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INFORMATION SYSTEMS EDUCATION JOURNAL

A combined MIS/DS Course uses Lecture Capture Technology to "Level the Playing Field" in Student Numeracy

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Abstract

This paper describes the process taken to develop a quantitative-based and Excel™-driven course that combines *BOTH* Management Information Systems (MIS) and Decision Science (DS) modeling outcomes and lays the foundation for upper level quantitative courses such as operations management, finance and strategic management. In addition, course outcomes needed to "level the playing" field for our seemingly growing bi-modal distribution of numeracy skills among business students.

Keywords: course development, online teaching methods, Excel™, management information systems, management/decision science.

1. "I'M IN BUSINESS, BUT I DON'T DO NUMBERS."

We repeatedly convey to our business students that we live in a complex global environment where the only "known" is change. Our technologically advanced classrooms demonstrate how the Internet allows almost immediate exchange of multifaceted data and information. Through a growing number of pedagogical methods, we consistently strive to improve the effectiveness of our practices as we encourage (and sometimes push) our students to develop a solid background in quantitative methods to support critical analysis and decision making.

Projections are in our favor. The Bureau of Labor Statistics National Employment Matrix indicates employment growth of at least 20% and a median salary of greater than $60,000 for both computer systems design and management analysts by the year 2018 (Sauter, 2011). A quick search on Monster.com resulted in hundreds of career possibilities in the college's regional area.

The beginning pages of the 2007 "College Learning for the New Global Century," state that graduating college students must possess intellectual and practical skills including:

- Inquiry and analysis
- Critical and creative thinking
- Written and oral communication
- Quantitative and information literacy
- Teamwork and problem solving

The report also summarizes goals for obtaining knowledge of human cultures and the physical and natural world as well as developing personal and social responsibility with a desire for lifelong learning (American Association of Colleges and Universities, 2007).

Discussion in my classes includes the notion of a "business analyst." Kizior & Hidding (2010) refer to the International Institute of Business Analysis (IIBA) to define the requirements of a business analyst: a knowledge-worker that understands business problems and opportunities and works as a liaison to analyze, communicate and validate changes to business processes. The chief information officer (CIO) at our college expects a business analyst to have a solid understanding of basic statistics, modeling, Total Quality Management (TQM) tools, process mapping tools and accounting. In addition, expectations include strong written and oral communication skills and an attitude that includes patience, curiosity and listening. Essentially, "one who can translate business needs into technical requirements to effect change in business processes." McClure and Sircar (2008) recommend that innovation and creativity for successful business practices cannot take place without business students learning and applying modeling techniques.

Still, I was *not* surprised to hear the above statement ("…I don't do numbers") uttered one fall day in 2007 in my junior/senior level Production and Operations Management course. Higher education stakeholders have raised concerns over college students' quantitative skills for years (i.e. U.S Department of Education, NCEE, 1983; Murtonen, Olkinuora, Tynjälä & Lettinen, 2008; Arum, A. & Roksa, J. 2010; McClure and Sircar, 2008).

Faculty in the college's Department of Business Administration and Accounting (DBAA) had anecdotally reported for many years that students often arrived in their courses with weak enumerative skills and a low comfort level using quantitative techniques to support decision making. Many of these skills should have been acquired in pre-requisite courses.

Around the same time, it was apparent that our required introductory Management Information Systems (MIS) course was becoming dated as research and experience had shown growing acceptance of online learning technology and general proficiency in Microsoft Office™ (i.e. Davis, Kovacs, Scarpino & Turchek, 2010).

I teach mostly quantitative business courses and am a heavy user of Microsoft Excel™ (in both teaching and research) to support model building, analysis and decision making. With the support of my department chair, I set forth a departmental quest to help our students "do numbers" by developing a quantitative-based and Excel™-driven course that would combine *BOTH* introductory Management Information Systems (MIS) and Decision Science (DS) modeling outcomes and lay the foundation for upper level quantitative courses, such as Production and Operations Management, Finance and Strategic Management.

From the beginning of the initiative, we recognized that course outcomes needed to "level the playing field" for our noticeable growing bi-modal distribution of numeracy skills among business students. Years of teaching quantitative courses and evidence from numerous student evaluations have shown that the overall learning experience for both students and instructor can be negatively influenced if there is a substantial gap between high-performing students and students that struggle with concepts. Comments in upper level quantitative courses, such as "this is too hard" or "there is too much busy work," necessitated built-in flexibility in the new course structure to address different student skill and comfort levels.

An additional benefit of offering a confluence course so early in the academic career was to emphasize the possibility of students selecting a second major in Computer Science or Information Systems or a minor in Computer Science (McKenzie, 2005). DBAA faculty recognized that Information Systems is a field that involves both technology and people and is constantly changing (Battig, 2010). Given student reluctance to embrace quantitative concepts, focusing on the practical value of computer science or information systems might pique interest in the field.

The following sections describe underlying principles of a new course, identify available campus technology, and review outcome assessment from the course as taught under the 3-credit system. The paper concludes with lessons learned and suggestions for improvement in the college's new curriculum as well as recommendations for future development.

2. RATIONALE FOR AN EXCEL™-BASED QUANTITATIVE COURSE

In late 2007, a curricular initiative addressed the weak numeracy skills evidenced in the college's business (BU) majors. Figure 1 in the appendix displays the course development timeline. Prior to the quest, a mathematics course, either finite mathematics or one of several calculus options, was a pre-requisite for Business and Accounting majors. DBAA faculty questioned whether students took the "easy way out" and registered for a lower level math, even if the student's academic record suggested a more advanced course.

A study of five years of entering first-year business students' high school and college math courses revealed some interesting patterns. Most notably, 50% of the students enrolled in a college math course that was "lower" (that is, covering less sophisticated concepts) than what they completed in high school, with the majority of these students enrolling in college finite mathematics. Topics covered in finite mathematics included matrices, sets, probability, difference equations and game theory.

Discussions with our colleagues in the Department of Mathematics helped us to identify that finite math was no longer meeting the needs of our majors, as determined by upper level course expectations, nor was it increasing their numeracy skills beyond what they had already achieved in high school. It was decided that the DBAA would develop a rigorous course that would construct a foundation for critical skills needed in upper level courses.

A course, *Management Decision-Making Tools* (MDMT) was designed under a two-phase approach. It was first run as a special topics course in Spring 2008 for seniors, with great success and then again in Fall 2009 for first-year students. The rationale for initially teaching seniors was to identify the topics and skill levels that would most benefit first and second year students.

For the second phase, prior to the start of Fall 2009, the Registrar identified a number of incoming declared BU majors who had originally opted for finite mathematics and placed them into the special topics course. An important outcome of that semester was realizing that students would perform better with a statistics pre-requisite. Table 1 in the appendix outlines the original objectives. Renamed *Management Decision Tools (*MDT*),* the 3-credit course was approved by the college's Curriculum and Education Policy Committee as an *alternative* to finite mathematics in the Business and Accounting major, effective Fall 2010, with a statistics (either elementary or business) pre-requisite.

With an upcoming Fall 2011 college-wide curriculum transformation, including an overhaul of the liberal arts course requirements, we decided to "wait and see" how the Mathematics department, as well as our Business and Accounting courses, would be revised before establishing MDT as a requirement for the DBAA major. The Mathematics department ultimately terminated finite mathematics and developed a new entry-level college math course available for all college students. The new liberal studies curriculum required a "quantitative reasoning" component. Business and Accounting majors satisfied this requirement by completing a statistics course.

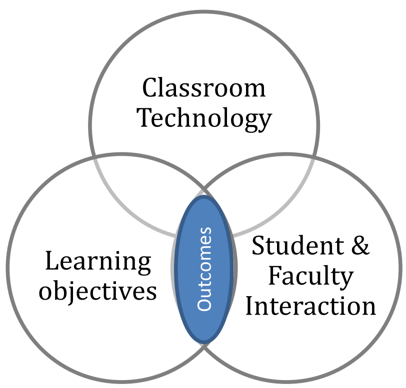
A focal theme of DBAA's new curriculum was to improve analytical and critical analysis, as our students sometimes opt for a business major because it does not require calculus (although it is *strongly recommended*). Students selecting majors based on perceptions of lower-level quantitative skills as well as the impact after college has been well documented in the literature (i.e. Ganesh, Sun & Barat, 2010; McClure & Sircar, 2008, Holtzman & Kraft, 2010 among others).

The new curriculum, identified college-wide as "4-4," effectively required all courses to become 4 credit hours and students would take 4 courses each semester, requiring 128 credits for graduation. "4-4" triggered a considerable modification throughout campus as majors had to be limited to 15 total courses, including pre-requisites. The Business major, for example was 18 courses. Our faculty had to re-design courses to meet college and departmental learning goals (see one of five DBAA Learning Goals in the table below). Simultaneously, academic rigor and student engagement across the curriculum intensified with a goal of 10 hours of outside class time work per week per course.

***DBAA Learning Goal*:**
Possess basic competencies necessary to operate and lead in an organizational environment. This includes the areas of group dynamics and operations, financial and quantitative applications and analysis, technology and problem solving.

As mentioned earlier, our *Management Information Systems* course in the existing curriculum was an introductory course often taken in the first or second year. The course introduced students to the role of information technology and information systems in formal organizations. It included the study of the use of information technology to build efficient and effective information systems. A particular focus was on basic development of information systems that provided meaningful information for management decision making. This was accomplished primarily through the Microsoft Office™ suite of applications.

The DBAA faculty, after great debate and meaningful collaboration, decided to combine *Management Information Systems with Management Decision Tools*. Our objective was to integrate faculty and student interaction while linking technology and learning objectives to achieve outcomes. Refer to the exhibit below.



This figure stemmed from the concept of "people, process and technology" which is very popular in the operations management literature for Enterprise Resource Planning (ERP) and Customer Relationship Management (CRM) implementation, see for example, Chen and Popovich, (2003).

In addition to literature on online and hybrid teaching methods for business quantitative courses, I used the "E-Learning Success Model" by Holsapple and Lee-Post (2006) as a framework to develop course projects, that include PowerPoint™ slides, case studies, practice problems, Excel™ tutorials, assignments and assessments. Table 2 in the Appendix provides a listing of grading components used to measure student performance.

3. CLASSROOM TECHNOLOGY

Similar to Davis et al., (2010) this paper used online learning (rather than a myriad of terms such as eLearning, Distance Learning, Technology-Supported Learning, Web-based Learning and computer-based learning) to describe any higher educational course that used technology to deliver all or part of the course content.

Campus-supported technology tools were not new to the campus. eCollege™, (a part of Pearson' LearningStudio™, similar to Blackboard™ or webCT™) was introduced in 2000 to several graduate classes and piloted to undergraduates during the 2004-05 academic year. Effective Fall 2009, faculty were required by the college to minimally post their syllabi and book list. It should be noted that many faculty members had an extensive eCollege™ site and made use of the many available online learning tools. These tools included online discussion threads, live chat, journaling, webliography, a dropbox for assignments, gradebook, email link and document sharing.

Most classrooms were connected wirelessly and were equipped with an instructor podium, SmartBoard or SmartPodium and an LCD projector as well as connections for laptops, video and document cameras. Faculty members could reserve classroom laptop carts for students that did not have laptops. In Spring 2009, the campus began to experiment with McGraw-Hills lecture-capture software, *Tegrity*™.

Davis *et al.*, (2010), in an exploratory study on IT/IS courses, determined that students preferred "on-ground" (i.e. face-to-face) and "on-ground with online supplement" formats to be more effective in the learning process, with an exception for Microsoft Office™ software. Their study also revealed that students in quantitatively oriented courses would have difficulty in completely online courses. Terry (2007) offers empirical evidence in that online students scored lower in their MBA quantitative course than did students taking the course on campus. Finally, Davis *et al.,* (2010) reported that students preferring online courses were generally non-traditional (in terms of age and work experience) and lived 6-10 miles from campus. Our college is primarily an undergraduate liberal arts institution with 30 majors and 32 minors where nearly all 2,000 students reside on campus. We have a limited offering of hybrid long-distance courses, generally taught during the summer sessions.

My previous experience in quantitative courses at the college confirmed the benefits and struggles of technology use in class. MDT in Spring 2011 was held in a computer lab, equipped with classroom management software and was limited to 25. The class was comprised mostly of first and second year students (with a handful of seniors taking the course as a special elective). The next sections discussed the Spring 2011 MDT 3-credit hour course.

4. COURSE STRUCTURE AND DELIVERY

Classes were held twice a week, on Monday and Wednesday and the instructor offered staggered office hours Monday-Friday, with several Saturday or Sunday afternoons for additional help. Email was responded to quickly (Sebastianelli and Tamimi, 2011) and always within 24 hours. The impact on student outcomes based on personal and electronic interaction between faculty and students, even in large classes, has been documented in the research, most recently by Conn, Boyer, Hu & Wilkinson (2010). Further, the E-Learning Success Model (Holsapple and Lee-Post, 2006) suggested that prompt, responsive, fair, knowledgeable and available faculty were important factors for service quality.

In attempt to capture student interest, as well as to meet the course objectives, while recognizing different learning styles (i.e. Prosperpio & Gioia, 2007), especially given the various quantitative and technological skills of students, cases and projects were integrated into MDT. Baugh (2010) recommended designing a semester project that was relevant to the student. Students in his qualitative study were proud of their results and often exceeded project requirements. Furthermore, students applied technology tools that interested them.

On the first day in Spring 2011, lab policies, which were also posted on the syllabus, emphasized that the computer was for classwork only; otherwise, privileges were revoked. Throughout the semester, there were only a few exceptions to staying focused on classwork and a quick reminder of the class rule solved any issue. Faculty visitors to the class noted that all students were engaged in the Excel™ model and offered assistance to neighboring students.

It was important at the start of the semester, without making students uncomfortable, to identify current knowledge of basic business formulas (such as the profit calculation as well as basic statistical functions, such as mean, median, mode and standard deviation) and Excel™ skill level.

After reviewing the syllabus, a brief non-graded assessment included basic questions involving business calculations and the corresponding Excel™ formulas, functions, charts, formatting and cell references. Students scoring 80% or higher were then identified as Excel™ "geeks" and students scoring below 80% were identified as Excel™ "newbies." The terminology was the class choice and was decided on after several minutes of energetic student interaction.

"Newbies" and "geeks" were then paired (about 8 "geeks" and 17 "newbies") and time was given to allow for introductions and exchange of contact information. Students were not required to sit with their "geek", but they now had access to a peer that would also be able to assist or mentor with course concepts and Excel™. "Geeks" were asked to respond to "newbie" questions within 24 hours. Students commented that they did not often email their "geek" but they knew they had a resource, especially if they missed a day of class. Support for peer mentors in higher education was well researched for retention, academic success and educational experience; see for example, Kram, 1983; Pagan & Edwards-Wilson, 2002; Topping, 1996 and recently Terrion & Leonard, 2010.

The course was split into the following units: overview of MIS, basic Excel™ review (break-even analysis, financial statements, VLOOKUPs, if-statements, Pivot Tables and charting), linear programming (graphically and then solved via Excel's™ Solver and What's Best™ add-in), project management (Gantt Charts, CPM and PERT) regression analysis, forecasting, simulation and decision analysis.

Each unit was one to two weeks in length, dependent on class progress. Students were assigned homework problems: there were "geek" problem sets and "newbie" problem sets. Both problems covered the same material, but the "geek" homework was enhanced with more challenging material. All students had access to all homework problems and "newbies" were welcome to also attempt "geek" assignments and vice versa.

For example, in a break-even analysis problem, "newbies" would find the break-even point and manually chart the graph of revenues and fixed and variable costs and then respond to questions. "Geeks" had the added challenge of building the chart in Excel™ by solving equations via Goal Seek. A second assignment covered importing web query data from the Bureau of Labor Statistics website (www.bls.gov). Students then created charts in Excel™ to show the trending of various employment fields and salaries. The "geek" portion included Pivot Tables with descriptive statistics of salaries by industry. Interestingly, by the 10th week of the 16 week semester, a little over 80% of the students were working on "geek" problems. By the end of the semester, nearly all students attempted "geek" assignments.

At the completion of each unit, an assessment was delivered. Assessments were two-part: qualitative concepts (written, short-answer or fill-in-the-blank) and a small case study to complete in Excel™ (or by hand graphing, in the case of the introductory linear programming unit).

It did not take long to feel the effects of trying to facilitate 25 students with different learning styles and various proficiency levels without a teaching assistant. Even with the peer mentoring groups, students would become frustrated and/or bored, which could impact class group dynamics (Billson, 1986) and the overall learning environment.

Lecture-capture software, in this case, Tegrity™, provided an interactive solution. Class sessions were pre-recorded (static image of the Instructor downhill skiing, recorded voice and video of step-by-step Excel™ actions) and were available for students via a link from eCollege™. Dey, Burn & Gerdes (2009) suggest that online presentations were helpful for "equation heavy" courses. Sebastianelli and Tamimi (2011) customized audio-video clips that illustrated the use of Minitab and Excel™ in step-by-step screen movements with great success and students found it an essential course component.

Students referred to the MDT class recordings as "mini-me sessions." One student commented,

> *The online step-by-step helped me to practice the formulas in Excel™ and were really helpful once I understood the formula by hand. I paused the video and worked through the homework at my own pace.*

When asked, students indicated that they did not use the index or searching functions. The lecture-capture software was easy to use, required just a few minutes of training and uploaded to eCollege™ without issue. I spent little time in the editing during the production process– it was not deemed necessary for this course. As with results from the literature (i.e. White, 2009), class attendance did not diminish with the availability of course recordings. It is possible that the students considered this a "small class" and that their absence would be noticed. Attendance was taken daily.

The log results of viewings at the end of the semester showed that 24 of the 25 students viewed all 10 lecture recordings and there were a variety of viewings of homework hints, for a total of 255 viewings. Individual viewings lasted from a few minutes to nearly two hours.

Pre-recorded lectures were not the only resource for demonstrating new topics. Traditional lectures covered each topic thoroughly and step-by-step with demonstration on the LCD projectors during the first 40 to 45 minutes of class. The remaining time, 30 to 35 minutes, was used for students to work in small groups, often with their "geek" on assigned homework problems. One student commented:

> *There was a lot of work but we were given sufficient time to ask questions in class, either to our mentor or to the professor. I think the combination of teaching methods was effective because of all the example problems she [the professor] walked us through before trying to do the problems on our own. I felt comfortable working outside of class because of the attention the professor was able to give to me during class.*

The final project, a semester-based project (Baugh, 2010), was to develop a decision model for "everyday use." Students were given the opportunity to be creative, to think "outside the box" and transfer their learning into a topic they found interesting. The guidelines included: working in a team of two if desired, use as many concepts and advanced Excel functions™ as possible and prepare an executive summary that explained the model. Students then presented their models on the last day of the course. The rubric included points for accuracy, complexity, usability, feasibility and formatting. A few examples are described in Table 3 in the appendix.

5. LESSONS LEARNED

The six seniors in the course, in addition to their course evaluations, were asked to consider how this course could be taught under the new curriculum. Each student wrote a two-to-four page reflection that offered some positive insights as well as constructive feedback on their experience. The information in this section is based upon my notes, student evaluations, faculty visitor comments and the senior reflections. Main concepts garnered identified that online tools, such as lecture-capture, improved the learning environment for both students and instructor; assessment tools were well received and the seniors also made suggestions to institute a personal portfolio and class-based journal.

At the beginning of the semester, before the implementation of the lecture-capture software, the experience could be summarized in one word: exhausting. Even though the instructor had already incorporated eCollege™ for the syllabus, daily agendas, helpful links, handouts and grading, it really was the online lecture-capture software that turned the course from a potential failure. Prosperio & Goia (2007) suggest that teachers were responsible for circumventing disconnects between current teaching methods and the technology rich "virtual generation" learning methods.

The "production" of the audio recordings and the step-by-step video procedure did take time. However, it was an effective preparation tool for class. Once the process was practiced several times it was actually very easy; even though the decision models were increasing in complexity. The pre-recorded sessions allowed the instructor to focus on the students during class time and cover more examples and application of models:

> *I felt that during this class I was learning valuable information about Excel™ however at times I felt like it was a little tough to keep up to pace. With the videos in front of me it was not so hard to keep up with how Excel™ worked and more class time was spent being able to understand WHY Excel™ worked.*

> *The videos allowed us to focus more on class time to ask questions and learn from those answers and to work with other people.*

> *Because we had the online videos, I feel as though a worthwhile assignment could be adding a mini project at the end of each topic on top of the assessment so we could apply these models to a business scenario.*

Students generally viewed assessments as a better evaluative tool then exams; although, in a sense, they were essentially one in the same. The main difference, though, was that the assessments were unit based rather than time based throughout the semester. Only one unit was assessed at a time. Several students felt that for concepts such as linear programming, simulation and forecasting, they needed more time to absorb the material. With the change from three to four credits, it will be possible to spend more time on each topical area. Surprisingly, students recommended quizzes. Students felt that quizzes would ensure that everyone was caught up on the chapter and supplemental reading material.

An interesting mention was made for both online discussion threads and building project portfolios. The discussion thread would:

> *offer the students and you* [instructor] *the ability to share thoughts and opinions on subjects in class. For example, the section on simulation models. Many businesses employ these types of models into their operations. Through discussion threads each person could find a real life situation where simulations are used. You [instructor] could also ask more in-depth questions that we would be able to have an even better understanding of the models we learned. I believe this would be key to understanding new material and retaining the information.*

Samkin & Francis (2008) suggest that, for those students who engage with them, learning portfolios could contribute by facilitating a deep approach to learning. The authors applied both a learning portfolio and personal journal entries to a third year accounting course.

A student recommended a semester portfolio as beneficial for reference in other courses. "We could even be "hired out" as consultants to the Introduction to Business course as they develop their business plans." One student stated, "I've been asked by my friends to help with Excel™ for their Finance course. It was fun to teach them something new." Another commented that "I have learned how useful and important Excel™ could be and it is just as important to know how to do the decision models and be able to teach someone else how to use modeling."

Students appreciated the chance to create their own decision model at the end of the semester, as shown by the comments above. Many students felt that each unit should have a small decision model that would "help a real company and we could have informal presentations a few times during the semester. This would also help us improve our presentation skills and show how many possibilities there were to use these models."

Beginning with Spring 2012 registration, it will be important to assess whether students pursue further courses in computer science or information systems. Furthermore, how students apply these concepts to their upper level business courses must be evaluated.

6. CONSIDERATIONS

As in any teaching method, there were a number of issues to be considered.

1. Faculty must be prepared to integrate technology into the classroom and must be willing to improve their technical skills. For example, faculty have been known to resist the latest version of Microsoft Office™ with the "ribbon toolbar." Adding to the complexity is learning to use Excel™ in both PC and MAC formats.

2. Murtonen (2008) suggested that students who experienced problems with learning quantitative methods did not necessarily have problems with learning mathematics, but their views and beliefs from previous experiences might not support the learning process. In my classes, I hear "I don't like math." If we can modify the negative connotation associated with quantitative methods and link theory to practice, such as MDT is designed, our student's performance might indicate better transfer of knowledge and improved overall learning.

3. The relatively small class size, due to lab seating limitations, was actually helpful in many ways. There were a variety of skill sets within the class and it would have been difficult to give each person equal assistance if the class was much larger than 25. A limited class size is often a recommendation in courses involving online elements. The inclusion of peer mentors was also helpful; although their work was often checked to make sure it was correct. Students were able to get to know one another more in this class by helping each other resulting in a close sense of a learning community.

4. Business students were quite used to a combination of online and "traditional" teaching methods. They were very comfortable accessing information from eCollege™ and downloading videos to their laptops or mp3 players. What was new was the ability to learn quantitative models using Excel™. In addition to learning the decision model under study, they had to develop their own skill set. Another recommendation by a student was to keep a journal that worked as an Excel™ "how-to" guide.

5. Zhu (2010) suggested that in a virtual classroom community, students demonstrated active participation, especially when experiences linked academic and social settings together. Several students recommended the importance of online discussion groups and one student stated, "keeping a journal and seeing what other students were doing would be useful to help me reproduce concepts to other classes."

6. Dey *et al.,* (2009) in their exploratory research found significant differences in transferring concepts between live lecture and multimedia and video presentation. Students watching the multimedia presentation scored higher than their counterparts that just listened to the lecture. It will be valuable to study whether other DBAA faculty feel that students quantitative and Excel™ skills improve over time. It will not be for several semesters before these students will be "tested" on their retention.

DBAA faculty presume that students will be prepared for upper level course work. Miller & Brooks (2010) suggest a deviation of SERVQUAL (Parasuraman, Zeithaml, & Berry, 1988) called ClassQual to evaluate overall "service" quality in the education setting, especially in regards to course content, faculty concern and student satisfaction.

7. How will the students "carry" learned concepts to other classes? Additional research on retention and confidence in numeracy skills needs to be studied as students take advanced quantitative courses. Rustagi (1997) examines retention of quantitative methods between courses and results are not overly positive. A difficulty with the MDT course is that it is placed early in the student's academic career. It is possible that an entire year could go by before a higher level business quantitative course is taken. The DBAA plans on studying the impact of this course as students continue in their academic program.

7. CONCLUSION

Millennial students are inundated with technology bells and whistles that encourage multi-tasking on a habitual basis: texting, updating Facebook and Twitter statuses, listening to music via their iPod or Pandora, occasionally taking a phone call, checking (several) email accounts and possibly writing a term paper, using online resources. Embraced, the virtual environment could actually create different opportunities for learning (Prosperio & Gioia, 2007).

Dey *et al.,* (2009) remind us that the digital generation would demand more interactive instruction. As faculty, we develop curricula based on our practices, attitudes, beliefs and technology skill sets. At the college, our faculty benefit from the strong resources of an effective team in Instructional Technology Services. In the end, our students ability "to do numbers" and apply information system concepts may well depend on the efficient integration of student and faculty interaction in a virtual world.

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Figure 1: Management Decision Tools (MDT) Course Development Timeline

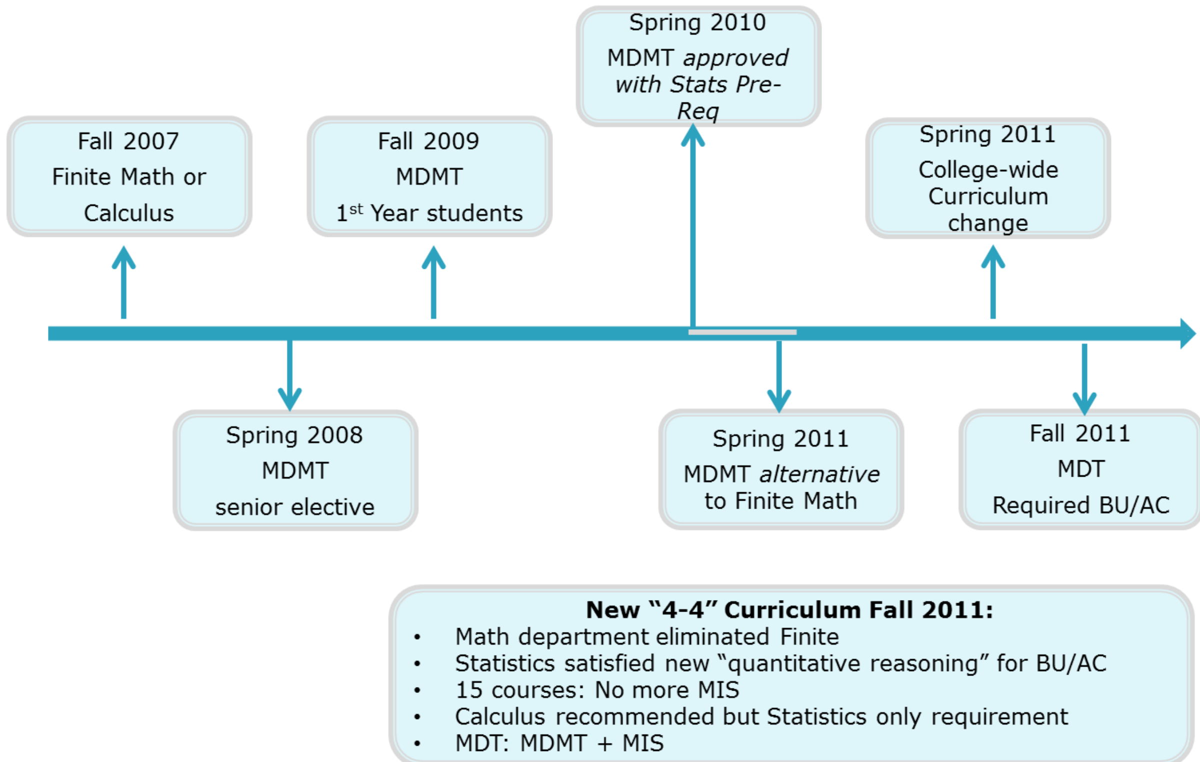

Table 1: Management Decision-Making Tools Special Topics (original) Course Description:

Course Description:
This course provides an introduction to the concepts and methods of Management (also known as Decision) Science, which involves the application of mathematical modeling and analysis to management problems. It also provides a foundation in modeling with spreadsheets. The primary goals of the course are to help you develop logic to build business models and analyze diverse decision-making scenarios utilizing computer software. Another important goal is to encourage a disciplined process to approach management situations.

More specifically, the course will:

- Introduce you to the basic principles and techniques of applied mathematical modeling for managerial decision-making. These methods will be applied to problems arising in a variety of functional areas of business, including economics, accounting, finance, marketing and operations. Sample topics include linear & nonlinear programming, project management, simulation, decision analysis, forecasting and queuing.

- Show you how to use Excel™ spreadsheets effectively for business analysis. You will learn a comprehensive set of spreadsheet skills and tools, including how to design, build, test and implement a spreadsheet.

- Sharpen your ability to structure problems and to perform logical analyses. You will practice translating descriptions of business situations into formal models and you will investigate those models in an organized fashion.

- Expose you to settings in which models can be used effectively. You will apply modeling concepts in practical situations. You will learn to extract insight from models and to use those insights to communicate, persuade and motivate change.

Textbook: ***Managerial Decision Modeling with Spreadsheets***, by Balakrishnan, Render & Stair. 2nd Edition

**Table 2: Management Decision Tools (MDT)
Grading Components/Student Assessment in the New Curriculum**

Description:	Points
Linear Programming Assessment	100
Project Management Assessment	100
Decision Analysis Assessment	100
Simulation Assessment	100
Forecasting Assessment	100
Homework	100
Journal	100
Excel™ in the "Real World"	75
Custom Decision Model	75
Why IT projects fail paper	50
Quizzes	50
Project Presentations	50
Total	**1000***

Table 3. Final Project Descriptions

Project Title	***Description***
Take me to the ballpark	Two students designed a network flow diagram for a trip to Boston for a Red Sox game, including rest areas, eating options, parking and overnight accommodations. To apply the critical path concept, they used a random number generator to apply "happiness" scores. The critical path determined the "happiest" way through the network. As the random numbers would re-calculate, the critical path would adjust and with the use of conditional formatting, would "light up" in Red Sox colors.
Stats, Stats and More Stats	A varsity baseball player collected statistics from the college's division competitors. Using a series of regression analyses, pivot tables and charting, he was able to provide a working model of key players as well as find statistically significant results on batting averages.
Scarves, anyone?	A two student team developed a business model, including forecasting and simulation, to determine net profit for their first year business course which required a business plan.
Is it Tax Season?	An accounting student developed a simulation model that would identify the profit of his tax preparation service for international firms. Firms with higher revenues were charged a higher preparation fee. The model included complex if-statements, VLOOKUPS and charting.
Leaving on a Jet Plane	A student from New York City developed a linear programming model that analyzed the optimal way home for various school vacations: bus, train, or plane. Constraints included an overall budget, travel times and a minimum number of flights needed to receive the maximum possible frequent flier points. There was also a constraint for "parental demand" for trips. The model was easily adapted to several other students in class.

Involuntary Commitment Application: An Online Training Module

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Abstract

The use of Web-based technology has enabled many government and corporate training divisions to reach more learners than ever before. Institutions are restructuring their budgets, obtaining funding from governments and foundations to fund resources needed to increase online learning offerings. While online learning is increasing, questions arise as to the quality when compared to traditional face-to-face instruction. Research indicates that online learning can be more effective than face-to-face instruction. The purpose of this project is to analyze training sessions used by a state judicial system in southeastern United States for their Involuntary Commitment (IC) training to determine if self-directed online training is a viable solution to replace the current face-to-face training program and if so, design, develop and evaluate a pilot program for online training material.

Keywords: Web based instruction, analyze training, training, online learning, research paper

1. INTRODUCTION

The use of Web-based technology has enabled many government and corporate training divisions to reach more learners than ever before (Bonk, 2002; Lynch, 2005; Smith, 2003). According to the 2010 State of the Industry Report, the American Society for Training and Development (ASTD) stated that in 2009; twenty eight percent of all training hours for organizations were completed online, up twenty three percent from 2008 (Prost, 2010). Institutions are restructuring their budgets or obtaining funding from governments or foundations to fund resources needed to increase online learning offerings (Lynch, 2005). While online learning is increasing, questions arise as to the quality when compared to traditional face-to-face instruction.

The quality and benefits of face-to-face versus online instruction have been debated for years. The U. S. Department of Education sponsored a study which compared over one thousand research studies from 1996 through 2008 to measure the quality of face-to-face versus online instruction (Means, 2008). In his study in 2000, Johnson compared online instruction with face-to-face instruction for a variety of learning outcomes. He concluded that course quality was considered slightly more favorable in face-to-face instruction than in online instruction (Johnson, 2000). Training in the workplace has also been shown to be more clearly defined, more collaborative and more innovative with face-to-face instruction (Smith, 2008). Face-to-face instruction also provides more opportunities for instructors to tailor the training session according to the needs of the students during instruction (Jefferson, 2009). Nonetheless, face-to-face instruction has its own challenges to learning.

Some studies suggest that if face-to-face training becomes instructor-centered it could encourage passive learning, ignore individual differences and needs of the learners (e.g., Banathy, 1994; Hannum & Briggs, 1982;

Johnson, 2000). Another limitation of face-to-face training is related to the degree of learner control. Learner control is where the learner believes their success is due to their own efforts (Lynch, 2004). Lynch (2004) contends that in face-to-face training sessions, learners may feel their success or failure is determined more by an external force and not by their own efforts. Flexibility of time and place are other obstacles for face-to-face learners. It is also argued that instructors often do not have enough time to adequately cover the material (Jefferson, 2009). Businesses usually allot only a small amount of time for training and expect learners to complete their learning while on the job. This can make mastering tasks difficult for learners who must perform immediately upon returning to work. Classrooms also have a limited number of seats and courses may not be offered when learners are available to attend. Face-to-face training can also be labor intensive and expensive (Bates, 2000). Organizations must pay the expense of travel for learners and instructors, equipment and instructional material costs. Thus, in spite of its many advantages, face-to-face instruction has limitations. Lack of learner control and inflexibility of time and place are some of the major limitations with face-to-face instruction. However, the question is can Online Learning eliminate some of these limitations and as a result, improve quality of instruction?

Before we can determine if online learning is the answer for training organizations, we must first define online learning. Bates (2000) uses the University of North Carolina Institute of Academic Technology to define online or distributed learning as an environment with a learner centered approach to education. According to this definition distributed learning integrates technology to enable opportunities for synchronous and asynchronous activities, which gives instructors flexibility to customize learning environments to meet the needs of diverse student populations while providing high-quality and cost effective learning (Bates, 2000). Online Learning activities used in distributed learning are also defined as a pedagogy that emphasizes asynchronous small group discussions, collaborative problem solving, reflective inquiry, and competency-based outcomes (Rudestam, 2004). Parsad (2008) states that distance education includes instructional delivery of online courses on or off-campus, remote locations, correspondence courses and hybrid/blended online courses. To summarize, online learning promotes a learner centered approach for synchronous or asynchronous learning activities and provides more opportunities for utilizing customized learning environments that can be accessed anywhere or anytime. For the purposes of this project we will focus primarily on asynchronous, self-directed online learning environments rather than synchronous learning. Now that we have defined online learning, the question remains, is online learning the answer to provide quality instruction for training organizations?

Benjamin Bloom (1984) compared the results of one-on-one tutoring with face-to-face classroom instruction in his 2-Sigma problem. He found learners achieved up to two standard deviations higher in favor of one-on-one tutoring. Although we cannot provide an instructor for every student, educational technologies such as online training has the potential of individualizing learning and can make education both affordable and accessible (Fletcher, 2007). In another study, researchers completed meta-analysis on over one thousand empirical studies and determined that on average, online learners performed better than those receiving face-to-face instruction (Means, 2009). One reason for learner's high performance was due to flexibility of time and place. This flexibility gave learners access to additional learning time with the instructional materials. Learners also performed better when face-to-face and online instruction was blended together than with face-to-face instruction alone. Group participation in online learning enables the learning to be constructed through the interaction with others and the outcome is enhanced learner satisfaction (Bonk, 2002; Smith, 2008). The quality implications presented here are just a few of the many advantages to online learning; however there have been challenges associated with online learning as well.

Researchers point to a number of challenges regarding asynchronous online learning environments. Many of these challenges are associated with factors related to motivation and social presence or the degree to which people are *perceived* as "real" in computer-based communication (Gunawardena, 1995). For example, learners must be able to motivate themselves to learn on their own and teach themselves new information (Jefferson, 2009). There is also delayed feedback response time from both learners and instructors when asking questions or clarifying instructions. It is also difficult to form personal relationships both with peers or instructors when courses are online only (Jefferson, 2009). Another study examining social presence in online courses found that students with high perceptions of social presence scored high in perceived learning and satisfaction just as students with low social presence scored lower in perceived learning and satisfaction (Richardson 2003). Even though motivation and social presence identified as challenges to online asynchronous learning, it is still considered a viable method of providing quality instruction for training organizations.

In summation, online training can be perceived as effective; if not more effective, than that of face-to-face training. Johnson completed a study in 2000 that compared student satisfaction with their learning experience in both a face-to-face and online learning environment. Johnson (2000) found that there was no difference in the quality of the learning but that students found a slightly more positive experience with online instruction (Johnson, 2000). Although face-to-face training may still be more advantageous in many cases, online learning has become the wave of the future. Learning in the workplace is initiated by individuals as part of their working lives. It is informal, self-directed and broken into small chunks of learning. It is driven by short term needs not by any conscious plan of study (Bates, 2000). Although there are startup and maintenance costs associated with developing online training, it can also be less expensive than face-to-face training. Once the expense of development, installing equipment and networks are completed, online training can be conducted by one instructor to many learners both near and far (Bates, 2000). Travel expenses are greatly reduced as are the expense of printing instructional materials which can be delivered electronically (Strother, 2002). Learners can complete online training any time and any place either from their workplace or from the privacy of their own homes (Parsad, 2008). Learners can also review the instructional materials many times to enhance their learning experience. In sum, online learning brings flexibility, of time and place, increased learner satisfaction and learner control and lower costs than with face-to-face instruction.

2. PROPOSE OF THE STUDY

The purpose of this project is to analyze training sessions used by a state judicial system in southeastern United States for their Involuntary Commitment (IC) training to determine if self-directed online training is a viable solution to replace the current face-to-face training program and if so, design, develop and evaluate a pilot program for online training material.

The Context of the Study

The judicial system in southeastern United States is established as a co-equal branch of the state government. The local judicial agency within the state judicial system serves the technology, training and regulatory needs of the system. The local agency supports over six thousand five hundred employees in over 200 offices throughout the state. The agency has a Legal Division, Technology Division, Human Resources Division and Training Division. The technology division provides employees with hardware and software resources. The training division works closely with the technology division to design, develop, implement and evaluate training for software solutions to employees. The agency has face-to-face, hands on computer training facilities in the corporate office.

Traditionally, upon identification of the training needs, the agency would offer face-to-face classroom training. Face-to-face training sessions are also offered quarterly in the corporate training center. Previously, the IC application training has also been offered only for face-to-face, hands on classroom instruction. The face-to-face IC application training enabled users to utilize software application during the training to record specific data in a secure, centralized, electronic repository. efficient data sharing with the federal government as well as between different local offices.

The development of the face-to-face application training required the coordinated efforts between the Technology Division (TSD), Training Division and external agencies. To meet the training needs for implementation deadline of the new Web-based application, the agency has recently begun to incorporate online learning into their face-to-face training course offerings. The online training, however, has been limited to synchronous meetings (webinars) using tools such as Cisco WebEx. In order to continue offering online courses, the agency has also improved its technology resources and provides access to computers to enable the organization and its staff to utilize online training.

3. NEEDS ANALYSIS

Needs analysis was conducted to assess the effectiveness of the training for the application. Analysis of statistical reports generated by the agency and interviews with the project sponsor revealed approximately 20 percent of the offices are using the application. Analysis also revealed that those 20 percent enter 80 percent of the data into the application; the remaining 20 percent of the data is entered by users who do not use the application on a daily basis. Further investigation revealed that there have been only three four-hour face-to-face training sessions held at the training center from January 1, 2009 through December 31, 2010. Interviews with the management revealed that because of budget restraints and instructor availability, the number of training sessions was limited to only four sessions for a two year period. The sessions were also poorly attended because they were not flexible in time and place for learners. Learners were also informed that they would only be reimbursed for a portion of their travel expenses to attend the training. Analysis also revealed that only 15 learners attended the training sessions. A minimum of 200 users have access to the application and the ability to enter data on a daily basis. Only 7.5 percent of the users with access to the application have attended training sessions. Several application enhancement recommendations include making data entry into the application more efficient and incorporate user suggestions into the new design to promote "buy in" from the user group.

Assessment of the effectiveness of synchronous online delivery of the training for the new Web-based application revealed that it has some of the same limitations as the face-to-face training. Travel expenses were reduced when compared to face-to-face training, but online attendance remained low and only represented by the few offices already using the application. The number of training sessions has also been limited due to budget constraints, travel restrictions and availability of the two instructors who teach the application. The synchronous online training sessions have been available for one year. A total of thirty six synchronous training sessions were held from February to October. The training sessions were two hours long and only offered on 12 days from February to October. There were ten sessions in February, four in March, eleven in June, five in July and six in October. Interviews revealed that scheduling training sessions was difficult due to limited instructor availability. Training sessions were held within those few days of availability. The results of learner evaluations revealed that the learners had little choice of days or times when to enroll in the training sessions and commented they would like training to be more flexible to their schedules.

A Summative evaluation was conducted for existing synchronous training sessions and found that learners' attitudes toward the training were mixed. Learners found the training organized and easy to follow, instruction was related to their work and instructional material was useful when returning to the job. Learners did not believe adequate time was allowed nor were there hands on activities included in the instruction. Interviews with the instructors revealed that they were only given two hours to complete each training session. Given the short amount of time involved, instructors did not have time to include hands on activities within their instruction. Instead, learners were given instructional materials which included examples and scenarios in the appendix. Learners also commented that once returning to work, they found they were unable to retain learned information and had to refer to the instructional materials. They also found the materials difficult to review on their own without the aid of the instructor. The instructional material was not designed to stand alone without learners attending training sessions.

Analysis has shown that face-to-face and synchronous online training sessions has not solved the problems of flexibility of time and place, increased learner satisfaction and learner control. Synchronous online training has reduced travel expenses for learners but still include travel expenses for instructors and equipment expenses. As a result of the needs analysis, it is recommended that self-directed, online training would address the needs of the learners, support learner control and have flexibility of time and place. The development of self-directed learning materials will not be without cost. However, the reduction in instructor and equipment expenses will compensate for some of the development cost. Furthermore, Self-directed asynchronous online training sessions would enable learners to have the flexibility to review and revisit the instruction as many times as needed to refresh their memories. Training would be designed to address the needs of the learners without the need for an instructor to be present. Learners will be able to ask questions and receive feedback from instructors through asynchronous means. Learners will be required to register for the self-directed online training. Registration is required to ensure learners can access the host website and to establish communication between the instructor and learners. Once registered, learners be sent a welcome email which will identify the instructor's contact information, how to access the self-directed training and who to contact for technical support. Learners will have unlimited access to the self-directed material and a 24 hour helpdesk support. Learners will also be able to email instructors with questions about the training. By using asynchronous means of communication, instructors have the flexibility to answer questions and provide feedback from any location and whenever they have time.

4. RECOMMEND SOLUTION

Based upon the research, data analysis and interviews, the recommended solution is to design, develop and evaluate a pilot program for online, self-directed training materials for the IC application. All technology resources have been established for learners and online training is a viable option to use for IC application training. The design of the online training material will follow the conclusions found in the literature research. The instructional material will be self-directed and broken into chunks of learning, have flexibility of time and place and can be reviewed multiple times to reinforce learning. Travel expenses will be greatly reduced as will the expense of printing training materials. The training will be produced through using advanced multimedia technology tools and delivered through the agency *Intranet.* The training will address the needs of the learners, provide environment for practice, serve as refresher training without extra cost and effort and offer learner flexibility and control.

In order to have flexibility of time and place, address the needs of the learners and support learner control, the self-directed, self-paced online training was developed with the following goals in mind.

- The self-directed, self-paced training will be available to learners any time and from any place in order to achieve the learning objectives of the training session.
- The learners will be able to retake (repeat) the course as needed.
- Learners will be able to transfer the knowledge and skills to their work environment upon completion of the self-directed training.

5. LEARNING OUTCOMES

Several learning outcomes were identified for the self-directed online training. First, Learners will be able to apply a set of rules to determine what is entered into the software application. Second, ensure the identified data is entered properly and without any error and lastly, self-assess the accuracy of the data that are entered into the system. Since only cases that contain a specific set of circumstances should be entered into the application, the learner is expected to identify which set of circumstances required data entry and which did not.

The objectives were defined using a task analysis to identify high, medium and low level tasks. Once all the tasks were identified, the instructional goal, learning outcomes and learning objectives were developed and refined. The assessment strategies were based on the instructional goal and learning outcomes. The assessment items represent measurable concepts of the instructional goal and objectives. Once measurable concepts were identified, assessment items and instructional strategies were developed.

6. INSTRUCTION DESIGN MODEL

The instructional method used for designing the self-directed online instructional materials is the Learning by Doing or Goal-Based Scenario model developed by Roger C. Schank (Riegeluth, 1999). Shank's model is based on skill development and learning factual information within the context of how it will be used. Shank based his model on several core values which include:

- Learning to do skills, not just know factual information.
- Learning occurs in the context of goals that are relevant, meaningful and interesting to the learner.
- Knowledge learned is in terms of relevant tasks and how learners will use it outside the learning environment.

The instructional material was designed to follow learning by doing or the goal-based scenario (GBS) training method. Using this model instruction was designed to incorporate Learning by Doing simulation where learners pursue goals by practicing target skills and using relevant content to help them achieve their goals.

Environmental Analysis
Environmental Analysis showed that network infrastructure and computer hardware installation was completed and was available to all users throughout the state. The agency had set up a public website which could be accessed anywhere and contained published information for both employees and the public. A private computer network or *Intranet* has also been established with employee only access to all secured agency information and documentation. The self-directed training material was created and delivered individually for the initial pilot training. The Instructor and learners accessed training materials from their own computers. See Appendix B for a sample welcome letter that will be emailed to learners.

Learner Analysis
Learner analysis was also conducted to identify characteristics of the target audience. The analysis showed that the state agency had over six thousand users with access to various software applications within the agency. These users are current agency employees, both men and women, of many races and ethnicities with ages ranging from 18 to 73 years old. Learner education levels range from a minimum High School Diploma or GED through PHD. Learner abilities range from moderate to advanced level. The entry behaviors survey indicates learners have basic to advanced computer skills and moderate to advanced English reading and comprehension skills. Learners also had prerequisite knowledge needed to enter data into agency applications and discriminate case information. Learners may not have necessary prerequisite knowledge of the instructional delivery system and will be directed to view tutorials already available to them before taking the online learning materials. Learners believed the use of self-directed training could enable them learn at their own pace while still being able to perform job responsibilities in a timely fashion. Learners appeared to be highly motivated and wanted to acquire skills to protect their jobs while having satisfaction in performing well on the job. See Appendix A, Table 1 for more information about the target learners.

7. FORMATIVE EVALUATION PROCESS

Methodology
The formative evaluation was conducted using the Dick and Carey Criteria (Dick 2005). As suggested by Dick, Carey and Carey (2009), one-on-one and small group formative evaluation was conducted to assess the effectiveness of the module and to identify the areas for improvement and change. The ARCS Motivation Model and modules' learning outcomes were used as a framework to conduct both one-to-one and small group trials evaluation process. The Dick and Carey formative evaluation Criteria suggest assessing the clarity of instruction, the impact on learning and feasibility of time and resources. The clarity of instruction is how clear the message (content of the instruction), images, links and procedures are to the learner. The impact on learning deals with the learners attitudes toward the instruction and their achievement of the objectives. The feasibility considerations are the capability of the learner and the appropriateness of resources or environment. The ARCS Motivation Model suggests evaluating the appropriateness of instructional strategies to gain learners attention, provide relevant information, ensure learner confidence to succeed and satisfaction with the learning experience. Thus, the outcomes for one-to-one trials are to ensure the instruction contains appropriate vocabulary, complexity and examples for the learner, yields positive learner attitudes and achievement and is feasible and useable within the given resources and environment. The outcomes for the small group trial are to refine the instruction to maximize effectiveness for the target audience.

Instruments
The formative evaluation instruments used to collect data include a survey, informal observation, a pretest and a posttest. The pretest and post included five questions based upon the course objective of entering, assessing and correcting data within the software application. The questions addressed the learning objectives which were determining what data to enter, demonstrating data entry procedures, assessing accuracy of data entered and correcting errors. The posttest question items were parallel to the pretest question items in order to measure learners' achievement of learning objectives. The survey was divided into four sections. The first section included questions about the clarity of instruction, the

impact on the learner and feasibility. The second section included navigation, feedback and organization questions. The third section included questions about the overall features of the module, the quality of instruction, relevance, gaining and maintaining learners' attention, and satisfaction with the learning experience. The last section included open ended questions about what learners liked and disliked and suggestions for improvement. See Appendix C for the survey, pretest and posttest instruments.

Participants
The self-directed instructional module was created because the target audience is located in various cities across the state. Due to time constraints to complete the formative evaluation, only six participants were available at the time of the evaluations. Three individuals were available in person and three live in remote parts of the state. The participants of the One-to-One evaluation and small group of the Involuntary Commitment Training Module were six adult learners. Three of the evaluations were conducted one-on-one and since the module was self-directed three of the evaluations were conducted remotely. The six participants consisted of two individuals with no experience in the Involuntary Commitment subject matter, one individual with some experience and three individuals with more than five years experience. Three learners have advanced level computer skills with experience in various types of software applications and three learners have moderate level skills also experienced in various types of software applications. Learners ages ranges from 30 to 60 years old. All learners were contacted before they began the instruction to explain the procedure, how to access the components of the instruction and answer any questions.

Procedure
The one-to-one evaluations were conducted in person for all three evaluations. This was to ensure consistency in functionality learners. Learners were under observation as they completed the pretest, instructional module and posttest. The author answered questions and recorded their comments and suggestions. Learners were allowed to complete the survey on their own to increase their confidence and comfort level when rating the instructional materials. The remote evaluations were initiated through Skype with video access to the learners and the ability to share desktops was used for observation. For the remote evaluations, the instructional module was loaded onto a web server and learners were given detailed instructions and links to the module, pretest, posttest and survey. Due to technical difficulties with software, the remote learners were unable to access the quiz questions imbedded within the instructional module. As an alternative solution, the quiz questions were emailed as an attached word document the learners completed while viewing the module. The learners then emailed the quiz with answers back to me after completing the instruction. The problem was fixed later, after the evaluations were complete. A thank you email was sent to the learners for their evaluations and included the new website link so learners could view the final product with quizzes in its entirety.

8. EVALUATION RESULTS

Overall learners achieved learning outcomes and commented that they did learn information they did not know before completing the instruction. All of the learners scored well on the instructional module quiz. Three learners answered all the questions correctly, two learners missed one question and one learner missed two questions. The incorrect answers were not concentrated within a single learning objective. The results of the pretest and posttest were also good. The results of the pretest were, four learners scored four out of five questions correct and two learners scored five out of five questions correct. A score of five out of five correct means that the learner would not necessarily have to complete the instructional module; however, this formative evaluation was conducted by three learners who are very familiar with the subject although they are not subject matter experts. On the posttest, two learners scored four out of five and four learners scored five out of five questions correct. Learners stated that incorrect answers were possibly due to the question instructions not being clear and the difficulty in using the quiz feature to answer questions correctly. See Appendix C, Table 2 and 3 for the quiz and pretest, posttest learning gain score results.

The survey indicated that overall, the learners had positive perception about quality of the instruction. The learning material gained and maintained their attention and they were satisfied with the learning experience. Learners thought the material was relevant to their needs. Learners also agreed the purpose and goals were clearly stated, it was appropriate for individuals with various levels of computer experience and it was organized and easy to navigate. All learners but one agreed the length of the module was appropriate. One learner thought the overall length of the module was long but stated they were glad it was broken up into short sections five minutes or less so they did not have to complete the module in one session. The primary negative issue was lack of quiz feedback within the module. The quiz components of the module were designed using a specific software quiz functions which limited the design capability. The module quiz design did provide feedback when working properly; however, due to technical difficulties the remote learners did not have the ability to view the quiz questions within the module after it was posted. The learners were given verbal feedback during the evaluations but stated that they would like to see the quiz function working within the module itself. See Appendix D, Table 4 for the survey results.

9. CONCLUSION

In conclusion, research revealed that while face-to-face training may still be more advantageous in many cases, online learning can be as effective if not more effective. Online learning has become the wave of the future. It brings flexibility, of time and place, increased learner satisfaction and learner control and once developmental costs are incurred, lower costs than with face-to-face instruction. The instructional module developed was self directed based on face-to-face instructional material. Instructional designers should realize they may spend just as much, if not more time designing the module than for a face to face instruction. The content had to be developed in its' entirety, knowing that an instructor would not be present while learners are completing the module. This created a different set of challenges than when designing face-to-face instruction. Further evaluation with a larger sample group is needed to determine more accurate learning outcomes.

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Editor's Note:

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Appendix A – Learner Analysis

Table 1: Learner Analysis Matrix

Information Categories	**Data Sources**	**Learner Characteristics**
Entry Behaviors	Interviews, Data analysis, Observation	Learners have basic to advanced computer skills and moderate to advanced English reading and comprehension skills.
Prior Knowledge	Data analysis, Interviews	Learners have prerequisite knowledge needed to enter data into agency applications and discriminate case information. Learners may not have prerequisite knowledge of the instructional delivery system and will be directed to view tutorials available to them before they begin the training.
Attitudes	Interviews, Observation	Learners believe the use of self-directed training will enable them learn at their own pace while still being able to perform job responsibilities in a timely fashion.
Motivation for Instruction (ARCS)	Interviews, Observation	Learners are highly motivated. They want to acquire skills to protect their jobs and have satisfaction in performing well on the job.
Education and ability levels	Data analysis	Learners have a minimum High School Diploma or equivalent through PHD level of education. Learners have moderate to advanced learning abilities.
Relevance of skills to workplace	Interviews, Data analysis, Observation	Learners view the skills learned in the training are directly related to their work environment and therefore relevant and valuable.

Appendix B – Welcome Letter

The Welcome letter will be sent to learners via Email once they have registered for the module.
Dear [Learner],

Welcome to the Involuntary Commitment Application Training Module. I am [Instructor's Name] and will be the instructor for this course. My contact information is below.

This instructional module contains information about how to use the application from the Intranet to enter data into the system. The module can be found on the company website, click on the link provided below to access the instructional module.

The Instructional module includes both Audio and Video components and can be viewed on any computer that has access to the Website. The module is designed to take thirty minutes to complete and is divided into seven sections the Introduction, Classify Cases, The Main Menu, How to use Case Add, How to use Search, Verifying Reports and How to use Case Edit. Each section is approximately five minutes long. The recommended instructional flow is to begin at the Introduction and continue sequentially throughout the sections.

There are no prerequisites to the course however each learner should have a userid and password to gain access to the Intranet application. Contact your supervisor to receive necessary forms and instructions.

Please take a moment to complete the Pretest found in the link below before completing the instructional module. After completing the instruction, complete the Evaluation Survey and Posttest found in the links below. These evaluations enable me to determine if the instruction is effective and identifies areas that may need revised.

Thank you for taking time from your busy schedule to complete this instructional module. If you have any comments or questions please contact me via email any time. I hope you find the instruction informative, helpful and enjoyable.

Sincerely,

[Instructor Name]
Instructor
Email:
Phone:

Click on the link below to access the instructional module or type the address into the web browser

Click the link below to access the Module Evaluation Survey

Click on the link below to access the pretest

Click on the link below to access the posttest

Appendix C – Formative Evaluation

Survey Instrument

The link to the formative evaluation survey is:

1. Involuntary Commitment Module Survey

After completing the Instructional Module, please answer the following questions.

1. Consider the following statements about the content of the instructional module and rate them on a scale of 1-5 where 1 indicates that you strongly disagree and 5 indicates that you strongly agree.

	5 Strongly Agree	4 Agree	3 Unsure	2 Disagree	1 Strongly Disagree
The purpose and/or goals of the module are clearly stated.	○	○	○	○	○
The module is appropriate for individuals with various computer experience levels.	○	○	○	○	○
The information was presented in a manner that made it easy to understand.	○	○	○	○	○
The information presented was appropriate in length.	○	○	○	○	○

Other (please specify)

2. Consider the following statements about the navigation and function of the module and rate them on a scale of 1-5 where 1 indicates that you strongly disagree and 5 indicates that you strongly agree.

	5 Strongly Agree	4 Agree	3 Unsure	2 Disagree	1 Strongly Disagree
The module was organized and easy to follow.	○	○	○	○	○
The Table of Contents and software navigation were available easy to operate.	○	○	○	○	○
The software provides feedback to user responses.	○	○	○	○	○

Other (please specify)

3. Consider the following statements about the overall features of the module and rate them on a scale of 1-5 where 1 indicates that you strongly disagree and 5 indicates that you strongly agree.

	5 Strongly Agree	4 Agree	3 Unsure	2 Disagree	1 Strongly Disagree
The overall quality of the instruction is good.	○	○	○	○	○
The material was relevant to my needs.	○	○	○	○	○
The module gained and maintained my attention.	○	○	○	○	○
I am satisfied with the learning experience.	○	○	○	○	○

Other (please specify)

4. What did you like best about the Involuntary Commitment instructional module?

5. What did you like least about the Involuntary Commitment instructional module?

6. Please, suggest ways the Involuntary Commitment instructional module can be improved.

Pretest

The link to the Pretest is:

Pretest - Involuntary Commitment Training Module

Question 1

What type of data should be entered into the application?

A. Involuntary Commitment
B. Voluntary Commitment
C. Inpatient Commitment
D. Substance Abuse Commitment

Question 2

Check the box next to the components of the Main Menu.

- ☐ Add Involuntary Commitment
- ☐ Edit Involuntary Commitment
- ☐ Search Involuntary Commitment
- ☐ View Reports
- ☐ Help

Question 3

Which of the data entry fields below are required to enter case information into the “Case Add” feature of the application?

A. Name
B. Address
C. Social Security Number
D. Judges’ Name

Question 4

What two data entry fields are used to search for information in the application?

A. Name and address
B. Social Security Number and Name
C. File number and County
D. None of the above

Question 5

What two items are analyzed to determine if there are any errors in data entry?

A. The Case File and the Case Add screen
B. The Judgment form and Data Entry Report
C. The View Search screen and Case File
D. None of the Above

Posttest

The link to the Posttest is:

Posttest - Involuntary Commitment Training Module

Question 1

What type of data should NOT be entered into the application?

A. Involuntary Commitment
B. Voluntary Commitment
C. Inpatient Commitment
D. Substance Abuse Commitment

Question 2

List the five components of the Main Menu in the Text Box below.

Question 3

Which of the data entry fields below are required to enter case information into the "Case Add" feature of the application?

A. File number
B. Address
C. Identification Number
D. All of the Above

Question 4

What feature is used to find case information that has been previously entered into the application?

A. Add Involuntary Commitment
B. Edit Involuntary Commitment
C. Search Involuntary Commitment
D. View Reports

Question 5

How are errors in data entry identified?

A. By comparing the Case Add Screen to the Case File
B. By comparing the Data Entry Screen to the View Report Screen
C. By comparing the Data Entry Report to the Judgment Form
D. By Comparing the Case File to the Case Report

Appendix D – Evaluation Responses

Table 2: Results of Quiz

Learner	Objective 1 Classify Cases			Objective 2 Case Add				Objective 2 Search	Objective 3 View Reports				Objective 4 Case Edit	Mastering Objectives	
	Q1	Q2		Q1	Q2	Q3	Q4	Q1	Q1	Q2	Q3	Q4	Q1	#	%
Learner 1	+	+		+	-	+	+	+	+	+	+	+	+	11	92
Learner 2	+	-		+	+	+	+	+	+	+	+	+	+	11	92
Learner 3	+	+		+	+	+	+	+	+	+	+	+	+	12	100
Learner 4	+	+		+	+	+	+	+	+	-	+	-	+	10	84
Learner 5	+	+		+	+	+	+	+	+	+	+	+	+	12	100
Learner 6	+	+		+	+	+	+	+	+	+	+	+	+	12	100
+ correct response															
- incorrect response															

Table 3: Learning Gain Score – Pretest and Posttest

	Learner 1	Learner 2	Learner 3	Learner 4	Learner 5	Learner 6
Pretest	4	5	4	4	4	4
Posttest	4	4	5	5	5	5
Learning Gain Score*	0%	-1%	1%	1%	1%	1%

Table 4: Results of Survey

Consider the following statements about the overall features of the module and rate them on a scale of 1-5 where 1 indicates that you strongly disagree and 5 indicate that you strongly agree. 1=Strongly disagree; 2=Disagree; 3=Unsure; 4=Agree; 5=Strongly agree						
Question	**Learner 1**	**Learner 2**	**Learner 3**	**Learner 4**	**Learner 5**	**Learner 6**
Consider the following statements about the content of the instructional module and rate them on a scale of 1-5 where 1 indicates that you strongly disagree and 5 indicate that you strongly agree.						
The purpose and/or goals of the module are clearly stated.	5	5	5	5	5	5
The module is appropriate for individuals with various computer experience levels.	5	5	5	5	5	4
The information was presented in a manner that made it easy to understand.	5	5	5	5	5	4
The information presented was appropriate in length.	5	4	5	5	3	4
Other (please specify)						
Consider the following statements about the navigation and function of the module and rate them on a scale of 1-5 where 1 indicates that you strongly disagree and 5 indicate that you strongly agree.						
The module was organized and easy to follow.	5	5	5	5	5	4
The Table of Contents and software navigation were available easy to operate.	5	5	5	5	5	4

The software provides feedback to user responses.	5	5	5	3	4	3
Other (please specify)				Quiz not working	No quiz	No quiz pop ups
Consider the following statements about the overall features of the module and rate them on a scale of 1-5 where 1 indicates that you strongly disagree and 5 indicate that you strongly agree.						
The overall quality of the instruction is good.	5	5	5	4	4	4
The material was relevant to my needs.	5	4	5	3	4	5
The module gained and maintained my attention.	5	4	5	5	4	4
I am satisfied with the learning experience.	5	4	5	5	4	4
Other (please specify)						
What did you like best about the Involuntary Commitment instructional module?	Easy to follow and understand the instructor	It was easy to use and understand and I could do it at a time convenient for me	there is not just one thing: (1) verbal and visual synchronization, (2) the ability to pause the video/presentation, (3) real life examples	Very complicated topic was well presented and easy to follow.	The module provided information that I didn't know about necessary data needed for court documents.	Use of forms in instruction, cursor navigating to correct parts of form
What did you like least about the Involuntary Commitment instructional module?	No response	No response	I am not sure there was anything	Did not get to see if my answers to the questions were correct or not.	That I had to go back into the module a couple of times to answer the questions, and then, I wasn't able to answer them all. Also, I didn't realize for quite awhile that by moving the mouse off of the module surface, the module surface was able to become enlarged.	Some of the quiz answers were space specific. Example, one answer required a space after a comma, even though the content of the answer was correct.
Please, suggest ways the Involuntary Commitment instructional module can	No response	No response	The rate of speech could be slower	This is a very informative module; I	Clearer instructions as to what information	No response

be improved.				did learn the objectives without having any prior knowledge of the topic. The module did breakdown a very complicated topic making it easy to complete.	to look for to answer questions and to consider for giving feedback.	

Treating the Healthcare Workforce Crisis: A Prescription for a Health Informatics Curriculum

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Abstract

A serious need exists for information systems workers who have an understanding of the healthcare environment. Traditional information systems degree programs do not adequately prepare students to enter the healthcare environment. In this paper, we propose a curriculum for a baccalaureate health informatics degree that combines the technical and business training of a traditional information systems degree with a strong foundation in healthcare courses to create a graduate that is able to function proficiently in a modern healthcare organization.

Keywords: health informatics, curriculum, information systems

1. INTRODUCTION

Today, there is a pressing need for workers that are both skilled in the use and management of information systems as well as knowledgeable about the field of healthcare. Driven, in part, by changes in government reimbursement policies and the accompanying incentives, interest has been growing among healthcare providers in implementing electronic health records (EHR) systems in their organizations. In addition, some organizations are reexamining their legacy health information systems and realizing that they are insufficient for the needs of a modern healthcare organization. This onslaught of interest in EHR's and health information systems in general has created a shortage of personnel that are skilled in both information systems and knowledgeable about the healthcare environment (Wager, 2009).

While changes in health information technology (HIT) and the workforce that support and use that technology have traditionally been co-evolutionary, the impact of these recent events has caused a massive increase in the usage of HIT that has not yet been met by a corresponding growth in the HIT workforce. Traditional university training programs that require a student to choose between being a technologist or a healthcare practitioner are inadequate since, as Hersh (2010) notes "a well-trained HIT professional should have knowledge not only of information technology, but also of healthcare, business and management, and other disciplines."

In order to meet this need for a skilled health informatics workforce and to increase enrollment in information systems programs that have previously only trained graduates to enter traditional manufacturing and service organizations, it is necessary to create a new degree program that blends the elements of a traditional information systems curriculum with the healthcare environment training that will be needed to work in a hospital or other healthcare organization. Such a proposal should also take into account the dearth of resources available for new programs in most universities today.

Our goal then is to create a multidisciplinary degree program that prepares graduates to assume new roles in the development and management of information technology resources in healthcare organizations and does not require an influx of funding for expenses such as hiring large numbers of new instructors or building new facilities. To do this, we must structure a curriculum that leverages existing programs and resources while adequately preparing students for a career working with information technology in the healthcare environment. This paper details our proposal for such a program.

2. BACKGROUND

To understand the needs of modern healthcare organizations, it is necessary to understand how the industry arrived at its current point in terms of the industry itself, the legislative environment, and the health information technology workforce. We will discuss events in each of these environments that have led to this pressing need for a skilled health information technology workforce.

Organizational Environment

Despite the rising cost of healthcare, many hospitals and other providers do not generally have surplus funds for large-scale technology investments. One of the reasons for this is that federal law requires hospitals that participate in Medicare to provide emergency treatment to patients regardless of their ability to pay. These hospitals must often write-off the cost of treating patients who cannot pay. Not surprisingly, facilities that serve communities with a large indigent population often run significant operating deficits. In addition, reductions in reimbursement rates by both Medicaid/Medicare and insurance companies have impacted providers' bottom lines significantly (O'Reiley, 2010). With the limited funds that these organizations do have available, most providers invest in information systems that will increase revenue.

Since the advent of information technology in healthcare organizations, technology use has been driven, in part, by government reimbursement policies. In the 1960's and 1970's, government reimbursement was cost-based, meaning that providers were paid based on what they spent. This encouraged the adoption of computer-based billing systems to reduce errors in billing and increase the speed with which patients and the government were billed (Wager, 2009).

This changed in the 1980's when the government introduced a payment policy based on diagnosis-related groups (DRG). Under this system, every ailment is assigned a specific code. Every code is reimbursed at a predetermined amount. Technology was introduced to improve the accuracy of DRG coding so that providers were able to bill for every ailment that a patient might have. Practice management systems were also introduced that helped office staff manage their offices more efficiently in order to treat more patients (Wager, 2009).

In the 1990's, the government introduced a resource-based relative value scale for physician reimbursement. This policy encouraged physicians to provide patient education as well as treatment and reduced reimbursement rates

for specialists. Technology was used to provide information to patients on their specific ailments so that they could better participate in their own treatment (Wager, 2009).
Until the start of the 21st century, there was not widespread adoption of health information systems that focused on patient care. Often the cost of such systems made them impractical for providers. This changed when the government introduced a number of pay for performance reimbursement programs in the 2000's. Pay for performance systems reward positive outcomes while penalizing mistakes such as errors in medication administration, surgical procedures, and other preventable mistakes that contribute to poor patient outcomes. Because of this, the healthcare industry has seen an increase in the adoption of new technologies focused on improving patient care and reducing human error (e.g. automated medication dispensing, bar-coding of patients and records, and computerized physician order entry) (Wager, 2009).

Despite the availability of these new technologies, many providers have still not had the economic resources to update their organization's information systems. With the passage of the Health Information Technology for Economic and Clinical Health (HITECH) Act in 2009, healthcare providers now have some economic support for the adoption of EHR systems (CMS, 2011). The vendors of these systems promise a significant reduction in preventable errors and a proactive approach to patient care as well as many other benefits.

Legislative Environment

Healthcare as an industry has routinely lagged behind other industries in their implementations of new technology. In order to remedy this situation, the United States Government has enacted the HITECH Act as part of the American Recovery and Reinvestment Act of 2009. The HITECH Act provides incentives for Medicaid and Medicare providers that implement an EHR system and meet a set of meaningful use rules established by the government by 2015. Medicare providers that that do not meet these targets will be penalized in their reimbursements by the government. There is currently no penalty for Medicaid providers (Lynn, 2011).

In many ways, the passage of the HITECH Act of 2009 is considered an update to another piece of important legislation that had a substantial impact on healthcare organizations' information systems: the Health Insurance Portability and Accountability Act (HIPAA). HIPAA, passed in 1996, was a wide-ranging bill that addressed more than just health insurance. It provided non-technology-specific requirements that healthcare organizations must follow in order to protect the privacy and security of the patient records within their care (HHS, 1996a and 1996b).

Because of HIPAA, the information systems (IS) staff of healthcare organizations had to take on the job of security experts in order to protect patient information. In addition, the generic wording of many of the provisions in HIPAA caused healthcare organizations to apply the most conservative interpretation of this new law or risk the substantial penalties that it prescribed. Unfortunately, healthcare organizations bore the cost of these changes because no additional funding was provided by the government (Levin-Epstein, 2001).

The HITECH Act provides clarification of many of the privacy and security provisions contained in HIPAA. In addition, it provides financial incentives for Medicaid and Medicare providers that implement an EHR system and meet a set of meaningful use rules established by the government by 2015. To further encourage adoption of EHR systems, the law states that Medicare providers that do not have EHR systems in place by 2015 that meet the meaningful use requirements will be penalized in their reimbursements by the government (Lynn, 2011).

In addition to the financial incentives available directly to providers by the HITECH Act, the Office of the National Coordinator for Health Information Technology (ONC) has created the HIT Workforce Development Program. This program provides funding to community colleges and universities to develop training programs to provide a skilled health information technology workforce through the use of certificate and masters programs. These programs cater to existing IS and healthcare workers and are generally not available for students without a degree and a minimum level of experience (ONC, 2010).

Healthcare Workforce Environment

The traditional roles of healthcare providers are changing. Budget constraints have caused many responsibilities to be moved from high cost workers (e.g. physicians) to lower cost workers (e.g. nurses and CNA's). Today's healthcare workers have to know about more than just care delivery, they must also be skilled in the technology used to provide that care (Gleckman, 2011).

There are a number of factors that drive the need for healthcare organizations to develop a more skilled HIT workforce. These factors include a desire to reduce mistakes in patient care through the use of technology, government sanctions for privacy and security breaches, and anecdotal reports of increases in mortality after some HIT implementations (Hersh, 2010).

HIT is quickly evolving and the workforce that supports and uses that technology is struggling to keep up. As mentioned in the last section, grant funded community college and university programs are available, but most aim to retrofit current experienced workers though the use of certificate and master's degree programs. This is important for bringing the current HIT workforce up to speed with new technology, but additional programs are necessary to train new workers that the healthcare industry will certainly need in the coming years.

3. HEALTH INFORMATICS CURRICULUM

Traditionally, students training for a career in healthcare rarely received training in the use or management of information systems. Similarly, those training for a career in information systems rarely received training in healthcare despite receiving some instruction on how traditional manufacturing or service organizations operate. In order to provide students with an education that equips them to work with HIT resources in the many different areas available in the healthcare field, it is necessary to build a curriculum that includes courses from a number of different traditional healthcare specialties as well as information systems. The program outcomes and objectives are listed in Table 7 (Appendix C). In the following sections, we discuss the main course areas in our proposed curriculum.

Pre-professional Area

The pre-professional area consists of required and elective courses to be completed in the student's freshman or sophomore year. These courses could be taken at a two-year institution as part of a 2+2 agreement between a state's community colleges and universities. These courses are intended to be foundational courses pre-requisite to the upper-division courses in the major. The list of courses in this area is reproduced in Table 1.

Table 1: Pre-Professional, Pre-Major, and Electives

Courses	Credit Hours
BMD 210 Infectious Disease in Health Care Environments	3
CIS 150 Introduction to Computer Applications	3
BUS 245 or STA 210 Statistics I or equivalent	3
BUS 255 or other advanced statistics or equivalent	3
CA 275 Small Group Communication	3
ACC 211 Principles of Accounting I	3
MGT 300 Management Theory and Practice	3
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The course BMD 210 provides an introduction to the fundamental concepts of host-parasite relationships involved in infectious diseases. This course is foundational material for more advanced health sciences courses in the clinical environment, for example, in understanding biostatistics and epidemiology. CIS 150 provides a broad-based introduction to the use of computers to enhance personal productivity. This course is foundational material for the advanced information systems courses. The courses BUS 245 or STA 210 provide a survey of statistical techniques used to support managerial decision-making and problem solving. This course is essential preparatory material for biostatistics and epidemiology in the clinical environment courses. This course should be followed by an advanced statistics course or quantitative methods designed to prepare the student for understanding the design of experiments and advanced data analysis techniques. The ability to work effectively in groups is a critical skill for the HIT professional. CA 275 covers the theory and practice of leading and participating in groups. Most major EMR systems are enterprise-wide or ERP systems. A working knowledge of accounting principles and terminology (ACC 211) is important for organizations with accounts receivable modules and DRG coding. Finally, EMR systems exist in the context of organizational structures, practices, and behavior. Effective leadership and change management require an understanding of the interaction of material and human resources in social/business systems. This material is covered in the MGT 300 class.

Clinical Environment

At our university we are fortunate to have Colleges of Allied Health and Nursing. These programs provide breadth-first introductory knowledge particular to their disciplines. We have selected courses from these sets because they provide a portfolio of experiences necessary for our health informatics professionals to possess. Although these "first" courses are not advanced; when taken as a set, they provide a richness in vocabulary and related methods. Both of these provide valuable insight into the needs of health care professionals. Without being conversant in the health care language, it would be difficult to learn, implement, and train users on EHR systems. The courses consist of those specified in Table 2, and in the detailed course descriptions (Appendix B, Table 7).

Table 2: Clinical Environment

Courses	Credit Hours
NU 311 Clinical Nursing Skills	4
NU 325 Health Assessment	4
HSC 343 Clinical Pharmacology	3
RAD 101 Principles of Radiographic Exposure	4
OT 201 Introduction to Occupational Therapy	3
CRC 330 Cardio-respiratory Care Assessment Skills	4
	------ **22**

Students who have completed BMD 114 and 115 will have acquired credible knowledge of human physiology and anatomy. These courses replace traditional courses in biology and chemistry for students whose primary interests will be in the health care arena. BMD 210 provides all students with knowledge of infectious disease, and limited introduction to patho-physiology. This course replaces the need for a microbiology course because of its broader and more general scope. While there are many other courses that might have been considered in these three pre-professional areas, these selected courses provide the focus needed for our health informatics degree program, as well as prerequisite knowledge for our clinical environment courses.

Because nursing cuts across all biomedical disciplines, NU 311 and NU 325 will be broadly applicable to patient and care definitions, records, issues, and procedures. Drug usage implies the need to define pharmacologic principles including classes of active compounds, routes of administration, drug interaction and safety, drug ordering, and potential errors and their prevention. Radiographic imaging is an enormous field requiring knowledge of radiation, physics, procedures, and images processing. In addition, other forms of imaging involving ultrasound and new scanners provide important diagnostic and even therapeutic modalities. Finally, occupational therapy, physical therapy and cardio-respiratory care are among the most important care and restoration responsibilities in biomedical care. Knowing the vocabulary as well as procedures within these disciplines will give our graduates the ability to engage intelligently in conversations, while also enabling them to be effective in their information systems related mission.

Information Systems Area

The Information Systems area courses are designed to prepare the student to leverage information technology to improve the performance of people in organizations, add business value, and help individuals, groups, and organizations achieve their goals. The list of courses in this area is reproduced in Table 3.

Table 3: Information Systems Area

Courses	Credit Hours
ISC 245 Information Systems in Organizations	3
ISC 272 Systems Architecture	3
CIS 321 Data Communications and Networking	3
CIS 324 Database Design, Development, and Management	3
ISC 360 Information Systems Analysis and Design (W)	3
ISC 462 Information Systems Strategy and Policy	3
	------ **18**

The course ISC 245 provides a breadth-first view of information systems from an organizational perspective. This course prepares the HIT professional to view an EHR system as an information system and as part of a larger organizational context. The courses ISC 272, CIS 321, and CIS 324 provide depth in the areas of operating systems, networking, and database. These courses give the healthcare professional the knowledge needed to communicate effectively with an IS staff or with software vendors and to make technology recommendations. The course ISC 360 is a traditional systems analysis and design course.

The (W) indicates it is a writing course in the curriculum, meaning the course includes significant writing assignments. This course provides the student with the foundational knowledge needed for conducting and managing lifecycle activities. Finally, the course ISC 462 provides the top management, strategic perspective for aligning competitive strategy with information systems. This course provides foundational material for aligning healthcare objectives such as improved outcomes, reduced cost, and reduced errors with EHR functionality.

Health Informatics Area

The health informatics courses are designed to apply the student's knowledge and experience of information systems and the clinical environment to the domain of healthcare systems and information technology. A major focus of the health informatics area is hands-on, applied experiences. Because of the cross disciplinary nature of this area, it was necessary to create five new courses. The capstone internship course was already in place in our traditional information systems degree program. The list of courses is reproduced in Table 4.

Table 4: Health Informatics Area

Courses	Credit Hours
ISC 300 Health Informatics Clinical Environment	3
ISC 410 Health Informatics	3
ISC 450 Health Sys Analysis and Design	3
ISC 455 Health Decision Support Sys	3
ISC 475 Information Systems Project Management	3
CIS 496 Computer and Information Sciences Internship	3
	------ 18

The course ISC 300 provides an overview of concepts, terms, organization, and processes associated with patient care and clinical environments as they pertain to health informatics. The patient journey, how a person accesses, moves within, and exits the system both as inpatient and outpatient to obtain care is examined. This course provides hands-on experiences through the use of a real fully functionally electronic medical records system.

ISC 410 provides an overview of the concepts, terms, tools, and architectures associated with health informatics as applied to healthcare delivery. Topics include: electronic record systems, computerized physician order entry, health system standards, terminologies, workflow modeling, security and privacy of clinical data, clinical reporting, and the impact of information technology use on the quality and efficiency of health care delivery and outcomes.

ISC 450 involves a thorough examination of the analysis and design of healthcare information systems from the informatics specialist's view. This course covers the entire life cycle of a system using an established systems development methodology including workflow analysis. At each step in the development life cycle, both the methodologies used and the documentation required will be examined. Students produce artifacts and deliverables for each stage of the life cycle. Unlike in a basic systems analysis course, ISC 450 students grapple with enterprise projects conducted within the environment of biomedicine and health care.

ISC 455 focuses on the design and management of electronic medical record systems and clinical decision support systems. A review of database concepts is provided. Course content related to electronic medical record systems includes architectural components, technical design issues, and management; and, content related to clinical decision support systems includes decision support roles, extracting useful information from data, and legal and regulatory restrictions. Laboratory assignments will provide students with opportunities to interact with these systems.

ISC 475 examines the principles and techniques of project management from an information technology perspective. Topics included are: project planning, scheduling, resource allocation, and project management software tools. There is a specific focus on management of software projects, integrating the principles of information systems/needs analysis, software engineering, risk management, and change management. Both the technical and behavioral aspects of project management are covered.

The CIS 496 internship provides the student with a capstone, culminating experience in a particular clinical or systems vendor setting. An emphasis is placed on the application of information technologies to improve healthcare outcomes and the reduction of costs and errors. Students work on supervised projects with faculty guidance. Educational objectives focus on the application of the theories, processes, methodologies, techniques, and technologies learned in the program.

4. DISCUSSION

In order to successfully attract and matriculate students, it is necessary to structure the proposed program to address the needs and interests of prospective students. There are many constituencies who must be considered in an implementation of the program including underrepresented groups (e.g. women), transfer students, and traditional four-year students.

Women in Science, Technology, Engineering, and Mathematics

Traditionally, women have been underrepresented in the fields of science, technology, engineering, and mathematics (STEM). A recent report (St. Rose, Hill, and Corbette, 2010) notes that women were much less likely than men to enter the fields of physics, engineering, and computer science. The study also found that over half of the degrees awarded in STEM were in the biological sciences.

Although the reasons behind the low number of women graduates in technology fields are open to debate, we do believe that creating a program that combines the biological sciences with environment appropriate technology training will attract a greater number of women students than traditional information systems programs.

Four-Year Degree Plan

Implementation of a curriculum eventually requires a degree plan by which students can graduate in a timely fashion. The four-year degree plan provided below in Table 5 (Appendix A) represents the proposed implementation at the author's university. The degree program is divided into lower and upper division course work. Lower division coursework is intended for the freshman and sophomore years. Upper division coursework is for the junior and senior years. Lower division course work focuses on general education requirements and pre-professional, pre-major courses, and supporting electives. Upper division coursework is comprised of information systems, health informatics, and clinical classes and as such represents the multi-disciplinary component of the degree program.

As feeder schools for universities, the two-year college system provides an opportunity for increased enrollments in computing. A major advantage of dividing coursework into lower and upper division is it facilitates 2+2 matriculation agreements with the two-year colleges. Because all lower division courses are 200-level or lower courses, these courses can be offered by junior and community colleges as an associate degree. A student with an associate degree (two years) can complete the baccalaureate degree in health informatics in two additional years.

The flow of the upper division courses in Table 5 should not be considered a pre-requisite structure. In our view, pre-requisites in the upper division should be kept to a minimum. Overly linear course sequences make it much more difficult for students to matriculate in two years. The course sequence of upper division courses should be considered guidance to academic advisors. The only "hard" pre-requisites are ISC 300 and ISC 410 as pre-requisites to ISC 450 and ISC 455. Both ISC 300 and 410 are introductory courses that should precede the more advanced health informatics courses. The remainder of courses are more-or-less independent of each other. The upper division courses are multidisciplinary and as such sample from a wide range of discipline specific "first courses". The overall aim of the course sequence is to provide an even balance of computing and clinical courses per semester. It is recommended that the internship, as a culminating capstone experience, be taken the student's last semester.

The structure of the degree plan described here is not intended to suggest upper division courses must be cohort based or that students must first complete the lower division courses before applying for admission to the health informatics degree program. Clearly this can be done, but it is not implied by the lower/upper division of coursework. We are implementing a lower/upper division separation at our university to facilitate 2+2 agreements with two-year colleges and to enable pre-nursing and pre-allied health majors to switch to the health informatics degree program in their sophomore or junior year.

The degree plan presented here assumes no summer classes and a goal of graduating in four years. Assuming the absence of a cohort system, any plan must be adapted to the actual circumstances of each student. Summer course offerings allow students to take lighter course loads in the fall and spring semesters and "catch up" if they are switching from other majors.

Finally, general electives could be implemented as required courses. Our goal in including three electives is to make the degree program flexible. Health informatics as a discipline is broad and varied. We submit that allowing students to customize part of their education results in a better prepared workforce because students are empowered to choose a direction that best aligns with their career goals and aspirations. For example, a student could choose to take business courses in order to pursue a managerial-focused career such as the Chief Information Officer of a hospital or perhaps a student plans to specialize in a particular clinical environment such as occupational therapy. At our university, the articulation of this direction is a shared responsibility of the student and academic advisor.

5. CONCLUSIONS

Our proposed curriculum addresses the needs of the healthcare industry by providing a workforce that is skilled in the use of information technology as well as having an in-depth knowledge of the healthcare environment. It stands apart from many other university and community college programs such as those funded by HIT Workforce Development Program because our aim is to train new HIT professionals instead of retraining existing professionals.

We have designed this proposed curriculum both to meet the needs of industry and to leverage resources that are already available at our university. Because of budgetary concerns, the authors realize that it is advantageous to create a curriculum that does not require a large number of new classes. In addition, we believe that it is likely that the addition of this program to an existing information systems program will increase the number of female students enrolled in the computing disciplines.

By selecting courses offered by a number of different programs, we have created a multidisciplinary curriculum that we believe will provide students with a versatile skill set that will allow them to function in a wide range of healthcare settings. To provide the student with real world experience in which to practice their skills, we have specified a senior year internship as the program's capstone experience.

We submit that this program offers students, healthcare providers, and universities a practical and academically valid option for meeting the diverse needs of all stakeholders.

Epilogue

Based on feedback from reviewers, ISECON conference discussions, and the author's colleagues in the College of Nursing and College of Allied Health Professions between the time of acceptance and publication of this manuscript, the specific course list in Table 2 (Clinical Environment) is being revaluated. Our original intent in formulating this list of clinical courses was to select from "first courses" in each of the subject areas most relevant to the role of the health informatics professional. However, most of these first courses are gateway courses designed to filter out students newly accepted into the program. Further, rather than breadth-first courses designed to provide an overview of the field, these courses are very detailed and in-depth and require hands-on demonstration of skill mastery. Our current plan is to develop a collection of three to four new Biomedical Sciences courses designed to provide a breadth-first overview of each of the content areas possibly combining two areas into a single course.

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Appendix A

Table 5. Health Informatics Four-Year Degree Plan

Fall 1	Credits
BMD 114 Human Anatomy and Physiology I	4
EH 101 Comp I	3
Social Sci elective	3
CA 110 Public Speaking	3
CIS 150 Intro to Computer Apps	3
	16

Spring 1	Credits
BMD 115 Human Anatomy and Physiology II	4
EH 102 Comp II	3
History	3
MA 112 or higher	3
Humanities elective	3
	16

Fall 2	Credits
Statistics I	3
Literature	3
BMD 210 Infectious Disease in Health Care Environments	3
Social science elective	3
ACC 211 Principles of Accounting I	3
	15

Spring 2	Credits
CA 275 Small Group Communication	3
PSY 120 General Psychology	3
Advanced Stats or quantitative methods	3
Art Drama	3
MGT 300 Management Theory and Practice	3
	15

Fall 3	Credits
ISC 300 Health Informatics Clinical Environment	3
ISC 245 Information Systems in Organizations	3
HSC 343 Clinical Pharmacology	3
NU 311 Clinical Nursing Skills	4
General elective	3
	16

Spring 3	Credits
ISC 410 Health Informatics	3
ISC 272 Systems Architecture	3
CIS 324 Database Design, Development, and Management	3
NU 325 Health Assessment	4
CRC 330 Cardio-respiratory Care Assessment Skills	4
	17

Fall 4	Credits
ISC 455 Health Decision Support Sys	3
ISC 360 Information Systems Analysis and Design (W)	3
ISC 462 Information Systems Strategy and Policy	3
RAD 101 Principles of Radiographic Exposure	4
OT 201 Introduction to Occupational Therapy	3
General elective	3
	19

Spring 4	Credits
ISC 450 Health Sys Analysis and Design	3
CIS 496 Internship	3
CIS 321 Data Communications and Networking	3
ISC 475 Information Systems Project Management	3
General elective	3
	15

Total 129 Hours

Appendix B

Table 6: Courses Establishing a Health Informatics Pre-Professional and Clinical Environment

Pre-Professional Courses Related to Health Informatics Clinical Environment	
Courses	Catalog Description
BMD 114 Human Anatomy and Physiology I	This is the first of a two-course sequence that covers an introduction to basic human anatomy and physiology, including the study of the structure and function of the normal human body. Included is a study of basic principles of chemistry related to human physiology, a study of cells and tissues, metabolism, joints, the integumentary, skeletal, muscular and nervous systems, and the senses.
BMD 115 Human Anatomy and Physiology II	A continuation of BMD 114. Topics include nervous, cardiovascular, lymphatic, immune, respiratory, digestive and urinary systems. Additional topics may include blood, metabolism, immunology and reproduction.
BMD 210 Infectious Disease in Health Care Environments	This course introduces the fundamental concepts of host-parasite relationships involved in infectious diseases. Included are virulence characteristics of microbes and mechanisms of host defenses. Principles of microbial physiology, genetics and antimicrobial therapy are provided as background. Specific infectious diseases of various anatomical systems are emphasized
ACC 211 Principles of Accounting I	The course provides an understanding of ways in which accounting information supports business decision-making. Topics include financial accounting and reporting for assets and liabilities
MGT 300 Management Theory and Practice	Theories of organizational structures, practices, and behavior, and the effective leadership and management of organizations. Emphasis on leadership and developing patterns and strategies of organization management in a dynamic environment as affected by the interaction of material and human resources using the technique of applied social and management sciences.
Health Informatics Clinical Environment	
Courses	Catalog Description
NU 311 Clinical Nursing Skills	The purpose of this course is to provide students the opportunity to acquire basic nursing care skills. The emphasis is on the responsibilities of the professional nurse in ensuring quality and safety. Students are introduced to simulation as an approach to sharpen clinical reasoning and communication skills in a safe environment
NU 325 Health Assessment	The purpose of the course is to provide students the opportunity to acquire basic nursing assessment skills. The emphasis is on the assessment skills of the whole person, including physical, psychological, socio-cultural, and spiritual aspects of persons from all stages of life. Students will learn skills associated with obtaining a health history and performing health assessments across the lifespan.
HSC 343 Clinical Pharmacology	The purpose of the course is to provide the student with the opportunity to acquire information related to the clinical application of drug therapy and the concepts relating to the mechanisms of drug actions, interactions, and adverse reactions, including the immunologic-idiosyncratic-allergic responses. Emphasis is on the current evidence related to pharmacokinetics, dosage, methods of administration, and adverse effects of major classifications of drugs to inform nursing care.
RAD 101 Principles of Radiographic Exposure	A beginning study of the principles involved in image formation including radiographic films, film processing, and exposure factors affecting film quality.
OT 201 Introduction to Occupational Therapy	An introduction to the occupational therapy profession and the scope of occupational therapy practice. Includes self assessment and development strategies to enhance students' readiness for the professional component of the occupational therapy curriculum. Familiarizes students with the functions, policies and services of the University, College and Department and includes an exploration of related allied health professions.
CRC 330 Cardiorespiratory Care Assessment Skills	A presentation of patient assessment skills to prepare for subsequent courses in the curriculum. Modules included are chart review and history, vital signs, physical assessment of the chest, chest radiography, laboratory assessment, bedside pulmonary function testing, electrocardiography, and cardiopulmonary resuscitation. Students are prepared to function in a problem-based learning curriculum.

Appendix C

Table 7. Health Informatics Program Objectives

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

Comparatively Assessing The Use Of Blackboard Versus Desire2learn: Faculty Perceptions Of The Online Tools

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Abstract

Current trends indicate that an increasing number of Universities have been offering online classes without assessing the faculty perspective of the online learning management tools. When a University understands the faculty perception they can implement an online education environment that is both conducive to student learning and faculty engagement. This paper provides a quantitative and comparative assessment of Blackboard and Desire2Learn, two tools used to implement online classes. These tools were utilized at a small rural Mid-Atlantic university in the 2010 and 2011 academic years. A survey was distributed to the faculty populations to understand their opinions about Blackboard and Desire2learn, and to assess the difference in their preferences between these two technologies. This survey is based upon an earlier study conducted at the University of Denver in 2006. The results of this survey were analyzed to better understand the faculty perceptions of these technologies and the commonly used features.

Keywords: Blackboard, Desire2Learn, Online Classes, Online Learning, Distance Education, Learning Management System, LMS

1. INTRODUCTION

Universities and colleges regularly improve the learning techniques and methods used to educate students. Distance learning has improved accessibility of education to a larger student population and it affords students the flexibility of classes without physically stepping foot in the classroom. Online learning has become an educational alternative to traditional learning styles.

Online education is expanding at a rapid pace. Universities and colleges have implemented web based learning management systems (LMS) that enable faculty to develop and teach courses. Since 2003, enrollments in online programs have been growing faster than that of traditional higher education. In 2010, online enrollments grew by 21%; this growth in online enrollment rate far exceeded the almost 2% growth of the overall higher education population. Three-quarters of institutions reported that the economic downturn of the decade has resulted in an increased demand for online courses and programs (Allen & Seaman, 2010). This growing demand for online courses makes it necessary for universities to provide students with the most optimal learning environment. In this context, the researchers conducted a comparative analysis of university faculty members' perceptions of Blackboard versus Desire2Learn.

2. LITERATURE REVIEW

Advances in technology and the Internet have changed the way people access and use information. A 2010 online education study by Allen and Seaman revealed that the recent growth in online enrollments has come from existing offerings, not from institutions new to online. This study defined online courses as those in which 80% of the course content is delivered online. Sixty-three percent of chief academic officer said that online education was critical to their long-term strategy (Allen & Seaman, 2010).

As of fall 2010, the entire Pennsylvania State System for Higher Education (PASSHE) transitioned from Blackboard to Desire2Learn (D2L). After a comprehensive review and assessment of online education tools (Blackboard, Desire2Learn, e-college, and various others), Desire2Learn turned out to be the overwhelming choice. Desire2Learn provided a greater number of tools and capabilities than Blackboard and featured a friendlier user interface for both faculty and students. One of the deciding factors was that it took about a third of the clicks to accomplish tasks in Desire2Learn as compared to Blackboard (Moore, 2010).

The University of Denver's Center for Teaching and Learning's Courseware Faculty Advisory Board (CFAB) completed a study of their student's perceptions of Blackboard (The Center, 2006). Of a total of 1,821 students that completed the survey, nearly 90 percent attested that Blackboard was an excellent web-based tool. Fewer than two percent reported having a bad experience with Blackboard. The number one reason that students liked Blackboard was the 24x7 access to the course materials. They also noted that there was a high level of communication and interaction with their instructors in the Blackboard environment. Other benefits included the immediate access to their grades, improved class discussions, and the ability to view assignments anytime. Approximately 82 percent of students preferred courses that utilized Blackboard or other web-based tools as compared to 10 percent that did not (The Center, 2006).

According to Kovacs, et al., there is little doubt that changes in higher education are being driving by technological advances in communication technologies and also in the media-rich extensions of the Internet. These advances have enabled universities to implement alternatives to the traditional classroom teaching and learning methods and to develop new ways to deliver course content to students. These new developments have resulted in the growth of a new paradigm in pedagogy; technology-enabled learning environments (Kovacs, Davis, Scarpino & Kovalchick, 2010).

A 2011 study conducted by the researchers on student perceptions of Blackboard versus Desire2Learn revealed that 65% of students used more features in Desire2Learn as compared to Blackboard. They preferred Desire 2 Learn because of ease of integration, sophisticated features, and enhanced functionality. Desire2Learn was consistently ranked higher than Blackboard in every level of education (Freshman, Sophomore, Junior, Senior) (Chawdhry, Paullet, & Benjamin, 2011).

A national survey of faculty perceptions in regard to online learning was conducted by Central Michigan University's academic affairs in April 2009. A total of 174 faculty members participated in the study. Fewer than half of the faculty members surveyed indicated that they had taken (39%), taught (44%), converted (31%), or developed (32%) an online course.

Fifty-one percent of faculty members rated the factor "online courses meet student needs for flexible access" as very important. Additionally, 26% believed that online learning was the best way to reach particular students that otherwise would not have attended class. It has been commonly perceived that online teaching took more effort on the part of faculty as compared to face-to-face instruction. Faculty members that taught online or developed courses online rated their level of effort in the online environment as compared to an equivalent course in the face-to-face environment. Eighty percent of faculty members reported that it took more effort to create an online course than a traditional class. This result was also true for teaching online; sixty percent of faculty believed that it took more effort to teach online than in a face-to-face class (Central Michigan, 2009).

A 2006 study conducted by Alexander, et al., compared faculty and student experiences with online learning courses. The study also did a longitudinal comparison of 2006 experiences with that of the 2000 study. A total of 140 faculty members responded to the 2006 study as compared to 81 faculty that responded to the 2000 study. Additionally, 300 students responded in the 2006 study as while 153 students responded to the 2000 study. The findings indicated that the faculty and students in both 2000 and 2006 reported overall satisfaction with the online learning experience. Students in the 2006 study reported significantly higher satisfaction levels as compared to faculty for online administrative support. Faculty and students in both studies agreed that two most important motivational factors for enrolling in online learning courses were accessibility and flexibility (Alexander, et.al. 2006).

In 2010, 183 two and four-year colleges and universities participated in The WICHE Cooperative for Educational Telecommunications (WCET) and The Campus Computer Project survey related to managing online education. This study found that colleges and universities engaged in online learning made major investments in faculty development. The results showed key differences between on campus and online courses. In contrast to teaching in traditional classrooms, both part-time and full-time faculty that taught online courses had to complete significant training. Mandatory training for faculty that taught online courses reflected an institutional awareness of the challenges of teaching in the online environment (WCET, 2010).

A 2010 study conducted by Stewart, Bachman & Johnson sought to determine predictors of faculty acceptance of online education. This study used an extended version of the technology acceptance model to predict intention to teach online. This study revealed that faculty who found learning management systems easy to use were likely to teach online, and that instructors who enjoyed traditional courses were reluctant to teach online. Online degree programs required faculty to commit to teaching several courses online in a strategic manner each semester. This study also found that intrinsic motivation to teach online was found to be the strongest predictor of interest in offering online degree programs (Stewart, Bachman, & Johsnon, 2010).

3. RESEARCH METHODOLOGY

The online learning environment has enabled faculty all over the world to access higher education; classes at their own convenience day or night. The purpose of this study is to compare the faculty's perceptions of Blackboard with that of Desire2Learn. This study explores the following research questions:

RQ1: What is the technology preference of faculty that have used both Blackboard and Desire2Learn?
RQ2: Is there a significant difference between using Blackboard and Desire2Learn to teach online classes?

This study compared faculty perceptions of Blackboard against that of Desire2Learn, at a small mid-Atlantic University during the months of February and March 2011. This study utilized a quantitative methodology to assess the differences between faculty perceptions of Blackboard and Desire2Learn. The response rate was about 9.85% of the total population. Of the 396 faculty members that taught during the Spring 2011 semester, 39 full-time and adjunct faculty members completed the survey.

The survey obtained information from faculty that had used both Blackboard and Desire2Learn. The survey was developed from a partial replication of a 2006 [3] Blackboard survey conducted at the University of Denver and an earlier study conducted by the researches at a mid-Atlantic University in

Pennsylvania in 2010. The researchers enhanced the survey with additional questions to obtain insights that were not captured in prior studies. The survey results were analyzed using SPSS, a software tool for statistical analysis. This study used Chi-square with a statistical significance at the .05 margin of error with a 95% confidence level to determine students' preference between Blackboard and Desire2Learn. Statistical frequencies were used to determine the basis for the students' use of the two online learning management systems. The study was a convenience sample; it surveyed faculty from the School of Arts and Humanities, Business, Science and Match, Engineering, Computer Science, Information Technology, Criminal Justice and Psychology.

The survey instrument consisted of 26 closed-ended questions and one open-ended question. Fourteen of the closed-ended questions provided an "Other" option, which allowed faculty to provide responses in addition to predetermined responses listed in each question. The first three questions focused on faculty demographics; they included gender, age, and department. Question four, was a contingency question that asked faculty if they had taught any online distance learning classes. If the faculty answered yes, they continued on to question five which asked if the faculty had taught online classes using both Blackboard and Desire2Learn. If the faculty answered yes again, they were to continue on with the survey. If the answer was no, the faculty exited the survey. Based on the faculty knowledge and use of both Blackboard and Desire2Learn, questions 6-25 focused on their preferences between the two online learning management systems. The final question was designed so that faculty could provide additional comments or concerns related to Blackboard and Desire2Learn.

4. RESULTS

The survey responses were analyzed to assess faculty technology preferences for Blackboard as compared to Desire2Learn and to determine if the difference in preferences was significant. Faculty responses indicated that 51.3% of the respondents were male and 48.7% of the respondents were female. The demographic and background information is further detailed in relation to gender in Table 1, which depicts age, department, and prior experience with online classes broken down by gender. There were no respondents in the 18025 age brackets. In age brackets 25-35 and 36-45, female respondents outnumbered the males. In stark contrast, males outnumbered females by a factor of 2 in the 56-65 age bracket. An equal number of males and females in the 46-55 age bracket responded to the survey. Males outnumbered females in the Arts and Humanities, Business, Computer Science and Information Technology Departments. In contrast, females outnumbered males in the Education and Science & Math Departments by a factor of 1.25 and 2.98 respectively. It should be noted that there were no females from the Business, Computer Science and Information Technology Departments. There were no male nor female respondents from the Psychology Department.

Table 1: Demographic Breakdown of Survey Participants

Demographic Information	***Male***	***Female***
Age:		
18-25	*0.0%*	*0.0%*
26-35	*7.7%*	*12.8%*
36-45	*15.4%*	*17.9%*
46-55	*7.7%*	*7.7%*
56-65	*20.5%*	*10.3%*
Department:		
Arts and Humanities	*19.4%*	*12.9%*
Business	*3.2%*	*0.0%*
Education	*6.5%*	*19.4%*
Science & Math	*12.9%*	*16.1%*
Computer Science	*3.2%*	*0.0%*
Information Systems	*0.0%*	*0.0%*
Information Technology	*3.2%*	*0.0%*
Psychology	*0.0%*	*0.0%*
Not Listed	*3.2%*	*0.0%*
Online Classes Before		
Yes	*46.2%*	*35.8%*
No	*7.7%*	*10.3%*
Total	*53.9%*	*46.1%*

After collecting demographic data, the researchers collected data about the faculty choices between Blackboard and Desire2Learn in relation to gender, age, and department. Males preferred Blackboard over Desire2Learn by a factor of 3.99; while females preferred Desire2Learn over Blackboard by a factor of 1.34. The first comparison focused on the faculty-preferred choice for online class technology; this was broken down by male and female. The result yielded a chi-square value of 2.487 with one degree of freedom. Additionally, the statistical probability was calculated to be .115 or 11.5%. Since this value did not fall below the required .05 or 5% threshold, the study did not find any statistical significance between gender and the faculty choices of technology for their online classes. Table 2 lists the percentage of faculty (by gender) who chose the specific online class technology. This table provides additional detail by subdividing gender according to the associated faculty department.

Table 2: Technology Choice by Gender and Department

Gender/ Department	Blackboard	Desire2Learn	Total
Male	**47.1%**	**11.8%**	**58.9%**
Arts & Humanities	11.79%	0.0%	11.79%
Business	5.88%	0.0%	5.88%
Education	0.0%	0.0%	
Science & Math	5.88%	5.88%	11.76%
Computer Science	5.88%	0.0%	5.88%
Information Systems	0.0%	0.0%	0.0%
Information Technology	5.88%	0.0%	5.88%
Psychology	0.0%	0.0%	0.0%
Undecided	11.79%	5.88%	17.76%
Female	**17.6%**	**23.5%**	**41.1%**
Arts & Humanities	5.88%	5.88%	11.76%
Business	0.0%	0.0%	0.0%
Education	0.0%	11.79%	11.79%
Science & Math	5.88%	5.88%	17.76%
Computer Science	0.0%	0.0%	0.0%
Information Systems	0.0%	0.0%	0.0%
Information Technology	0.0%	0.0%	0.0%
Psychology	0.0%	0.0%	0.0%
Undecided	5.88%	0.0%	5.88%
Total	**64.7%**	**35.3%**	**100.0%**

The second comparison investigated the faculty; choice for online class technology; the variable in this case was age. There were no respondents in the 18-25-age bracket. The respondents in the 26-35-age bracket were split down the middle with 11/1% each for Blackboard and Desire2Learn. Respondents in the 36-45-age bracket preferred Desire2Learn over Blackboard by a factor of 3.01. Respondents in the 46-55 and 56-65 age brackets preferred Blackboard over Desire2Learn by a factor of 3.01 and 4.00 respectively. The results yielded a chi-square value of 2.221 with three degrees of freedom. The statistical probability was calculated to be .528 or 52.8% which is above the allowable limit of 5%. Therefore, this study did not find any statistical significance between age and the faculty choice of technology for online classes. Table 3 below lists the percentage of faculty (by age) who chose the specific online class technology.

Table 3: Technology Choice by Age

Age	Blackboard	Desire2Learn	Total
18 – 25	0.0%	0.0%	0.0%
26 – 35	11.1%	11.1%	22.2%
36 – 45	11.1%	16.7%	27.8%
46 - 55	16.7%	5.55%	22.25%
56 – 65	22.2%	5.55%	27.75%
Total	61.1%	38.9%	100.0%

The third and final comparison was between the faculty department and their choice of technology for their online classes. Respondents from the Arts & Humanities, Computer Science, and Information Technology Department favored Blackboard over Desire2Learn; while respondents from the Education and undecided departments favored Desire2Learn over Blackboard. The results of this comparison yielded a chi-square value of 5.960 with eight degrees of freedom. The statistical probability was calculated to be .428 or 42.8%, which is above the allowable limit of 5%. The study concluded that there was no statistical significance between a faculty department and their choice of technology for online classes. Table 4 displays the student’s degree versus their technology choice.

Table 4: Technology Choice by Department

Concentration	Blackboard	Desire2Learn	Total
Arts & Humanities	17.65%	0%	26.6 %
Business	5.88%	5.88%	13.4 %
Education	0.0%	11.76%	13.3 %
Science & Math	11.76%	11.76%	26.6 %
Computer Science	5.88%	0.0%	6.7%
Information Systems	0.0%	0.0%	0.0%
Information Technology	5.88%	0.0%	6.7%
Psychology	0.0%	0.0%	0.0%
Undecided	17.54%	5.88%	6.7%
Total	53.3%	46.7%	100.0 %

One of the questions in the survey determined if faculty used more features in Desire2Learn. Of the total number of respondents, 61.1% said they used more features in Blackboard as compared to Desire2Learn; this was in contrast to 38.9% that used more features in Desire2Learn over Blackboard. The second question asked those who said they used Desire2Learn more than Blackboard for their reasons for using Desire2Learn more than Blackboard. 71.4% of those who said that they use Desire2Learn more than Blackboard stated that they did so because of "Ease of Integration." Table 5 below details reasons for the faculty preference for Desire2Learn as opposed to Blackboard. Additionally, this question allowed for an open-ended response "Other;" the responses for "Other" are listed below Table 5.

Table 5: Reasons for using Desire2Learn More

D2L: More Features	% who used feature
Training Options	14.3%
Ease of Integration	71.4%
Intuitive Interface	14.3%
Other	28.6%

Other reasons why faculty used Desire2Learn more than blackboard are:

- More sophisticated features in grade book are available.
- Relying more on web-based learning opportunities than I did in previous years

The questionnaire asked the faculty a series of questions to further determine the faculty's utilization of features in both Blackboard and Desire2Learn to better understand if one technology was used more than the other. The faculty evaluated 11 features and were allowed to provide open-ended responses in the "Other" field. Blackboard was the preferred option for all but one of the features where it was equal. This breakdown is detailed in Table 6.

Table 6: Usage of Blackboard and Desire2Learn Features

Features	Blackboard	Desire2Learn
Announcements	42.5%	40.0%
Syllabus	42.5%	35.0%
Discussion Board	35.0%	30.0%
Email	45.0%	37.5%
Digital Dropbox	32.5%	30.0%
Quizzes and surveys	35.0%	35.0%
Group Tools	15.0%	12.5%
Collaboration (chat)	7.5%	5.0%
Imbedded audio/video	17.5%	7.5%
Blackboard mobile	5.0%	0.0%
Notification System	7.5%	5.0%
Other	0.0%	0.0%

Those who responded to the above did not elaborate using the "other" option.

5. DISCUSSION

The first research question determined the technology preferences between Blackboard and Desire2Learn from the perspective of the faculty. Based upon the results of the surveys discussed in the previous section, these results could be discussed in one of two ways: (1) the technology preference both overall and broken down by gender, age, and department; (2) the percent usage of similar features in both systems.

Approximately 38.9% of the respondents said they preferred Desire2Learn, while 61.1% preferred Blackboard. These results were further broken down based upon other variables. With respect to gender, Blackboard was the preferred choice for males, while Desire2Learn was the preferred choice for females. With respect to age, each of the age brackets preferred Blackboard; determination could not be made about the 26-35-age bracket since there were no respondents in this bracket. Lastly, most of the department categories ranked Blackboard as preferred over Desire2Learn with the exception of Business, Education, and Science & Math which ranked Desire2Learn higher. It should be noted that there was no statistical significance between characteristics (gender, age, and department) and the online class technology preference.

The second method to determine the technology preference for the online class compared the percent usage of similar features in both Desire2Learn and Blackboard. Of the 12 features listed, eleven features were being used more in Blackboard as opposed to Desire2Learn. The feature that was used more in Desire2Learn as compared to Blackboard quizzes; it must be noted that this feature had the same percentage for both technologies. Clearly, Blackboard was preferred by a majority of faculty who took the survey in comparison to Desire2Learn.

The second research question focused on determining if a significant difference existed between the faculty preferences for Blackboard and for Desire2Learn. The study illustrated that respondents used more features in Blackboard as compared to Desire2Learn; however, this difference between the percent usages of these two technologies was under ten percent. This variance was not considered as significant. We concluded that faculty as their technology choice for their online classes preferred Blackboard, but there was no statistical significance in their preferences for Blackboard as compared to Desire2learn.

6. CONCLUSIONS

The acceptance of technology is important if it is to be successful. Many faculty members chose Blackboard over Desire2Learn at this university. The percent difference between corresponding features was not significant; this led us to believe that no technology is perfect. In order to keep up with the fast pace at which technology changes, universities must be willing to implement new tools and features in their online learning environment. Not keeping up with the current technology for online education is equivalent to not having proper seating in a traditional brick and mortar school classroom. Universities should constantly enhance their online environment and provide training to faculty and students to ensure that the application is used as intended.

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Cloud Computing as a Core Discipline in a Technology Entrepreneurship Program

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Abstract

Education in entrepreneurship continues to be a developing area of curricula for computer science and information systems students. Entrepreneurship is enabled frequently by cloud computing methods that furnish benefits to especially medium and small-sized firms. Expanding upon an earlier foundation paper, the authors of this paper present an enhanced model program for including cloud computing as a discipline for further learning technology entrepreneurship. In the program, students can learn skills for leveraging cloud computing practices in the context of an enterprise strategy. This paper will be beneficial to educators exploring new initiatives in industry that might improve innovation projects in a technology entrepreneurship program.

Keywords: cloud computing, cloud service provider (CSP), cloud sourcing, computer science and information systems curricula, entrepreneurship, infrastructure-as-a-service (IaaS), interdisciplinary, platform-as-a-service (PaaS), software-as-a-service (SaaS), technology.

1. BACKGROUND AND DEFINITIONS OF PAPER

"Change is coming thanks to cloud computing: the over-hyped computing trend … actually hides within it the seeds of a genuine information technology revolution." (Morrison, 2011)

Cloud is defined essentially as a breakthrough "model for enabling convenient, on-demand network access [by firms] to a … pool of configurable computing resources … that can be provisioned rapidly and released with minimal management effort or [cloud] provider [CSP] interaction" (Walz & Grier, 2010). Cloud computing is delivered in models of infrastructure-as-a-service (IaaS), consisting of CPU, networking and storage services; platform-as-a-service (PaaS), consisting of framework services to deploy, host and maintain systems; and software-as-a-service (SaaS), including a model of pay-as-you go services to manage network systems (Yachin & Patterson, 2009). Cloud computing may be deployed as a public cloud, a private cloud, or a hybrid of private and public clouds (National Institute of Standards and Technology, 2009). Benefits of cloud computing include cost efficiency in lesser investing in generic hardware systems, faster implementation of features of new products and systems, and flexible provisioning and resource scalability of systems, in a model of pay-as-you-go services (Lawler, 2011). As functions in the office migrate to the cloud, cloud computing is perceived to represent a fundamental migration in the delivery of technology in 2011 and beyond (Srinivasan & Getov, 2011).

Entrepreneurship in the field of technology may be defined as a method for exploiting breakthrough high-potential models of technology, in order to furnish improved processes, products, services and systems to the marketplace (Byers, Dorf, & Nelson, 2011, p. XV). Medium to small-sized firms may be enabled to furnish new products and systems on the cloud model, having CPU, host and networking systems scaling to requirement (Miles, 2009, September), but not investing in any hardware technology and only paying for used or variable services of the technology, as large-sized firms furnish excess computing capacity or a "spot market" for cloud computing (The Economist, 2011). This enablement lessens a barrier to entry for emerging small-sized firms that might be founded on a cloud computing model (Habiby & Coyle, 2010). Entrepreneurs forming firms founded on the cloud paradigm might formulate ideas for new processes and services into fully functioning products and systems speeding to the marketplace sooner than in traditional ventures (Entrepedia, 2011). Firms may be enabled to initiate opportunities learned from the open innovation (Chesbrough, 2011) or sourcing of technologies on the Internet. They may be enabled to initiate opportunities even more in virtual offices instead of physical traditional offices, through the cloud computing model (Aquino, 2010). Literature indicates entrepreneurship as a nexus of enterprising entrepreneurs and opportunists (Shane & Venkataraman, 2000), of which the cloud may be an example of infinite opportunities in the marketplace. Cloud models may furnish opportunities for processes, products, services and systems (Khalidi, 2011), still to be discovered by entrepreneurial firms.

Despite the benefits of the cloud for entrepreneurial firms, concerns on control and security of information (McCall, 2010), integration and on-demand performance, reliability and scalability of CSP systems (Castro-Leon, Golden, & Gomez, 2010) may be factors indicating immaturity of the model. However, literature is concurrently indicating firms to be bullish about the future of the cloud (Narasimhan & Nichols, 2011), especially business entrepreneurial firms (Keating, 2010) – in a forecasted growth model of five times that of traditional technology ventures (Machi, 2010, p. 1), though they are cognizant of the concerns. Firms may manage the cloud model as another mere model of technology (Montalbano, 2011). Entrepreneurs in firms that are start-ups, or future entrepreneurs that are lab students in schools of computer science and information systems, might exploit interdisciplinary opportunities for processes and services in business non-technology firms or technical opportunities for products and systems in CSP technology firms, as consultants or inventors. Immaturity of the model might be indicative of opportunities in new products and systems, such as a data mining product for gathering information integrated on the cloud at lower cost expenditure (Linthicum, 2011); a system integrating information on the cloud for localized smart-phones and tablets; or a security or storage management system for improving CSP platforms of technology. Medium to small-sized firms might even exploit opportunities that leverage the cloud from office software to sophisticated systems that were once exploited only by large-sized firms in industry (Miles, 2009, January). Large-sized firms might further exploit intrapreneurial opportunities for profit (Pinchot, 2000). Schools of computer science and information systems may benefit by having students cognizant of not only the cloud, but the cloud as an entrepreneurship model of opportunities and possibilities.

2. INTRODUCTION TO PAPER AND PROGRAM

"… Cloud computing is going to make the level playing field [for large, medium and small-sized firms] a reality – great opportunities for entrepreneurs." (Almandoz, 2010)

Pace University is considered an entrepreneurial institution in the northeast corridor of the country (Drucker, 1994), along with other leading institutions in the country (Buchanan, 2011). The Seidenberg School of Computer Science and Information Systems of the university is currently enhancing a concentration in Technology Entrepreneurship in its Bachelor of Arts in Computer Science Program, defined in an earlier foundational paper and funded by the National Science Foundation (Lawler & Joseph, 2011). The concentration is for computer science and information systems students to learn the practices of skills needed to be business opportunists. The emphasis of the program is on the development of competitive ideas for marketable processes, products, services and systems, infused by entrepreneurial innovation if not invention of technologies, in a fictitious firm, or if feasible in an actual firm. The concentration in Technology Entrepreneurship is essentially a fusion of entrepreneurship, interdisciplinarity, and technology, on projects for firms.

As defined in the earlier foundational paper (Lawler & Joseph, 2011), the flow of the Technology Entrepreneurship program is described below for computer science and information systems majors (*):

- Define an idea for a business opportunity in a process, product, service or system that might be further infused by technologies or invention of new technologies;

- Design and develop a process, product, service or system, or a prototype, in a manner of creativity and innovation that furnishes cutting edge in business opportunity, by integration or invention of solution technologies;

- Develop a business plan for communicating the process, product, service or system, and the potential for profitability, as a new department of a firm or as a new firm, for funding by potential investors;

- Develop customized plans for marketing the process, product, service or system, infused by technologies, to targeted consumers or customers, or firms, in the marketplace; and

- Identify forthcoming innovation in technologies that might impact the process, product, service or system of the new venture.

(*) Finance, management science and mathematics majors are currently included in the program, but are a minority of the students.

The outcomes of the concentration in the Technology Entrepreneurship program are in the learning of analytical, business, communication, creativity and innovation skills on interdisciplinary and technology projects – entrepreneurship skills.

In this paper, the authors, who are also the principal instructors in the Technology Entrepreneurship program, discuss an enhancement for including the cloud model as a course discipline for further learning technology entrepreneurship. The emphasis of the discipline is for computer science and information systems students, and the other students, to exploit the cloud model for breakthrough business opportunities that may benefit from cloud methods and technologies. Students might exploit the immaturity of the model for improved if not new processes, products, services or systems for business non-technology firms, consumers or customers in the marketplace, or CSP technology firms that furnish the potential for profit. They might exploit the cloud for possibilities, if not solutions, from office productivity software or sophisticated systems housed on cloud CSP technologies for products or systems in their own ventures. The focus of the cloud model, as a course discipline in the Technology Entrepreneurship program, is for the students to learn skills that leverage cloud computing practices in the context of an entrepreneurial enterprise strategy.

The inclusion of the cloud model into the Technology Entrepreneurship program of the Seidenberg School is current with the literature. Developers in entrepreneurial firms are excited about the creative ferment and fun of the model (Vance, 2011) and are exploring opportunities for new frameworks of infrastructure processes and products, new methods of programming, and new services in software and systems (Vasan, 2011). They are exploring for example possibilities for new data mining petabyte storage systems on a cloud SaaS platform (eWeek, 2011). Firm managers already leverage productivity software, such as collaboration, data base, e-mailing, middleware and Web conferencing (Black, Mandelbaum, Grover, & Marvi, 2010), and systems, such as customer relationship management (CRM) and enterprise resource planning (ERP) technologies. Students in the Seidenberg School might leverage the cloud platform in a portfolio of entrepreneurial interdisciplinary projects, such a data mining product integrating social media systems, and pure technology projects, such a security management system safeguarding international cloud systems, in a cloud sourcing strategy – leveraging the cloud to the utmost. Students of Generations X and Y are not intimidated by the technology (High, 2009). Schools of computer science and information systems moreover might leverage tools and utilities of CSP technology firms that are partnering with universities (Blankenhorn, 2010).

The inclusion of the cloud computing model into the Technology Entrepreneurship program is current with the dismal marketplace. Computer science and information systems students graduating schools without industry positions are frequently forming entrepreneurial firms

(Seligson, 2010). Entrepreneurs are heroes to students – 51% of teenagers desire to be entrepreneurs in industry (Daley, 2009, p. 4). Entrepreneurial managers, and others no longer employed in industry, are frequently forming firms – firms grew 4.5% or 1 million more self-employed in 2010 (Daley, 2009, 2). Financial firms are increasingly investing in medium and small-sized entrepreneurial firms and technology funds (Rusli & Kopytoff, 2011). The introduction of the cloud computing platform into the Technology Entrepreneurship program of the Seidenberg School may be apt to computer science and information systems students desiring to learn the skills to be distinguished as the best opportunists in the marketplace.

3. FOCUS OF PROGRAM

The concentration in the Technology Entrepreneurship program, enhanced by the cloud computing model, is focused on the below courses of study:

- Entrepreneurship and Technology, a concept course integrating computer science and entrepreneurship in a project for business decision-making;

- Customer Relationship Management (CRM) and Entrepreneurship: Data Mining, a concept course integrating targeted marketing, sales and service in a project for decision-making on strategy;

- *Cloud Sourcing*, *a core course new to the program integrating the practices of cloud computing in the context of domain enterprise strategy*;

- Entrepreneurship and Financial Computing, a domain course integrating algorithmic computing, computer science, entrepreneurship, finance and financial analysis in a project for decision-making;

- Modeling of Financial Processes, Products, Services and Systems through Technologies, an adjunct domain course integrating computer science, finance and information systems in projects for decision-making on implementation of prototyped or real software technologies;

- Entrepreneurial Health Informatics, a domain course integrating governmental mandates, health industry programs and information systems on a project for decision-making;

- Energy Efficiency Entrepreneurship, a domain course integrating energy programs and information systems on a project for decision-making;

- Entrepreneurship and National Security, a domain course integrating national policy on protection and security technology on a project for decision-making strategy; and

- Special Topics in 21st Century Technologies and Ventures, a survey course integrating leading edge marketplace technologies that might impact new ventures.

The program continues to be focused not on generic entrepreneurship and technology, but on an integration of entrepreneurship and technology into the fields of energy, finance, health, security and technology (Vallino, 2010) – fields of interdisciplinary practices that might be improved by introduction of cloud sourcing technology. Entrepreneurial interdisciplinary projects may be attractive to business-expert students, and entrepreneurial technology projects may be attractive to technology-expert focused students, in the Cloud Sourcing course. The goal of this program is for the computer science and information systems students to become business entrepreneurs or opportunists, not pure technologists, knowledgeable now in the possibilities of the cloud.

The program is depicted in Figure 1 of the Appendix.

4. METHOD OF PREPARATION OF PROGRAM

The Seidenberg School of Computer Science and Information Systems initiated the Technology Entrepreneurship program in the semester of spring 2011 (*), as presented below:

2011:

- Customer Relationship Management (CRM) and Entrepreneurship: Data Mining (Spring);

- Entrepreneurship and Technology (Fall); and

- *Cloud Sourcing* (Fall).

2012:

- Entrepreneurship and Financial Computing (Spring);

- Modeling of Financial Processes, Products, Services and Systems through Technologies (Spring);

- Special Topics in 21st Century Technologies and Ventures (Summer); and

- Entrepreneurial Health Informatics (Fall).

2013:

- Energy Efficiency Entrepreneurship (Spring).

2014:

- Entrepreneurship and National Security (Fall).

Each of the courses is 4 credits or 36 credits for the full program through 2014.

(*) Once presented in the school, the courses in the program are to be scheduled in 2012 – 2014 and beyond once a year.

The prerequisites of this program are undergraduate sophomore, junior or senior students with a C+ grade index overall in the university.

5. CLOUD COMPUTING IN MODEL PROGRAM

"Maybe the cloud craze will spawn the next generation of technopreneur millionaires." (Machi, 2010, p. 2)

The Technology Entrepreneurship program at the xxxxx School is enhanced now with the core discipline of the cloud computing model and is depicted in detail in Table 1 of the Appendix.

The course in cloud computing, or cloud sourcing that is denoting the sourcing of technologies, is designed for educating computer science and information systems students in the school on the business dimensions of the cloud – business process management (BPM), entrepreneurship and service-oriented architecture (SOA) – in weeks 1 and 2 of the semester. The course is also designed for educating students on the technical dimensions of the cloud – platforms, products and utilities – in week 3. The element of management of the technical and business dimensions of the cloud – change management, cloud project prioritization and program management methodology – is designed in week 4 of the semester. The highlights of the course are in the execution of entrepreneurship scenarios – interdisciplinary projects (e.g. a data mining system for a client non-technology firm or a new venture) and technology projects (e.g. a security system for a client CSP technology firm or a new venture), in which students explore, if not exploit, ingenuity and improvisation in processes, products, services and systems leveraging functionality of the cloud – in weeks 5-7 and 8-10. The projects are positioned for profitable thresholds or tipping points (Byers, Dorf, & Nelson, 2011, p. 273) in week 11. In the final 12-14 weeks of the semester, the course is designed for helping students in the management and migration of the projects into systems if not ventures.

The deliverables of the Cloud Sourcing course, and the other courses in the Technology Entrepreneurship program, are competitions for the best of projects furnishing opportunities or potentially profitable ventures. The projects are to be developed in incubating small (3-5) student teams, mentored by entrepreneur experts and investors in local industry, who have volunteered to be mentors in the program, and by the instructors. The development is to be done from agile method (Lohr, 2010), emphasizing rapid application development (RAD) prototyping (Byers, Dorf, & Nelson, 2011, pp. 222-225), and from entrepreneurship (Byers, Dorf, & Nelson, 2011, pp. 225-227) and project management principles (Richardson & Butler, 2006), referenced in Table 1. The best of the projects is to be decided by the aforementioned mentors on a panel of fictitious venture capitalists in week 14 of the semester, and the best of the teams is to be granted a cash prize (The Economist, 2010). Interaction of instructors, mentors and student teams is to be in the classroom, discussion forums of the Blackboard Learn System, and if feasible localized meetings at entrepreneurial technology firms in downtown New York City that might beta test the projects.

Cloud Computing Strategies (Chorafas, 2011) is the required text, and Behind the Cloud: The Untold Story of How Salesforce.Com Went from Idea to Billion-Dollar Company (Benioff & Adler, 2009) is the supplementary text, of the Cloud Sourcing course; and Technology Ventures: From Idea to Enterprise (Byers, Dorf, & Nelson, 2011) is one of the required texts, and How to Change the World: Social Entrepreneurs and the Power of New Ideas (Bornstein, 2007) is one of the supplementary texts, of the program.

(The designs of the Customer Relationship Management (CRM) and Entrepreneurship: Data Mining and Entrepreneurship and Technology courses are available upon request to the authors, and the designs of the other courses in the program are in current development by the authors.)

6. IMPLICATIONS OF PROGRAM

"The idea of entrepreneurship is so powerful … and resonates with so many American values that President Obama has … called on entrepreneurs to lift the [country] out of the economic crisis." (Daley, 2009, p. 2)

The design of the Technology Entrepreneurship program in the Seidenberg School of Computer Science and Information Systems, enhanced with the cloud model, facilitates entrepreneurship goals. Entrepreneurs have infinite opportunities in initiating projects leveraging the cloud in essentially an adolescence of maturity of the technology. Interdisciplinary process and product projects further insure numerous possibilities for productive services and systems. Projects might be for entrepreneurs in business client non-technology firms, CSP technology firms, or in new firms formed from project solutions. The impact of the enhanced program as a design is that the cloud computing model in Technology Entrepreneurship furnishes high potential of profitable projects.

The Technology Entrepreneurship program, enhanced with the cloud model, improves the likelihood of marketability of computer science and information systems students who finish the Cloud Sourcing course or the program. Students learn the cloud computing model in the context of interdisciplinarity and the excitement and ferment of leveraging the model on processes, products, services and systems, not pure technology leveraging pure technologies – "something that could be [made] into a business [proposition]" (Dignan, 2008). Students learn grounded-in-reality non-technical skills, distinguishing them from other students learning purely technical skills (May, 2010). They might be employed as interns at entrepreneurial technology firms in the city. These students might pursue self-employment in the marketplace leveraging the skills – more than 50% of the fastest growing firms in the country were formed in a downsized economy (Daley, 2009, p. 3). The impact is that the cloud computing model in the Technology Entrepreneurship program as a design furnishes more potential for practitioner student success.

The new Technology Entrepreneurship program insures an offering that positions the xxxxx School at the forefront of leading edge methodology and technology. The fun of including the cloud model on enterprise solutions insures that the students are also at the forefront of a marketable technology (Marsan, 2011). Schools of computer science and information systems need to be involved with non-technology and technology firms, as the cloud model is further integrated into a mainstream maturing methodology and technology. Schools might join initiatives of firms, such as IBM (Kutzer-Rice, 2011), organizations, such as the National Collegiate Inventors and Innovators Alliance, and other schools, such as the Stevens Institute of Technology (Luftman, 2011), in insuring that entrepreneurship programs involving technology remain state-of-the-art. They might join societies, such as the IEEE Computer Society, in further insuring entrepreneurship knowledge of students (Gates & Romero, Alonso Jr., Klett, Naveda, & Requena, 2011). The implication is that new Technology Entrepreneurship programs as designs furnish potential school success if schools strive to be up-to-date with the inherent technology.

7. LIMITATIONS AND OPPORTUNITIES IN RESEARCH

Evaluation of the full Technology Entrepreneurship program may not be feasible until full implementation in 2014. However, the authors will be conducting a detailed evaluation of the learning outcomes and performances of the students in the Cloud Sourcing, Customer Relationship Management (CRM) and Entrepreneurship: Data Mining and Entrepreneurship and Technology courses of the program in late 2011. Evaluation of the full program in 2014 will include formation of new firms and new processes, products, services and systems by students through technology. Recent registration for the Cloud Sourcing course in fall 2011 is an encouragingly high 25+ students in the Seidenberg School.

The introduction of the Cloud Sourcing course into the Technology Entrepreneurship program will enable exciting opportunities in project research, as instructors and students in partnership with mentors pursue opportunistic projects. Future graduates of the course, if not the program, will furnish opportunities for further research in entrepreneurship, interdisciplinarity and technology if they personally pursue these ventures.

8. CONCLUSION OF PAPER

The paper expanded the Technology Entrepreneurship program of the Seidenberg School of Computer Science and Information Systems of Pace University. Computer science and information systems students in the school may learn more of the skills for taking advantage of the cloud model on opportunistic projects of technology. They may learn possibilities on projects taking them to potentially profitable ventures not so readily feasible under prior technologies. These skills may be more marketable to the students than if they learned technology entrepreneurship without the cloud computing model. Though further research is pending on the results of the program at the university, this paper in its current presentation will be helpful to instructors in other schools of computer science and information systems in furnishing ideas for integrating a paradigm of technology into their own technology entrepreneurship programs.

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APPENDIX

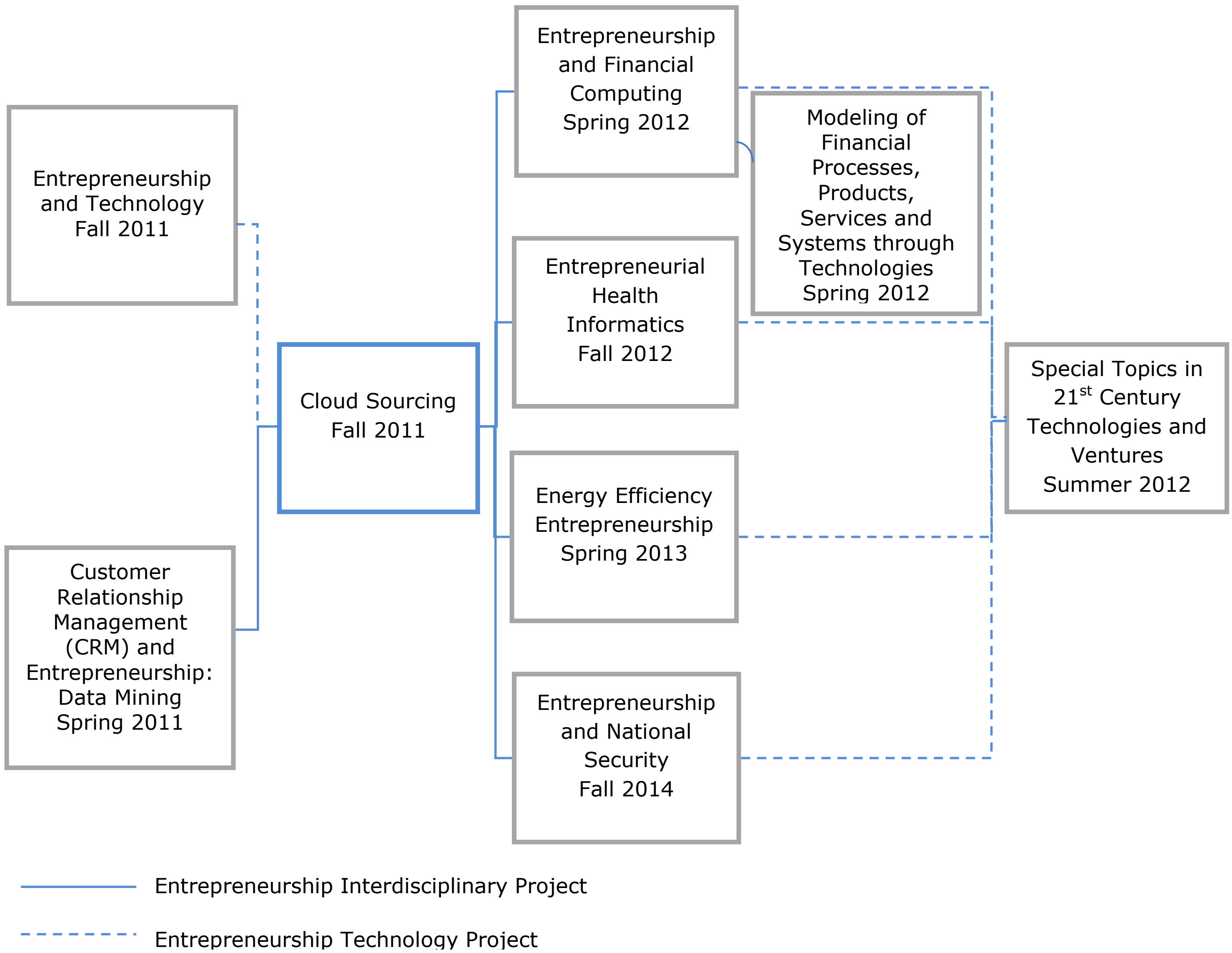

Figure 1: Bachelor of Arts in Computer Science – Concentration in Technology Entrepreneurship Enhanced by Cloud Computing Model – 2011 – 2014

Table 1: Bachelor of Arts in Computer Science – Concentration in Technology Entrepreneurship

Technology Entrepreneurship Program: Cloud Sourcing – Fall 2011 Semester

Week	**Modules**	**Project(s)**	**Source(s)**
1	Business Project Management (BPM) Business Process Management (BPM), Cloud and Entrepreneurship Cloud Models of Infrastructure-as-a-Service (IaaS), Platform-as-a-Service (PaaS) and Software-as-a-Service (SaaS)	-	Lawler, 2011
2	Cloud Computing as Design Patterns Cloud Computing, Service Orientation and Service-Oriented Architecture (SOA) Cloud Computing Information Model and Infrastructure of Services	-	Lawler, 2011
3	Platforms of Cloud Service Provider (CSP) Technology Firms Product Specific Cloud Technologies, Tools and Utilities	-	Lawler, 2011
4	Change of Culture Management Planning and Prioritization for Cloud Program Management Methodology for Projects	-	Lawler, 2011 Lawler & Howell-Barber, 2008
5	***Entrepreneurship Scenario – Interdisciplinary Project*** **(e.g. Data Mining System)** **Process or Product Scenario** **Critical Success Factors** **Marketplace Forces** **Process or Product Rationale** **Scenario or Story of Process or Product on Cloud** **Outcomes of Story** **Learning of Alternative Possibilities to Story**	Interdisciplinary	Byers, Dorf & Nelson, 2011
6	***Entrepreneurship Scenario – Interdisciplinary Project*** **(e.g. Data Mining System)** **Process or Product Strategy** **Objective** **Definition of New Process or Product on Cloud** **Differentiation of New Competitive Process or Product on Cloud** **Industry Perspective on New Process and Product Plans on Cloud** **Project Scope** **Strategy**	Interdisciplinary	Richardson & Butler, 2006 Lawler, 2011
7	***Entrepreneurship Scenario – Interdisciplinary Project*** **(e.g. Data Mining System)** **Process or Product Prototype Strategy** **Process or Product Specifications** **Prototyping of Stages of System(s)** **Rapid Application Development**	Interdisciplinary	Byers, Dorf & Nelson, 2011

	(RAD) Steps **Presentation of Full Prototype for Funding of System**		
8	***Entrepreneurship Scenario – Technology Project* (e.g. Security Management System) Process or Product Scenario** **Critical Success Factors** **Marketplace Forces** **Process or Product Rationale** **Scenario or Story of Process or Product on Cloud** **Outcomes of Story** **Learning of Alternative Possibilities to Story**	Technology	Byers, Dorf & Nelson, 2011
9	***Entrepreneurship Scenario – Technology Project* (e.g. Security Management System) Process or Product Strategy** **Objective** **Definition of New Process or Product on Cloud** **Differentiation of New Competitive Process or Product on Cloud** **Industry Perspective on New Process and Product Plans on Cloud** **Project Scope** **Strategy**	Technology	Richardson & Butler, 2006 Lawler, 2011
10	***Entrepreneurship Scenario – Technology Project* (e.g. Security Management System) Process or Product Prototype Strategy** **Process or Product Specifications** **Prototyping of Stages of System(s)** **Rapid Application Development (RAD) Steps** **Presentation of Full Prototype for Funding of System**	Technology	Byers, Dorf & Nelson, 2011
11	Positioning of Entrepreneurship Scenario – Interdisciplinary Project and Entrepreneurship Scenario – Technology Project for Thresholds on Tipping Points Responsibilities and Roles Schedule	Interdisciplinary Technology	Byers, Dorf & Nelson, 2011 Richardson & Butler, 2006
12	Industry Regulations Standards on Cloud	Interdisciplinary Technology	Lawler, 2011
13	Risk Management and Security of Cloud Systems through Security Strategy, Security Techniques and Disaster Recovery Planning	Interdisciplinary	Lawler, 2011
14	Migration Planning for Cloud Systems Migration and Uploading Tutorials Systems Management of Cloud and Monitoring of Systems through Service-Level Agreements Trends in Cloud and Technology Entrepreneurship	Interdisciplinary Technology	Lawler, 2011

Course: *Cloud Sourcing*

Reasserting the Fundamentals of Systems Analysis and Design through the Rudiments of Artifacts

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Abstract

In this paper we present an artifacts-based approach to teaching a senior level Object-Oriented Analysis and Design course. Regardless of the systems development methodology and process model, and in order to facilitate communication across the business modeling, analysis, design, construction and deployment disciplines, we focus on (1) the ability to define the boundaries of the system through context analysis, (2) the separation between business needs and technology requirements (business requirements vs. software requirements specifications), (3) the clear separation between analysis and design (business-domain models vs. analysis models vs. design models), (4) the evolution of artifacts from domain artifacts, to analysis artifacts and to design artifacts, and (5) the application of abstractions, formal methods and patterns to produce the necessary design artifacts. Thus, we emphasize the transition from computation-independent models, to platform-independent models, to platform-specific implementation models. We assert that the qualities of the produced artifacts convey the essentials of a student's understanding of analysis and design. In this sense, as students engage the artifacts of design, they converse with the problem and solution space in a manner that strengthens their command of the interface between information systems and organizations. We assert that faculty teaching an Analysis and Design course should focus on the quality of artifacts that serve as the "meeting point or interface" between the problem space and the solution space rather than on the development methodology(s) and process model(s) involved.

Keywords: Object Oriented, Analysis, Design, Use-case, object model, sequence diagram, artifacts

1. INTRODUCTION

Systems analysis and design persists as a core concern for the Information Systems discipline and programs designed to instruct students in the fundamentals of Information Systems. Systems analysis and design remains a core concern as the processes and artifacts of analysis and design reconcile between the technical and organizational concerns for any information system. While the composition and depth of curricular content in analysis and design have always been debatable, the curriculum in analysis and design has always been influenced by: (1) the structure of the academic program; (2) the skill set of the faculty teaching the course; (3) the experience of the faculty in software development; (4) the set of tools used in the course; (5) the paradigm used to teach the course (Object-Oriented, structured, etc.); and (6) the position of the course in the program curriculum (Russell, Tastle, & Pollacia, 2003).

Generally, our concern with systems analysis and design is in developing (1) an in-depth understanding of the problem domain; and (2) a multi-contextual (Analysis, Design, Construction, Testing and deployment) communication of descriptions regarding the solution domain. These elements have been well-articulated: "To program is to understand: The development of an information system is not just a matter of writing a program that does the job. It is of the utmost importance that development of this program has revealed an in-depth understanding of the application domain; otherwise, the information system will probably not fit into the organization. During the development of such systems, it is important that descriptions of the application domain are communicated between system specialists and the organization." (Madsen et al., 1993, p.3)

In a course on systems analysis and design, it is quite common that, in addition to systems analysis and design topics, faculty also tend to focus heavily on the development process itself. As a design process model suggests operations at a higher order of analysis, some of these topics are difficult for students to comprehend. Put another way, the concerns of process are premature for students who must first grasp the fundamentals of the artifacts of analysis and design, and particularly, of design. Furthermore, some related subjects, such as user interface design and database design, often require separate courses despite their obvious connection to the concerns of systems analysis and design. Similarly, operating in a development environment, preparing the deployment environment, designing for scalability, designing for quality assurance, and configuration management are hard to teach in a classroom - they typically require many years of experience and on-the-job training. Accordingly, educators need to be very selective of the content they teach and the prerequisites needed as they need to concentrate on the core topics of analysis and design.

To teach students how to analyze, design, build and maintain **useful** and **usable** software system products (Brooks, 1995), IS programs typically offer a system analysis and design course that focuses on requirements gathering, analysis, and high-level design as an essential element of the undergraduate curriculum. Also, if complemented by a capstone "finishing" and synthesizing course, a course in systems analysis and design can also focus on low-level design, construction, testing, deployment, and packaging. These two courses cover the major aspects of the factory-life phases of a software system product in contrast to its lifetime-in-use. Throughout this curricular process, students learn about the tools, processes, artifacts, and quality-assurance aspects of what is needed to build a software system product (Brooks, 1995; Gupta and Wachter, 1998).

This paper illustrates how we address the following questions in teaching the students how to perform analysis and design: (1) where do we start the analysis and design process? (2) What are the activities that are performed? (3) What are the artifacts that are produced? (4) What are the dependencies between the different artifacts? (5) How to evolve domain artifacts to analysis artifacts to design artifacts to development artifacts? (6) How to use UML tools to support and automate the creation, maintenance and transition of artifacts? This artifacts-centered, UML-Tools based approach focuses our students on the rudiments of systems analysis and design by focusing on the quality of artifacts and their evolution that facilitate these activities. By the time, our students start their profession, they should be comfortable and versant in the rudiments of the SAD course as they pertain to the essential artifacts of design. Given a description of a business problem from a subject matter expert, our students should be able to identify their business needs in the form of business requirements and system requirements. They should be able to produce the appropriate system context, functional architecture, use-cases and use-case diagrams. Given a use-case, they should be able to produce the object models, sequence diagrams and activity diagrams and screen layouts. Given an object model, they should be able to produce the conceptual database schema. Given a conceptual database schema, they should be able to produce the logical database schema (SQL DDL(s)) etc. This is a simpler, and perhaps not-synthesized, level of understanding, but it is focused on the outcome of mastering the basics.

Explicating our Exemplar

In our program, our first course in systems analysis and design is a junior/senior level course. For a textbook, we have used "Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design" by Larman (2005), and supplemented by other course materials and Microsoft Word document templates from IBM Rational. For analysis and design software tools we use IBM Rational Architect. As reference texts, we use *Requirements Management Using IBM Rational Requisite Pro* (Zielczynski, 2008), *Visual Modeling with IBM Rational Software Architect* (Quatrani & Palistrant, 2006), and *UML and IBM Rational Unified Process Reference and Certification Guide* (Shuja & Krebs, 2008). We use IBM Rational Software Architect as a UML-based CASE tool. IBM Rational Architect provides support for creating, sharing and managing of UML models during analysis and design. It is used as a repository and a management tool for the various artifacts across the team members (model, documents, etc.) (Quatrani & Palistrant, 2006). Figure 1 IBM Rational: User ViewFigure 1 is a screenshot a user's view of the tool's frontend, it allows analyst designers and developers to collaborate and share the various analysis and design artifacts (models and documentation) into a repository with visual front-end. All IBM Rational software and educational materials are available free of charge for academic programs participating in the IBM Rational Academic Initiative Program.

Our course has object-oriented programming and database design as pre-requisites. For homework assignments, students are required to produce the necessary analysis and design artifacts using a combination of Word documents (using IBM Rational document templates) and UML models using IBM Rational Software Architect. For the final project, students work in teams to produce the complete analysis and design artifacts (Word documents, UML models, and prototype demos).

In this paper, we share an artifacts-based approach in the delivery of our Object-Oriented Systems Analysis and Design course. By "artifacts-based" approach, we mean that regardless of the software engineering methodology and process model (Agile, Unified, SCRUM, Extreme Programming, etc.), we focus on the artifacts, their dependencies and transformation that lead to the construction of the product. The Rational Unified Process lists twenty-one analysis and design artifacts (Crain, 2004), some of the artifacts are redundant and they do overlap we do not cover all of the artifacts in the course. In this paper, we emphasize on the structure of six primary artifacts (System Context, Requirements, Use-Case Modeling, Object Modeling, and State Diagrams) and activity diagrams. We hold that such an emphasis strengthens the perceptive skills students require in order to understand the wider process of systems development. A focus on the qualities and mechanics of the analysis and design artifacts serves to remind students about the role these artifacts play as an interface between the 'inner' environment, the substance and organization of the artifact itself, and an 'outer' environment, the surroundings in which it operates." (Simon, 1996)

2. THE ANALYSIS DISCIPLINE

To analyze a system is to build a set of consistent and interrelated models on the basis of which a software system can be designed. During analysis, we define:

(1) The boundaries of the system represented as a UML system context model.

(2) The users of the system represented as a set of primary and secondary actors.

(3) The functional requirements of each actor(s) group organized and described in a Word document (explicitly listing capabilities requirements – the "should" and "should-nots").

(4) The business logic of the elementary business processes of the system represented as UML diagrams (use-case, system sequence, collaboration diagrams, and activity diagrams) and a Word document containing descriptions of use-case scenarios.

(5) The information models of the system represented as UML domain object models.

(6) The functional architecture of the system represented as UML functional subcomponents.

(7) The software requirements specifications of the system (non-functional or other requirements depending upon what it is named) which also includes performance, reliability, security, and other concerns.

Essentially, the analysis team produces robust and consistent professional documents and rich graphical models using a word processor and a modeling tool such as IBM Rational Architect. Accordingly, the analysis team produces artifacts related to documenting an expressive platform independent model on the basis of which the system can be designed.

Where to Start?

Software development is the art of moving forward. To overcome the "analysis paralysis" dilemma, the challenge facing the designer is: to orbit sufficiently in problem-domain modeling to generate enough momentum to begin analysis; to orbit sufficiently in analysis to gather enough momentum to move to design; etc. One of the biggest challenges is to teach students where to start. The artifacts of design create the milestones for an analysis and design project and signal to the designers that we have gathered enough quality artifacts to move forward, partially or completely, to the next phase.

We start by defining the system context. By doing so, we define the boundaries of the system. We define the primary actors (both humans and other applications) and the secondary actors of the system. The system context is typically conveyed in a Word document that details the characteristics of each actor group accompanied by UML architectural models that highlights the primary and secondary actors of the system and their patterns of interaction with the system through system-level sequence diagrams. We use the actors list defined in the system context to define and produce the functional requirements document and the functional architecture model, see Figure 1. We use the functional requirements to detail the use-case scenarios and produce the use-cases document, use-case models and system sequence diagrams models. For human-actors we produce detailed sequence diagrams user interfaces and storyboards, for application-actors we produce contract (API) specifications. We then use the use-case scenarios to build bottom-up domain object models. We use the domain object models to produce the state transition diagrams of the noteworthy objects. We use the analysis models and software requirements specifications to produce the design models. We use the use-cases, system requirements and domain models to produce system architecture and the detailed design.

The System Context

The system context artifact starts as a UML model. It documents the primary and secondary actors of the system and their characteristics. It allows us to define the boundaries of the systems. The system context is the primary input to the functional requirements of the system. It helps us define (1) primary business actors (both human and other systems) that require services from the system, (2) the primary system administrator actors responsible for administering and maintaining the system, and (3) the secondary actors (which are other systems) that are in the workflow of the elementary business processes of the primary actor(s).

The analysis domain is not without its difficulties, as analysis is where we reconcile between the technical and organizational concerns in the identification of actors. When defining primary actors, we sometimes have the tendency to ignore the serviceably of the system (primary system actors); we do, however, emphasize that there is always an application administrator actor, a system administrator actor, and in some cases a service layer monitor actor (another system that may have to monitor the health of the application). Primary application actors are responsible for the monitoring, operations support, administration, backup, recovery, maintenance and serviceability of the application. They have their own "System-Level" functional requirements to perform their operations. Using a Student Information System as an example, the system context in Figure 2 shows Student(s), Faculty, the Library System, Application Admin, and System Admin as primary actors, and the Finance System, the Financial Aid System and the Library System as secondary actors. We are highlighting the Library System as both a primary and a secondary actor to make the point that an actor can be both primary and secondary. Within the UML tool front-end, as illustrated in Figure 1, we can capture the characteristics of each actor group and provide text description within the document editor or attach a document detailing the characteristic of the actor group as a URL.

The Requirements

A requirement is a service that the system needs to provide or a capability to which the system needs to conform to. Although completely different, requirements are usually divided into (1) the functional or business requirements that capture the business functions of the system and (2) the system requirements (Software requirements specifications) that provide the scaffolding and the infrastructure support of the business functions of the system. Depending on the software engineering methodology used, the system requirements are also called the nonfunctional, other, or supplementary requirements. UML allows for the modeling of functional requirements through use-case diagrams, system sequence diagrams, and activity diagrams. UML however, does not provide a framework for modeling system requirements. The requirements document is a well-written Word document that includes both the functional and system requirements of the proposed system. It clearly captures the functional and the non-functional requirements of the system. Figure 3 illustrates a sample table-of-contents for a requirements document that our students use as a template. We provided the figure to emphasize the importance of uniformity of content, and as a road map of what to expect from analysis and design in terms of content and deliverables. Students have always struggled with how a document should look like, what to include in the project documentation, the table-of-content provides them with a road map of what to expect in terms of artifacts and content and their level of detail.

The Functional Requirements

The functional requirements are the business capabilities that the system should provide. They are written in a request for proposal (RFP) format by, or at least with the assistance of, subject matter experts. These requirements are written in clear and unambiguous short paragraphs (as capabilities expressed in terms such as "should" and "should-not"), with one- or two-paragraph descriptions to provide a high-level understanding of the capability or the restriction.

For each primary actor, we create categorized lists of business functions that reflect the business needs of the actor group. The following is a sample of functional requirements listings:

1) **Student Requirements**
   1 A student should be able to add a course section to their Schedule. During the registration period, using the internet, a student should be able to add a course section to their schedule from the list of open sections as long as it does not exceed the maximum allowed limit for that student.

   2 A student should be able to delete a course section from their schedule. During the drop period, using the internet, a student should be able to drop a course section from their schedule as long as they maintain the minimum residency limits.

2) **Catalogue dept. Requirements**
   1 Catalogue dept. should be able to change prerequisites of an existing course. …………

   2 Catalogue dept. should be able to assign a course to a degree plan.

3) **Etc**.

In summary, the functional requirements provide a list of capabilities and restrictions. It is an input to the use-case documents where business logic is detailed.

The System Requirements

The system requirements are capabilities the system needs to conform to. According to Zielczynski (2008), they are all the requirements that cannot be expressed in use-cases. They drive the design and specify the system properties. They are categorized into aspects covering security, performance, reliability, usability, testing, technology, external interfaces, operations support, legal concerns, etc.

Although two software systems may have very different functional requirements (Billing vs. HR), it is often the case that they have very similar system requirements. System requirements are usually based on common corporate and industry best practices and standards (IEEE Computer Society, 1998). According to their level of interest in the system, various stakeholders write the system requirements. For example, security engineers write security requirements that comply with corporate and industry standards. Maintenance, operations support and system administrators write serviceability requirements. Database administrators write the data requirements. User-centered design (human factors) groups write the usability requirements to comply with the look and feel standards of the organization.

The system requirements document is an input to the use-case details document, system architecture document, deployment architecture, and test cases.

The following is a sample of system requirements listings:

1) **The** System should respond to a user request for a service within 3-5 seconds 90% of the time and no longer than 10 seconds at any time.
2) A user account should become in-active if it has not been used for a configurable (default 45) consecutive days.
3) A user should not be able to have more than one concurrent active session.
4) The date, time and the IP address of the machine from which a user logged in should be stored into the system.
5) No Open Source code should be used as part of the System
6) All System Windows should have a title that reflects the task at hand, should display the user name and should display the current local date and time.
7) All System windows should have context help.
8) All necessary data should be carried over across multiple active screens
9) Stale records that are more than a configurable (default one year) old should be purged out of the system.
10) The System should support single sign-on products.
11) Security should be X507 Compliant.
12) Client and Server Ports should be configurable.

The Use-Case Model

Use-case modeling is comprised of use-case UML diagrams and use-case details that are textual documents. Use-case diagrams are representations of each actor, their underlying use-cases, and the dependencies between use-cases (extends and includes). The business logic of functional requirements is detailed in the use-case details document(s). Each functional requirement is traced to one or more concrete use-cases and each concrete use-case is traced back to one or more functional requirements. A concrete use-case details an elementary business process. It is a coherent set of functions, which embodies the business logic needed for the system to provide while moving the system from one consistent state to another consistent state in response to an actor's request for service. During analysis, abstract use-cases are extracted from the concrete use-cases. Abstract use-cases contain reusable business logic components that are common to more than one use-case. When a use-case is too big, it is also abstracted into a simpler set of use-cases to simplify the business logic through abstraction. For example, "check-prerequisites," "get-probation-status," and "validate-registration-card" are abstract use-cases of the "register-for-class" concrete use-case, **Error! Reference source not found.**.

During analysis, use-case details are also captured as activity diagrams (see Figure 9).

Many sources provide templates for use-case documents. We use the templates from IBM Rational as a skeleton and we modify them as needed (Zielczynski, 2008). The following is a common use-case template:

<Use-case Name>

1. Brief Description
2. Satisfied Requirements List
3. <Use-case Name>
4. Brief Description
5. Satisfied Requirements List
   1. <Requirement Name a& Number>
   2. <Another Requirement Name & Num.>
6. Actors List
   1. <Actor Group Name>
   2. <Another Actor Group Name>
7. Preconditions
   1. <Precondition>
   2. <Another precondition>
8. Use-case Flow
   1. Basic Main Flow
   2. Alternative Flows
   3. Optional Flows
   4. Exception Flows
9. Post Conditions
   1. <Post Condition>
   2. <Another Post Condition>
10. Included Use-cases
    1. <Use-case Name and Number>
    2. <Another Use-case Name and Num.>
11. Special Requirements
    1. <Special Requirement>
    2. <Another Special Requirement>
12. Special System Requirements
    1. <Special System Requirement>
    2. <Another System Requirement>
13. Assumptions, Open Issues and Comments

The Domain Object Model

The domain object model is the set of domain objects, the attributes of each object with their constraints and data types, and the set of associations between objects. Associations have cardinality and are regular, aggregation, containment, inheritance or taxonomic. The domain object model is a UML artifact that is comprised of a set of diagrams and the underlying descriptions and semantic content of the object model artifacts. In summary, it is a visual representation of the domain objects of the system, their attributes, constraints and associations with other classes. Each use-case scenario exposes certain objects, object attributes and relationships. For example, from a login use-case, we learn that a user (student, faculty, staff, etc.) has a user id and a password. From the "add class" use-case scenario, we learn that students have study plans and majors, and courses have prerequisites. By analyzing the use-cases, the object model is built from the ground up. In Figure 5 is an example of a mini object model.

The State Diagrams

For each domain object, a state diagram captures the noteworthy, finite, and discrete states of an object. Not every object necessarily has noteworthy states. State transitions of the same object are usually confused with the inheritance hierarchy of an object. For example, a student status as freshman, sophomore, junior, or senior represents the possible state transitions of the undergraduate student object rather than as subclasses of student. Figure 6 is an example of a state transition diagram of the object student

3. THE DESIGN DISCIPLINE

Design is an intermediate phase in the process of moving the system from the problem space (Analysis) to the solution space (Final Product). To design a system is to develop a set of artifacts – and subsequently an overall system model – from which a software system can be built. Given the set of all the Analysis artifacts, time constraints, technology constraints, and financial constraints, the system design is a proposal for feasible solution that satisfies these constraints. During design, inputs, processing, data storage, output and communication software artifacts are materialized into a set of layered architectures that are comprised of user-layers, processing layers, data layers, communication layers, security layers, etc. In this sense, designing is about making commitments on the distribution of business logic and the processing of business logic across the layers.

From Analysis to Design

Transitioning from analysis into design, students have learned how to create analysis models and document (1) the system context with its primary and secondary actors, (2) the functional architecture of the system and the dependencies between its functional components, (3) the requirements of the system both functional and system requirements, (4) use-cases and use-cases analysis and (5) the domain object model, (5) the user interface in terms of story boards and contract specifications.

During design, students learn how to realize a solution for the analyzed problem at hand. They build platform-independent models during high-level design and platform specific models during low-level design. During design, students learn to realize uses cases through use-layer components, processing layer components and data layer components. Using the web as a computing model, students realize that they need to (1) deign web pages based on the story of the use-cases, (2) design database tables based on the design object model and connect the user layers with the data layers using a dynamic content processor like PHP, Java Server Pages, Python, etc.

Into Design

During design, students learn:

- To refine and redefine objects, create abstractions, add methods to objects, refine the data types and add constraints to attributes based on Class Responsibilities and Collaboration (CRC) design pattern as shown in Figure 11.
- How to use the Model-View-Controller and Class-Responsibilities-And-Collaboration patterns to define the view components or boundary classes if any (Screen designs and layouts), controller components or processing classes (class responsibilities and collaborations) and Model components or entity classes (tables and views of the underlying data layer is a relational database system). For the Transcript object for example, students learn to produce the boundary (GUI), processing and entity (database) realizations as shown in Figure 12.

- How to use design patterns to create other design objects such as control classes, listener classes, messaging classes, information expert classes, etc.
- How to utilize knowledge learned in their database class to implement design and implement a relational database with the required integrity constrains.

In summary, during design, use-cases are realized into detailed sequence diagrams where commitments are made as to the distribution of processing. For example, given a login use-case, should the processing to validate a user be performed in the user layer, the processing layer, or in the data layer through stored procedures? Each one of these designs has its own advantages and disadvantages. During design, a commitment as to how to implement the business logic is clearly outlined.

Using a student login to the system use-case scenario, students learn to identify the design objects of the use-case Figure 7. A design commitment needs to be made as to who is responsible for validating the credentials. Students learn to produce detailed sequence diagrams to realize the design of use-cases. In Figure 8, the "Login-Screen" object controls all the authentication operations and the creation of other objects.

However, another sequence diagram could have distributed the logic among the various objects. Accordingly, design is a commitment to a processing logic scenario that is low coupled and highly cohesive.

From Analysis and Design to Design and Development

It is prudent to identify what has been left out of our discussion, as these left-out parts are a also a vital component of our systems analysis and design curricular sequence, but are included in our capstone course. To wit, there are other important design issues for which a rudimentary and artifacts-centered approach is also appropriate. A few of these issues that we feel are important are: (1) testing; (2) designing for performance; (3) designing for scalability; (4) designing for security; and (5) designing for robustness. As such, each of these are deferred to our capstone course, which itself is a synthesizing course meant to bring the principle pillars of our curriculum together.

To some degree, we can think of these as intermediary concerns, and are, appropriately, left to a course focused on culminating the rudiments and undertaking a deeper study of software processes: our senior capstone course. Once students have grounded themselves in systems analysis and design, modern object-oriented programming, advanced web programming, and database management, we feel that these additional concerns of design can then be addressed in the richer context of a business problem in need of an information technology solution. Once past the rudiments, even a capstone course is merely a beginning; students will only learn about designing for performance, scalability, and robustness in the context of practice in the profession. While we feel it is prudent to discuss these issues, the "laboratory" environment of the capstone project course makes it difficult, but not impossible, to demonstrate these important design issues. That is to say, while our capstone course seeks to involve students in projects with real clients and attempts to provide as meaningful of an experience as would be possible, most capstone courses, including ours, are far from the pressures, constraints, and strictures of reality. Typically, these projects are either a pilot/prototype project, or some other non-essential product that is typically NOT on the critical path. However, we have enjoyed notable exceptions to this. For instance, we have experience with on-campus clients who have either gone on to utilize the outcomes of our capstone course in their daily operations, or have been very impressed with the outcomes of the capstone course and have incorporated our students' work in some fashion.

4. DISCUSSION AND CONCLUSION

In this paper we presented a road-map for an outcomes-focused, artifacts-based, hands-on, and disciplined approach to an analysis and design course. Our objective is to present a disciplined approach to understanding and producing the necessary analysis and design artifacts (documents and models) which consistently lead to a successful system regardless and irrespective of the systems development paradigm, model, and methodology used to build the system. With this approach, students gain hands-on technical skills that are deliverables-centric. Our premise is that the adherents of a predictive model, such as the Capability Maturity Model, or the adherents of an adaptive model, such as

Extreme Programming, should both be equally comfortable with commonly accepted artifacts. We also acknowledge that bridging the gap between process modeling and object-oriented systems modeling remains a challenge; we contend that students will bridge this gap with experience. However, without a solid grounding in the qualities and characteristics of the artifacts themselves, the "craft" of systems design will be elusive. We think of the artisan who must learn the tools of their craft before they worry about the holistic and philosophical concerns of their craft. In this sense, we feel that we are preparing our students to use their knowledge of the characteristics and qualities of design artifacts to then develop their experience.

We foresee that our students will approach their initial years in the profession as an opportunity to learn how their designing of artifacts and their interdependencies helps them to understand the systems they build and the context of the organizational problems these systems address. More importantly, by knowing their tools, our students can then focus on what is, and is not, possible as they navigate the complexity of systems specification. As they mature in their profession, our students must develop a sense of how the juxtaposition of the materials of design (the artifacts), the constraints of the design process, and the organizational constraints of the system's intended operational environment, transform their understanding of the analysis and design process. This is so also in a cumulative and iterative tradition: experience is accrued as the design process is continually engaged. We err on the side of the artifacts-based approach as we believe our students are better equipped to learn about the art and craft of systems designing if they are first aware of the indelible truth inherent in the characteristics and qualities of the artifacts of design.

Schön and Bennett (1996) put it well when they described a "reflective conversation with materials" that designers conduct as they reflect on practice. In this case, "practice" is the consistent use of design artifacts, which is only possible when design artifacts (the materials of designing) are well-understood. We see this in other areas which invite mastery: those learning the piano practice and exercise in the structures of chords, notes and scales; those learning to dance exercise in the mechanics of movement; and those learning a team sport exercise in the patterns of play. Accordingly, in our course we have chosen to focus on the artifacts of design in our curriculum. Once armed with the "scales" and building-blocks of design artifacts, we believe that our students can design within the framework of a development model in the same manner that a musician trained in the virtues of sight-reading can work within the context of many styles of music. In this sense, familiarity with the artifacts of design – the rudiments – students will have comfort with a "grammar" of design which will serve as a repertoire to draw from in future practice.

Most fundamental to our approach is that the characteristics and qualities of the artifacts of design provide the best interface between the system and those that will use the system. In the artifacts, we have a "lingua franca" which allows the realm of Information Technology to understand and accommodate the realm of the organization. This interfacing is at the heart of the Information Systems discipline and is most representative of the skills and knowledge most suited to our students' development.

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APPENDIX

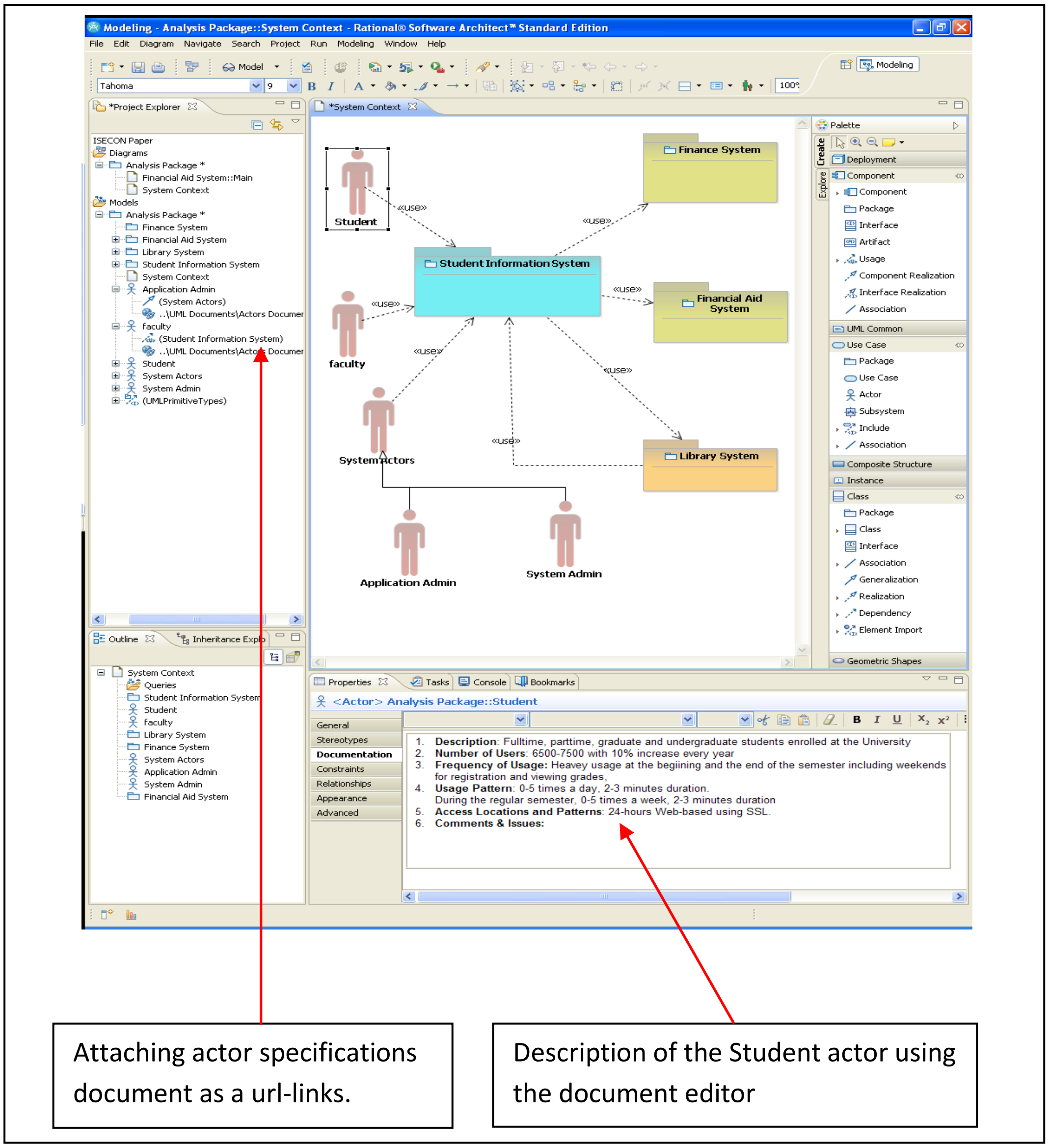

Figure 1 IBM Rational: User View

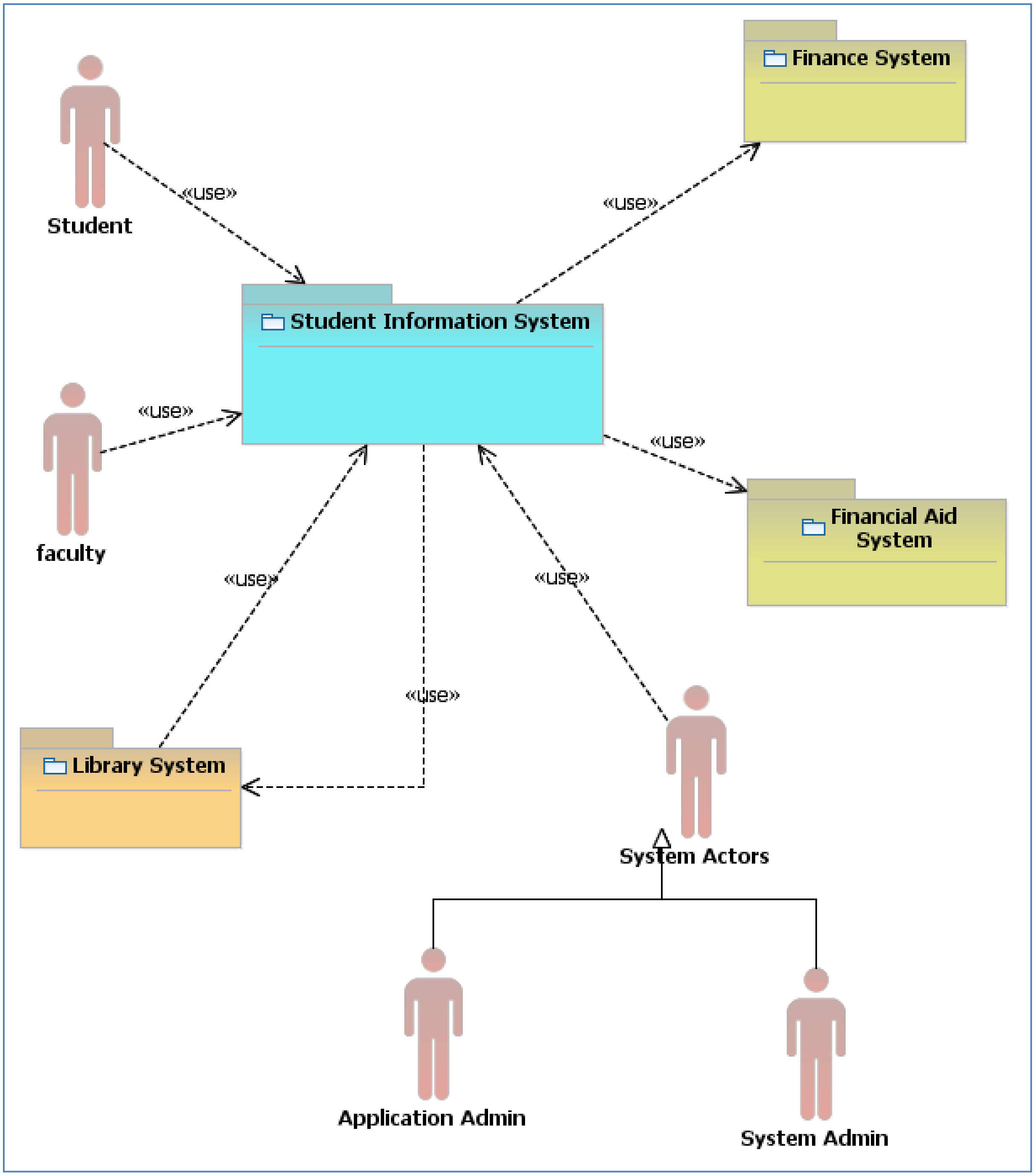

Figure 2 A System Context Diagram

1. INTRODUCTION AND PURPOSE **1**
2. DEFINITIONS, ACRONYMS AND ABBREVIATIONS **1**
3. DEPENDENCIES AND REFERENCES **1**
4. DOCUMENT OVERVIEW AND TARGETED AUDIENCE **1**
5. CUSTOMERS AND OWNERS **1**
6. REVISION HISTORY EVOLUTION **1**
7. PRODUCT OVERVIEW **2**
7.1 Product Perspective 2
7.2 Summary of Capabilities [Later] 2
8. THE CURRENT FUNCTIONAL ARCHITECTURE **2**
8.1 The Current Functional Architecture Diagram 2
8.2 <Functional Component Name and Description> 2
9. STAKEHOLDERS AND STAKEHOLDER GROUPS PROFILES **3**
9.1 <Stakeholder Group Name> 3
9.2 <Stakeholder Group Name> 3
10. USERS AND USER ROLES' PROFILES **4**
10.1 <User-Role Name [Primary | Secondary] Actor> 4
10.2 <User-Role Name [Primary | Secondary] Actor> 4
11. THE SYSTEM CONTEXT **5**
12. FUNCTIONAL REQUIREMENTS **6**
12.1 <Primary Actor Group One> 6
12.1.1 Requirement *6*
12.1.2 Requirement *6*
12.2 <Primary Actor Group Two> 6
12.2.1 Requirement *6*
12.2.2 Requirement *6*
12.3 <Common Requirements> 7
12.3.1 Requirement *7*
12.3.2 Requirement *7*
13. SYSTEM REQUIREMENTS **8**
13.1 Usability 8
13.2 Reliability 8
13.2.1 <Reliability Requirement One> *8*
13.3 Performance 8
13.3.1 <Performance Requirement One> *9*
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13.4.1 <Supportability Requirement One> *9*
13.5 Design Constraints 9
13.5.1 <Design Constraint One> *9*
13.6 Online User Documentation and Help System Requirements 9
13.7 Purchased Components 9
13.8 Interfaces 9
13.9 User Interfaces 9
13.10 Hardware Interfaces 9
13.11 Software Interfaces 9
13.12 Communications Interfaces 9
13.13 Licensing Requirements 10
13.14 Legal, Copyright and Other Notices 10
13.15 Applicable Standards 10
14. SUMMARY AND CONCLUSIONS **11**
15. OPEN ISSUES **12**
16. APPENDIX LIST **13**
17. REFERENCES LIST **14**
18. INDEX **15**

Figure 3 The Table of Contents for A Requirements Document

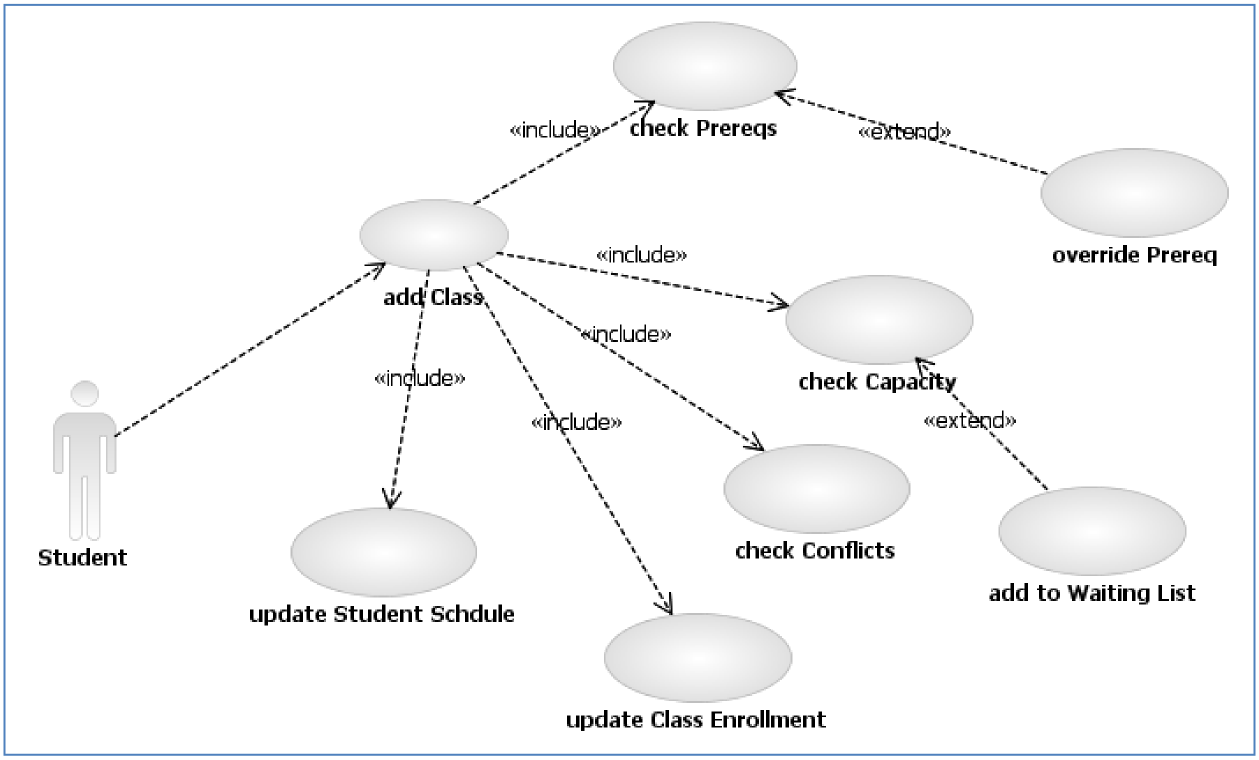

Figure 4 A Use-case Analysis UML Diagram

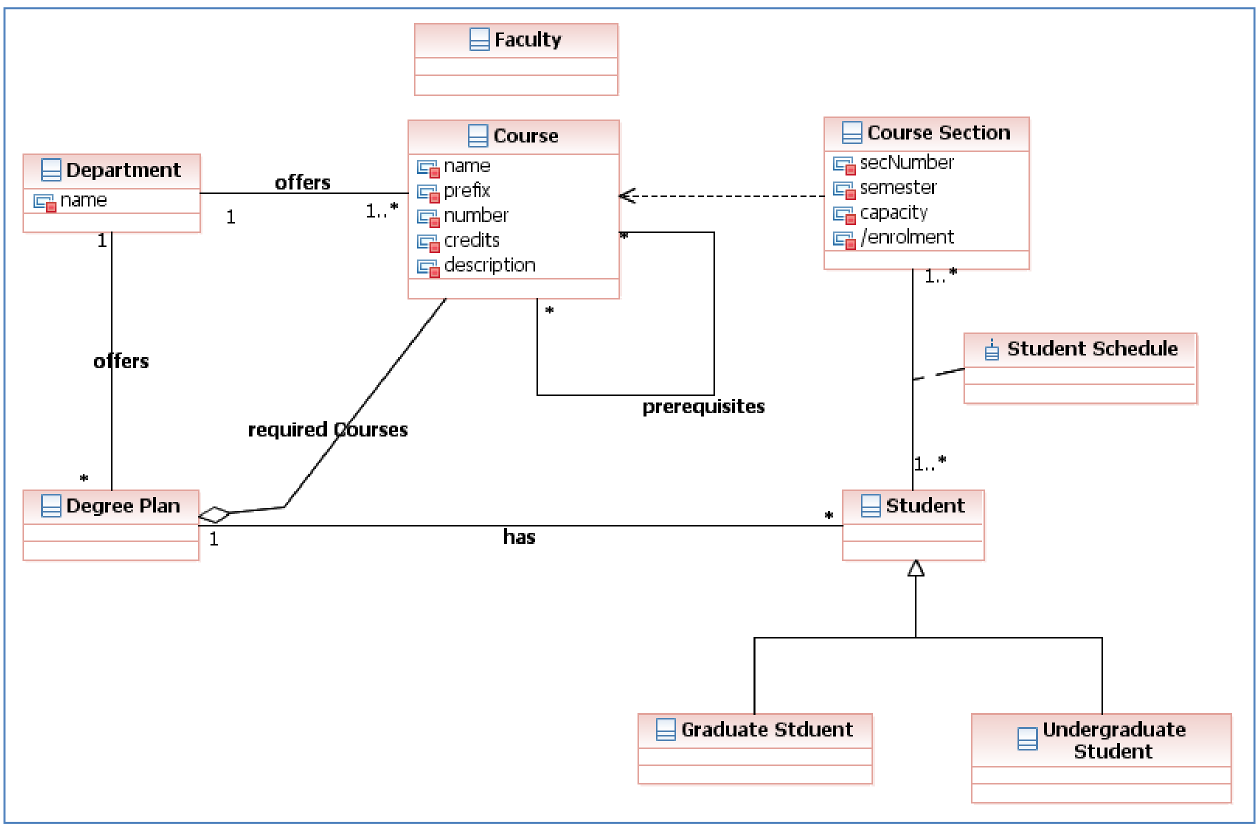

Figure 5 A Simple Domain Object Model

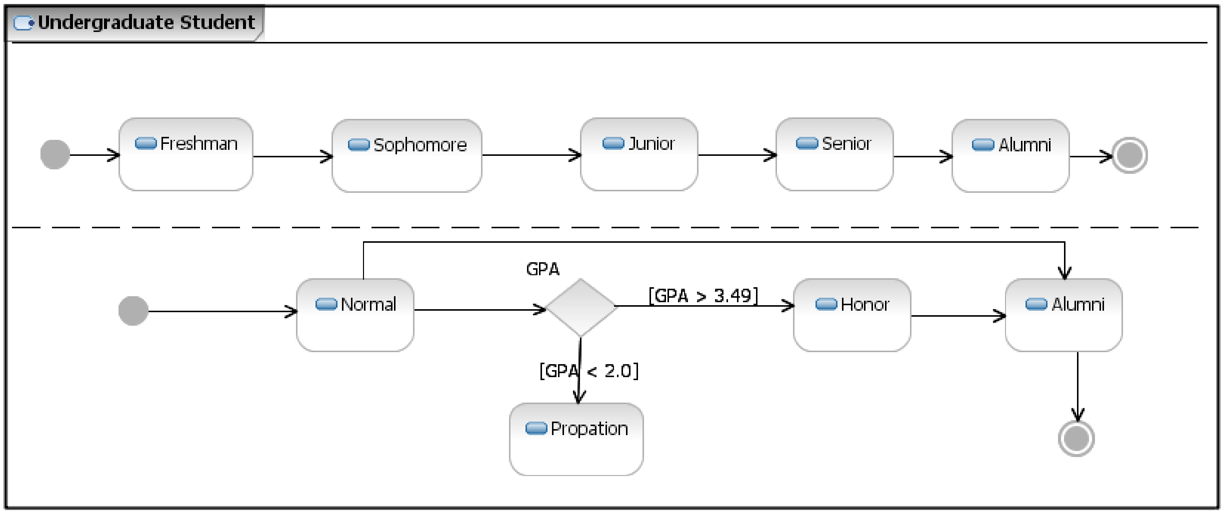

Figure 6 State Transitions of an Undergraduate Student

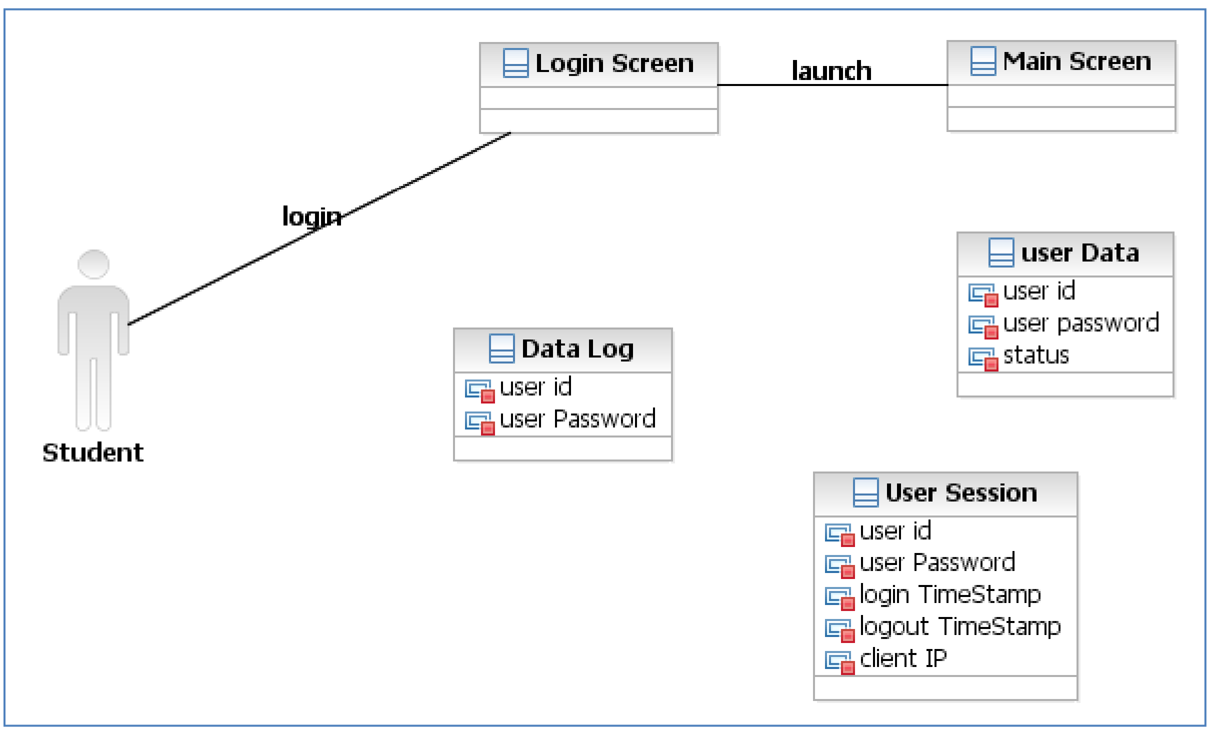

Figure 7 A design Object Model of Login Use-case

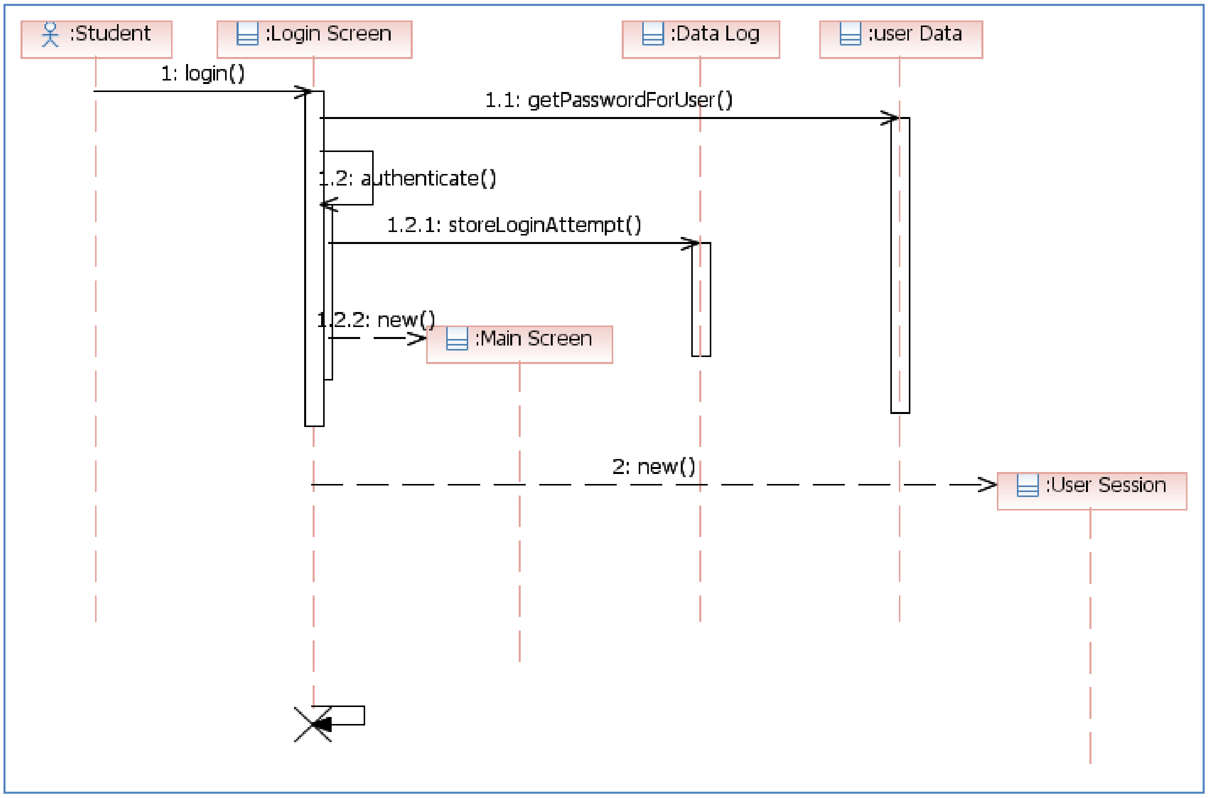

Figure 8 Login Sequence Diagram One

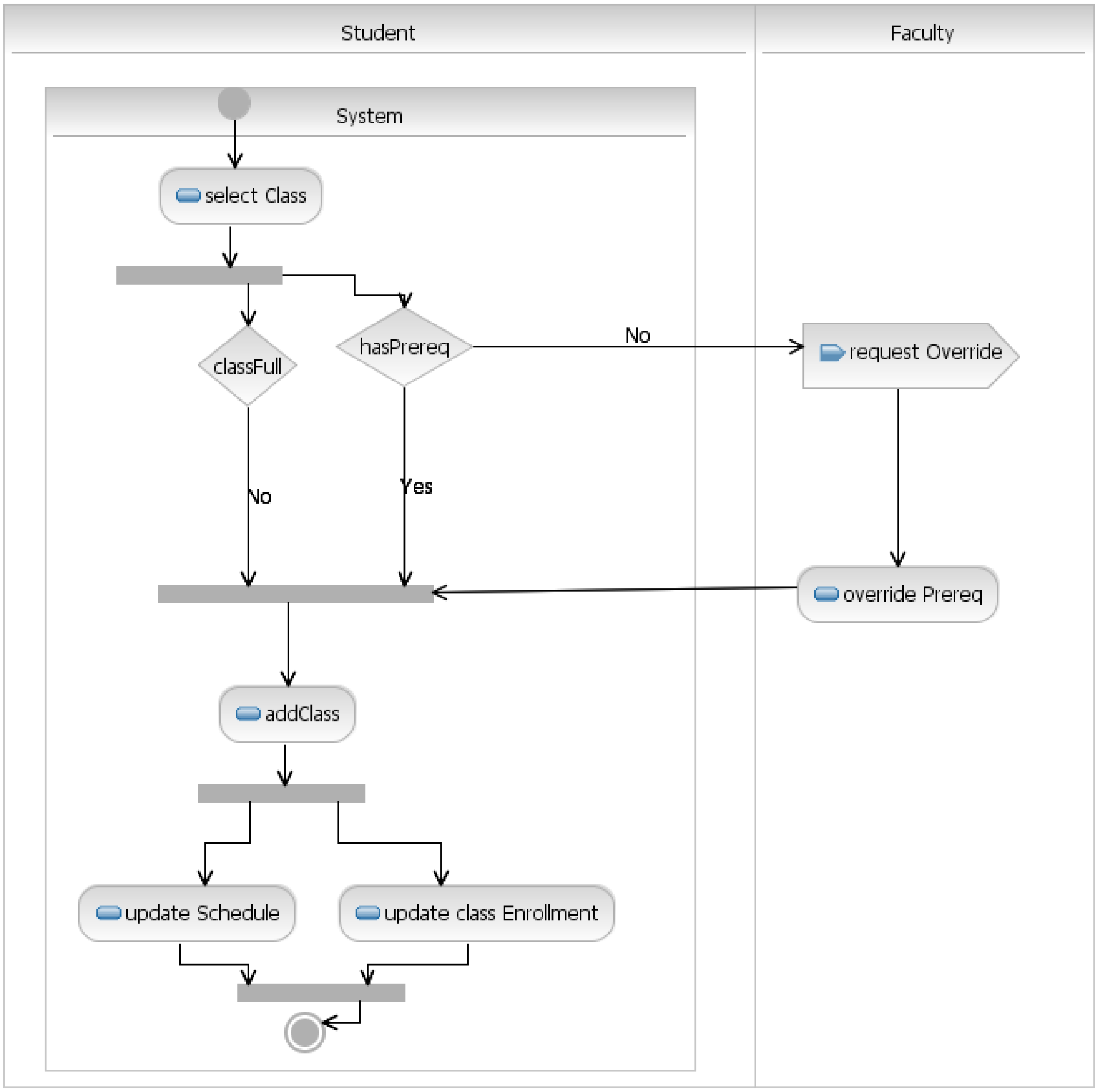

Figure 9 A Skeleton Activity Diagram for Add Course

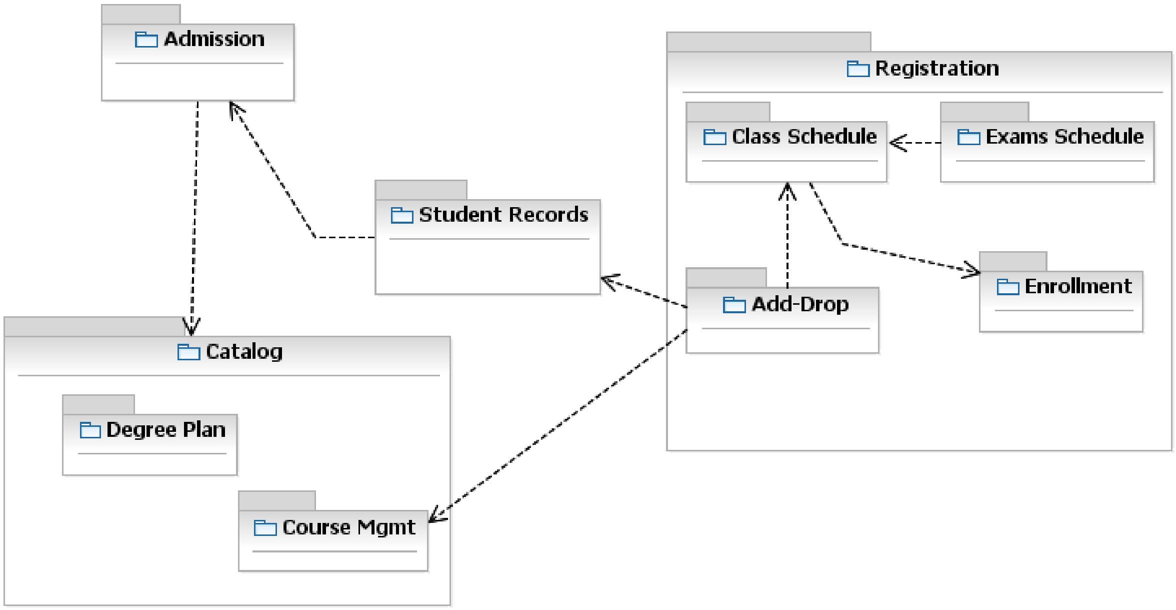

Figure 10 Functional Architecture

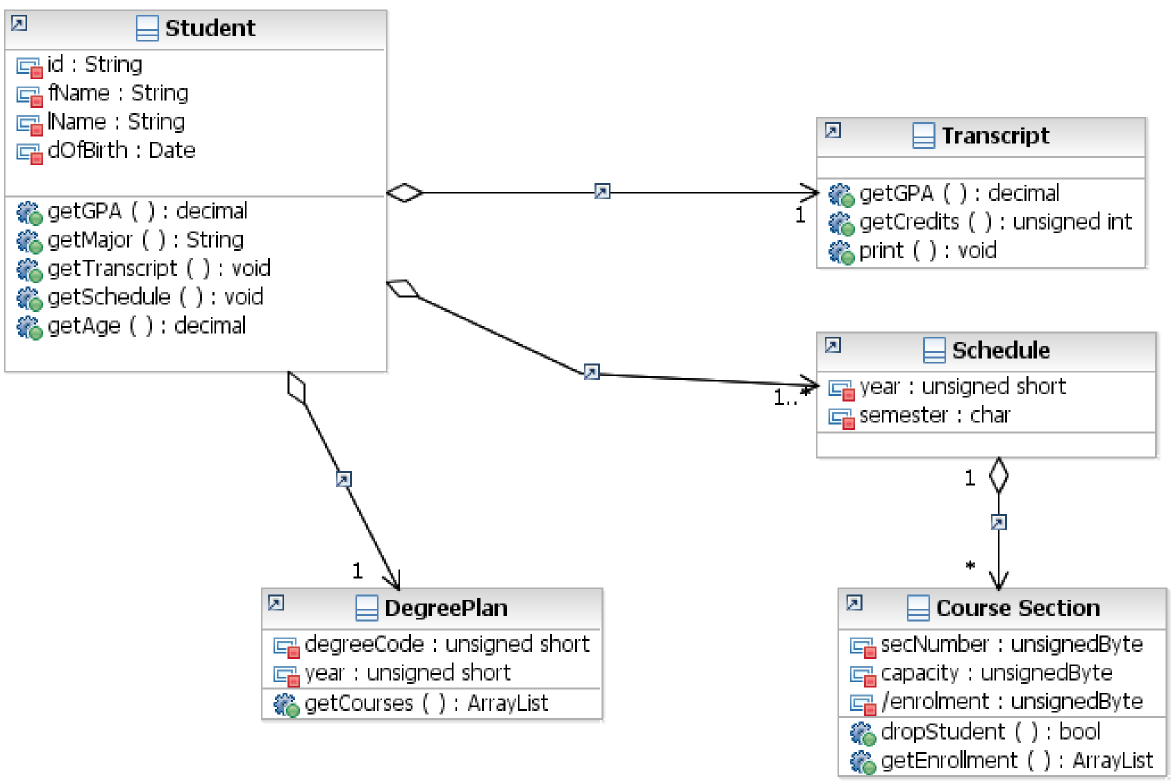

Figure 11 Platform Independent Model

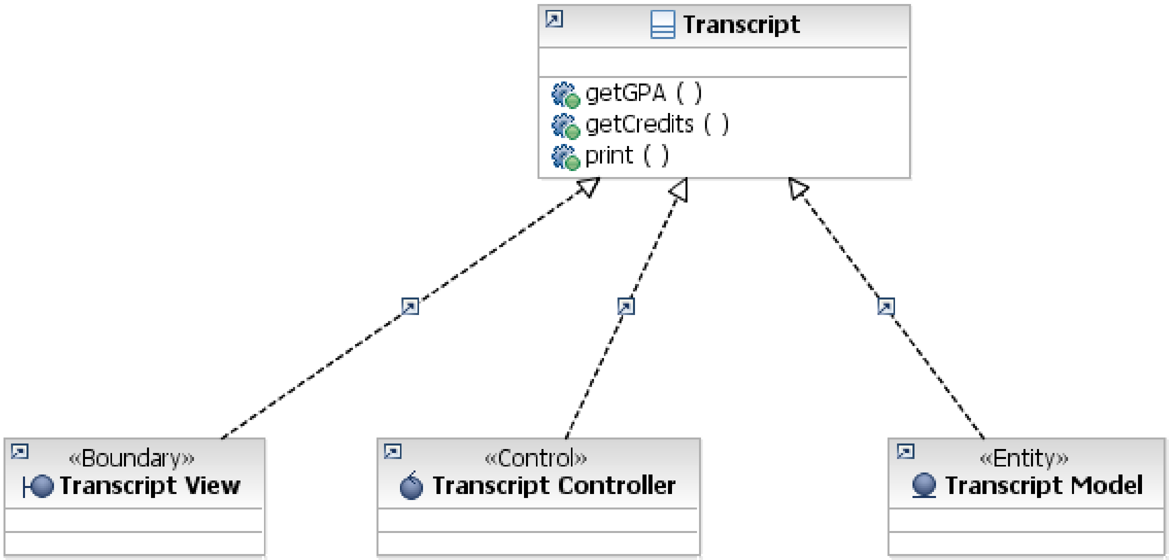

Figure 12 User, processing and Storage Realizations of the Transcript Object