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INFORMATION SYSTEMS
EDUCATION JOURNAL

Using Business Analysis Software in a Business Intelligence Course

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Abstract

This paper presents an example of a project used in an undergraduate business intelligence class which integrates concepts from statistics, marketing, and information systems disciplines. SAS Enterprise Miner software is used as the foundation for predictive analysis and data mining. The course culminates with a competition and the project is used to enhance communication and presentation skills.

Keywords: business intelligence, data mining, data analysis, experiential learning

1. INTRODUCTION

Business intelligence is an umbrella term used to describe a variety of topics. Historically, business decision making depended upon the ability of an IT professional to develop reports based on internal information collected and stored in the transaction processing systems of a firm. These reports were not very flexible and could take a substantial amount of time from the initiation of the request by a decision maker until the appropriate information was available. As relational databases, ERP suites, and business analysis tools were developed, managers began to access and analyze data with greater speed and flexibility. The rapid growth of the internet also provided access to external market and business research databases. A new generation of software concepts and applications began to emerge. These activities included data warehouses, data mining, online analytical processing, online query, and online reporting. Analytical software packages were also developed to take advantage of these concepts to aid business decision making, cut costs, review processes for reengineering possibilities, and identify new business opportunities (Mulcahy, 2007; Stefan, 2009). These trends in industry have caused some universities to begin developing curriculum to support these concepts under the umbrella of business intelligence.

University approaches have varied. Some universities have created a specific major in business intelligence that includes course work in ERP suites, data warehouses, data mining, and dimensional analysis. Other programs have defined the term more narrowly to the analytical tools associated with improving decision making. In either case, one of the problems facing curriculum design for business intelligence is the selection of analysis software to be used in the classes and the design of instructional projects that can effectively demonstrate the concepts. This paper describes one approach that was successful in an introductory level business intelligence class using SAS Enterprise Miner as a data modeling tool for predictive analysis. The instructional techniques and the project presented and described in this paper might be useful for designing a course using business intelligence analytical software packages.

2. BUSINESS INTELLIGENCE IMPACT

Industry is embracing recent trends in Business Intelligence applications and recognizing the benefits for adopting an integrated business intelligence strategy. Chickowski (2009) identified five important trends, one of them being predictive analytics. The other four are agile development, customization of BI information, visualization improvements, and operationalization of BI systems or the ability for operational level managers to see the predictive results of operational decisions in real time. In addition, Software as a Service (SaaS) and cloud computing are technological trends which enable firms to develop and deploy BI initiatives more efficiently (Henschen, 2009; Thompson 2009). A survey conducted by CIO Insight identified business intelligence/data mining as the technology most likely to make significant contributions to business strategy (Sircar, 2009).

The convergence of technology and applications that has occurred since 2000 has made business processes and data analysis a key differentiator for competitive advantage (Brannon, 2010). Integration provides even more advantages and opportunities. Benefits of adopting an integrated BI strategy include cost savings related to consolidation of data marts, time savings for data suppliers and users, higher quality data leading to better decisions, and improved business processes (Popovie, Turk & Jaklic, 2010; Watson & Wixsom, 2007). The types of data stored for analysis has also expanded. Baars and Kemper (2010) have stressed the importance of integrating both structured and unstructured content within the BI framework.

Despite these technological trends and organizational benefits, there is a disconnect between industry needs and business school curriculum (Sircar, 2009). Sircar examined BI course offerings in the top 50 undergraduate business schools as ranked in Business Week and found that only 7 schools had specific courses in BI or Business Analysis. None of the schools offered a major in BI, and only one, Miami University of Ohio, offered a minor. Analytical competency and insufficient employee quantitative skills were found to be serious concerns of business executives yet universities have been slow to adopt BI into their curriculum (Sircar, 2009).

3. BI COURSE DESCRIPTION

In order to address the shortcomings of the business school curriculum in regards to Business Intelligence, a new course was introduced at both the undergraduate and graduate level. The catalog provides the following course description and is a required course for all undergraduate Information Systems Management majors: Development and application of the strategies, methods, and techniques used in data mining and other decision support systems. The course employs testing, documenting, and using software programs in functional areas of business such as finance, production, marketing, and accounting. The use of SAS software is employed for hands-on data mining experience. Students are required to have completed a business statistics course prior to enrollment in the BI course.

SAS software was chosen for multiple reasons. SAS has been a leader in business analytics software and is used by several of the potential employers of our student body. SAS also offers a certification in predictive analytics. Students are encouraged to consider certification for improving their personal job search opportunities. SAS also offers access to their business analysis software through the cloud. This carried a tremendous advantage for our university since we do not have computer labs. Students are required to have a laptop, therefore, it was very easy to approach this course using software as a service. SAS also provides free training to university instructors and extensive course material which can be used in the classroom, alleviating the necessity to purchase costly textbooks. SAS also provides online support and quick response to user problems that can and will be encountered. Last but far from least, SAS was chosen for its policies toward its employees. SAS has been on Fortune's list of Best Companies to Work for the past 13 years, as long as the rankings have been published. In January 2010, SAS was named as the number one best employer (http://money.cnn.com/2010/01/21/technology/sas_best_companies.fortune/).

The course content closely follows the Trainer's Kit provided by SAS when the software agreement with the university was finalized. Because the university requires undergraduate students to have a laptop computer, the software was accessed as a cloud application. This environment is termed OnDemand for Academics by SAS. Regression analysis, decision trees, and neural networks are the three modeling tools upon which the course focuses. Students learn to build all three models and use tools to compare and identify the model with the best fit for the situation. SAS provides datasets which spotlight business decisions.

4. CLASS CHARACTERISTICS

Business Intelligence is a required, senior level class for all undergraduate IT majors under a newly implemented IT curriculum in the Bill Greehey School of Business. It is also available to any business major as an elective predicated upon completion of a basic statistics course. Seven students enrolled in the initial offering of the undergraduate course and participated in the project described below. The students were primarily IT majors although two of those were pursuing a double major, one in accounting, the other in marketing. Two other students were general business majors and a sole marketing major had enrolled. Students had varying viewpoints and skills when beginning the course which supported the interdisciplinary approach. While the course is currently taught by Information Technology faculty, it is possible for the course to be conducted within the domain of other business disciplines. Marketing, in particular, could benefit from the offering of such a course due not only to the survey aspects addressed but also the type of data SAS has incorporated into their examples and training materials. The statistical aspects of the course support upper level Finance decisions and SAS has included training data to assist students in decision-making in this field, too.

Table 1 below provides the list of topics covered in the undergraduate Business Intelligence class. The project provided the students the opportunity to integrate coursework and add to their portfolio of experiential learning activities.

Table 1 Topics Covered

Problem Formulation	Presentation Techniques
IRB Certification	Descriptive Statistics
Informed Consent Forms	Regression Analysis
Survey Development	Decision Trees
Data Collection	Neural Networks
Data Entry	Collaboration Software
Data Integrity	Cloud Computing
Graphs/Charts	Teamwork

5. THE PROJECT

Problem Identification

Students were asked to explore opportunities in and around the campus for a research project that could help management in a decision-making situation. After some brainstorming, the group chose a project that could aid on-campus bookstore sales. Students noted that online textbook purchasing had become easier and economically feasible. Thus students may be more apt to buy online rather than spending money at the bookstore. The goal of the project was to develop a predictive model for bookstore textbook purchases. By recognizing important variables, bookstore management could take action to manipulate those variables or offer enticements to individuals identified as most likely to buy online.

IRB Certification

While determining the problem to be researched, students became certified by the IRB (Internal Review Board) to perform human subject research. They also began preparation of the IRB application. Google Docs was one of the IT tools used extensively throughout the project. This collaboration tool was used not only for the IRB application, but also in the informed consent form, the survey development process, and later in data entry. Even when all of the students were located in the same room, they often worked individually without discussion on the one copy of the document.

Survey Development
The items used on the survey were developed primarily through student discussion rather than literature review. Students speculated causes and characteristics which might influence textbook purchases on campus and those that could impact online purchases. The survey was comprised of 10 questions which students believed were independent of each other. It was decided that the target participation group would be students in the business and law schools due to easy accessibility and time constraints. The appendix includes the questions included in the survey.

Data Collection
All students were assigned to the process of data gathering by approaching target group representatives in a random manner. The instructor also distributed the survey in business classes. Each potential participant was verbally asked to assist in the class project but was also informed of his or her right to refuse without penalty. A total of 76 responses were used in the analysis.

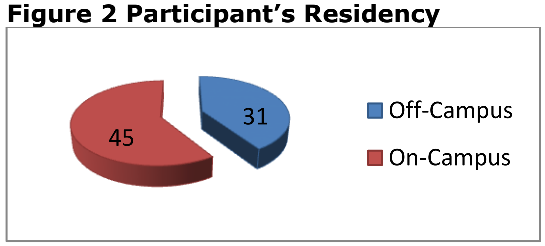
Study participants were comprised of both business and law school students currently enrolled within the University. Participants were selected based on the courses in which they were enrolled and accessibility to individuals. Faculty were asked to assist with the distribution during class periods. The research project was depicted to participants as a study focusing on the purchasing patterns of individuals who purchase textbooks online or at the St. Mary's bookstore. Involvement in the study was voluntary and anonymous. A numeric code was utilized to manipulate and aggregate the data. Research participants were not compensated for their participation in this study.

Data Analysis
The foundation of this course is explored in the data analysis stage. Students used SAS Enterprise Miner to develop models that predict which business and/or law students are most likely to purchase their textbooks in the campus bookstore. Figure 1 in the Appendix is a picture of the SAS models and the nodes used in the comparison.

Presentation of Results
Students prepared a presentation using Microsoft PowerPoint to summarize results. This was used in the Computer Sciences' department IT Symposium. Area IT professionals participated in the symposium as reviewers and judges. This added the opportunity to display our students' IT and communication skills as well as additional exposure to the school's IT curriculum. The students were awarded cords that can be worn during their graduation ceremony.

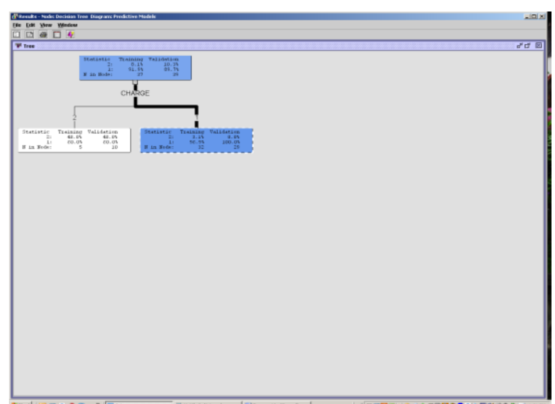
Descriptive statistics of the participants were presented. For example, the distribution of respondents living on campus and off campus is displayed in Figure 2 below.

Figure 2 Participant's Residency



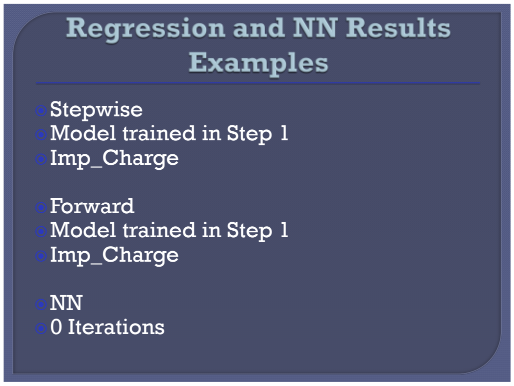
The results of the decision tree were presented. As can be seen from the diagram in Figure 3 below, the only significant factor was found to be whether or not the student had a charge account at the bookstore.

Figure 3. Decision Tree



Various methods of regression were applied. Results of stepwise as well as forward regression analysis are shown in Figure 4 below. Both resulted in the imputed variable Charge to be the only significant factor determining if the student would likely buy online or at the bookstore. In addition, the neural network was trained immediately with the dataset entered.

Figure 4. Regression and NN Results Examples



The Average Squared Error was used as the fit statistic to choose the appropriate model. As can be seen from the results in Table 2, the decision tree and regression equation produced similar model fits.

Table 2 Results

Model	ASE - Validation	# Misclassified
Tree	.062265	0
Reg	.062265	0
Reg2	.062265	0
NN2	.062268	4
NN3	.062268	4
NN4	.091663	4
Reg3	.091663	0
NN	.511218	35

The benefits of this study include enhancing theoretical concepts within the dynamic field of business intelligence and data mining. Using the SAS Enterprise Miner 5.3 statistical package will also aid the study in analyzing key elements influencing an individual's purchasing habits when it comes to purchasing course textbooks within a physical store or online. The research findings were expected to identify key predictors in an individual's behavior and also illustrate the efficiency and effectiveness of utilizing information technology applications to manipulate data into relevant information

6. BI COURSE BENEFITS

While empirical data depicting the learning outcomes was not obtained for this course, anecdotal evidence suggests that the content helps bridge the gap between the use of business intelligence software in the corporate environment and the neglect of this topic in business school curricula. The project approach helps students integrate the importance of data integrity and statistical analysis for decision-making in multiple arenas. The software exposes undergraduates to techniques such as decision trees and neural networks which are available in the business world to assist in problem-solving. The use of the software itself is simply a secondary benefit derived from the course. We hope that other faculty members can benefit from our approach to expanding student knowledge in the field of Business Intelligence.

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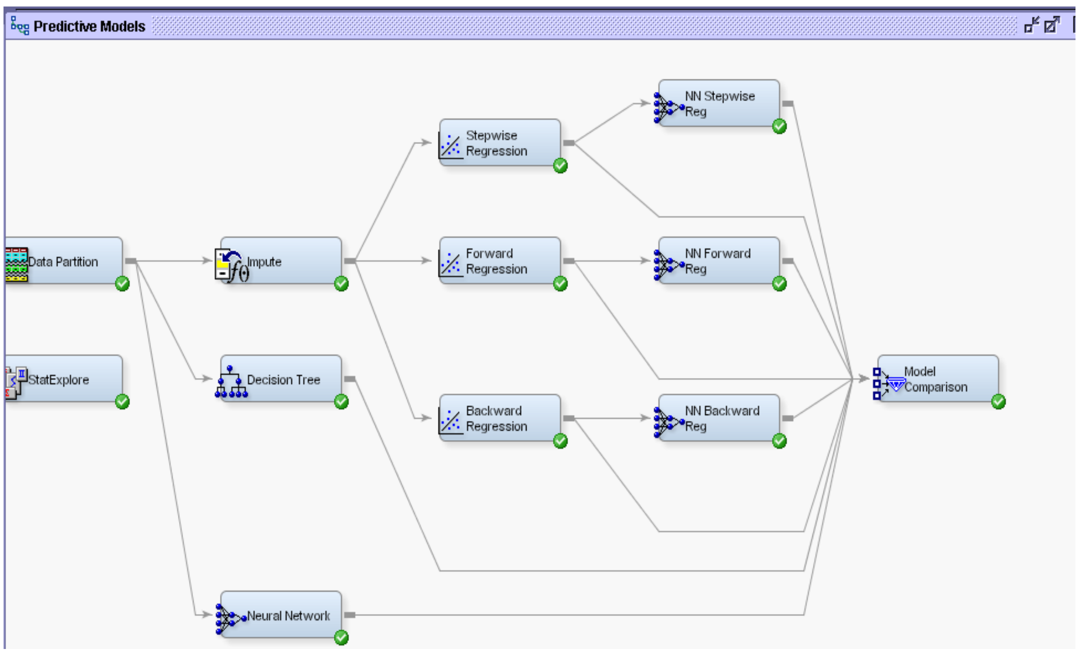
APPENDIX

Figure 1. Example SAS Model



Business Intelligence Book Purchasing Survey

1. **Gender?** (Please Circle One) Male Female

2. **Where is your place of residence during the school semester?** (Please Circle One)
   on-campus / off-campus

3. **What is your academic classification?**

   Undergraduate: (Please Circle One) Fr. Soph. Jr. Sr.
   OR
   (Please Circle One) Graduate Law Student

4. **Do you purchase textbooks in the St. Mary's bookstore?** (Yes / No)

   If no, do you purchase textbooks online, in another bookstore or from another student?
   Indicate here:

5. **Do you engage in online banking?** (Yes / No)

6. **How comfortable are you purchasing course-related textbooks online?** (Circle One)

   A. Extremely Uncomfortable
   B. Slightly Uncomfortable
   C. Uncomfortable
   D. Comfortable
   E. Extremely Uncomfortable

7. **Do you currently use the school's bookstore charge account?** (Yes / No)
   (Circle **no** if you don't have access to one)

8. **Which factor deters you the most from purchasing books in the St. Mary's bookstore?** (Circle One)

   A. Cost of new/used textbooks
   B. Selection of used books
   C. Selection of new books
   D. Other
   (If other please specify):

9. **What is your current status of employment?** (Circle One)

   A. Unemployed
   B. Part-time
   C. Full-time
   D. Paid/non-paid internship

10. **Do you currently receive financial assistance (scholarships, grants,loans, etc.)?** (Yes / No)

    If yes, do you use it towards the purchase of textbooks? (Yes / No)

Developing Information Systems Higher Education – Lessons Learned from an Inter-organizational R&D Project

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Abstract

In this paper we focus on lessons learned from developing information systems (IS) higher education in an inter-organizational (IO) network focusing possibilities and challenges. Developing higher education is one area among others where organizing joint efforts in networks are possible. An IO R&D project is described and analyzed in this paper. The overall research design is qualitative and interpretive. The research is based on a case study of the project and the network collaboration between four Swedish universities as participants. Theoretical concepts that characterize an IO relationship (continuity, complexity, symmetry, and formality) and concepts that describe dimensions of such relationships (links, bonds, and ties) helped us to describe and to analyze interaction in the IO network together with the characterization of context, content and process related to the development work. The IO network in this paper is classified as a joint problem solver; a functional network. Findings in the paper address several possibilities and challenges related to higher education development in IO networks. Findings highlight e.g. the need to involve active teachers and researchers, to manage distributed teams, to be aware of the critical and sensitive matter of opening up the "black box" of courses using critical friends, and the time and effort needed for anchoring projects and changes at the participating universities.

Keywords: Higher education, networks, learning outcomes, information systems, action research, IS education

1. INTRODUCTION

There is a rapid development in the area of higher education (HE). From a European perspective several joint European Union (EU) initiatives are taken. The Bologna Declaration of 19 June 1999 with a joint declaration from the European Ministers of Education is a major point for development of HE in Europe. In the declaration, facilitation of mobility of students, graduates and HE staff are focused. Preparing students for their future careers (focusing employability) and for life as active citizens in democratic societies is also important dimensions of the declaration. Offering broad access to high-quality HE, based on democratic principles and academic freedom, are also focused. With the Bologna Declaration, and the inbuilt focus on learning outcomes, a R&D

project named “A learning outcome model – reflected assessment” (further described below), with four Swedish universities as participants, where launched in 2007. The projected ended in 2009. The idea was to deal with the fact that almost all HE syllabi were re-written and re-formulated (under time pressure) according to the new standards during the year 2007 at all Swedish universities and that the need for reflection and improvement were huge. Working with these challenges together in an inter-organizational project – an inter-organizational network – learning from each other was an important ground for the joint initiative. The R&D project is an action research project (Avison, Baskerville and Myers, 2001; Baskerville and Wood-Harper, 1996) trying to achieve the dual purpose of improving HE and developing scientific knowledge – combining relevance and rigour (Keen, 1991). This paper focuses on lessons from this development project. The project is, thus, the case studied.

An important incentive when organizing the joint effort as an IO network was the collaborative advantage (Moss Kanter, 1994) opportunity. The collaborative advantage can be regarded as a contrast to competitive advantage. Of course the involved universities in the present project compete on the research funding market and on the student recruitment market, but have joined forces in this project focusing on learning outcomes. Organizing work in an inter-organizational network, or a virtual organization, have several potentials regarding pooling of resources, actors’ competence, mutual trust, building relationships, identity (Hedberg and Olve, 1997) and setting up a dynamic and heterogeneous group together.

Developing HE is one area among others where organizing joint efforts in networks (see e.g. Fincher, 2002) is possible and present. In this paper we will focus on lessons learned from developing information systems (IS) HE in a network focusing possibilities and challenges. Our analysis of the activities in the project will be guided by concepts from inter-organizational theory, i.e., the industrial/business network approach (Håkansson and Snehota, 1989; 1995). Theoretical concepts that characterize an IO relationship (continuity, complexity, symmetry, and formality) and concepts that describe dimensions of such relationships (links, bonds, and ties) will help us to describe and analyze interaction. Concepts from Pettigrew (1987; 1990) will also be used to characterize context, content and process related to the development work.

The purpose of this paper is to analyze and describe lessons from a higher education development project within the IS discipline in Sweden. The development work is organized in an IO network and lessons are presented in terms of possibilities and challenges. Research questions addressed are: (1) what possibilities and challenges are present in joint development of higher education in networks? (2) What lessons can be learned from the present development effort?

After this introduction, the paper is organized in the following way: In Section two we describe the research design, followed by the introduction of the R&D project and the participating universities in Section three. The theoretical background is then presented in Section four. The empirical findings from the case studies are compared, discussed and analysed using concepts from the interaction approach in Section five. The paper is concluded in Section six, where some statements about the need for further research efforts in this area are also made.

2. RESEARCH DESIGN

The overall research design in this paper is qualitative and interpretive (Walsham, 2006) and based on a case study (Stake, 1995; Yin, 1994). In this paper we reflect upon our own R&D project (the case), trying to systematize experiences and put them in the light of theories. Concepts from theories (as stated above) have been used as guide (Walsham, 1995; 2006) when analyzing the experiences in the R&D project. The R&D project as such is classified as action research (AR), as introduced above, with a typical dual purpose of changing and studying change (Avison et al., 2001; Baskerville and Wood-Harper, 1996). The project group members have acted as change agents (Checkland, 1991) and researchers.

Based on interviews with members of the project group from the four universities, reflections, studies of documents, activities and process experiences and lessons have been identified and later on structured using theoretical concepts (introduced above). The level of analysis in this piece of HE research (cf. Tight, 2003, p. 10) is related to: individuals (students and academics), courses, department and university level.

3. THE HIGHER EDUCATION DEVELOPMENT PROJECT

Below the R&D project is introduced followed by an introduction of the participating universities.

3.1 R&D Project Introduction

A major point of departure for the project, "A learning outcome model – reflected assessment", is the Bologna Declaration introduced above with its focus on learning outcomes. Keywords such as knowledge, understanding, ability, skills, assessment, and perspectives are focused. When applying learning outcomes in HE courses the need for assessment of student achievements vs. learning outcomes is highlighted. The work with learning outcomes has a great potential, but several challenges are present. In order to be able to perform reflected assessment of student achievements, we, among other things, developed a framework in the present project. The framework is related to learning outcomes from different perspectives, such as employability, student learning outcomes, research and subject oriented profiles. The project is grounded in and related to didactic practice and pedagogical research. The R&D project is based in the IS subject area in Sweden but is relevant to other subject areas as well.

3.2 Participating Universities

Research has been performed at the four universities taking part in the R&D project. The settings in these domains are diverse regarding some aspects which have led to the following categorization of the participating organizations; *the big university (Big Uni)*, *the international university (International Uni)*, *the distance learning university (Distance Uni)*, and *the profession university (Profession Uni)*. The *Big Uni* is the largest of the four. This university has mainly program education; i.e. bachelor and master programs within a subject area where courses are grouped together and offered to students as a united education. Due to the size of the university, the process of learning outcomes formulation and decision making is rather formalized. This process is in parts separated from the teachers at the department which gives the IS education. The *International Uni* has an international profile for all their programs and courses. This implies that there are many students from other countries taking the courses, but also that Swedish students go abroad for parts of their education. Regarding learning outcomes this means that cultural and linguistic aspects have to be taken into account both when formulating the learning outcomes as well as when examining them. Diversity in education from different countries must also be handled when comparing and evaluating learning outcomes. The *Distance Uni* offers many distance learning courses without any demand for students being present at campus. The IS program we have studied is given under the parole of "free start and free speed" which means that a student can start taking courses in the program at any time of the year and in any tempo he or she likes. All course activities are handled via Internet. Learning outcomes and an individual plan for the studies are very important tools to get this kind of distance learning to work properly for each student. The *Profession Uni* emphasizes its close connection to the students' future labor market. Companies and other organizations in the region take active part in many courses as the relations between the university and important employers of students are seen as essential for the quality of the education. This profile means that students should be prepared for a future profession by integrating employers early in the process. Regarding learning outcomes this implies that they have to be discussed with future employers.

4. THEORETICAL BACKGROUND

Below a short background to development activities in networks are introduced followed by a characterization of the particular domain (higher education) and concepts from the industrial/business network approach supporting the understanding of interaction in networks.

4.1 Development in Networks

In this paper we interpret the R&D project as an inter-organizational network (Aldrich, 1979). The formation of a network is based on the ambition that collaborative advantage is more productive than competitive advantage (Moss Kanter, 1994, p. 97 ff.). The ambition is to create advantages through cooperation and creation (ibid.). Hedberg and Olve (1997) also highlight several potentials regarding pooling of resources, actors' competence, mutual trust, building relationships, identity setting up a dynamic, and heterogeneous group as a part of a network. Oliver (1990) identifies a set of needs when developing a network; necessity, asymmetry, reciprocity, efficiency, stability, and legitimacy. These issues will be elaborated more on using the industrial/business network below. Networks are not controllable in an organizational sense, due to the inter-organizational and distributed arrangement.

4.2 Developing Higher Education

Networking is considered to be an important phenomenon when developing HE (Fincher, 2002). Networking can be discussed using several dimensions for example informal and formal dimensions. Such dimensions can be everything from having coffee and chatting with like-minded people (informal) to more organized (formal) networks based on explicit target communities, benefits, conceptual models and a set of desired aims (Fincher, 2002). The present network is a formal network trying to act as a joint "problem solver" (cf. Fincher, 2002, "functional network"); focusing on one particular aspect, in this case trying to make use of learning outcomes in the Bologna Declaration in a broad-minded sense.

Research on educational development (e.g. Baume, 2002) suggests some insights regarding planning and management: *context* should be taken into account (with its local norms, policies, and priorities), *discipline* (generic educational development should consider the practice, in particular disciplines and involved stakeholders), *change plans and goals* (adapting to changing circumstances), *framework* (avoiding a-theoretical approaches – using explicit theoretical basis for planning as well as analysis and evaluation of project results).

We consider our approach to teaching in a university context to be a mix between what Ramsden (2003, p. 115) characterizes as "teaching as organising" and "teaching as making learning possible". For example, we try to organize for active learning and apply skills to improve learning on one hand, but also try to engage and challenge students and to make teaching as a "research-like, scholarly process" (ibid., p. 115).

4.4 The Business Network Approach

The industrial/business network approach, called the Uppsala School (e.g., Håkansson, 1982; Axelsson and Easton, 1992; Håkansson and Snehota, 1995), is a mature line of thinking that supports the understanding of interaction in networks. Interaction is an aspect of reciprocal action or interplay; it is not the case of just one organization acting and the other organization reacting (ibid.). In this approach business relationship's characteristics can be described and analyzed in terms of its levels of continuity, complexity, symmetry, informality, and its dimensions (links, bonds, and ties).

When studying the interaction between organizations we can find several characteristics of relationships; (1) continuity (2); complexity; (3) symmetry and (4) informality as structural characteristics of a relationship (Håkansson and Snehota, 1995).

1. *Continuity* refers to the relative stability that tends to characterize relationships.
2. The *complexity* can comprise the number, type and contact channels for those from each organization who are involved in relations (ibid.). Also, contacts can vary from level to level between organizations.
3. It is typical for relations in industrial networks for customers and suppliers to be *symmetrical* in terms of resources and initiatives on each side.
4. The relationships often demonstrate a low level of *formality*. Even though contracts exist, they are seldom referred to (ibid.).

Another important aspect to study is different dimensions of relations, such as links, bonds and ties. Link refers to the connections that exist in the activities between organizations, so-called activity links. An activity is defined as: "a sequence of acts directed towards a purpose" (Håkansson and Snehota, 1995, p. 52). Activities can be of various types, for example technical, administrative or commercial. The links between activities reflect the need for co-ordination which affects how and when various activities are carried out. The links between activities make up a certain structure within the respect of organization at the same time as it also creates certain patterns in the network.

Bonds between the actors in a network can be of various types, for example technical, social, time-based, knowledge-based, administrative, economic or legal (Håkansson and Snehota, 1995). Bonds arise in relationships as two related actors mutually acquire meaning in their reciprocal acts and interpretation (ibid., p. 197). Bonds may have various aims, an example being to achieve co-ordination as a means of saving resources.

An IO relationship affects the way in which the organizations use their personnel, equipment, know-how, and financial resources, only to mention a few. An IO relationship can comprise pooled resources of these kinds, so-called resource ties. The relationships between organizations are not just a way of assuring access to resources, they are also a way of getting various types of resources to meet, confront and combine (Håkansson and Snehota, 1995), and to develop, create or refine.

5. ANALYSIS AND DISCUSSION

In the following section important activities in the present R&D project are summarized. The activities are then analyzed and discussed using theoretical concepts and issues introduced above.

5.1 R&D Project Activities

An important part in our R&D project network has been to (1) critically examine a selection of courses and study programs in IS at the participating universities. Furthermore, we have (2) generated empirical data from a number of employers and students and examined and compared the findings to local educational profiles and topics; (3) related emerging models under development to established pedagogical and didactic theory, and (4) continuously anchored results mainly from teachers and students (cf. Tight, 2003). These four types of activities are further described below.

The selection of courses and study programs (1) has been coordinated within the network and has been adjusted to the characteristics of the programs at the various universities. We have pursued both homogeneity and heterogeneity in the sample; homogeneity in terms of identifying similar courses from each university in the network. Heterogeneity on the other hand, in terms of variation in the set of studied courses regarding content, positions (e.g. introductory vs. advanced) in programs, etc. Regarding the selection of employers (2) we have generated empirical data from typical employers. A reference group of students (2) also participated in the work at each university and the joint project activities in the network.

While the approach of the project has had the common principles of design and implementation among the universities, the methodology has been adjusted to local conditions, practice and needs. The *International Uni*, for example, conducted group interviews and a survey among students in a bachelor´s program in IS including current perspectives on learning outcomes, as well as interviews with the program manager and a study counselor. The *Big Uni* has generated the equivalent empirical data with the use of focus groups with students and interviews with teachers, study counselors and a program director. Students at *the Big Uni* have also contributed to a logbook in an introductory course on learning in general and learning outcomes in particular. *The Profession Uni* has worked with participant observation in addition to interviews and document analysis. The latter has also been performed by and shared between all participating universities in the network. *The Profession Uni* has also been particularly successful in recruiting students from the active student section to participate in this project. *The Distance Uni* has conducted interviews with the program director and the head of the department and a member of the department board. The data from students (newly enrolled and in training) was obtained by e-mail due to the e-learning setting used at *the Distance Uni*. The variation described above was considered to be fruitful for the project and the participating universities – allowing each university to work in their particular areas "at home" – but sharing a common project platform in the network.

An important part of the cooperation in the network has been, in addition to anchoring and grounding models well in empirical needs, to include findings and experiences in established pedagogical and didactic theory (3). The IO dimension in the project has opened our eyes regarding the subject – IS - as such and its unique character in our departments and universities, while we have identified an interdisciplinary nature (through theoretical roots) for the emerging knowledge in the project.

In order to achieve results in active teachers' everyday teaching, anchoring of the results is central to its success (4). This has been proved by experience from a previous externally funded educational development projects at the *Big Univ*. Anchoring in teacher groups at each university has been an ongoing activity in the project. However, this has taken more time, energy and resources than anticipated. The collaborative climate in one of the participating universities has not been the best to anchor and begin implementation of the models. One reason for that is based on the fact that our work has an amount of self-reflection and collegial critique. Sometimes these activities were interpreted as critique on a personal level by teachers. Overall, we underestimated the need for time and other resources, in parallel with this project network cooperation to pursue a more active process of change at each department regarding systematic and open minded work with learning outcomes.

As the systematic work on generating empirical data, analysis and publishing have been prioritized in the project from the start; we consider it important that we have had both research and teaching staff active in the project. There is a clear success factor to be genuinely interested and active in both arenas - research and teaching. It is also a way of creating legitimacy in the cooperation. The reason for emphasizing research experience is that we have placed emphasis on theoretical grounding of our results, a systematic approach and methodology, and dissemination of knowledge (scientific articles and conference papers). This was done in order not "only" to stay on the level of experience and the development of "local theories". The research process as such has been a distinct metaphor and a strong ambition in our work.

The construction and use of multiple perspectives to identify learning outcomes has resulted in an exposure of conflicting objectives (such as different priorities of different interest groups) as we noted above. This has been particularly interesting from an implementation and a learning point of view, but this has not always benefited the project's progression. Our intention has been to highlight the trade-offs in order to search for explanations for its occurrence and increase a more thorough understanding. Our aim was also to demonstrate the importance of the perspectives taken when learning outcomes in relation to quality in IS education is discussed. Such discussions have been more delicate than we expected since courses often are seen as a personal property rather than an institutional, organizational, property to initiate, design, manage and develop further. Open criticism of the courses' design, content and learning outcomes can be perceived as criticism and questioning of person (and his or her personal views, teaching styles and expertise in the field as mentioned above) rather than constructive criticism and questioning of learning issues and course content and design as a part of an ongoing quality development.

Collaboration and the systematic research approach applied in the project as such benefit from the fact that all departments and actors have relationships through their postgraduate studies in IS development or economic IS - both based at the Big Uni. In this context, however, IS education (at basic and advanced levels) and development, is focused. These relations and alliance that we have has resulted in a shorter "takeoff" when initiating the present network cooperation. We also believe that we have been able to work productively and with a good atmosphere. If the elements discussed above have hampered the project's progression, the latter have clearly benefited the project's progression.

5.2 Possibilities

The *context* for and the *content* of the work performed in the IO network are important. This is e.g. expressed in the following way:

"Beyond the statements in the project plan, I think that our educational project has put educational development on the agenda, made it to a research object and expanded it from just being operational implementation. The project also has important image-building impact internally at our university, our reputation as being a proficient and ambitious subject area is being affected. We become role models in several contexts, etc." (Project Member, *Big Uni*)

The *Profession Uni* also emphasizes the importance of incentives in the *context*. An ongoing certification activity and the need for quality assurance departmental level were important. The project contributed to that work. The *International Uni* had a similar set of incentives related to a launch of a new bachelor study program in IS and an active work with learning outcomes related to that needed support.

The *Big Uni* has had a number of R&D project in the educational development research area. However, the present project is organized in a network – an organization that has not been the case in the earlier R&D projects in the educational development research area. The present project is also a part of an ongoing renewal of IS study programs at the *Big Uni*. This context is important as an empirical source, a "test milieu", and as a receiver of the result (cf. AR, above).

Common for all universities, and an important part of the set of incentives in the *context*, is the national evaluation of the IS subject area that is going to be performed by the Swedish National Agency for Higher Education in 2011. Quality assurance is an important part of this evaluation motivating development work in line with the present R&D project *content*. Finding means and methods of quality assurance and improvement of IS courses are essential and emphasized particularly by the *International Uni* and the *Distance Uni*. One possible explanation for the emphasis of quality assurance particularly from these two universities is the dimensions of handling students from 80 different countries in the first case and the dispersion in time and space in the second case.

The *content* and the combination of research and development are also considered as important from an individual incentive perspective: "To develop the educational activities *and* research is my driving force. One of these reasons was not enough, but the combination makes it interesting" (Project Member, Big Uni).

Several project members also emphasize discussions concerning approaches to handling learning outcomes, common practical obstacles (sharing and comparing experiences and theories – the comparative dimension between the universities) and the exchange of different perspectives as particularly valuable. These aspects can be related to the *content* of the cooperation as well as the *process* as such.

Other *process* related aspects are e.g. "fun", "great discussions", "time for reflection" etc. The last aspect is also highlighted by the *Big Univ*. It is considered as important to have teachers active, not only performing "course after course" without reflecting upon their practice, but instead be a reflective, research based, practitioner within their own field of expertise. The *content* in the project, focusing learning outcomes and employability, is also aligned with policies at the university level and the national level, legitimizing the work performed in the present project.

All project members also accentuate the even more important need for (IS) researchers to uphold and improve their pedagogical portfolio and their publication portfolio in the IS area in general, and in this case, the IS educational area.

5.3 Challenges

Many challenges are identified in the *process* of working with the issues focused in this paper. Some of the challenges (highlighted by all project participants) are related to the implementation of the emerging results from the R&D network (in the daily operations at every participating university) – the *context*.

"[…] summarized, the biggest obstacle is teachers' unwillingness to change and lack of time, which means that we do not have time to implement changes even if we can identify the need. (Project Member, Big Uni)

At one university one interviewee even viewed the *content* as a "flash in the pan" or a as a token of opportunistic, market oriented, behavior linked to the overall Bologna Declaration and especially the focus on learning outcomes and employability. At another university the student representative phrased the challenge regarding implementation in the following way also linked to organization culture: "You have to be a warrior to make your opinion heard […]" [Student Representative, International Uni].

To assess colleagues by analyzing the learning outcomes of their courses is not considered as appropriate and certain questions were not allowed to be asked. This is an obvious challenge when trying to develop IS education. An organizational culture like this shows a lack of respect for opinions from colleagues and students (cf. Handal's critical friends, 1999). A culture like this also stresses the question of ownership of a course. Who owns a course? Who owns the learning outcomes? The university? The school? The study program? The director of studies? The teacher? The students? We identify a need to open up the black box that a course can be. To be explicit about the design, content etc. To invite to dialogue and criticism (cf. Handal, 1999). To be inspired by the research process and the seminar.

Another challenge is the student involvement. Perhaps the focus of the project *content* is not perceived as super important to students? - At least not in a development phase. Compared to the interest of updating the course content as such, the students' interests in learning outcomes are rather weak. This has resulted in some challenges regarding the level of student involvement.

The exploring nature of the project regarding the *content* is partially interpreted as a challenge – there is e.g. a lack of models and principles covering the issue of focusing learning outcomes.

The fact that the project members are colleagues *and* competitors – representing different universities is maybe more of a potential challenge than a present one in the network. The different profiles of the universities may have reduced the risk of competition affecting the project negatively. A collaborative advantage (cf. Moss Kanter, 1994) identified when setting up the project was identified and reported also at the end of the project when evaluating the collaboration *process*.

Different ways of working, at the universities, mentioned above, can also be regarded as a challenge (related to *process* and *content*) – not just a possibility to generate interesting R&D results. Challenges in the comparative analysis are one aspect.

From a project management perspective, the geographically distributed network is a challenge. There is a need that the present project should be a part of everyone's weekly agenda – but this is more challenging to achieve because the small talk (e.g. in corridors, coffee areas, lunches etc.) about the project *content* and *process* is not possible to achieve. All the participants in the project are active teachers and researchers – an extremely good knowledge base and resource in the project – but also a challenge in terms of recurrent attention. Other, closer tasks and actors tend to get more attention which is a general challenge with distributed project and networks. The work has, besides to local activities at every university, been performed at a number of joint workshops and a number of distance meetings using Internet (Marratech software). Another activity introduced in order to reduce the challenges related to the distributed network was "writeshops" (cf. workshops). These "writeshops" were based on a boarding school metaphor and contained several parallel and linked writing processes with the aim to produce co-written paper drafts.

5.2 Interaction and Relationship Characteristics

The issue of interaction – not just one actor acting (Håkansson and Snehota, 1995) – has been important in the present cooperation. This is e.g. shown in the variation between the universities regarding methodology, focus, etc. We have also identified a number of crucial relationship issues that were important in the present cooperation. There was continuity in the relationships based on common post-graduate background (the use of social bonds; Håkansson and Snehota, 1995), an informal atmosphere in the project, and a matching of resources (resource links; ibid.). The latter aspect made the project content important for the participating universities trying to e.g. learn from each other when handling a new situation (the explicit use of learning outcomes) and understanding the different university profiles in IS.

The interaction between project members from different universities has also, e.g. in discussions and comparative analysis, been a situation where resources have met, been confronted and combined (cf. pooled resources; Hedberg and Olve, 1997, Håkansson and Snehota, 1995).

5.3 Other Lessons and Reflections

Some of the implementation challenges may have been reduced if a kick off activity (e.g. a conference for our colleagues at all four participating universities) would have been launched. Examples and needs from all universities could have been highlighted in order to anchor the project and the need for development in the different IS divisions.

In a final evaluation of the project we have also reflected upon the need to – even more - emphasize a deeper literature study and analysis early in the project and to make use of e.g. staff from the different universities' pedagogical development units. The overall reflection from the participating universities can be illustrated using the following citation: "We have certainly accomplished more together than what any of us could have accomplished in his or her own." (Project Member, International Uni)

6. CONCLUSIONS AND FURTHER RESEARCH

In the sections below we summarize the possibilities (6.1) and the challenges (6.2) (RQ1) identified in our analysis above. We also summarize lessons from the present development effort (6.3) (RQ2). This section is concluded with some remarks on further research needs.

6.1 Possibilities

- To perform relevant development work in cooperation with colleagues from other universities – learning from each other in a network, making use of different universities' unique profile, dilemmas and situations.
- To interact, pool resources, confront and combine them in a fruitful way in an IO

network in order to perform rewarding HE development work.

- To anchor the project well, in the appropriate context, with a rewarding content and an efficient process. This can make a real difference for participating individuals and organizations. A research process can be used as a blueprint for HE development.
- To allocate staff that is active in both teaching and research in order to build trust, legitimacy and to pool research handicraft skills.

6.2 Challenges

To be aware of the:

- Effort to be put into the implementation of ideas and issues developed in the network at every participating university. This is not necessary a part of the development work – but needs to be taken into account early in the development work in order to create a platform for change. Change takes time! Implementing the results from the project in teachers' everyday life is an important aim in the AR project.
- Challenges related to distributed teams in IO networks – the lack of "small talk" (mutual adjustment; cf. Mintzberg, 1983) when coordinating the project on an everyday basis.
- Critical and sensitive matter of opening up the black box of courses – from design all the way to evaluation and redesign. Critical friends (Handal, 1999) are a good ideal in theory – but a delicate matter in practice. This aspect is related to the ownership of courses, organization culture, etc.
- Importance of creating a project that is legitimate in the different organizations.
- Importance of having students involved in relevant parts of the development work.

6.3 Lessons Learned

The network analyzed in this paper is a joint "problem solver"; a "functional network" (Fincher, 2002) using collaborative advantage (Moss Kanter, 1994) as a point of departure. The possibilities and challenges above summarize the lessons learned from the cooperation regarding e.g. the need to involve active teachers and researchers, to manage distributed teams, to be aware of the critical and sensitive matter of opening up the black box of courses using critical friends, and the time and effort needed for anchoring projects and changes.

The present work, both as a process and as a result, becomes a part of the participating universities' ordinary course and program development work, quality assurance processes, etc. This is a challenge but also an opportunity. Local supporters and stakeholders are needed in order to promote the knowledge base developed in the present project and in order to gain sustainable results in the organizations. This is in line with e.g. Baume's (2002) insights regarding planning and management in networks for educational development.

6.4 Further Research

Further research is needed in order to further anchor the results more thoroughly in theory and in practice. However, the findings above are an illustration of the possibilities and challenges when developing IS HE in an IO network. To add an international dimension (e.g. a comparative case study) could be interesting both within the EU (and the Bologna Declaration) and outside EU.

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Peer Mentors and Their Impact for Beginning Programmers

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Abstract

The Computer Science department at SHSU is currently employing student mentors to assist with recruitment and retention. The primary purpose of these students is to help frustrated new majors in the beginning programming course realize that they are not alone in their struggles and to assist the students over hurdles in their learning and skill development. We examine the impact of peer mentors on students, including a breakdown of that impact across underrepresented groups.

Keywords: mentoring, retention, tutoring, social networks

1. INTRODUCTION

The Bureau of Labor Statistics in the U.S. Department of Labor predicts 34% growth in software engineering and 17% growth in IT management positions between 2008 and 2018 (Bureau of Labor Statistics, 2010a, 2010b). Enrollment in computer science, computer engineering, and information systems is increasing, although evidence suggests that work still needs to be done on recruiting and retaining capable students who will complete these degrees (Zweben, 2009). However, the reported number of majors does not begin to match the predicted growth of the field, even without considering the retirement and promotion of current IT workers.

Efforts need to be made across the education spectrum to attract and retain individuals to help fill this need. At the college level, we can take steps to ensure that capable majors do not become unnecessarily frustrated and discouraged without lowering our expectations; some of these same steps can create an environment that will attract students who did not, at first, consider a computer science or information systems major.

In 2009, the Texas Workforce Commission awarded SHSU the Texas Youth in Technology grant as part of an effort to recruit and retain students in technology-related majors. In addition to scholarships and travel money to bring us to high schools and bring high school teachers and counselors to us for workshops, the grant included a payroll budget for up to ten students who would act as peer mentors and support our recruitment efforts.

Students who are programming for the first time may view coding errors as a personal failure on their part, getting frustrated as hours pass without success. Some students, upon seeing a correction increase the number of reported syntax errors, will immediately re-introduce the original error to make the numbers go back down (D'Souza et al., 2008). They need to be reassured that errors are normal and that they have someone to which they can turn if they are unable to make progress. Students are more likely to seek assistance from a fellow student closer to their own age than they are a graduate student or, especially, a professor (Miller & Kay, 2002). The authors disliked "bothering" professors with questions, often thinking that they expected us to be able to design a solution without their assistance. However, we welcomed and occasionally sought advice from our fellow students. Asmar et al. (2000) stated that Freshmen view their peers as their most important support system; also, new majors will often change to a different major if no peer interaction is easily available (Barker, McDowell & Kalahar, 2009).

The department is very excited about the mentoring program, and the students appear to view it as a very positive addition to our program. A number of majors, including the mentors, themselves, have expressed regret that peer mentors were not available when they were starting the major.

We have conducted surveys of students before and after they have participated in the mentoring program and present our findings regarding the perceived impact of the mentoring program across gender and ethnicity. In addition, we share some lessons learned and ideas for the future.

2. CURRENT DUTIES OF MENTORS

The CS major at SHSU begins with a course in beginning programming using the Java programming language and includes a lab for hands-on work. A second course introduces basic data structures and deepens their understanding of algorithms and Java. Ten undergraduate students, many of whom are within a year of taking these courses, work with the students currently enrolled in these courses to help them understand course material, assist them over a mental block that is preventing them from completing assignments, and simply assure them that problem solving is sometimes difficult for everyone.

The ten more experienced undergraduate students are employed primarily as mentors. One to three mentors are assigned to a lab so that students get to know them and can ask for assistance without having to wait for the instructor or lab assistant to become available. Mentors are encouraged to be pro-active, ensuring that students have their e-mail or phone number, offering struggling students extra tutoring outside of class, and organizing study groups to help clarify issues and review for exams. In order to meet the needs of students who don't want to wait for the next lab or even e-mail reply, mentors are required to maintain known office hours so that students can seek assistance outside of class. Originally, students were required to come to an actual office to meet with mentors face-to-face, but the department has recently organized an independent computer room that can be used as a work area for the students; the mentor can then maintain a visible presence in an area where the students may choose to work, in any case.

In addition to their duty to support the beginning students, the mentors also assist us with recruitment efforts. Depending on their skills, they may assist us with the development or updating of recruitment videos, presentations, and tutorials. The presentations inform high school students, teachers, and counselors of the ways in which our major can help people achieve technology-related goals and inform them of related job opportunities. The tutorials are offered as part of a teacher workshop and provide teachers with tools that can encourage students to learn computational thinking and develop an interest in how technology can be used to accomplish goals. Mentors are also sent to high schools to make presentations for classes and at career fairs to let students know about the major and its opportunities.

By participating in these presentations and workshops, we hope that the mentors, themselves, will develop a better understanding of the major and the job opportunities to which it may lead. Ideally, mentors should be able to offer guidance and advice from their slightly greater experience that can impact students' college experience and awareness of career choices while helping them build a solid foundation for the major.

3. IMPACT OF MENTORS

Instructors of the beginning programming course often express their appreciation of the mentoring program. In order to evaluate the impact of the mentors on the students, themselves, we surveyed the students at the beginning and at the end of the semester. Then, we broke down the results into different groups to see if the mentors had a greater impact on any particular group, such as underrepresented groups.

Methodology

In spring 2010, the enrollment was 115 from Introduction to Programming (87) and Introduction to Data Structures (28). The collected post-program survey sample was 56 which made a 48.7% of participation rate. The survey was constructed with a total of 14 questions divided into two parts (see Appendix A). The first part is constructed from seven demographic information questions with multiple-choice selection. The demographic questions included the age, ethnicity, gender, classification, transfer students, state financial aid support, and the methods of seeking help from a mentor. The second part included six Liker-scale questions and one open question regarding the students' expectation of the mentoring program (based on 5 scale system: 1 as being the least and 5 as being the most value). The Liker-scale questions allowed us to discover students' perception of the degree to which the mentor assisted their success in the course, impacted their college life, helped them select their future career path, participated in building a solid foundation in the major, and made them feel more a member of the department "family." The demographic questions allowed us to compare groups based on gender, ethnicity, and the degree to which they made use of a mentor either in the lab or outside class.

Analysis

The research hypotheses to be tested were as follows:

H1: The mentoring program has a profound impact on those who take full advantage of it.

H2: Students of underrepresented groups will find the mentoring program to be of higher value than others.

To test these hypotheses, the Statistical Package for the Social Sciences (SPSS) version 17.0 was utilized to determine if significant differences existed among the students' demographic information and their responses for each research question. Data was analyzed with independent t-test, cross tabulations, and analysis of variance (ANOVA).

Findings

Overall, students agreed that the mentoring program was valuable. Our impression that underrepresented groups might not be as confident and, thus, perceive a greater value in the program was not reflected by the results, largely because all groups valued the program, highly, at least with regard to its support of the course, itself.

Seventeen female (30.4%) and thirty-nine male (69.6%) samples were collected from this study. We found that there was not a statistically significant difference between genders in all of the post program survey items (see Table 1 in appendix 2). However, the females' mean scores were lower than the males' mean scores, except, specifically, for the question about the mentors' assistance in the course; female participants valued the mentors' assistance in the course more highly than male participants (see Table 2 in appendix 2).

Regarding the utilization of mentors by students, this study found that all of the female students used the mentoring program. 53% only used mentors during the lab time, and 47% took advantage of mentor support outside of lab, as well. For male students, 2 male students reported that they did not use mentors at all and 1 male student only approached mentors outside of lab. 41% of males stated that they only used mentors during the lab time; 51% used mentors both in and out of lab time (see Table 3). Since there were only one or two students who responded to the items of "Did not use mentors" and "only use mentors outside of lab", we will ignore these two items for the rest of the analysis.

We found that there are no statistically significant differences among ethnic groups in all of the post program survey items (see Table 4). However, certain trends were observed in the mean scores; due to the small sample size, particularly among underrepresented groups, further data should be collected to confirm these trends. This study found that the mean score from the Hispanic group is higher than the rest of the ethnic groups' mean scores on almost every item (see Table 5). Moreover, we found that the African American group joined the Hispanic group as the top two groups who value the mentor program and stated that the mentors did indeed assist with their success in the course.

To verify the validity of the feedback, we also added the one-sample t-test to compare with a value of 2.75 (above average from 5 point scale) to determine to what degree the students evaluate each survey item. We found that each survey item showed statistically significant difference (see Table 6), except the items that asked if mentors were of assistance to the students in their college life, in general, and their future career path. We were not surprised to see those two items show a minor lower score than the rest of the survey items, because the beginning programming course is used to introduce programming to other majors who often question why they must take it. One of the students provided the following statement: "I am an MIS minor so the mentor didn't really need to help with my success in college life or my future career path, but he was very helpful with my [course] work."

Based on the feedback and the statistical analysis, we confirmed Hypothesis 1, the mentoring program has a profound impact on those who take full advantage of it. The breakdown by student participation with mentors proved unnecessary as even those who did not utilize the mentors recognized their value. Hypothesis 2, students of underrepresented groups will find the mentoring program to be of higher value than others, was not significantly confirmed because all groups found the mentoring program helpful and the number of members in underrepresented groups was too small for firm conclusions in this case. However, the numbers do suggest that underrepresented groups do value the program slightly more in helping them get through the first major courses.

Students' Thoughts about the Mentoring Program

At the end of the survey, we asked the participants to provide some feedback about the mentoring program they experienced. There were 20 responses provided, all of which constituted positive feedback. To reach the goals of our mentoring program, we are glad to hear that there were significant and positive impacts in the mentees' learning and future plans. The following are some common statements we found:

For Mentors:

"Always ready to help."

"I appreciate the help they have given me."

"Mentors were very friendly, understanding, and helpful."

"The mentors helped a ton!"

"Very kind and patient."

"Very patient and helpful. Also very nice."

"They were all very great and helpful."

For Mentoring Program:

"I think the mentor program is excellent."

Impacts in their Learning:

"I felt that the mentors in my lab greatly helped me in developing in Java programming."

"I would like to help people when they need it."

"They helped me understand the basic concepts behind the subjects in the class and helped me be successful in the lab and class."

Contrary to expectations that students who refused to take advantage of the program might not appreciate it, one of the students who did not use the mentor stated that "I never really used the CS mentors. They rocked though!"

4. FUTURE POSSIBILITIES

We were awarded a grant that allows us to pay our mentors. We have been forced to handle a small number of situations where students were just looking for any job and were not mature enough to handle flexible hours and remain sufficiently pro-active about helping students. Many of our mentors, however, have truly risen to the challenge and exceeded our expectations. It may be that a system of rewards for volunteer mentors might address that issue. If students are only paid in experience and opportunities, then only motivated students would apply. At some point, we may want to try motivating participation with something other than money.

Our students, some of whom have little support from parents, tend to feel pressure to take a job while in college, so we were concerned that volunteer mentors would not spend enough time working with students between the requirements of their job and their own classes. However, some of our better mentors actually push themselves to maintain a second part-time job while continuing to maintain high involvement with their students, so this reasoning may be flawed. Consistently well-motivated students would have an even stronger impact on new majors.

Mentors report learning valuable leadership and communication skills while also improving their own understanding of the field as they try to determine how to explain aspects of it to their students (Miller & Kay, 2002). If these advantages are, by themselves, insufficient to motivate participation in the mentoring program, other rewards that would appeal to better students might be used, such as the opportunity to take classes for honors credit or the opportunity to work on professors' research with the option to gain credit in an independent study course.

Studies have shown that students gain a greater understanding of the possibilities of their area of study and its appropriateness for them through greater professor-student interactions (Crenshaw et al., 2008) and are more likely to stay in a major with healthy peer networks (Barker et al., 2009). Rather than consider these concerns in an isolated fashion, departments should make an effort to integrate professor and peer mentoring throughout their program. The computer science department at Appalachian State University seeks to make mentoring a priority by establishing it as the natural behavior for interactions between professors and students (Tashakkori, Wilkes & Pekarek, 2005). Professors write prescriptions for students in need of help and occasionally participate in peer mentor sessions to offer guidance to the mentors at least as much as the mentees, helping both to learn from the experience. In addition, more advanced students are selected to work directly with professor and graduate student mentors on more advanced material related to research.

Many mentoring programs referenced here rely on volunteer participation. Rather than paid tutors, the goal is to create "communities of scholars" (D'Souza et al., 2008). Although paying for basic assistance during labs might still make sense, utilizing every student with a willingness to serve could conceivably meet students' needs more effectively. Advanced mentors could help new mentors as well as students in sophomore or junior level courses. Mentors enrolled in sophomore and junior level courses would help new majors in the freshman level courses. The instructors would meet with mentors helping their students, and the advanced mentors would work directly with professors who would share their research and teaching experience. Mentoring would become an accepted part of the learning experience instead of a part-time job.

4. CONCLUSIONS

Healthy IT salaries in the United States make it easy for countries with growing technological expertise to compete. Failure to inspire students to prepare for technology-related careers will logically require that industry look elsewhere for their technological needs. When technology-related jobs and technological innovation are primarily overseas, how will this affect the U.S. economy and our own ability to keep IT and CS departments active?

No doubt a media campaign and K-12 education reform are necessary components of any long-term plan to improve the strength of U.S. technology, but the truth remains that many students are getting frustrated and considering a change of major before they truly see what is possible in the major. Making the mentoring of students a priority is one step we can take toward meeting the needs of industry and our economy. Recruiting mentors from underrepresented groups will also provide role models to other members of those groups; however, mentoring benefits everyone.

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Appendix 1

Mentee Survey: Post-Program Survey

Name: ____ Date: ______________

Demographic information: Please circle the proper status.

Age	Younger than 18	18	19	20	21 and older
Ethnicity	African American	Asian American	Hispanic American	Caucasian American	Other
Gender	Female	Male			
Classification	Freshman	Sophomore	Junior	Senior	
Transfer Student	Yes	No			
State Financial Aid Support	Yes	No			
Sought help from mentor	Never	In Lab	Outside class		Both

Please answer the following questions based on a 5 scale-system: 1 as being the least and 5 as being the most value.

To what degree have you benefited from your participation in the mentoring program in the Computer Science Department?

1 2 3 4 5

To what degree do you believe the mentor assisted your success in ***your course***?

1 2 3 4 5

To what degree do you believe the mentor assisted your success in ***your college life***?

1 2 3 4 5

To what degree do you believe the mentor assisted your success ***in selecting your future career path***?

1 2 3 4 5

To what degree do you believe the mentor assisted you with ***building a solid foundation in the major***?

1 2 3 4 5

To what degree do you feel the mentoring program helped you feel ***more a member of this community***?

1 2 3 4 5

Please share your thoughts on other ways that the mentoring program has assisted you:

Appendix 2

Analysis

Table 1. Gender Independent Samples Test

Survey Item	*t*	*df*	*Sig. (2-tailed)*
Benefitted from Mentor Program	-1.570	52	.122
Assisted with success in this course	.624	54	.535
Assisted with success in college life	-.051	54	.960
Assisted in selecting future career path	-1.622	54	.111
Assisted in building a solid foundation in the major	-.519	54	.606
Helped you feel more a part of this community	-1.687	54	.097

Table 2. Gender Group Statistics

Survey Item	*Mean*		*Std. Deviation*	
	Female (*N*=17)	Male (*N*=37)	Female (*N*=17)	Male (*N*=37)
Benefitted from Mentor Program	3.823	4.243	.951	.895
Assisted with success in this course	4.471	4.333	.717	.772
Assisted with success in college life	3.059	3.077	1.197	1.244
Assisted in selecting future career path	2.647	3.231	1.367	1.180
Assisted in building a solid foundation in the major	3.882	4.026	.857	.986
Helped you feel more a part of this community	3.412	3.974	1.372	1.038

Table 3. Gender related seeking help from the mentors

Participation	*Female (N=17)*	*Male (N=37)*
Did not use mentors at all	0 (0%)	2 (5%)
Only use mentors during lab	9 (53%)	16 (41%)
Only use mentors outside lab	0 (0%)	1 (3%)
Use mentors both during and outside of lab	8 (47%)	20 (51%)

Table 4. Ethnicity ANOVA Test

Survey Item	*Mean Square*	*F* (*df*=4)	*Sig.*
Benefitted from Mentor Program	1.027	1.220	.314
Assisted with success in this course	.597	1.059	.386
Assisted with success in college life	.759	.492	.741
Assisted in selecting future career path	.429	.257	.904
Assisted in building a solid foundation in the major	.951	1.073	.380
Helped you feel more a part of this community	1.073	.910	.465

Table 5. Ethnicity Descriptive

Survey Item	*Mean of Ethnicity Groups*				
	Africa American *N*= 8	Asian *N*= 4	Hispanic *N*= 6	Caucasian *N*= 33	Other *N*= 3
Benefitted from Mentor Program	4.250	3.500	4.667	4.091	3.667
Assisted with success in this course	4.500	4.000	4.500	4.429	3.667
Assisted with success in college life	2.625	3.250	3.500	3.057	3.333
Assisted in selecting future career path	2.875	3.250	3.500	3.000	3.000
Assisted in building a solid foundation in the major	3.875	4.000	4.333	4.029	3.000
Helped you feel more a part of this community	3.875	4.500	4.167	3.714	3.000

Table 6. One-Sample Test

Survey Item	*Mean*	*t*	*df*	*Sig. (2-tailed)*
Benefitted from Mentor Program	4.111	10.815	53	.001 **
Assisted with success in this course	4.378	16.165	55	.001 **
Assisted with success in college life	3.071	1.973	55	.053
Assisted in selecting future career path	3.054	1.808	55	.076
Assisted in building a solid foundation in the major	3.982	9.771	55	.001 **
Helped you feel more a part of this community	3.804	6.759	55	.001 **

Note. **P* value < .05; ** *P* value <.001

Non Directed Utilization of a Hand Held Device: How Does a First Year University Engineering Student Use an iTouch?

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ABSTRACT

Handheld computer technology has been available for decades. The college student today has been exposed to various types of handheld computing devices for most of their lives yet there is little known about how a college student utilizes this type of technology tool as a learning advantage to an anytime or place scenario. This study looks at how one incoming class of freshman engineering students at a mid-sized university in Western Pennsylvania utilized Apple iTouch PDA/Mobile computing devices they had been given upon their enrollment at the university. Survey questions resulted in no significant trend in usage. Personal use and curriculum use resulted in an even split. There was a strong indication of expected future usage.

Keywords: iTouch, Mobile Computing, Communication Technology, Social Networks, Instant Messaging, Twitter, Enrollment Incentive

1. INTRODUCTION

The Technology world has always experienced an inexorable march of progress that has devised devices that constantly push the limits of smaller, faster, and more powerful. Over forty years ago, Gordon Moore predicted that the number of transistors that can be placed inexpensively on an integrated circuit has doubled approximately every two years (Moore, 1965). This prediction came to be known as Moore's law and a benchmark for computing power. Today it is undeniable that this march of advancement has produced systems which are available to everyday consumers that allow for tasks to be accomplished in ways unthinkable just a short time ago.

"Over the next decade, the raw materials--technology, computers, disc space, bandwidth--will get cheaper and more powerful at a very rapid rate. Our job is to figure out how to layer invention on top of those raw materials to make things that actually matter to people (Bezos, 2005)." This is a quote from Jeff Bezos, the founder and CEO of Amazon.com that was published in 2005 just as his company was beginning to lay the ground work for a seismic shift from just selling books online to becoming one of the leading developers of Cloud Computing. Mr. Bezos sought to take those resources he found available and utilize them in a very productive and beneficial fashion. This lead to Cloud/Hosted services, not just for Amazon, but also for the millions who now utilize the services. This is not always the case with innovative ideas. Much of the most popular and profitable applications utilizing this wellspring of new found mobile power and connectivity are considered by many to be frivolous or simply entertainment (Jones, Johnson, and Bently, 2004). While companies like Amazon and Apple have leveraged the new channels of delivery to great success, traditional outlets of primary content such as newspapers, magazines, and book publishers have been attempting for decades to find ways to leverage many different delivery methods in meaningful and money making ways with little or no success.

The history of content delivery through technology can be traced from cave drawings, through Johannes Gutenberg and movable type, Guglielmo Marconi and radio, Thomas Edison and moving pictures, Philo Farnsworth and television, to DARPA and the Internet of today. This is not even including so many of the other technologies too numerous to itemize but significant nonetheless, such as Alexander Graham Bell and the Telephone, or even Samuel Morse and the Telegraph. There is always something new, a different way of getting a message from point A to point B. Technology Acceptance Models (TAM) can begin to explain and predict how some devices become ingrained into everyday use while others fade away to obscurity. The TAM's are based upon the argument that the individual impact of perceived usefulness and ease of use of technology will influence the attitude of an individual when using a particular technology and will have an impact on behavioral intent and continued use of computer technology (Davis, Bagozzi, Warshaw, 1989). The current environment has proven this notion time and again as the introductory market of gadgets proves that in a battle for survival and adoption, designers and manufacturers must push the envelope of development, while also driving ease of use for the general consumer. The product that can make a person feel like an instant expert when first touching the device is the product that is going to thrive. It becomes, in and of itself, a resource. It becomes one of the raw materials that Mr. Bezos speaks of that can be used as a conduit, or as a tool – a pathway to other things.

An Apple iTouch is a mobile computing device that is capable of many different tasks. As a basic computing system, it certainly fits a definition of allowing for input through a touch screen interface, and WiFi networking. It allows for gigabytes worth of storage internally, and through networking infinitely more with Cloud storage. Processing allows for many different applications to be run, anything from games, internet browsers, movies and music, to productivity software such as word processors and spreadsheets. Output of these applications can be displayed through the screen interface or sent as files through networking. The iTouch is by definition a computing device in every sense. While other Apple products such as the iPhone and iPad, might have captured the public fancy and become best sellers, the iTouch is still a very viable computing platform. The iTouch has a much smaller price tag yet runs the same iOS4 as it's other Apple mobile brethren.

Since the mid 1990's, more and more colleges and universities have been utilizing technology giveaways as part of incentive programs for student recruitment (Finn and Inman, 2004). What began as a laptop for computer science majors has branched into notebook computers for all incoming freshmen at some institutions. With the release of the Apple iPad, more than a few schools were very quick and willing to use the newest and shiniest gadget as a symbol of their commitment to being current with technology (Young, 2010). It is an easy sell and essentially a no brainer of a promotion for a school's recruitment department. The problems is, though, are these devices just so many 'pull over fleeces' or 'carry all tote bags' free with your subscription? Or can they be utilized to become a part of the curriculum and *matter* when it comes time to be in the classroom?

This study will look at how one incoming class of freshman engineering students at a mid-sized university in Western Pennsylvania utilized Apple iTouch PDA/Mobile computing devices they had been given upon their enrollment at the university. These devices were handed out to the students with no strings attached. They became the property of the student and were not to be returned to the university at the end of the term, or upon graduation. The devices were also not integrated in the curriculum of the courses the students were enrolled in. No special steps were taken to utilize the iTouch in the classroom specifically; eBook editions were not mandated for any course. The use, or non-use, of the iTouch was completely up to the student.

The purpose of this study is to determine, given the opportunity to have such a powerful and mobile piece of computing in their hands, what did a group of engineering students use their iTouch for?

2. LITERATURE REVIEW

The current generation of college student has been exposed to handheld computing devices most of their lives. These devices range from the handheld video game to the more sophisticated applications available on the iPhone. With student familiarity with handheld computing devices it would seem that the natural next step would be to utilizing this type of tool as a teaching, learning advantage to extending the classroom curriculum to an anytime or place scenario (Jones and Johnson, 2003; Yuen and Yuen, 2003). That natural next step does not seem to have materialized.

Although some modular computing devices existed through the 1970s and 1980s, the field of hand held computing was successfully pioneered commercially seventeen years ago in 1993 by the introduction of Apple's MessagePad. A few years later, PalmPilots popularized the technology and the acronym PDA (Personal Digital Assistant) became common. Yet after almost two decades, incorporating the wireless-enabled handheld computing device for classroom use has been minimal with only the fields of medicine and law utilizing this type of tool in their curriculum (Olsen, 2002; Shields & Poftak, 2002).

Medical schools and nursing programs were quick to adopt the handheld devices because many medical software packages were made especially for PDA's and widely available. In one example, Robert Morris University had implemented the distribution of PDA's to all incoming freshman for more than ten years. The students are using the devices to check medical references, compare interactions of prescription drugs, and also to share notes. Carlson conducted a study on the effectiveness of legal-study materials on PDA's at Stanford University (Carlson, 2002). However, Computer Information Systems education, where handheld computing would be expected to be found, has only referred to handheld computing in course topic coverage and as a platform for systems deployment (Jones, 2000; Mull and Lutes, 2001).

The focus of research literature on the use of handheld computing in an academic environment has primarily been reported in educational trade publications and on Internet/web published testimonials on vendor sites. Some research in the usage of handhelds has centered on use as required in specific curricula. This approach is limited in that it ignores the individual choice in usage by the student (Jones, 2002; Johnson & Rudd, 2003: George, et.al. 2010). This study explores the usage and non usage by a group of Engineering freshman students that were given a free iTouch device at the beginning of their freshman year.

This investigative study into the uses of Apple iTouch mobile computing devices utilized a survey as the research instrument to gather information from current first year engineering students of a single academic institution. It is the goal of this study to identify if these personal choice usage trends can lead to a better integration of mobile computing devices into the University environment.

3. METHODOLOGY

University X, a private suburban 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 2009, Spring 2010, University X had 22 first year students enrolled in the Scholarships in Science, Technology, Engineering, and Mathematics (S-STEM) program who plan to major in one of the fields offered by the School of Engineering, mathematics, and Science.

A survey was developed to gather information on how much students were using the devices, whether they were using them for personal or course work, and what their common activities were. (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.

E-mail invitations were sent to all 22 individuals as determined through their inclusion within University X's enrollment as first year students in the University X Engineering school. The invitations were sent April 20th, 2010 with one follow up reminder sent one week later on April 27th, 2010. At the completion of two weeks, 10 surveys had been returned though the web collection service

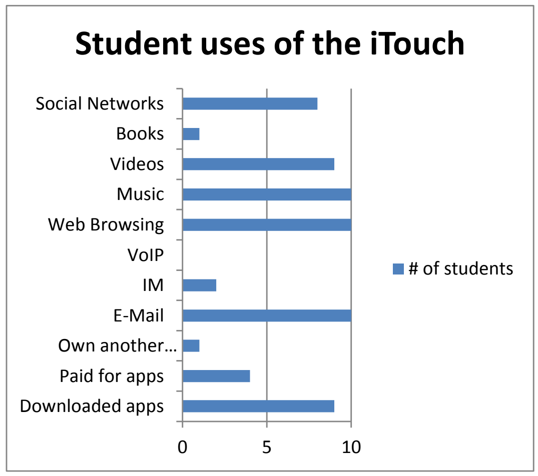
4. RESULTS

Of the 22 students who received iTouch devices, 10 (45%) responded to the survey through ESurveyPro.com, an online survey service. In Question 1, all ten of these respondents replied that they had used the device. When asked in Question 2 how often they use the iTouch, four responded at least once a week, three that they used the device two to three times a week, and three responded that they used the iTouch multiple times a day. One of the ten respondents responded to the Question 3 that they had used the iTouch only for personal use. The remaining 9 all responded that they had used the device for both personal and course activities. When asked if their use had been more personal or course related in Question 4, three fell into the more personal category; three fell into the more course work category, while 4 determined that they had used the device about equal for both course and personal use.

Question 5 asked the students if they had any other mobile device capable of accessing the internet. Two of the student did have such a device, while the other 8 answered that they did not. Question 6 began a series of questions inquiring into various areas of use for the iTouch. For Question 6, nine of the students responded that they had downloaded an application at some point. Only one student had not downloaded any applications. In Question 7, five of those having downloaded applications only had done so with free applications. Four of the students had paid. The tenth corresponds to the lone subject who had not downloaded any applications. Question 8 provided an opportunity for the participants to supply five of their most used applications, with five doing so. Facebook appeared 4 times, a general "Games" showed twice. Others submitted include Angry Birds, Wapedia, IMDB, Weather, Pittsburgh Penguins Mobile, Table of the elements, Unit Converter, and a dictionary. Facebook was named by 2 in Question 9 asking what the favorite application was. Angry Birds and Wapedia also received a vote each.

In other more general use category questions, all ten survey participants responded to Question 10 that they had performed a search of the internet through the iTouch. Nine of the ten responded to Question 11 that they had played a game. Question 12 saw all ten replied that they had played music with the device. In Question 13, nice of the ten had viewed a video with the mobile. In response to Question 14, only one student had read a book through the iTouch.

In terms of communication, Question 15 asked if the students had used the iTouch for sending E-mail, Instant Messages, or Tweets. Eight responded that they had sent E-mail. Two used the device to send both E-mail and Instant Messages. One user reported that they had not sent any messages through the device. Question 16 asked if the iTouch had been used to utilize any Voice over Internet protocol (VoIP) applications, such as Skype. Only one of the ten responses indicated that the mobile device had been used with a VoIP program. Question 17 asked if the users had updated any social networking profiles through the iTouch. Eight of the response said that they had updated a profile, with two responding that they had not.



Self-assessment of the importance the device has in their everyday lives was the subject of Question 18. The students were asked to rate the importance of the device in their lives from 1 (not very important) to 5 (very important). The spread was exactly even. Amongst the ten responses, each ranking of 1 through 5 received two votes each. Question 19 asked for a forecast of future use. Six responded that they expected to use the iTouch about the same as they have. Three felt that they would be using the device somewhat more, while one expected to use the mobile device much more. When asked in Question 20 what they would be using the device for in the future, another even split was found. Four responded that they expected to use the iTouch more for personal use, with the same number responding that they expected to use it more for course work. Two did not respond to this question.

Question 21 allowed for free comment responses. Three students supplied their personal views. One positive user said, "I Also have an iPhone. The best part about having the iTouch does not have to carry around a laptop to class." The other two responses were not as glowing. One user stated, "Mine has had issues like freezing so I've had to restart it. Also the headphone jack is broken and doesn't register that it has headphones plugged in. They're useful but faulty sometimes." The final comment also described issues, "It is not really that feasible to use for course work, other than checking emails, because you cannot write papers or anything like that."

5. DISCUSSION

Charting the use of a changing technology is difficult task, but an important one. In the case of wireless and mobile computing systems it is becoming more and more essential to garner hard facts and numbers to support decisions from both manufacturers as well as consumers. Very significant failures have been incurred by major players in the smart phone and mobile computer communities. Palm lost their chance of survival as a company and was sold to Hewitt Packard after the failure of the Palm Pre and Pixi phones to meet sales expectations in late 2009 and early 2010 (Vance and Wortham, 2010). Microsoft has pulled their latest effort in the smart phone arena, the Kin, after only three months of its arrival on the market place and some reports noting that only 500 units had been sold in that time (Buley, 2010). How could such significant companies get it so wrong?

Investment firm Morgan Stanley's unique approach of utilizing a 15 year old to create a market analysis report on how his peer group utilized and consumed various forms of media blew commonly held conventional wisdom out of the water (Robson, 2009). In his report, Mr. Robson noted such observations that whist the vast majority of his peer group were very active on Facebook, almost none used Twitter. The common sense reason was that to use twitter to its fullest extent would require the user to expend text messages, a commodity best spent in direct communication rather than updating a site few others in their group used, if any (Robson, 2009). Another observation from this report was that very few of Mr. Robson's peer group owned smart phones due to a combination of cost of the phone, fear of loss of the phone, and the reluctance to enter into long term contact commitments for data plans. Microsoft may have been able to avoid the embarrassment of the Kin phone directly marketed to this age group had it analyzed this report more closely. Instead it has lost millions of dollars and another chance at re-entry into a burgeoning market they have been all but locked out of.

From a consumer point of view, choosing what to buy, and when, becomes a game of risk assessment. Just as a company cannot afford a product line failure such as the Palm Pre, many individuals cannot afford to back the wrong device in their purchasing decisions. With long term contract commitments and early termination fees, the cost to and individual can be great in terms of money, but also equally great in terms of prestige and appearance. The cost to an organization such as a law firm or a school can be multiplied even more with the quantity purchased in bulk as well as expenditures that may be incurred in extra infrastructure to support the devices. Thus, for an education institution on a very strict and tight budget to advocate the purchase of any piece of technological equipment, there certainly needs to be some hard numbers that the device is going to be used, and continue to be relevant, for a certain time of life cycle to justify the risk of purchase.

In looking at the use of a wireless mobile computing device such as the iTouch, certain patterns can begin to emerge that can help in gauging how other technologies may be used. From the results of this survey of first year university students, it is seen that at least part of Mr. Robson's observations of younger telecommunications users is true. Only one user in this group possessed a second mobile device that was capable of accessing the internet. What was also of note was that no users reported utilizing the device for VoIP usage. Though much has been made over the popularity of services such as Skype, none had utilized the free method of making telephone calls over the internet.

As for being a significant feature in their lives, no telling trend was found. The split was exactly even for each stage of relevance from significant to irrelevant. What was important was that every respondent expected to use the device more in the future. Again there existed an even split on whether this increased use was to be for personal use or course work – but all did expect the iTouch to become a bigger part of their lives.

Without the iTouch being integrated into the curriculum of any specific class, there was little motivation for the students to purchase or seek out any e-book versions of their texts. Thus only one reported having read a book on the device. This could be significant when deciding to force a change from print to electronic versions of texts.

Several areas exist of further inquiry for this study and environment. The limitation of having a small sample can be overcome through the continuation of following these students, as well as the next group of incoming first year students. It is suggested that the initial survey should also be followed by in person interviews for clarity and depth of insight into the reasoning. Also, given the brief nature of the survey, it is strongly advisable that it be administered in person rather than online. Another line of research should begin to include the instructors of the courses for these students.

It should be investigated if these professors would begin to include the use of these devices into their class plans, or even if the faculty is prepared to do so.

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Appendix A:

Survey Questions (*possible responses in italics*)

1. Have you used your ITouch? *Yes / No*

2. How often have you used your ITouch? *Multiple times a day – at least once a day – 2-3 times a week – used it once and never again*

3. Have you used your ITouch for Personal use or Course related use? *Personal use – Course related use – Both*

4. If you have used your iTouch for both Personal and Course related use, which of the following applies: *More personal use – About equal use for both – More course related use*

5. Do you own any other mobile device capable of accessing the Internet? *Yes – No*

6. Have you downloaded any apps? *Yes – No*

7. If you have downloaded any apps, have you paid for any? *Never downloaded apps – Only downloaded free apps – I have paid for an app*

8. List your top 5 most used apps? *(Open)*

9. What is your favorite app? *(Open)*

10. Have you performed searches on the Internet through the ITouch? *Yes – No*

11. Have you played any games on the ITouch? *Yes – No*

12. Have used the ITouch to play music? *Yes – No*

13. Have you used the ITouch to view videos? *Yes, Online – Yes, from file – no video viewing*

14. Have you used the ITouch to read a book? *Yes - No*

15. Have you used the ITouch to send E-Mail, Instant Messaging, Tweets? *E-mail – IM's – Tweets – None*

16. Have you used the ITouch to access a VoIP phone service such as SKYPE? *Yes - No*

17. Have you used the ITouch to update a social networking profile? *Yes – No*

18. Do you feel that the ITouch is an important part of your everyday life? *(1) Not important – (3) Somewhat Important –(5) Very Important*

19. Do you plan on using the ITouch more or less during the upcoming semester? *No Use – Somewhat more – Much More*

20. If you plan on using the iPod Touch more in the upcoming semester, will it be for personal use or course work use? *Personal use – Course work use*

21. Please enter any comments you would like to make concerning the iTouch. *(Open)*

22. If you would be willing to be contacted for further questions, please include your e-mail address below: *(Open)*

Integrating Health Information Systems into a Database Course: A Case Study

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Abstract

Computer Science is a rich field with many growing application areas, such as Health Information Systems. What we suggest here is that multi-disciplinary threads can be introduced to supplement, enhance, and strengthen the primary area of study in a course. We call these supplementary materials *threads*, because they are executed alongside the material presented in the course, reinforcing and augmenting it but not replacing it. Many studies have been performed on how making a topic more meaningful and relevant to students can improve their outcomes. Integrating Health Information Systems into the Computer Science curriculum can achieve this. In this paper, we present a case study in which the development of a health system is integrated into a Database course. The results indicate that students enjoyed the course more, were more motivated to complete the course project, and were able to learn and apply the core course materials more readily.

Keywords: multi-disciplinary, health information systems, threads, database, curriculum

1. INTRODUCTION

Computer Science (CS) is a field that is poised to grow in the foreseeable future, with lucrative job opportunities and interesting application areas. Even though the future is bright for Computer Science majors, many leave the major to pursue other career paths. "Rising crescendos of voices sound alarm about the sharp downturn in young people selecting a computing field for their careers…Finding people to fill the growing number of IT jobs will soon be more difficult than ever (Denning & McGettrick, 2005)." One reason suggested for this migration is a lack of knowledge or interest in the areas where CS skills can be applied.

The Association for Computing Machinery (ACM) has launched several initiatives to reverse the trend, including endorsing "experiments to find curriculum formulations that express better what computing is about and are more appealing (Denning & McGettrick, 2005)."

The case study presented here helps to support this idea of expressing what computing is about – why it is valuable and where it can be applied to benefit society. In this case, the path we take toward this goal is in merging the introduction of Computer Science topics, specifically database systems topics, with the quickly emerging field of Health Information Systems (HIS). Health Information Systems is an area that is currently growing and flourishing and is in need of skilled technical contributors. Recently, the US government has provided significant funding towards efforts in this area as well as emphasized patient safety and high-quality medical care initiatives (Cantrill, 2010). Data mining and analysis are being done on medical data that assist in treatment and advances in medicine. Greater progress can be made as computer scientists work together with doctors, researchers, and statisticians to record and utilize medical data appropriately.

What we propose here is the integration of Health Information System topics within a database design course. We present a case study of a HIS project that was integrated into a second-semester database course. In this course, the project was integrated to reinforce all of the concepts typically addressed in this type of course. Instead of utilizing a fabricated set of requirements, this work was done with a real set of HIS requirements produced by the Biomechanics and Motion Analysis Research Lab at the Mayo Clinic Rochester. The results were positive in that a system was produced, polished, and is now utilized by the lab. More important, the students were intrigued and invested in the project. This was clearly indicated by the improved learning outcomes. In this paper, we present details of the collaboration and its outcomes.

2. HEALTH INFORMATION SYSTEMS

First, let's examine Health Information Systems and the need for Computer Science contributors. Health Information Systems are systems used by the health care community that deal with managing health related information. Reichertz points out the "need for education in health informatics and/or biomedical informatics, including appropriate knowledge and skills on HIS. (Reinchertz, 2006)" In a recent CACM article, Cantrill points out that "there are many potential advantages from the application of health information technology (or HIT, the current buzzword). These include improved communication between a single patient's multiple health-care providers, elimination of needless medical testing, a decrease in medical errors, improved quality of care, improved patient safety, decrease paperwork, and improved legibility. (Cantrill, 2010)" The movement toward creation and adoption of these types of systems in the health care environment has many challenges. The systems are complex, and evaluation of the systems is difficult (Ammenwerth, Graber, Herrmann, Burkle, and Konig, 2003). Success is often elusive, with improper communication between those developing the systems and the end-users (Tan & Hallo, 2008).

It is interesting to note that when compared with other industries, health care is significantly behind in adopting information technology (Goldschmidt). Goldschmit believes that "Health Information Technology combined with the Internet is expected to foster patient-focused care, to promote transparency in prices and performance, and to enable consumers to drive the transformation of the health care system." These are formidable goals.

3. THE PROJECT

The integration of HIS as a thread in this course was achieved primarily through a semester-long project. The project in this course was a collaboration between the university and the Mayo Clinic's Biomechanics and Motion Analysis Lab. The Lab needed a database and web application that would allow them to record, query, and analyze patient data, both for the research and for clinical aspects of the lab. Eighty percent of the work they do is for research, with the remaining twenty percent for clinical work. Their problem was a common one in research-intensive labs. They have a large data set, and they would like to have the ability to utilize this data for their research goals. However, they do not have the technical staff or the technical knowledge to produce a system to achieve this. For example, clinical decision support systems can be introduced to improve patient outcomes (Hunt, Haynes, Hanna, & Smith, 1998). Initial data recording and analysis is a first step toward this goal.

A Kinesiologist from the Lab was in contact with us about developing a computer software system to support their research and patient care. This type of project could be utilized to reinforce the key ideas of database design and development that we wished to present in the course. It would also allow us to introduce the field of Health Information Systems, a growing application area for Computer Science. A partnership was formed, and development began. Requirements for their particular system were gathered, and database design alternatives were discussed in the context of the Lab's particular needs and specific data set.

The development of the project was done incrementally. It was partitioned into individual assignments that corresponded to the topics introduced in a more traditional manner throughout the course. But more life was breathed into the topics by having a real and interesting application area. The students came away with an understanding of key course concepts, the basic needs of Health Information Systems, and a real world project that sparked their interest. A description of overall course goals, as well as specific project goals and outcomes, are presented in the next section.

4. COURSE GOALS

Course goals included making students knowledgeable on core database concepts, along with the introduction of Health Information System concepts and team development experience.

Presentation of core knowledge was the number one goal of the course. Key concepts include the relational model, database design and normalization, interaction with a database from an application, and advanced database programming and security.

Additional learning surrounding Health Information Systems was a secondary goal. The discussion of HIS focused on its relevance to other course topics, and on how to apply database design techniques to HIS.

While team development was not a primary goal of the course, it was also a piece of the coursework. Team development proved to be of benefit in terms of student confidence, drive to complete the project, and growth of excitement in discussing the project.

In previous courses where team development was employed (and especially when an outside party was involved), we have utilized two different techniques. One approach was to use competition as a motivating factor. In past courses, teams of students were asked to produce solutions to the same problem. They were competing to produce the best solution. This often resulted in a very good solution by a subset of the teams. Some teams, however, became discouraged as they saw other teams developing more sophisticated solutions. They would eventually give up hope of having their solution "win", or be selected by the 3rd party in cases where outside organizations were involved.

An alternative approach is to have students cooperate to produce a single solution. Here, the job can be partitioned into multiple tasks that can be assigned to separate teams. As the tasks are completed, the resulting components can be integrated together. The benefit of this approach is that all teams contribute to and feel ownership of the final solution. This is actually a very "real world" approach.

However, there are several issues with taking the cooperative approach. First, it is only feasible with a project of fairly large scope, since there must be enough tasks to allow all to contribute. It requires a lot of organization and guidance from the instructor. Communication between teams needs to be increased. Learning communication skills is important for computer scientists, but it takes time away from learning the theory and technologies needed to complete the project. In addition, it can be difficult to include all of the desired course objectives into each team's portion of the project. Another key issue is when one team doesn't successfully deliver their portion of the project, and the final system is not completed successfully. This can be upsetting to the students, but it is more devastating to the client organization when one is involved.

A successful balance was achieved for this case study. The first part of the project involved the development of the database, which the class performed cooperatively. Many discussions were held regarding proper database design and normalization. These were key course concepts, and everyone was able to contribute and learn from this discussion. Output from this stage of the project included an entity- relationship model, which evolved into a normalized database schema.

In the next phase, groups cooperated in implementing the database tables and performing data entry. This was not done together as a class. Instead, pieces of the design were assigned to each group for implementation. This was not particularly difficult, nor did it require a lot of communication. It was fairly simple to construct the final database using this divide-and-conquer strategy.

In the final phase, the application that communicated with the database was developed. Since we were working with a real Lab with critical data, we had to produce a solution that they could put into operation and would function successfully. For this phase, teams were asked to compete to produce the required application. The Lab would then select their preferred version to be utilized for live patient data storage and querying.

5. OUTPUT

Output from the project is similar to what you would expect to see from assignments given in a typical database course. In Figure 1, you can see the entity-relationship diagram produced for the initial design of the system. While most of the details are not significant for this discussion, you may find it interesting to note that some of the entities are common to many Health Information Systems. For example, you will usually wish to store data about patients, such as diagnoses and treatments they have received, as well as individual visits to the clinic/hospital. You will also see data specific to this Lab, such as assistive devices used by patients, and the video system used to record tests performed on the patients to measure different aspects of their strength and locomotion.

This ER diagram shown in figure 1 represents a high level view of the system. This must be fleshed out into an implementation level view. A database schema was next created by students to reflect the details. For example, below is the schema for the BillingCodes table.

BillingCodes(<u>billingCodeID</u>, visitCharge, CPTCode, integerIncrement, visitID)
*visitID foreign key to visit(visitID)

The schema can be used to write *create table* statements, which define attributes, data types, and constraints (including primary keys and foreign keys). Once the tables are created, *insert* statements can then be written. To implement all of the DDL (data definition language) statements produced by the students, one needs to be conscious of the foreign key constraints, so that the tables are created in the proper order. (An alternative is to define the tables without foreign key constraints, and then write *alter table* statements to add these constraints.)

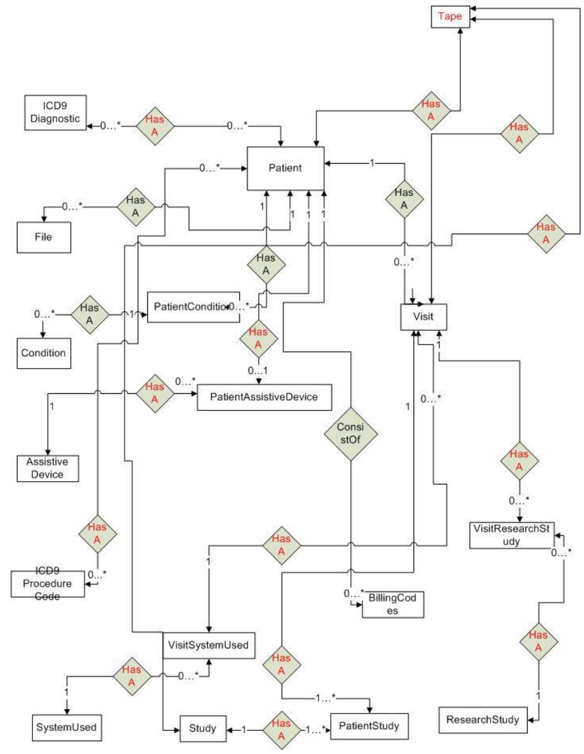

FIGURE 1: Motion Analysis Lab ER Diagram

The output described so far was produced during the cooperative phase of development. The competition phase followed to produce the application software that would sit on top of and connect to the database. The application would allow users to quickly and easily insert, view, and query the data to produce interesting results. Due to the nature of the project and the sensitivity of the data set, we cannot show the outcomes of this portion of the project here.

6. STUDENT FEEDBACK

Student feedback on the course was overwhelmingly positive. Much of the feedback focused on core course concepts. No students indicated that having a project like this one detracted from this core learning. Some general course comments included:

"I gained a much more complete understanding of how to design, implement, and maintain a database."

"I essentially went from not knowing anything about building this type of system to developing an entire site within the span of a month."

Many students commented on the project. They enjoyed working on something they considered real world, and they enjoyed being introduced to a new application area for their recently gained knowledge. Here are some of the comments on the project and on the integration of Health Information System concepts into the course:

"I'm really glad I learned this because it's one of those things I really enjoy and will likely pursue outside class, it's probably the single most favorite thing I learned all semester."

"The project was fascinating to me."

We certainly don't base our curriculum decisions primarily on whether or not students enjoy certain material. We do believe that, if they find the material interesting and relevant, they are more likely to put in the effort necessary to learn it well.

7. ADDITIONAL OUTCOMES

Some additional outcomes resulted from this collaboration. The key goal was to present course concepts in a relevant and motivating way by applying the concepts to the development of a Health Information System. We believe we achieved this goal. Grade outcomes in the course were slightly higher than in previous semesters, including on exams that were equivalent conceptually and not HIS-focused for either group. In addition, one student was hired to continue work on this development. Several students are continuing to pursue research related to Health Information Systems with the faculty involved in this project. Finally, the University and Lab are forging a long-term relationship that will result in continued collaboration. While these are not key goals, we feel they are important benefits that have come out of the collaboration.

8. CONCLUSION

Integrating multi-disciplinary threads into the Computer Science curriculum can increase interest in and relevance of the material for the students. In this case study, we integrated Health Information Systems into a database course though the use of sequential homework assignments, producing a database application for the Mayo Clinic's Biomechanics and Motion Analysis lab. Other areas such as Geographic Information Systems could be used with a similar goal. We believe the end result of this project will live on beyond the end of the semester, and will be even greater than just achieving the outcomes defined for the course. We expect, as a lasting benefit, increased retention of aspiring CS students when they discover Computer Science areas that they are truly passionate about.

Future work includes continuing to monitor emerging application areas in Computer Science nationally and in our community to facilitate additional connections and collaborations. We also plan to monitor the paths of students in this course to determine if a larger number remain in the field and if they are able to use the additional information gained on Health Information Systems in other ways.

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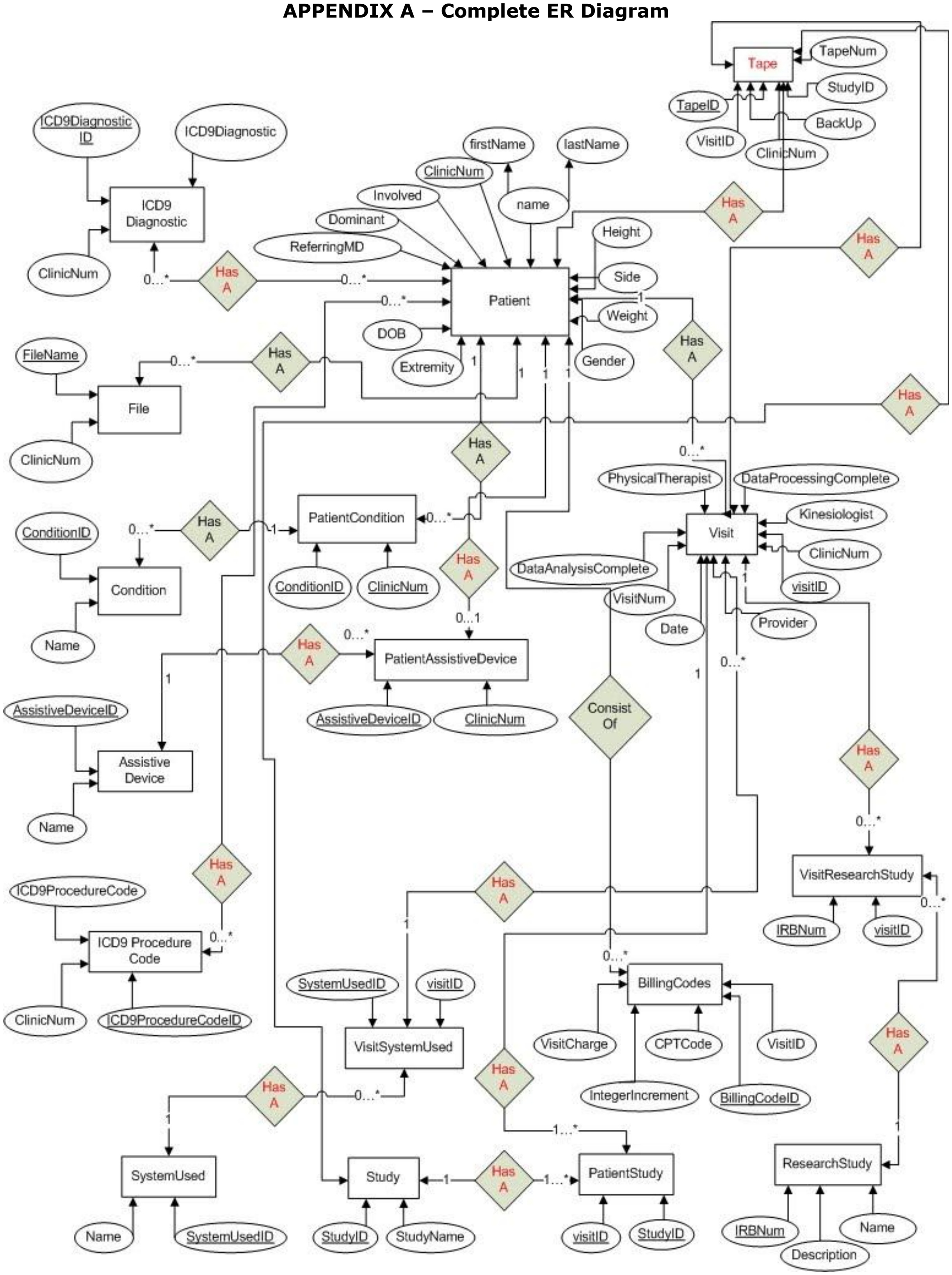
APPENDIX A – Complete ER Diagram



Visualizing Opportunities: GIS Skills for Retail Marketing

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Abstract

Business students need to develop skills in the intelligent use of information, especially spatial information, for decision-making. Geographic Information System (GIS) is a viable tool for that purpose. Yet the few GIS courses in the Information Systems curriculum offered in various business schools tend to focus on different concepts and skills. In this paper, we examine the application of GIS in retail marketing. With access to appropriate data, GIS is an excellent tool for the analysis and identification of market opportunities. We describe a skill set of three specific approaches in GIS application using demographics data pertaining to potential customers and collected competitors' information. These approaches include visualization using choropleth maps, spatial overlay to classify feature information based on spatial correlation, and proximity analysis for site selection. These techniques allow us to identify where the potential customers are located, study competitor locations, and analyze opportunities for site selection. By identifying these techniques in the GIS skill set, we also discuss the pre-requisite knowledge for the students and what we may or may not emphasize in the design of GIS courses in the IS curriculum.

Keywords: GIS, geographic information system, retail marketing, visualization, spatial overlay, proximity analysis.

1. INTRODUCTION

Fueled by much lower costs and easier access to data, geographic information system (GIS) is becoming more widespread in the IS/IT market place (Gewin, 2004; Sinton & Lund, 2007). GIS is useful in a wide range of application areas ranging from traditional logistics planning to political campaigning, health care, environmental studies, community development, retail marketing, and more. The past decade has seen a healthy growth of GIS courses in academia to prepare students for the need in industry. However, the growing body of knowledge pertaining to the use of GIS has led to different courses in different business schools having widely different emphases (Glover, 2005; Reames, 2005). This paper focuses on the GIS skills pertaining to the use of GIS in retail marketing. Our intention is to discuss the appropriate content of a GIS course focusing on business as an area of interest in the IS curriculum.

In the section 2, we describe and discuss the GIS skills we have identified as useful in retail marketing. In sections 3, 4 and 5 we discuss the use of GIS in the context of application examples, starting with simple information visualization (North, Fee & Bytnar, 2009) and then more advanced techniques of applying spatial overlay and proximity analysis. The three GIS techniques comprise the basic skill set for using spatial information in retail marketing. In section 6, we discuss what this means to us in the design of GIS courses in the IS curriculum with a business focus. Section 7 presents the summary of our paper.

2. GIS FOR RETAIL MARKETING

A major focus of retail marketing is on the potential customers: Who are our best customers? What do they buy? Where they are located? Where are similar customers located? How can we better serve them? Given the right data, GIS is an excellent tool for answering those questions. To identify the opportunities there, we need to analyze the information about the people and to visualize where they may be located. We need the relevant demographics information and the appropriate maps. Maps are costly to make, but for most community mapping in the United States, these maps are publicly available on the internet. Large collections of demographics information are also published by the U.S. Census Bureau on their web sites. The information is updated every decade in accordance with census. Table 1 and table 2 below present the web sites from which we obtained the maps and the demographics information for use in this paper.

Web site for maps (by ESRI)
http://arcdata.esri.com/data/tiger2000/tiger_download.cfm

Table 1. Source of Maps

Web sites for Census Data
http://www.census.gov
http://factfinder.census.gov

Table 2. Source for Demographics Data

While keeping individual private information confidential, the US Census Bureau publishes census information in various aggregations. Figure 1 shows the map of 416 census tracts in Allegheny County in the state of Pennsylvania.

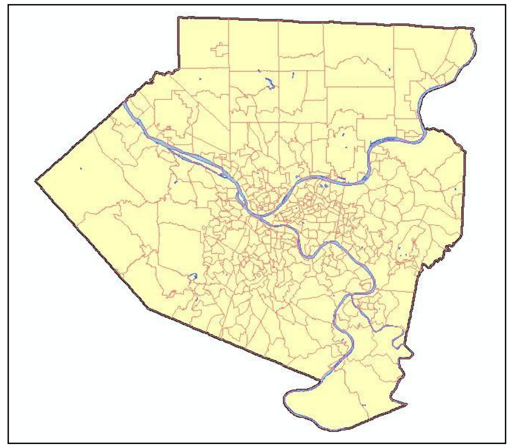

Figure 1. Census tracts in Allegheny County

While each county is subdivided into census tracts, each census tract is further subdivided into census blocks. The smallest unit is the census block for which aggregate information is published. Figure 2 illustrates the map of census blocks in the city of Pittsburgh.

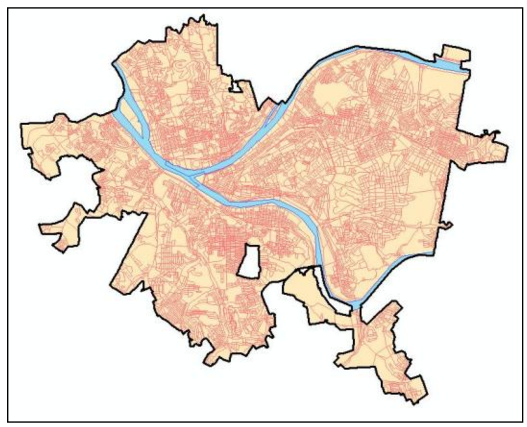

Figure 2. Census blocks of Pittsburgh

Using demographics information from the Census Bureau, we can then utilize GIS to learn where our potential customers are located. The following sections describe three different approaches to identify marketing opportunities using GIS.

3. INFORMATION VISUALIZATION

Depending on what we plan to sell in retail business, we may want to identify people at a certain income level as our target customers. Since the average per capita personal income is published in the aggregate information for each census tract, we can choose various income levels to shade the regions in graduated colors, in order to visualize how income varies across a geographic area. Figure 3, an example of a choropleth map, illustrates the census tracts of Allegheny County, shaded in light, medium, and dark blue for per capita annual income levels respectively at 25,000 or less, 25,000 to 50,000, and above 50,000 (in US dollars).

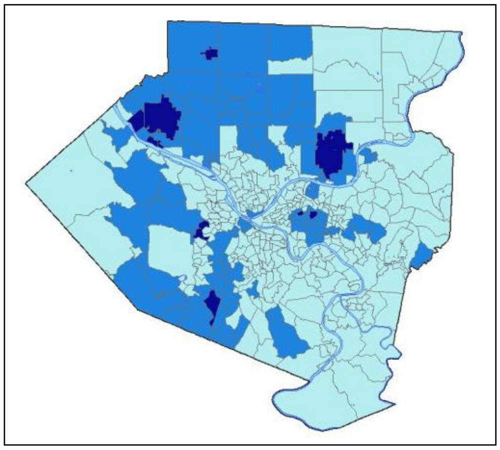

Figure 3. Per capita income by census tract

However, we should note that tracts of larger areas show up in the map prominently do not necessarily indicate more population. Rather, census tracts are chosen so that they have roughly the same population. Instead, we use a pin map with graduated size marker at the centroid of each tract. The marker may also use graduated colors to indicate the different average income levels. Figure 4 is the pin map based on the same data as in figure 3, but it uses a marker at the centroid of each tract. The different colors and sizes of each marker indicate the per capita annual income levels in the tract.

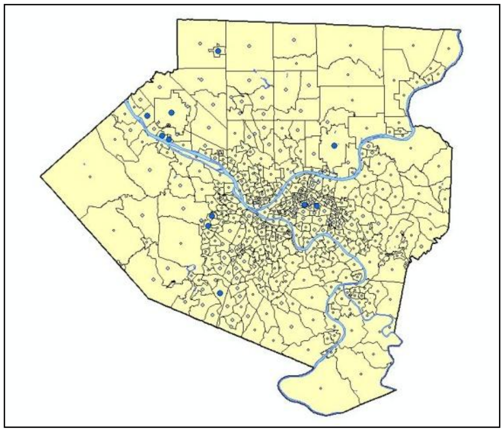

Figure 4. Per capita income using markers

By choosing different intervals of per capita income level, we can use GIS to conveniently visualize the location of the higher income neighborhoods. If we can gather the data for different years, we may also visualize the changing patterns in a sequence of maps.

We may target a specific ethnic group in marketing. Suppose we want to promote a certain product to the Hispanic population. Figure 5 is a map to illustrate the Hispanic population by the census blocks in the city of Pittsburgh.

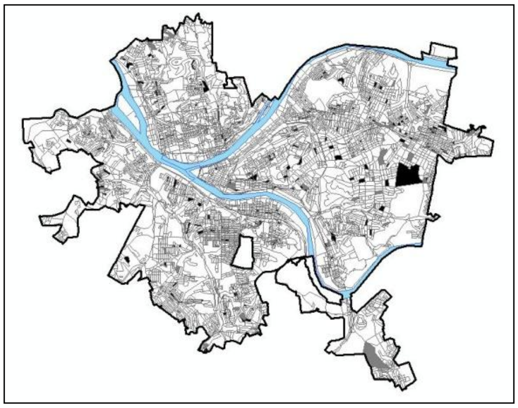

Figure 5. Hispanic population by census block

The Census Bureau publishes the population information of every major ethnic group at the census block level. The shading scale of black, grey, and white indicates the Hispanic population of each census block, respectively at 10 or less, 11 to 20, and more than 20.

There is also population information per age group at the census block level. Suppose we want to find where the elderly population is in order to target senior citizens of age 65 or older. Figure 6 uses a graduated size marker at the centroid of each census block in the city of Pittsburgh.

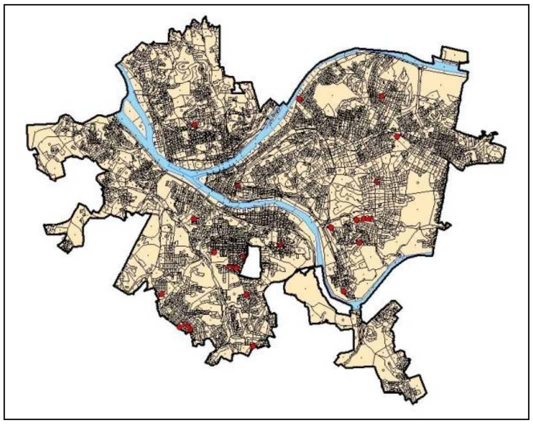

Figure 6. Senior population by census block

The markers indicate the senior (65 or older) population in each census block: small light blue marker for 10 or less, medium beige marker for 11 to 30, and big red marker for above 30.

4. SPATIAL OVERLAY

The administrative regions of our business may not coincide with the census tracts, or with the census blocks. The information we need also may not be readily available, or associated with our administrative regions.

For example, we may want to examine where our business competitors are located, by the municipalities in the city. Given the physical addresses of competitor locations, we apply geocoding to create a point feature layer of the locations in a map. Geocoding is the process of converting coded information such as postal address into a map location. It is often one of the featured functions in GIS. (Wu & Rathswohl, 2010)

Figure 7 presents a map showing the locations of the competitors, indicated with markers in the municipalities in the city of Pittsburgh. Note that the point markers are maintained in a separate map layer in the GIS. This means that the information pertaining to each competitor is associated with the point feature as marked, but not with the municipality in which it is contained.

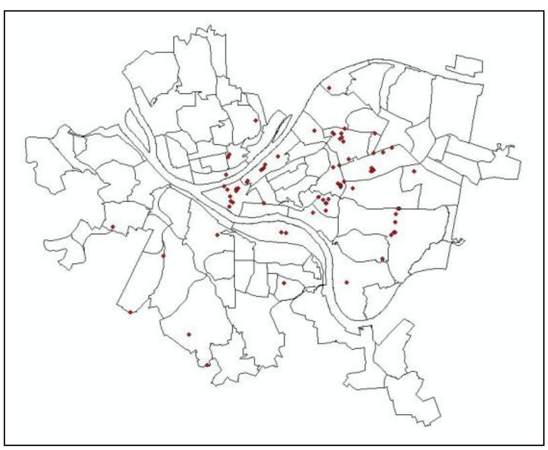

Figure 7. Competitor locations in the city

To associate each point with the municipality containing the point, we need to apply spatial overlay, or spatial join. With spatial overlay, each municipality will be associated with the marker points contained in the region. With spatial join, we add an attribute value to each point location to recognize its containing municipality. After the overlay operation, we can easily count the number of competitors within each municipality. Figure 8 illustrates a map using graduated shading to indicate the number of competitor locations in each municipality.

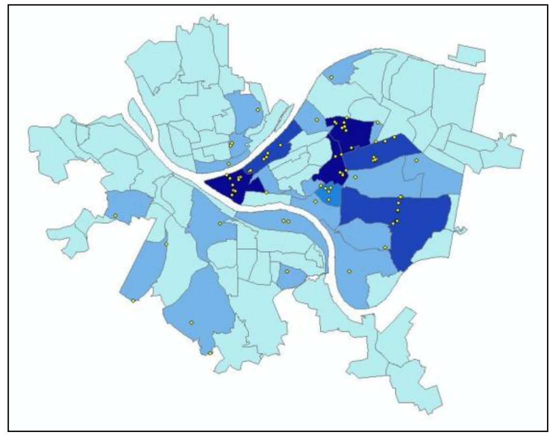

Figure 8. Graduated shading after overlay

The shading scale has five shades of blue to indicate the number of competitor locations. The class intervals are: 0, 1-2, 3-5, 6-8, and 9-10 stores in the municipality, respectively.

GIS generally offers many map processing operations. We have chosen spatial overlay as an indicative example to illustrate how GIS does the computation of spatial correlation in map data processing.

5. PROXIMITY ANALYSIS

Another aspect of spatial correlation is the question about the vicinity. GIS can help us answer the question using proximity analysis. It applies to retail marketing, for example, when we plan to select an appropriate site for a store.

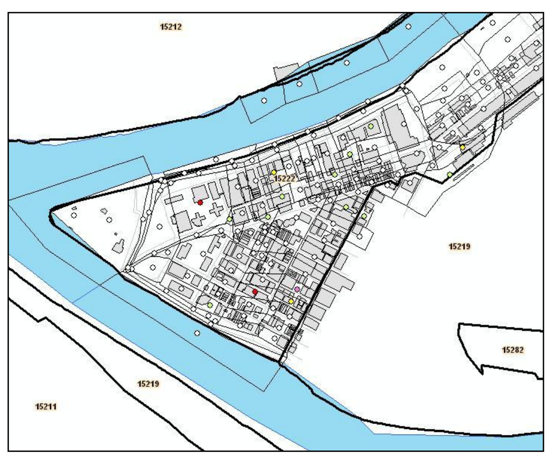

Figure 9. Population details in downtown area

We want to have potential customers within certain proximity to the location. Figure 9 shows a map of the Central Business District in the city of Pittsburgh, with detail information about the population per census block, within the zip code areas of Pittsburgh downtown, the Central Business District.

Suppose we want to find a desirable site for a grocery store in downtown area. Even with the tax credit incentive to promote residence in the downtown area, there are mostly commercial buildings. The census data gives us the population of residents per block. We want to identify suitable sites with a resident population of at least 3000 within the walking distance of 0.5 mile radius. GIS allows us to effectively do that interactively. Figure 10 below illustrates how we may do that.

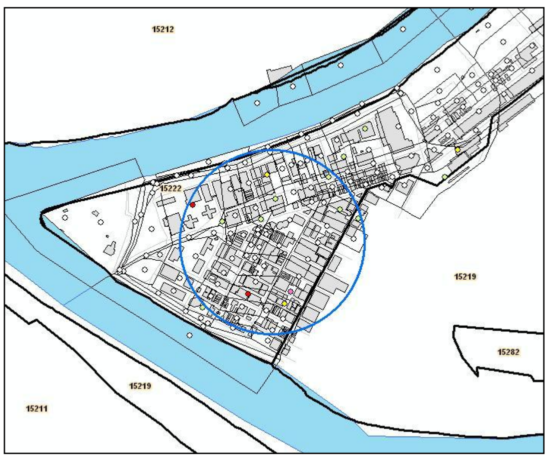

Figure 10. Proximity analysis for site selection

We first create a circular graphic of 0.5 mile radius to overlay on top of the map. We then move the circular graphic around interactively with the mouse, and direct the GIS to select the census blocks with the centroids within the circle, and conveniently calculate the total resident population in the vicinity. GIS effectively turns the type of traditionally tedious chore into an easy task of analytical mapping.

6. DISCUSSION

Studies continue to show that today's businesses are looking for IS/IT professionals mature in communication and skillful in analyzing and solving problems (Caputo, Kovacs & Turchek, 2004). Good training in IT skills is undoubtedly a requirement for IS graduates. However, students with a winning edge are those also trained in the intelligent use of information, especially spatial information, for problem analysis and problem solving. GIS is obviously a good tool for that purpose (Boasson, Boasson & Tastle, 2004).

This paper discussed three hands-on skills of utilizing GIS to analyze retail marketing questions. There are many resources for students to develop GIS skills in the context of retail marketing, including for example GIS textbooks and websites that describe real-world retail applications (Miller, 2007; ESRI, 2010a). Another GIS resource for retailing is ESRI Business Analyst Online, especially the Tapestry Segmentation tool that classifies U.S. neighborhoods into 65 segments based on demographic and socioeconomic characteristics; the student can use this easy-to-use tool to quickly analyze customer preferences in any particular geographic vicinity (ESRI, 2010b; Traore, 2010).

While we focused on the example GIS skills applicable to retail marketing, we have also shown that GIS training is multi-disciplinary. In this section, we will discuss the pre-requisites necessary, and the appropriate emphases, to prepare the student for success in such a GIS course.

GIS is a very special tool for handling large collections of data, especially for spatially related data. Our examples show that the student needs a mature understanding of basic statistics. Without that, the student's learning may be seriously hindered. An introductory level of statistics should be required, although a student may benefit even more by taking a well-designed spatial statistics course incorporating the use of geostatistical tools (Dramowicz, 2010).

GIS is a database system with its very unique graphical user interface for user manipulation of data. In fact, GIS is often thought of as a relational database with the additional capability for handling geometry and topology graphically. The student well versed in relational database or SQL usually finds the knowledge helpful. In practice, however, we do not think the student needs the training of a full course in database systems. Skills in using a spreadsheet will also be helpful in that regard. Our suggestion is for the course to provide extra coverage on the use of data tables, and possibly simple SQL.

Geographers well versed in mapping usually feel that GIS students need to understand various map projections for the purpose of map making (Clark, 2003; Demers, 2005). We however do not concur. GIS use for business purposes generally works with community mapping. Maps used in analysis and presentation usually are relatively large-scale local maps dealing with states, cities, small neighborhoods or municipalities. Students do need to be aware of the different kinds of projections in use, so that they can work with data from different sources. Very thorough treatment of different projections for mapping will not be necessary, much less the mathematics training in projective geometry, with the exception of engineering students who may want to get into the programming aspect of GIS use. GIS today usually has built-in functions for translation of data sets from one projection to another, sufficient for use in most community mapping. Hands-on experience for the student serves our purpose better.

An interesting but much less discussed aspect of GIS training is in graphic arts design. GIS is a problem solving tool which facilitates the intelligent use of information. Yet the results to be presented usually involve maps. From an engineering point of view, a map is partly geometric, partly topographic, but it is also partly symbolic. To the audience, quite often it also has to be aesthetically pleasing. The choice of colors and the separation of ground and figure are fundamental and essential. We did not discuss that in this paper, although our examples may have high-lighted some of that aspect. Few, but some textbooks also cover the basic principles of graphic arts design (Gorr & Kurland, 2006).

Lastly, effective use GIS depends on one's conceptual skills in understanding spatial information. The IS curriculum needs to help students, when they are analyzing a situation, to think spatially, to ask spatial-oriented questions, such as "What is at …?", "Where is it located?", "What spatial patterns exist?", "What has changed since …?", "What if …?" We need to design the GIS courses in the curriculum to take advantage of the positive relationship between improved spatial thinking and improved problem analysis (Kolvoord, 2010).

7. SUMMARY

An important focus of retail marketing is evaluating the characteristics of people who are potential customers. Given the easy access to the relevant digital maps and the publicly available demographics information published by the US Census Bureau, GIS today is a viable tool for that purpose.

In the IS curriculum today, GIS courses are springing up to offer training for the intelligent use of spatial information, including the identification and analysis of these marketing opportunities. We describe three different approaches to using GIS. Firstly, we present demographics information visually in a map. GIS makes this very convenient. Simply choose the appropriate attribute for the information we want to look into, and we can visualize where the potential customers are located. Secondly, when relevant data gathered from different sources may not be appropriately associated for analysis and presentation, GIS provides the spatial overlay function to create the necessary association by spatial correlation. In our example, it allowed us to present demographics information according to our regional sub-divisions. Thirdly, proximity analysis allows us to ask questions about the vicinity. By quickly aggregating information about the vicinity at any location, the use of GIS for the kind of analytic mapping becomes a practicable tool for site selection.

These examples of application show us what we may want to focus on as the important GIS skills set for an IS student in business. While GIS skills involved also show that a course has to be multi-disciplinary, we went on to discuss the different levels of pre-requisite knowledge in different areas of the discipline. Statistics is the most important. Basic SQL and understanding of relational database system would be helpful. Full treatment of map projection standards is not necessary, as long as the different projections relevant to community mapping are covered, and shown how we can use GIS to work with data from different sources with hands-on experience. Basic principles of graphic arts design are also relevant in map presentation. The GIS course has much practical value in the IS curriculum for business.

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Tag Clouds as a Pathway to Improved Pedagogical Efficacy in Information Systems Courses: A Baseline Study Involving Web 2.0 Technologies

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Abstract

Various Web 2.0 technologies can be used to support pedagogy. Examples include wikis, blogs, and social media including forum discussions. Online class forum discussions involving electronic text can result in robust strings of data containing meta-knowledge, inherent meaning, themes and patterns. Based on instructional design, learning outcomes guide and reflect class generated work product such as assignments, activities, and discussions. As such, class discussions should evolve with alignment to learning outcomes. One measurement of instructional efficacy involves the closeness with which this alignment occurs. In this experimental research the authors report on the design and prototyping of a deterministic model utilizing a tag cloud engine to determine dominant and emerging themes from a text string, namely word data collected from a threaded discussion. Textual data used in this investigation involved two Information Systems online classes where threaded discussions during one week were captured as a text string. Text from a learning management system threaded discussion was fed into a tag cloud engine where emerging and dominant asynchronous conversation themes were determined. Calculating a correlation coefficient as an indicator of pedagogical efficacy, the application evaluated the pedagogical efficacy evidenced in the discussion forum through comparison of themes with instructional objectives. In this experimental research, a real-time online analytical processing (OLAP) tool prototype to support pedagogical intelligence via systemic formative evaluation was designed and developed. Findings from the investigation were used to reach conclusions regarding the use of Web 2.0 technologies in guiding instruction.

Keywords: Web 2.0, eLearning, tag cloud, word cloud, correlation, coefficient

1. INTRODUCTION

This study represents a continuation of an existing line of inquiry (Conn, Hu, Boyer, and Wilkinson, 2009) involving the use of Web 2.0 technologies in curriculum and instruction. Motivation for this study also is supported by consistent advances in eLearning tools, technologies, and applications. Higher education institutions continue to engage in eLearning initiatives at an accelerating rate. According to Sloan Consortium [Sloan-C] (2009), by the end of the decade the number of students taking courses online is expected to grow to over 2.6 million. Moreover, 40.7% of institutions offering eLearning courses found that students have an equivalent level of satisfaction with online instruction, 56.2% had no opinion, and a minor population (3.1%) was not satisfied with online instruction.

eLearning courses, as a percent of the overall market for education and training, now exceed 10% of the total. The trend toward fully online programs continues to increase; two-thirds of the largest United States (U.S.) higher education institutions now have fully online programs (Sloan-C, 2009). Moreover, a traditional learning management system (LMS) is no longer able to keep pace with advanced Internet technologies and increasing e-Learner requirements (Dagger, O'Connor, Lawless, Walsh, & Wade, 2007). Of concern is seamless information interoperability in the eLearning platform; thus, the monolithic architecture of the LMS is not an accommodating solution (Dagger et al.). Although this research was conducted primarily with an Information Systems online eLearning student environment in mind, the research also is applicable to ground-based classroom environments and other disciplines where technology is available to facilitate and mediate instruction.

The term tag cloud refers to a visualization of word data based on a scheme of relevance, importance, or popularity represented by manipulated visual properties such as font size, color, intensity, width, position, or weight (Bateman, Gutwin, & Nacenta, 2008). According to Xexéo, Morgado, and Fiuza (2009), many new approaches to the use of tag clouds exist. In this experimental research specific Web 2.0 technology, namely a tag cloud engine, was used to generate outputs that were evaluated using Spearman's rho (**ρ**), a rank correlation coefficient. The researchers sought to construct a deterministic model using prototyping. Initially, conceptually applying various methods to examine relationships, the researchers considered use of:

(i) functions to determine if a causal relationship exists,
(ii) regression analysis,
(iii) pattern assessment using scatterplots,
(iv) reasoning under uncertainty using probability, and
(v) correlation coefficient.

After consideration of the phenomena between bivariates, the researchers selected a coefficient of correlation as the estimating equation. This selection provided confirmatory data to determine if an empirical relationship exists between the data or if discipline specific or contextual narrative (data) generally yields physical constants.

For the purpose of this study the terms tag cloud, word cloud, and data cloud are used interchangeably. As noted, the theory of performance in the prototype design utilizes a correlation coefficient as an indicator of how closely student discussions are following stated learning objectives. A rising correlation coefficient would indicate a class discussion in close alignment with stated learning objectives; whereas, a sinking correlation coefficient would indicate a class discussion is off-track with stated learning objectives. In the latter case, instructor intervention would be required to alter the discussion in response to the stated learning objectives.

Instructor interventions could take the form of restating goals and learning objectives for the class, guiding the discussion through leading questions, highlighting threads in the discussion that are in alignment with learning objectives, or radically altering the discussion via corrective narrative. The correlation coefficient serves as a dynamic indicator of instructional efficacy and can be visualized in a digital dashboard embedded in the LMS or as a stand-alone application.

The experimental prototype developed for this study extracts a text string from any mediated discussion (e.g., wiki, blog, or discussion thread) as the input to a tag cloud engine. The output of the tag cloud is analyzed and sorted based on the level at which the word appears in the cloud. Higher level words are considered emerging themes, dominant arguments, or narrative basis for the discussion. The standard or goal for the discussion is seen in the tag cloud output from the learning objectives. Code base evaluates the correlation coefficient of the student discussion to the learning objectives to determine how closely the discussion correlates to the goal.

The outcomes of this study provide a basis for follow-on investigation into the use of Web 2.0 technologies in guiding instruction and improving pedagogical efficacy. The act of relating relevant keywords to a site is known as tagging. Tagged data exists that could supplement the accuracy of diagnosing online discussion efficacy using tag cloud engines. The authors present case findings from two populations of online Information System students where discussion threads from one week on instruction addressing learning objectives related to the study of database technology were generated. The prototype model was applied to the week-long discussions from each population to determine which population most closely tracked with stated learning objectives.

2. LITERATURE REVIEW

The term Web 2.0 refers to services and user processes created with emerging Internet and Web open standards and technologies. Concatenation of maturing Web applications and technologies to create innovative, facilitative design for collaboration, knowledge creation, and information mediation (infomediation) represents a central Web 2.0 concept. Aggregation and brokering of user data, construction of social networks, creation of Web services, and exploration and discovery are driving goals in Web 2.0 initiatives. In effect, the old model of the Web as an information repository passively accessed by users changes to a platform for social constructs and collaboration, interaction and exchange, and personalized content ontologies (Torniai, Jovanović, Gašević, Bateman, & Hatala, 2008).

According to Anderson (2007), the term Web 2.0 is not best described by a set of technologies but as an idea encompassing individual contributions to content, knowledge construction using a "power of the crowd" methodology, large volumes of data and information, user participation, open architecture, and network attributions. In 2004 Dale Dougherty, a vice-president at O'Reilly Media Inc., introduced the term Web 2.0 and defined it as using the Web as a platform to construct collaborative, user-centric content and interactive applications. Safran, Helic, and Gütl (2007) posit that Web 2.0 has coalesced with the eLearning domain. Following O'Reilly's introduction of the Web 2.0 term, Stephen Downes introduced the term eLearning 2.0 (Wever, Mechant, Veevarte, & Hauttekeete, 2007).

The primary attribute associated with Web 2.0 technologies, and associated eLearning 2.0 concept, involves a focus on making connections between learners and learning resources (*connectivism*) and the inclusion of social networking and Web 2.0 technologies as new elements of eLearning instructional design (Wever et al., 2007). As a result of implementing Web 2.0 technologies, learning spaces and communities of learners are created and social data can be utilized to best meet the instructional needs of a given learner population.

Nascent Web technologies, now associated with Web 2.0, offer an opportunity to change development and delivery of instruction. Web 2.0 is less a category of technologies and more an idea or design concept that supports constructivist approaches to eLearning. For example, the Community of Inquiry (CoI) model (Garrison, Anderson, & Archer, 2000) optimizes synchronous and asynchronous computer mediated communication in a design focused on three core elements: social presence, cognitive presence, and teaching presence. eLearning environments utilizing Web 2.0 can play a key role in supporting discourse, based on the CoI model. Parturient eLearning is accommodated not by a Web used only for component connectivity, but a Web used as a platform for development.

Conceived by Jorn Barger in 1997, Weblogs (Blogs) refers to Web-based scrolls, presented in reverse chronological order, utilized as a mechanism for communication between interested user groups (Boulos & Wheller, 2007). Blogs are ideal for controlling a 1:M relationship between an instructor and a class of students (Ullrich, Borau, Luo, Tan, Shen, & Shen, 2008). Blogs contain posts and each post is generally tagged with one or more keywords. Associated tags allow the post to be cataloged based on a theme in a standard menu system. Meta-data

tags appear in close proximity to the posts and allow the user to navigate to other related posts (Alexander, 2006). Generally, blogging facilitates syndication, or the generation of feeds using RSS or, increasingly, Atom. Blog aggregators and special blog reading tools accept these feeds. The term blogosphere refers to the universe of bloggers who contribute to blogs in real time.
Wikis were introduced by Bo Leuf and Ward Cunningham in 1995 as an online system to permit users to create, edit, revise, or link hypermedia. Ideal for collaborative work, the term wiki can be described as a knowledge management system used as collaborative media groupware. According to Ebner (2007), wikis have alternative functionalities to blogs. Wikis contain a history function, storing previous versions, and a rollback function, to restore previous versions. As a group work tool, wikis feature a simple, hypertext-style linking of pages to create navigation pathways.

The term social bookmarking refers to a method for Web users to organize, store, manage, and search for bookmarks of resources online and has evolved into folksonomies which social bookmarking tools use as meta-data tags for search purposes. Essentially, folksonomies represent an ontology that has evolved from a community of practice where folksonomic meta-data is created by users who generate and attach related words to content. As a result, folksonomies interrelate learning content information. According to Boulos, Maramba, and Wheeler (2006), tools based on folksonomies are available to locate information related to specific research and capitalize on the observations and comments of other similar researchers. Folksonomies can identify a collection of resources that is evolving in concert with a specific research initiative. Folksonomical tagging illustrates a best-practice with respect to meta-data. Szomszor, Cantador, and Alani (2008) studied the correlation of user profiles using folksonomies and presented a framework to demonstrate cross-linking distributed user tag clouds to identify users separately on the Web.

According to (Ullrich et al., 2008), social bookmarking services allow for the collection and annotation (i.e., tagging) of online content. This action enables a simple distribution and sharing of resources among a user community. Examples of social bookmarking sites include del.icio.us (http://del.icio.us), Furl (http://www.furl.net), Connotea (http://www.connotea.org), and CiteULike (http:www.citeulike.org). Social bookmarking sites can be used as an online community tool to classify resources based on informally assigned, user-defined keywords or tags. Tags, when made public, can serve as a methodology for locating sites and other Web-based resources based on common or related keywords. Tags, in effect, serve as meta-data definitions for digital content and/or digital content objects.

Moreover, sets or groups of tags (i.e., tagsets), can be visually displayed in a form of concept map known as a tag cloud. Tag clouds are useful in determining common or dominant themes from tagsets, Websites, documents, or other text-based content, such as the discussion in an online forum (e.g., blog, wiki, chat, or threaded discussion). According to Schrammel, Leitner, and Tscheligi (2009), tag clouds are used frequently to interact on the Web. As an adjunct outgrowth of tags, the concept and use of *folksonomies* (folk taxonomies) has increased. Based on the use of taxonomies to define and provide structural organization, folksonomies are developed by users as a collection of tags, created for personal use. Folksonomies involve the grouping of common user-created tags as a structured means of organizing and accessing digital content. Research tools using folksonomies as a methodology for locating related information are available.

Moreover, tag clouds provide a helpful visual summary of content (Schrammel, Leitner, & Tscheligi, 2009). Szomszor, Cantador, and Alani (2008) studied the correlation of user profiles using folksonomies and presented architecture to demonstrate cross-linking distributed user tag clouds to identify users separately on the Web. Xexéo, Morgado, and Fiuza (2009) describe the output of a tag cloud with the term *semantic field*. The semantics illustrate and define the contextual meaning of the input text string. According to Hearst and Rosner (2008), tag cloud input primarily involves unstructured social data or annotations of information by authors where clouds are generated using query terms, word frequencies, category labels, or other heuristically determined algorithm. They also note that the primary value of the cloud is as a signal or marker of individual or social interaction with the contents of an information collection and functions as a suggestive device for some underlying phenomena.

Kuo, Hentrich, Good, and Wilkinson (2007) used tag clouds to summarize Web search results and found that tag clouds provide an overview of knowledge represented by an entire response and an interface to discover potentially relevant information hidden deep within the text string. In a study by Koutrika, Zadeh, and Garcia-Molina (2009), the researchers found that tag clouds can dynamically highlight the most significant concepts and hidden relationships within unstructured data. According to Bateman, Gutwin, and Nacenta (2008), clouds have been shown to assist in understanding data and semantic exploration.

3. EXPERIMENTAL RESEARCH PROTOTYPE CASE

Theory of Prototype Construction
The prototype application was fashioned as a digital dashboard and consists of three primary modules:

(i) data extraction and staging,
(ii) a tag cloud engine, and
(iii) correlation coefficient calculation and output rendering.

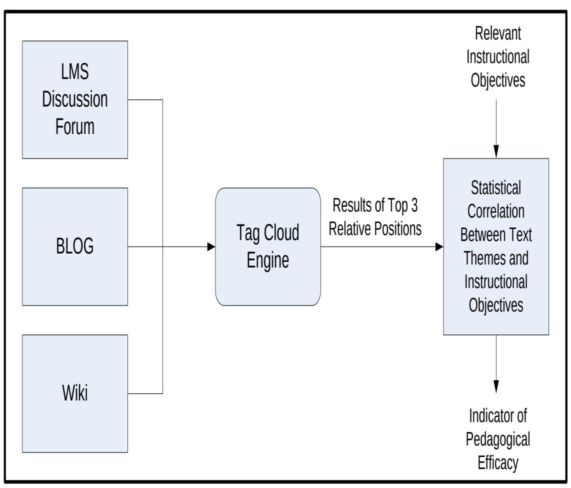

Figure 1: High-level architecture for prototype design and construction

As illustrated in Figure 1, a text string can be extracted from any social media communication forum, in this case the discussion threads from a LMS. The text string serves as the input to a tag cloud engine where the tag cloud output is organized by (minimally) the top three relative positions. Level one indicates the top level output, level two indicates the secondary level output, level three indicates the tertiary level output, and so forth.

Visually, the tag cloud output matches the organization of words into levels. In this research, the prototype evaluated words to 15 levels. With more levels evaluated and scored, more data is available for calculation of the correlation coefficient, the final module of the prototype application.

Use Case Applied to Prototype
The student populations involved in this study included two sections of a graduate level Information Systems course on database system development. Both sections of the course were sampled in the fifth week of the term. During the fifth week of the term the control group (population 1) received no pedagogical facilitation or intervention, whereas the variable group (population 2) received daily pedagogical facilitation and intervention. The control group (N=15) and variable group (N=17) were composed of the following homogenous demographics:

(i) 28-40 years of age,
(ii) professional, adult students,
(iii) technical undergraduate degrees, and
(iv) at least four previous online courses completed.

In this experimental research, three text strings acted as input to a tag cloud engine:

(i) the learning objectives specified for the fifth week of instruction,
(ii) the week five discussion forum for student population 1 taken from a LMS, and
(iii) the week five discussion forum for student population 2 extracted from the same LMS.

Text string output from a tag cloud engine for populations 1 and 2 were individually compared to the text string output from a tag cloud engine for the learning objectives. Populations 1 and 2 were provided instruction online based on intended learning objectives.

Two behavioral learning objectives were specified for the week of instruction utilized in this study and were stated as:

After successful completion of this course, students will be able to:

1) Compare structured and agile development methodologies and, after comparing, evaluate for the most appropriate life-cycle methodology for a given database or information system project; and
2) Utilizing a structured approach, apply a system development life-cycle methodology in construction of a database system.

Figure 2 features the tag cloud generated from the learning objectives captured as a text string. Based on tag cloud visual properties, dominant themes are defined by the terms *system*, *development*, and *methodology* at the top (most important) level, followed by the terms *database*, *life*, and *cycle* at a secondary level of emphasis. This output is noted in Table 1.

Figure 2: Tag cloud engine results (learning objectives)

Figure 3: Tag cloud engine results (Student population 1: control group)

The tag cloud output from student population 1, the control group where no instructor facilitation or intervention occurred during the week, is featured in Figure 3. Based on tag cloud properties, dominant themes are noted by the term *development* at the top level, the term *agile* at the secondary level, and the terms *database*, *methodology*, and *project* at a tertiary level. Additional levels of word data for this population are shown in Table 1.

The tag cloud output from student population 2, the variable group where instructor facilitation and intervention occurred during the week, is featured in Figure 4. Based on tag cloud properties, dominant themes are noted by the term *data* at the top level, the terms *development*, *database*, and *system* at the secondary level, and the terms *requirements* and *process* at a tertiary level. Additional levels of word data for this population are shown in Table 1.

Figure 4: Tag cloud engine results (Student population 2: variable group)

5. RESULTS AND CONCLUSIONS

Based on output from the tag cloud engine, Table 1 illustrates the word groupings by dominant theme for three text strings:

(i) the stated learning objectives for the week,
(ii) the week-long discussion forum for the control group, and
(iii) the week-long discussion forum for the variable group.

Table 1: Word groupings by dominant theme			
	Learning Objectives	**Student Population 1: Control Group**	**Student Population 2: Variable Group**
Level 1	System, Development, Methodology	Development	Data
Level 2	Database, Life, Cycle	Agile	Development, Database, System
Level 3		Database, Methodology, Project	Requirements, Process
Level 4		Process, Software, Design, System, Approach	Agile, Design, Work
Level 5			Methodology, Warehouse, Manage

To achieve results and subsequent conclusions, the authors utilized a ranking scoring system based on the level at which each word data occurred where 100 represented the primary level, 90 represented the secondary level, etc. The integer 1 represents the lowest level where no occurrence exists.

Table 2 illustrates the level and associated score for occurrence. The ranking scoring method appropriately awards higher level word positioning and assigns linearity to best accommodate use of **ρ** rank correlation coefficient to calculate the strength of linear relationships between the data.

Table 2: Scores assigned by level of occurrence	
Level	**Score for occurrence**
1	100
2	90
3	80
4	70
5	60

Fifteen distinct terms, taken from the top five levels of word data in the three tag clouds were assigned scores based on the linear scoring method (Table 3). Two correlation coefficients were calculated: tag cloud output from the stated learning objectives and student population 1, and tag cloud output from the stated learning objectives and student population 2.

The authors found that student population 1, the control group with no instructor facilitation or intervention, calculated significantly lower than student population 2, the variable group with instructor facilitation and intervention. Using r coefficient inclusive values of +1 (positive correlation) to -1 (negative correlation) as an indicator of pedagogical efficacy as measured through class topical discussions, lack of instructor facilitation and intervention is shown in the control group by a **ρ** score of .481. Evidence of instructor facilitation and intervention in the variable group is shown by a **ρ** score of .715. In practice, online class facilitators using a digital dashboard dynamic indicator of a weekly discussion's correlation to intended learning objectives could intervene appropriately to alter course discussions toward higher positive correlation. In large online classes, facilitators could save time reading long discussion threads by utilizing correlation coefficients as indicators to intervene and meet a pre-determined threshold of acceptable achievement in discussions.

Table 3: Correlation coefficients				
	Word	**Learning Objectives**	**Student Population 1: Control Group**	**Student Population 2: Variable Group**
1	System	100	70	90
2	Development	100	100	90
3	Methodology	100	80	60
4	Cycle	90	1	1
5	Life	90	1	1
6	Database	90	80	90
7	Project	80	80	1
8	Structured	80	1	1
9	Agile	80	90	70
10	Information	80	1	1
11	Apply	80	1	1
12	Approach	80	70	1
13	Appropriate	80	1	1
14	Comparing	80	1	1
15	Construction	80	1	1
Correlation Coefficient to intended learning objectives			**0.48168**	**0.71584**

Qualitative evaluation of the forum discussion in both populations revealed that students in population 2, the variable group, engaged in discussion more directly related to achievement of the intended learning objectives. Moreover, their discussion was more detailed, cited more examples in support of arguments, and resulted in end-of-week summarizations reinforcing what had been learned. The qualitative evaluation served to reinforce the outcomes of this study.

6. CONTRIBUTIONS AND FUTURE RESEARCH

This experimental research contributes to the existing body of knowledge on application of Web 2.0 technologies in eLearning environments. Construction of a prototype based on the architecture represented in Figure 1 demonstrates that social data, as collected in wikis, blogs, and LMS discussion forums, can be used to increase the efficacy of online and ground-based classroom instruction. Moreover, this research serves to inform educators of innovative uses and applications for Web 2.0 technologies, specifically tag clouds. As a baseline study, this research serves as a foundation for additional exploration using an Information Systems approach to construction of mediated learning applications.

Future research opportunities include collection of data in disciplines other than Information Systems to better understand the generalization of the application. Additionally, additional technology research into integration of the code and tag cloud engine with a LMS to create a digital dashboard as a component of the LMS. Currently constructed as a software development kit (SDK), the application programming interface (API) would benefit from further development. Other tools and utilities could be developed to provide analysis and reporting of the data in support of indicators such as the correlation coefficient.
Finally, future research opportunities include prototype use in real-time. Students using laptops to blog during class on lecture related material could be sampled in short (60 second) intervals to determine at a group level the threshold of understanding based on learning outcomes. Online sample frequency also should be investigated further to determine the impact on pedagogical strategies and interventions.

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