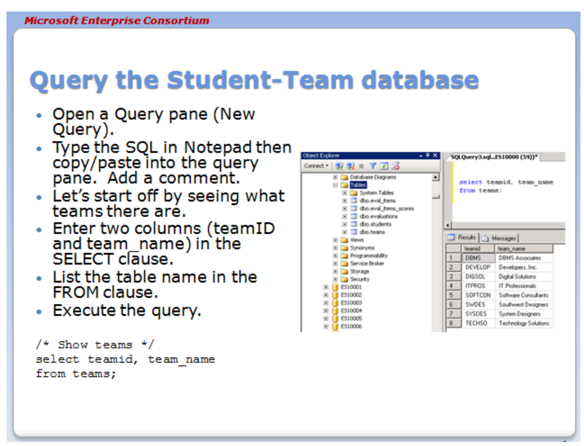


Figure 2. Hallux ERD

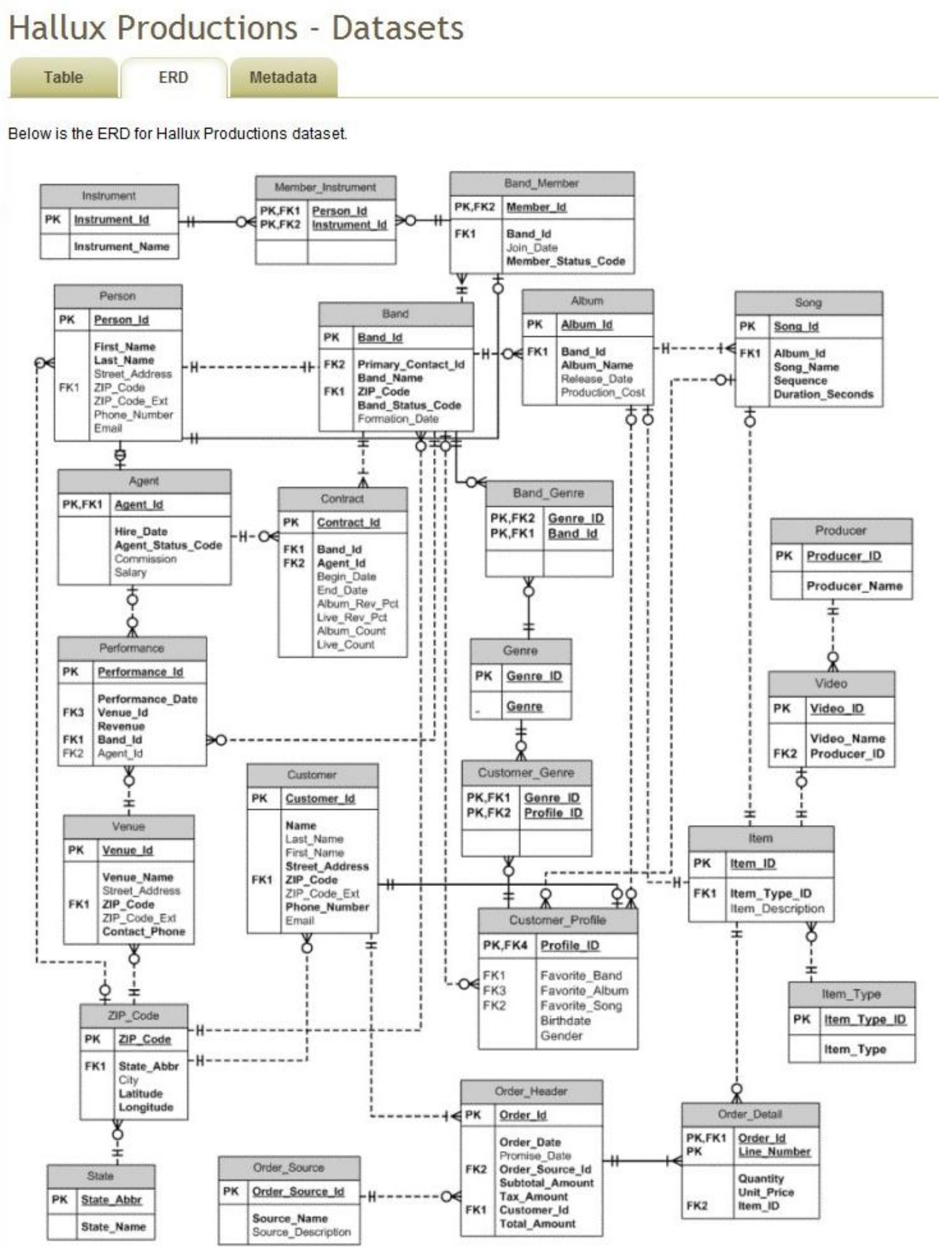
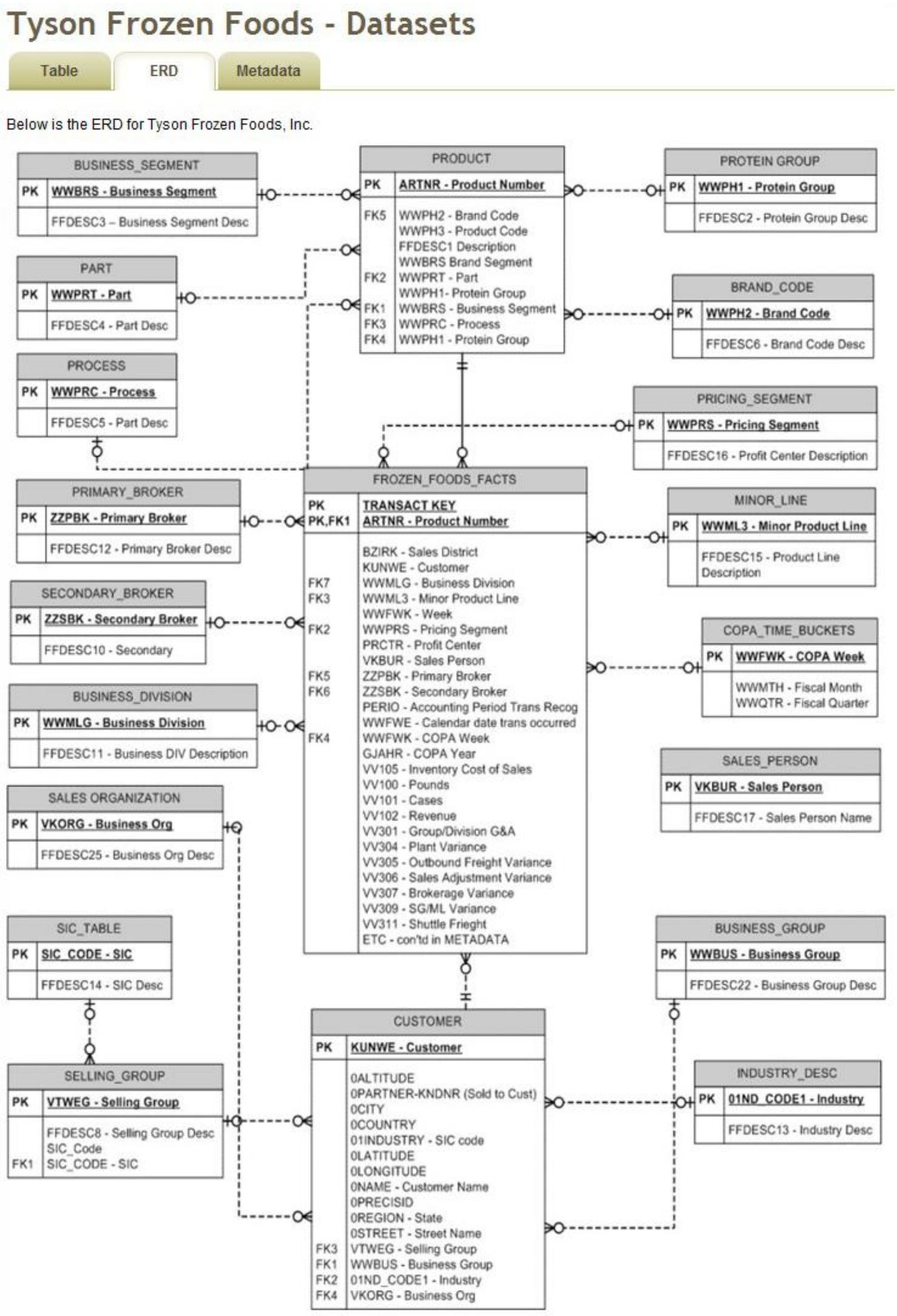


Figure 5. Tyson Frozen Foods ERD



Adjunct Communication Methods Outside the Classroom: A Longitudinal Look

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ABSTRACT

The ubiquitous nature of social networking and online/electronic communication has become expected in every area of life by those students that are entering colleges and universities today. This is in direct opposition with the trend of colleges and universities to reduce support for basic infrastructure services such as school provided E-mail. The continued rise of reliance on adjunct professors as a source of direct on ground instruction has also led to a shift and reduction of the opportunities for the student to interact with their teachers. The availability of modern technology for communication has provided many new avenues for this interaction to take place. It is necessary for adjunct faculty and institutions to explore and leverage new channels of electronic and online communication to provide opportunities for timely and valuable exchanges between instructor and student outside of the classroom.

Keywords: Communication, Adjunct Faculty, Communication Technology, Social Networks, Instant Messaging, Twitter, Facebook, Out Of Classroom Communication

1. INTRODUCTION

Social Networking is the buzz topic of this moment of time of the still early 21st century. Almost every area of society is looking to leverage multiple channels of communication for profit, for presence, and for pleasure. To be considered a "Social Network" seems to mean simply to allow for bi-directional collaborative communication. In a dedicated issue, the Journal of Computer-Mediated Communication issued the following definition of a Social Network: "web-based services that allow individuals to (1) construct a public or semi-public profile within a bounded system, (2) articulate a list of other users with whom they share a connection, and (3) view and traverse their list of connections and those made by others within the system. The nature and nomenclature of these connections may vary from site to site (Boyd and Ellison, 2007)." When fit to this definition, there is little difference between Facebook and course management systems such as BlackBoard or eCollege. Both systems allow for the creation of communication environments amongst peers and the flexibility of leveraging multiple channels to do so.

The competitive environment of the 21st century necessitates that universities develop innumerable ways to attract students. These efforts can involve technology giveaways (Carr, 2001; Finn & Inman, 2004; Lassiter, 2010), better living conditions (Woodall, 2010), and athletics (Roberts, 2010). Once enrolled, efforts in enhancing student satisfaction to increase retention of existing students are aided through increased facilities and resources made available to students. One of the most obvious and important resources offered to students is the faculty of the institution. Faculty contribute to the college experience primarily via the classroom - through curriculum design, course content, and course delivery method. However, while the classroom may be the most obvious point of contact between faculty and students, the ability of professors to contribute to the college experience of their students does not end when class is dismissed. To highlight this extension of influential reach, research has shown that interactions between students and faculty that take place outside of the classroom have a very significant impact on students (Endo & Harper, 1982; Iverson, et al., 1984; Ku & Hu, 2001).

Unfortunately, while the teacher may be the most valuable resource to the student's education, more and more colleges and universities are relying on adjuncts to teach the predominance of their courses. The global economic recession of 2008 produced profound effects on every industry. Like every other business, education has been asked to do more with less. Higher enrollments have not led to the hiring of more teachers. Full time faculty are asked to produce more than ever before in administrative duties and larger course loads. The combined stresses of satisfying government assessment requirements, producing publishable research, learning new classroom technologies, as well as actually preparing lessons to teach classes all have led to a very full schedule for full-time faculty professors. Still, the efforts of full time faculty members will never be enough to completely fill all the multiple needs of a school. Adjunct, or part time, instructors are needed to fill the ranks of qualified instructors.

The use of adjunct faculty has been growing over the past 30 years. Three decades ago, adjuncts, both part-timers and full-timers not on a tenure track, represented only 43 percent of professors, according to the American Association of University Professors, which has studied data reported to the federal Education Department. The association says part-time faculty account for nearly 70% of professors at colleges and universities, both public and private (Finder, 2007). Other studies have shown that adjunct faculty comprise some 46% of college and university teachers overall and 65% of non-tenure teaching positions (Euban, 2006). As the use of adjuncts grows, it becomes more and more essential to study the effect they have on the quality of experience that the student has. By nature, adjuncts simply are not as available as full time faculty. Supplemental channels of communication must be developed to allow for further contact between the adjunct and the student outside of the classroom.

The use of mobile communications by young adults as traditionally aged students, as well as working adults returning to school has exploded. Educause, an educational-technology consortium, released findings of a Spring 2010 survey encompassing 36,950 freshmen and seniors at 100 four-year institutions and students at 27 two-year institutions. In just two years, from 2008 to 2010, the percentage of students using smart phones to connect to the Internet has grown from 10% to 50% (Smith & Caruso, 2010). A Pew Internet and American Life study shows just how adoptive the college student is to new communication methods. In a December 2010 report, Twitter usage rates among college studies was found to be three times as great than other American adults (Smith & Rainie, 2010).

The purpose of this study is to continue to trace the evolution of how adjunct faculty utilizes various communication channels. Through repetition of an inventory gathering survey given to adjunct faculty at mid-sized Midwestern University after a two-year period, this project aims to answer the following research questions:

RQ1 – With a measured increase in student adoption of mobile data plans, have adjunct faculty also shown an increase in mobile data plan attainment?

RQ2 – With the measured rise in membership of social networking sites such as Facebook and Twitter, will there be a measured increase in membership of these sites by adjunct faculty as well?

RQ3 – In general, will the passage of two years show an increased tendency of adjunct faculty to communicate with their students through methods other than university provided e-mail addresses.

2. LITERATURE REVIEW

The following is a review of various journal articles and studies related to variables associated with this problem, adjunct faculty, electronic communication methods, and out of classroom communication.

The portrait of the adjunct in the literature is a nebulous one, but some qualities tend to be common. According to Banachowski's (1996) review of ERIC (Educational Resource

Information Center) literature on part time faculty, three main rationales institutions used when hiring adjuncts could be identified. The first was financial. Adjunct professors received a lower pay rate than full-time employees. Second, the use of adjuncts provided flexibility when student enrollment exceeded the expected number. Universities were able to provide additional classes taught by adjunct professors to meet student demand. Third, adjunct professors brought real world experiences into the classroom (Banachowski, 1996). Other studies and surveys have shown that adjunct faculty members frequently came from outside academe and provided unique perspectives to their work (Wilkinson, 2003). Many times these professors were employed full time, outside of university settings. Other part time faculty members were ending their careers or had retired. Both groups enjoyed sharing their expertise with their students (Lyons, 1999).

In 2009, *The Chronicle of Higher Education*, a leading news service for the academic community, performed a survey of adjuncts teaching in the greater Chicago area. Between April and July of 2009 the study received 625 responses from 90 institutions. Some of its findings were: Only 30% of the respondents had been offered professional development; 30% were not expected to spend any amount of time outside the classroom with their students; 37% were expected to spend less than 2 hours a week with students outside the classroom; only 16% had been teaching 2 years or less; 67% were only teaching at one institution; 81% did not teach online; 60% did not have a job separate form part time teaching (Wilson, 2009). Many colleges and universities commonly have programs to support and encourage the adoption of technology for full-time instructors (Gracy & Croft, 2007; Trentin, 2006; Crawford, 2008). Examples of support for learning new technologies include ongoing Continuing Education Units (CEUs), and clock hours for attendance at seminars geared towards professional development or voluntary offerings (Felton, 2000; Gander, 2008; Neumann & Terosky 2007). Few programs exist that are geared exclusively to adjunct faculty (Glaskin-Clay, 2007; Flemming, et al, 2004). Unfortunately, adjunct faculty are most often only encouraged to participate in the same programs offered to the full-time faculty rather than required to participate. These separate standards are just the beginning of the differences between the two teacher groups.

In a qualitative study of nine adjunct professors employed by a southwestern United States University, Ritter (2007) found that separation from the main body of full-time faculty members in the department was the major concern among adjuncts. Separation between adjunct faculty and university or fulltime faculty led to isolation. Isolation, then, was named as the major cause of the challenges the adjunct professors faced. These challenges included little or no support regarding class content; choice of textbooks; and access to resources including offices, telephones, copy machines, or even computers. Obtaining computer accounts, using BlackBoard (a common online learning management system) to communicate with their students and learning to provide quality instruction, either online or in person, were the major concerns. One adjunct professor suggested a way to lessen the isolation was to use a BlackBoard virtual classroom where adjunct professors could discuss current issues. Such utilization provides a way for the adjunct professors to network with one another and with the full-time professors without physical presence being necessary. Virtual learning environments also provide a way for the adjunct professors to discuss successful teaching strategies and to help each other successfully manage the occasional problem student (Ritter, 2007).

The multichannel communication environment approach is growing. Every major online mail provider (AOL, G-Mail, Hotmail, Yahoo) also includes a synchronous instant messaging/online chat portion in addition the asynchronous e-mail functionality. Facebook has included the synchronous channel of Live Chat for years, and is only now bolting on more traditional asynchronous e-mail client in 2011. Another sign of the multichannel trend is the re-organization of the online portal for the University of Phoenix. Elements of the new platform were rolled out to business students in the Spring term of 2011 with full roll out expected in Fall of 2011. In addition to the familiar features of announcements and discussion boards, the new platform will have a much more "live" look and feel. Mr. Satish Menon, who left an executive position at Yahoo to spend two years developing the platform, says the new elements are a response to demands from the hundreds of thousands of students University of Phoenix has had in the past decade. "The driving force is live interaction. When students log in, they see recommended tasks for that day and a personalized discussion feed that resembles one pioneered by Facebook. They can see who else is online and chat with other students and instructors… It is a very simple way to show where adaptiveness comes into the classroom" (Keller, 2011).

Cox and Orehovec undertook a qualitative study in 2007 to identify the nature of faculty-student interaction outside of the classroom. Their resulting typology identified five types of interaction: Disengagement, incidental contact, functional interaction, personal interaction, and mentoring. Their analysis suggests that even non-academic interactions between students and professors can be meaningful to students (Cox & Orehovec, 2007).

Using the phrase "Cyberinfrastructure" to describe the use of instant messaging for virtual office hours, Balayeva and Quan-Haase (2009) undertook an experiment to test the effectiveness of online chat as a new possibility for facilitating out of classroom communication. The purpose of the study was to gauge student perceptions of the usefulness of IM as a tool for student faculty interactions. Participants in the study were undergraduate sociology students enrolled in a communications course at a large research-intensive university in western Canada. Out of 76 students enrolled in the course, 52 participated in the study. Office hours were offered through IM to the class one hour a week and expanded to 2 hours the week of midterm exams and finals. In their findings, Balayeva and Quan-Haase reported that 83% of the students used an IM client at least once a day, and 83% used IM for over 4 years. This number suggests familiarity and comfort with the technology, making it a good choice for a communication channel between students and faculty. Prior to the study, only six participants had used IM to communicate with a professor. In summarizing the perceptions of the participants after the semester, researchers found that students did not think that IM should be used only for social interactions, that is, to communicate with just friends and family. The majority of the students were comfortable with the idea of using IM to communicate with faculty. This suggests that, although not all students are comfortable interacting with faculty via IM, most of them feel that IM would be a good tool for offering virtual office hours. Respondents reported that the key reasons why they think the technology was a good tool for the purpose of virtual office hours are: IM was convenient to use from home, campus, or anywhere else; IM provided a speedier form of communication; and that IM was not intimidating. The key disadvantage reported by respondents was that IM did not allow for conversations about complex matters. In addition, respondents indicated that they would be more careful about making mistakes on IM, such as grammatical errors, when communicating with faculty in comparison to their communications with friends and family. Students liked the idea of faculty offering virtual office hours with 69% of participants reporting that they liked this idea ‵‵somewhat′′ or ‵‵very much′′ (Balayeva & Quan-Haase, 2009).

3. METHODOLOGY

The investigation into current technologies in use by adjunct faculty was quantitative in nature and utilized a survey as the research methodology to gather information from current adjunct faculty of a single academic institution. The use of the survey was necessary as this instrument allowed for the gathering of responses from a large and scattered pool of respondents.

University X, a private suburban Mid-western school has a student population of approximately 5,000 Undergraduate and Graduate students that represent 29 states and 36 foreign countries. Approximately 1,000 of those students are resident, living on campus. For the academic year including Fall 2010 and Spring 2011, University X had 273 unique personnel designated as "part time" faculty.

A survey was developed to gather information in four significant areas: adjunct demographics; communication technologies in use; reasons for not using technologies; and opinions on effectiveness of technologies (See Appendix A).

The survey was designed and administered through a web service, ESurveyPro.com. The survey was evaluated for time and clarity through administration to four test subjects. The survey administered in 2011 varied only slightly from that given in 2009, one additional question was included to request which department the respondent was a part of. At that time of initial availability in 2009, a possible 394 adjunct faculty members existed, with 75 surveys being returned.

For this second administration of the inventory survey, E-mail invitations were sent to all 273 individual adjunct faculty members as determined through their inclusion within the University's electronic E-mail distribution lists for Part Time Faculty during each respective academic session. The invitations were sent March 3rd, 2011 with one follow up reminder sent one week later on March 16, 2011. At the completion of two weeks, 50 surveys had been returned though the web collection service. Incomplete surveys were retained for results on questions that were answered, as there was no contingency between sections of the survey.

4. RESULTS

Results of the survey are presented in three sections: demographics, technologies in use, and reasons not in use. Comparisons will also be given between the results of the most recent survey (2011) and the original (2009) through simple percentages.

Demographics:

In Question 1, 50% of the respondents fell in the over 50 year old age range (25 of 50). This is slightly higher, percentage wise, than 2009 where 48% fell in this category. The Under 40 age bracket was equal in both years at 28%. In Question 2, the ration of terminal degree holders to Masters degree holders remained relatively thee same. In 2011, 68.75 reported a Masters degree, as did 66.2% in 2009. Level of experience in Question 3 showed some turnover. In 2011, 48% reported to having taught over 6 semesters for the University, while in 2009, 65.7% had claimed 6+ semesters. Question 4 was similar in nature but more specific in asking the number of classes taught. Again, the over 6 category was high in both yeas (58.6 in 2009 and 49% in 2011). However, a shift did occur in the lower end. In 2009 only 17% chose 2 or less, while in 2011 31% chose 2 or less years. In Question 5 requested which department the respondent was a member of, the predominant response was the School of Communication and information Systems (20 of 50) with Education (7) and administration tied for second (7). Only one respondent claimed the School of Business. In terms of overall years teaching at any school, Question 6 showed little change. In the 2011 survey, 64% reported over 6 years, while 69% reported the same in 2009. As for teaching at other institutions in Question #7, both years reported that 48% did not teach anywhere else. A similar percentage reported 1 other school t 28% (2009) vs. 26% (2011), respectfully. Another small shift was seen in online experience in Question 8. In 2011, 38% reported having taught an entirely online course, while 32% had reported the same in 2009. A slight decrease in outside employment was shown in Question 9. In 2011, 32% reported having a job outside the University, a small drop from the 35.7% reported in 2009. In Questions 10 and 11, an increase was seen in the number of adjuncts who reported possessing a phone capable of receiving E-mail and browsing the Internet. In 2009, only 46% reported this, in 2011, a full 60% reported having such a device.

In Questions #12 and #13, respondents were asked if they held regular office hours and if so, how many students per class contacted them during those hours. A percentage increase was seen with 42% reporting that they held office hours in 2009 and this number climbing to 50% in 2011. Even, though, was the number of reported students attending. This held comparatively steady, 63% (2009) to 64% (2011)

Technologies In Use:

	2009		2011	
	Have	Shared	Have	Shared
University E-Mail	100%	100%	98%	98%
Private E-Mail	94%	47%	98%	34%
Work E-Mail	70.5%	27%	48%	4%
IM	27.3%	3%	28%	6%
Social Net	45.5%	10%	78%	6%
Twitter	12.3%	4%	16%	2%
Personal Web	25.4%	10%	8%	2%
Presentation	12.9%	6%	26%	6%
Online Collaboration	13%	7%	28%	8%

Table 1: Comparison of communication technologies in use and shared.

Question 14 of the survey asked which technologies the respondent had utilized and shared with their students. Nine technologies were listed, and an allowance was made for write in answers. More than one answer was allowed. Each respondent to this question included University E-mail as a method of out of class communication, 50/50 (100%). Second in popularity was a personal E-mail address, 9/50 (18%), and third was Blackboard 3/50 (6%). Only four other technologies received even one vote, Phone, Personal web Site, and Hosted

Presentation Service (Go To My PC). This was down from 11 different technologies that received votes in 2009 (Table 1).

Details of each of the nine listed technologies from Question 14 expanded upon if the communication method had been shared, utilized and if it had improved communication. Outside of E-mail, and especially University E-mail, none of the technologies had great use. Private E-Mail led again, but with decline in use. Most notable in drop off was the sharing of a work E-mail address which dipped from 27% to only 4%.

Reasons Not In Use:

As in 2009, the reasons given for not utilizing or sharing the various channels of communication fell mainly into three categories: wanting to channel all communications through one method, privacy concerns, and unsure how to use/unfamiliar with the technology. Record keeping continued to be a concern for some, with this reason appearing as the steady fourth choice as to why respondents had chosen not to utilize a particular channel.

Open responses were also allowed when providing reason why a channel was not in use. Some of these highlight that lines are being drawn between personal and public/classroom availability. One response to Social Network sites stated, "inappropriate to being dealing with students in this fashion. There is an important distinction between the student-teacher relationship and a personal/friend/purely social relationship." Another expressed concern about ethical and legal issues in posting class content to Facebook. Finally, one comment seemed to sum up the leading response of needing to channel communication rather succinctly, "It gets to all be too much."

5. DISCUSSION

The purpose of this study was to continue to trace the evolution of how adjunct faculty utilizes various communication channels. At the outset, the following research questions were proposed:

RQ1 – With a measured increase in student adoption of mobile data plans, have adjunct faculty also shown an increase in mobile data plan attainment?

RQ2 – With the measured rise in membership of social networking sites such as Facebook and Twitter, will there be a measured increase in membership of these sites by adjunct faculty as well?

RQ3 – In general, will the passage of two years show an increased tendency of adjunct faculty to communicate with their students through methods other than university provided e-mail addresses.

For RQ1, the 2011 results show that of the respondents to the survey, the percentage that do have data plans on their mobile devices has increased by 14% to a level of nearly two thirds. This number remains above the 2010 mark of incoming students measured at 50%, but the two year percentage growth is terribly behind. The percentage growth of 400% in just a two year period shows the trend clearly in the incoming student category, a trend that is not expected to slow down until near total saturation in that market demographic. The growth in faculty mobile data plans is encouraging.

The ubiquitousness of Facebook and Twitter in everyday life has not completely taken over the academic world. While it might be the constant battle of an adjunct to keep their students from being online while in class, it has certainly not become a priority to meet them on these channels outside of the class. RQ2 surprisingly turns up a decline in use of what would be generally accepted as social network technologies. Percentage declines in use by adjuncts were shown in Instant Message use, Social Networking sites (Facebook, MySpace), and Twitter in sharing these channels with their students. Private use has increased in all three. The bridge simply has not been made to integrate these channels into a holistic educational approach.

The specifics of RQ2 go a long way to answering the more general RQ3. Taken as a whole, the 2011 results of the adjunct faculty communication method inventory show a disturbing trend. Across the board, through all of the nine communication technologies/channels listed, there has been a trend towards less inclusion of new methods of communicating. With so many ways in which to continue student teacher interaction outside of the classroom today, this is simply unacceptable. In the light of Diffusion of Innovations theory (Rogers, 1962),

adjunct faculty in general, through these results, show to be technical laggards.
It is important to note, however, the environment of both the survey and the adjunct in general. As noted in the introduction and lit review, adjunct faculty is notoriously under supported. Even when colleges and universities do provide educational technology centers and support staff, these services are rarely utilized by the transitory adjuncts. The 2011 survey results included several responses that inferred that they respondent simply was unaware that the service was available through the school. University X has no distinct program for adjunct orientation or support. There is no mandate from the school in general, nor specific departments for adjuncts to even hold office hours. No second form of communication is required, only the school issued E-mail address. There simply is no outside motivation for the adjunct in this environment to take on the extra burden of learning a new technology or method.

The initial survey in 2009 was administered directly after the spring semester. The timing of the 2011 survey was moved forward to take advantage of the session still being in progress. However, this movement in timing had little effect and the number of returns decreased overall. However it is recommended that the further iterations of this survey also be conducted mid-term as well. A mitigating factor of survey fatigue may have contributed to the lowered amount of responses. University X was conducting several faculty surveys concurrently in preparation for Middle States accreditation review. In the future, this will not be in conflict.

Suggestions for future study include a more qualitative approach. Focus groups that are inclusive of representatives from several schools and departments can provide a more intimate dialog on the true feelings of the faculty in several areas. From the results, it appears that current adjuncts continue to be concerned most by security, privacy, and management of multiple channels. For security and privacy concerns, much of the fears could be allayed with simple education and training. Ignorance of the features might be the deterring factor. For instance, on first glance Instant Messaging "conversations" appear ephemeral, disappearing when logging out and back in. Most common IM clients do contain an archiving feature that can hold these strings for reference with just a simple click. Most clients also include the ability to encrypt, which would quickly alleviate most security concerns. The management of multiple channels of communication is an individual, personal, task. Any of these technologies inherently offer the choice to turn it off. Allowing the channel to be open during limited windows of time can be utilized to allow for "virtual office hours" and enable some level of control to the teacher on when they can be contacted. In the end, personal time management skills, technology aside, are essential.

Unfortunately, the main roadblock to adoption of various communications techniques and technologies continues to be time. Of the reasons provided for not using the several technologies in the survey, a commonality is that they all could be overcome with the application of time. The time to spend in learning the technology, time to spend in becoming familiar and comfortable with the technology, time to spend in organizing the implantation of the technology into their lives in and out of the classroom. Too many adjuncts feel that their time is already stretched to the maximum, and that there is no more room for anything new. It is here where a strong mandate by the University, department head, or even accreditation organization could be used to set the lead and require ongoing training and exploration of new tools and methods. As shown in the online education world, where electronic communication needs to overcome the lack of face to face interaction, necessity is the mother of invention. The similarities in the best online platforms, whether it be the new portal being developed by the University of Phoenix or the myriad of add-ons and modules offered in Blackboard, and the multifaceted approach of the most popular social networking sites is striking. Blending multiple channels and reaching beyond the normal hours of classroom instruction is essential in providing the best learning opportunities today and being ready for the future.

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Appendix A:

Survey Questions (*possible responses in italics*)

Page 1. Personal background
1. Please indicate your age group: *20-25; 26-30; 31-35; 36-40; 41-45; 46-50; over 50*
2. What is the highest degree you have earned to date: *Masters; Doctorate*
3. How many sessions (semesters) have you taught for University X: *1; 2; 3; 4; 5; 6 or more*
4. How many classes have you taught for University X: *1; 2; 3; 4; 5; 6 or more*
5. What school within the University are you a part of?: (OPEN)
6. Overall, how many years of teaching experience do you have: *1; 2; 3; 4; 5; 6 or more*
7. How many other institutions do you teach at: *0; 1; 2; 3; 4 or more*
8. Have you taught an entirely online course: *Yes; No*
9. Are you currently employed in private industry outside of the Education field: *Yes; No*
10. Do you own a cell phone capable of receiving e-mail: *Yes; No*
11. Do you own a cell phone capable of browsing the internet: Yes; No

Page 2. General interactions
12. Do you hold set regular office hours: *Yes; No*
13. If you have set office hours, approximately how many students per class contact you during those set office hours: *1; 2; 3; 4; 5; 6 or more*
14. Of the following list of forms of communication, please check any that you are required to have an account, or presence, in and share with your students. (School can be one other than RMU. Please check all that apply.) *In-person office hours; University e-mail; Personal e-mail (Gmail, Hotmail, Yahoo, etc.); Work e-mail; Instant messaging (AOL, Yahoo, ICQ, etc.); Social Network Site (Facebook, MySpace, etc.); Twitter; Personal Web Site; Online Presentation Service (Go to Meeting, etc.); Online Collaboration Service (Google Docs, etc.); Other (Please Specify)*

Page 3. Method 1 - University E-Mail
15. Do you use your University X issued e-mail address: *Yes; No*
16. Have you shared this address with your students: *Yes; No*
17. If you have shared this address, have any of your students communicated with you through that address: *Yes; No*
18. If you have shared this address, how has contact through this method improved interaction between you and the student: *1-7 rating (1 low, 4 no change, 7 greatly improved, 8 not applicable)*

Page 4. Method 2 - Private E-Mail
19. Do you have a private e-mail address (G-mail, Hotmail, Yahoo, AOL, etc.): *Yes; No*
20. Have you shared this address with your students: *Yes; No*
21. If you have shared this address, have any of your students communicated with you through that address: *Yes; No*
22. If you have shared this address, how has contact through this method improved interaction between you and the student: *1-7 rating (1 low, 4 no change, 7 greatly improved, 8 not applicable)*
23. If you have not shared this address with your students, please check any reasons why you have not: (check all that may apply): *Personal privacy concerns; School policy disallows this; Control/funnel student communication through other channel; Concerns about archiving and keeping record of contact; Copyright/restricted materials distribution concern; Security concerns; Unaware technology existed; Unsure of how to use this technology*

Page 5. Method 3 - Work E-Mail
24. Do you have a outside work e-mail address: *Yes; No*
25. Have you shared this address with your students: *Yes; No*
26. If you have shared this address, have any of your students communicated with you through that address: *Yes; No*
27. If you have shared this address, how has contact through this method improved interaction between you and the student: *1-7 rating (1 low, 4 no change, 7 greatly improved, 8 not applicable)*

28. If you have not shared this address with your students, please check reasons why you have not: (check all that may apply): *Personal privacy concerns; School policy disallows this; Control/funnel student communication through other channel; Concerns about archiving and keeping record of contact; Copyright/restricted materials distribution concern; Security concerns; Unaware technology existed; Unsure of how to use this technology*

Page 6. Method 4- Instant Messaging
29. Do you have an Instant Messaging account (AOL, Yahoo, ICQ, etc): *Yes; No*
30. Have you shared this address with your students: Yes;
31. If you have shared this address, have any of your students communicated with you through that address: *Yes; No*
32. If you have shared this address, how has contact through this method improved interaction between you and the student: *1-7 rating (1 low, 4 no change, 7 greatly improved, 8 not applicable)*
33. If you have not shared this address with your students, please check reasons why you have not: (check all that may apply): *Personal privacy concerns; School policy disallows this; Control/funnel student communication through other channel; Concerns about archiving and keeping record of contact; Copyright/restricted materials distribution concern; Security concerns; Unaware technology existed; Unsure of how to use this technology*
34. Would you be interested in exploring this technology more: *Yes; No*
35. How effective do you feel this technology could be in augmenting your communication with your students: *1-7 rating (1 low, 4 no change, 7 greatly improved, 8 not applicable)*

Page 7. Method 5 - Social Networking Sites
36. Do you have a Social Networking website account (Such as Facebook or MySpace): *Yes; No*
37. Have you shared this address with your students: *Yes; No*
38. If you have shared this address, have any of your students communicated with you through that address: *Yes; No*
39. If you have shared this address, how has contact through this method improved interaction between you and the student:*1-7 rating (1 low, 4 no change, 7 greatly improved, 8 not applicable)*
40. If you have not shared this address with your students, please check reasons why you have not: (check all that may apply): *Personal privacy concerns; School policy disallows this; Control/funnel student communication through other channel; Concerns about archiving and keeping record of contact; Copyright/restricted materials distribution concern; Security concerns; Unaware technology existed; Unsure of how to use this technology*
41. Would you be interested in exploring this method of communication more: *Yes; No*
42. How effective do you feel this technology can be in augmenting your communication with your students: *1-7 rating (1 low, 4 no change, 7 greatly improved, 8 not applicable)*

Page 8. Method 6 - Twitter
43. Do you have a Twitter account: *Yes; No*
44. Have you shared this address with your students: *Yes; No*
45. If you have shared this address, have any of your students communicated with you through that address: *Yes; No*
46. If you have shared this address, how has contact through this method improved interaction between you and the student: *1-7 rating (1 low, 4 no change, 7 greatly improved, 8 not applicable)*
47. If you have not shared this address with your students, please check reasons why you have not: (check all that may apply): *Personal privacy concerns; School policy disallows this; Control/funnel student communication through other channel; Concerns about archiving and keeping record of contact; Copyright/restricted materials distribution concern; Security concerns; Unaware technology existed; Unsure of how to use this technology*
48. Would you be interested in exploring this method of communication more: *Yes; No*
49. How effective do you feel this technology can be in augmenting your communication with your students: *1-7 rating (1 low, 4 no change, 7 greatly improved, 8 not applicable)*

Page 9. Method 7 - Advanced web site features
50. Do you have a personal web site: *Yes; No*
51. Have you shared this address with your students: *Yes; No*

52. If you have shared this address, how has contact through this method improved interaction between you and the student: *1-7 rating (1 low, 4 no change, 7 greatly improved, 8 not applicable)*
51. If you have not shared this address with your students, please check reasons why you have not: (check all that may apply): *Personal privacy concerns; School policy disallows this; Control/funnel student communication through other channel; Concerns about archiving and keeping record of contact; Copyright/restricted materials distribution concern; Security concerns; Unaware technology existed; Unsure of how to use this technology*
53. Would you be interested in exploring this method of communication more: *Yes; No*
54. How effective do you feel this technology can be in augmenting your communication with your students: *1-7 rating (1 low, 4 no change, 7 greatly improved, 8 not applicable)*

Page 10. Method 8 - Hosted presentation services
56. Have you ever utilized online presentation services, such as "Go To Meeting", or "Adobe Connect": *Yes; No*
57. If you have used such technologies, where have you used online presentaton services, such as "Go To Meeting" or "Adobe Connect": *Work; School; Both Work and School; Not applicable*
58. If you have utilized this technology, how has contact through this method improved interaction between you and the student: *1-7 rating (1 low, 4 no change, 7 greatly improved, 8 not applicable)*
59. If you have not utilized this technology with your students, please check reasons why you have not: (check all that may apply): *Personal privacy concerns; School policy disallows this; Control/funnel student communication through other channel; Concerns about archiving and keeping record of contact; Copyright/restricted materials distribution concern; Security concerns; Unaware technology existed; Unsure of how to use this technology*
60. Would you be interested in exploring this method of communication more: *Yes; No*
61. How effective do you feel this technology can be in augmenting your communication with your students: *1-7 rating (1 low, 4 no change, 7 greatly improved, 8 not applicable)*

Page 11. Method 9 - Online apps
62. Have you ever utilized online collaboration services, such as "Google Docs”: *Yes; No*
63. If you have experienced such technology, where have you used online collaboration services such as "Google Docs": *Work; School; Both; Neither*
64. If you have utilized this technology, how has contact through this method improved interaction between you and the student: *1-7 rating (1 low, 4 no change, 7 greatly improved, 8 not applicable)*
65. If you have not shared this address with your students, please check reasons why you have not: (check all that may apply): *Personal privacy concerns; School policy disallows this; Control/funnel student communication through other channel; Concerns about archiving and keeping record of contact; Copyright/restricted materials distribution concern; Security concerns; Unaware technology existed; Unsure of how to use this technology*
66. Would you be interested in exploring this method of communication more: *Yes; No*
67. How effective do you feel Online collaboration services such as Google Docs can be in augmenting your communication with your students: *1-7 rating (1 low, 4 no change, 7 greatly improved, 8 not applicable)*

Page 12. Most Common
68. What is the form of communication that has been MOST used by your students to contact you outside of the classroom? (Open Text Response)