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INFORMATION SYSTEMS EDUCATION JOURNAL

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Ideas Tried, Lessons Learned, and Improvements to Make: A Journey in Moving a Spreadsheet-Intensive Course Online

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Abstract

Using information systems to solve business problems is increasingly required of everyone in an organization, not just technical specialists. In the operations management class, spreadsheet usage has intensified with the focus on building decision models to solve operations management concerns such as forecasting, process capability, and inventory management. This paper presents an experience in moving the course to full online delivery. Of particular concern was maintaining the impact that the in-class workshop approach to spreadsheet activities and exams had when converted to the online setting. The LMS used by the university proved inadequate to handle a fully online spreadsheet intensive course such as this one, so new capabilities had to be found or developed. This proved to be non-trivial as it required designing custom solutions. This paper covers what was tried, how it worked, and ideas for improvements. Links to resources developed and used are provided in the appendices for others to improve upon.

Keywords: distance education, spreadsheet-intensive, decision making

1. INTRODUCTION

Instructors in business programs have long been concerned with developing students to be solid problem solvers who can make good decisions using appropriate technology and techniques. This is especially important in today's world where technology is evolving rapidly and the problems are more complex than ever.

Organizations are looking for individuals who can thrive in the complex, fast-paced environment and thousands of jobs are going unfilled, despite stubbornly high and persistent unemployment rates. According to the sixth annual Manpower Talent Shortage Survey (Manpower, 2011), employers are reporting increased difficulty in filling positions because of a lack of available talent possessing the right combination of skills and abilities. The top ten jobs included not only technical positions but sales representatives, managers, and even assistants and support staff. All of these positions are becoming more technical in nature.

Developing Solutions Designers

It is incumbent upon instructors to prepare students to be successful throughout their decades-long careers by helping them to become the originators and implementers of solutions and technology, and not merely the consumers of someone else's idea. Spreadsheet programs, such as Microsoft Excel©, are a nice match for business courses, particularly operations management (OM). The OM course includes many quantitative decision models that can be used as drivers for teaching good

decision modeling practices with wide-spread applicability. It should be noted that while Microsoft Office programs will often be mentioned in this paper, other platforms such as Google Docs or Open Office could be alternatives.

The operations management course is particularly important to business students because it is one of only three upper-division core courses taken by all majors in the college. Over the years, the course has evolved from a traditional lecture course with pencil and paper exams to the current structure where students must develop spreadsheet models from scratch. In a very real sense, the course has evolved from the lower-level learning concerns of remembering and understanding to higher order concerns of analyzing, evaluating, and creating (Anderson & Krathwohl, 2001).

Students are now challenged to be general solution architects by learning how to build spreadsheet decision models of traditional OM topics. This includes material covering forecasting, productivity analysis, statistical process control (SPC), process capability, location analysis and inventory modeling. Appendix A has detail on the course topics.

Anonymous Comments from In-Class Students
This course is where VALUE is added to students.
Very intrigued to learn the information in this course. One of the best courses I have ever taken!
Exams motivated me to think. It wasn't like the same boring lecture/text exam as I had in every other class.
I have never used Excel for so many functions in my life. Having this increased knowledge has made me more competitive, even in my current job position.
The learning experience was beyond excellent. I look forward to taking more classes with you!
This course is designed to make you learn real world applications and (instructor) makes sure of it.
Exams were applications of the material, not just book work.
This class will be useful in the real world.

Table 1. A sample of in-class student comments offered voluntarily and anonymously via Student Survey of Instruction from spring 2011.

Students build upon the basics they learned in computer applications (a prerequisite course) to understand the power of modeling the logic of a problem rather than simply calculating an answer for a given set of conditions. This is integrated with tips and techniques on how to build models efficiently by, for example, using the row and column structure for advantage; structuring spreadsheets for sensitivity analysis; anticipating future enhancements and scaling concerns; building models for use by others; following sound practice in developing formulas using absolute and relative referencing, among others. Students have really responded and OM is a well-reviewed course, as student feedback in Tables 1 and 3 reveal.

From Traditional to Online Delivery

As the course was being considered for full online delivery, concern centered on finding a way to deliver the same significant learning experience online that was accomplished via the in-person format. An online version had to maintain the rigor and value that the spreadsheet-based approach brought. This had to be true for all aspects of the course but especially for the spreadsheet exercises used as learning tools in the regular classroom and for the spreadsheet-based exams. The exams are particularly important to the course pedagogy and not something to be compromised.

Early in the development it became clear that the university's LMS was simply not capable of meeting the requirements for this spreadsheet intensive course migration. Learning management systems such as Blackboard, WebCT, or Moodle had many of the capabilities needed but nothing fully satisfied the desired requirements. This significant realization meant external capabilities and systems had to be found or developed to accomplish course goals.

Other instructors (e.g., Palocsay & Stevens, 2008; Heizer, Render, & Watson, 2009) had reported success in using web-based tools for quantitative business courses but even these publisher-based tools were not aligned with regards to how students are evaluated on exams, where student spreadsheet models are checked for not only correctness but for decision model structure choices too.

Given the limitations of the LMS used by the university, it was apparent that alternative methods and tools had to be developed to accomplish the online implementation. Furthermore, it was important to develop these course capabilities from commonly used business resources, as possible, to demonstrate to students that the program and instructors

valued learning how to create solutions just like they were being challenged to do. As a result, the Microsoft Office suite was chosen for several practical reasons. MS Office is a standard in the college, is familiar to students and instructors alike, and it is ubiquitous in business.

A development goal to do a 100 percent asynchronous online course of essentially equivalent accomplishment and value was set. As such, functional online equivalents for traditional course capabilities had to be found or developed in-house. This meant that all facets of the course (quizzes, lectures, spreadsheet-based exercise workshops, exams, and helping students via office hours and other assistive means) had to be considered for conversion to online. Some factors were easier to address than others and the remainder of this paper will detail what was tried, why, and what was learned for each concern. Of particular focus was the prospect of cheating on exams, so a discussion of academic honesty is next.

Addressing Academic Dishonesty Concerns

Academic dishonesty in college classes is not a trivial matter. Indeed, up to 80 percent of college students admit to some form of cheating (McCabe & Trevino, 1993) where business students have been shown to have a higher rate than other majors (McCabe, Butterfield, & Trevino, 2006). More recently, business students were characterized as "liberal" in their views of online cheating behaviors such as consulting with others during an exam, obtaining information from others, using more time than allowed, and using prior exams from others (King, Guyette & Piotrowski, 2009). The profile of an online cheater is similar to general cheating surveys, which include being male, young, and single (Lanier, 2006). While the rate of cheating online appears higher than in-class sections, the overall rate is lower than earlier studies have shown (Lanier, 2006).

For the OM course, the possibility of cheating on the asynchronous, online exams was an especially important concern. In the end, the realization became that almost all traditional take home exams, papers, or programing assignments share some level of this concern. In subjects where multiple sections are taught, some exam communication is going to exist even though the exam itself is given in-class and despite using different exam versions. With the regular exams and out-of-class assignments, steps are taken to minimize cheating risks so it was decided to try to implement equivalents for the online approaches developed. Furthermore, it is true that printed-out papers and exams generally leave less forensics evidence than electronic submissions do, so making students aware that this information exists for electronic submissions could act as a deterrent because they realize the instructor probably knows more about this than they do.

This follows advice from Whitley and Keith-Spiegel (2002) and Lanier (2006) who recommend trying to convince students that what they needed to learn in the course is important to their future success, that cheating involved significant risk and punishment, and that there were systems in place to identify it should they decide to try. While there would undoubtedly still be a few problem students, it was decided that the initial concern would focus on indicators of a systemic problem that might require more aggressive actions during improvement efforts.

2. ISSUES OF CONCERN

This section contains some of the issues of concern in bringing the face-to-face version of the OM course online. Some of these issues come from course specific concerns, while others result from LMS inadequacies. Each issue is introduced, ideas discussed, and resources that others might find useful are presented.

Presentation of Traditional OM Concepts and Lecture Material

While spreadsheet-based assignments and exams are the focus of the course, students are still required to learn traditional OM concepts and theories. A textbook is assigned but students get traditional lectures delivered via videos created with Adobe Captivate. Video production was not an issue because many videos had already been created previously. Multiple choice content quizzes, accounting for about one-fourth of the final grade, were implemented via the university-specified LMS.

Spreadsheet Exercise Dynamics

The spreadsheet exercises are completed dynamically in class using a workshop-type of structure in a computer classroom. Students have a scenario to employ or directions to follow while the instructor circulates through the room

helping, asking questions, and relating what is being implemented on the computer back to theory and the course lecture material.

For online students, spreadsheet solutions are revealed via Captivate videos. The videos are interactive and challenge students to work on the problem and not just observe passively. A link to a sample video demonstrating the approach is in Appendix B for interested readers.

Enforcing Exam Timing and Time Limits

For in-class students or via a course management system where simple exam structures like multiple choice or essays are used, it is easy to enforce when a student may take an exam and for how long. Since the university provided LMS could not handle the spreadsheet-based exams as needed, an exam submission process was developed for students to complete using Gmail. Gmail provided an external control system, independent of the university systems, for backup verification, and corroboration.

The process requires students to send an email to a specific Gmail account to indicate they desire to begin the exam, then the system replies enabling them to obtain their password to open the exam. Then, when the student is finished, s/he emails the exam file to the Gmail account validating exam completion. A sample of the email sent to students detailing the process steps and rationale is available from Appendix C while details on how to set up the Gmail system is shown in Appendix D.

The process appears intimidating at first, which is why a trial is required before students are allowed to take the first exam. Once they complete the trial, they find it is not burdensome; yet the formality of the process signals to students the seriousness of cheating as recommended by Whitley & Keith-Spiegel (2002).

Identity Validation

In an unproctored environment, there is the possibility that someone other than the student is completing the work or there is collusion amongst students. Since this issue is pertinent to nearly any out-of-class assignment, such as take-home exams or papers, strategies similar to these familiar assignment types were tried that focused on minimizing the incidence rate.

For example, exams required more than just getting the right values and these extra requirements would only be understood by someone who actually completed the spreadsheet exercises. A certain structure for sensitivity analysis might be required, for example, where that structure was demonstrated in the video. Or, the use of specific built-in Excel function like =sumproduct() or =vlookup() might be required as in the exercises. Other times, students must use advanced Excel capabilities such as the solver to optimize a value or to perform multiple regression. Then, they build and use the equation with references to the output table in the spreadsheet in a manner similar to what was done for them on video. While nothing outside of proctoring can totally eliminate this risk, these nuisances increase the cost of involving someone else.

To monitor for systemic problems, a comparison in performance between the proctored in-class students and the online students is investigated per King et al (2009). In addition, trends in exam performance by submission order are considered to see if systemic collusion, similar to what might happen when multiple sections of a course are held, could be identified. In any case, this issue continues to be a concern and is expanded upon in section four.

Tracking of Exam Completion Activities

In addition, concern existed that students might be tempted to simply copy work from their previously completed spreadsheets or from someone else's, so tracking features in Excel designed for shared workbooks were tried. This adds a different perspective into monitoring the completion process that holds promise for significant capability gains in the near future. A video demonstrating how to set this up in Excel is found from Appendix E.

Excel change tracking history was used as a means to gauge completion effort and time. A typical exam submission may have between 120-180 change actions listed. If someone copied work from elsewhere, the change history can indicate this. In addition, timestamp inconsistencies may point to cheating when used in conjunction with Gmail logs.

The tracking abilities are improved in Excel 2010 but still are limited. The real interest is in near-

term gains from the new cloud and increasingly collaborative focus of Microsoft Office products going forward. These abilities should improve significantly, especially if deployed via the SharePoint platform.

Submission Acknowledgement and File Handling

Many students completing the online exams are anxious to know immediately that their submission was received properly, so an automated reply system using server-side rules in Outlook and Exchange was developed. Along with a few basic client-side file-handling rules, instructor course management efforts are greatly streamlined freeing time and effort for higher value accomplishments. This was a pleasant surprise and an area that worked well. A video demonstration on how to accomplish this is found in Appendix F.

Evaluation Consistency and Efficiency

Rubrics were developed and used in all sections of OM. Grading for higher-level concerns on exams was more efficient than expected. Standard Outlook and Word capabilities more than sufficed for grading as rubrics were developed in Word and then copied to a reply email for communicating results. Dual screens or a single large one facilitates this workflow. Emails require HTML and some student email clients have this turned off. It can be switched back on, so a note was put at the top of the grading email to alert students that the formatting will only appear correct if HTML layout is used. In addition, exam results emails were batch sent to students using the delay delivery capability in Outlook.

Office Hours and Consultations

Office hours and consultations were conducted via Skype because of limitations in our university LMS. Audio and group video conferencing is possible in Skype and screen sharing is useful for troubleshooting spreadsheet design problems and reviewing exam performance. A Skype phone number has proven valuable as students can call from their cellphones and it automatically routes to a computer or forwards to phone numbers as desired. Subscriptions for premium Skype capabilities were required to achieve this functionality, which cost about $120 per year.

3. RESULTS

With the implementation plans in place, several issues relating to the success of the new online offering were monitored. First, performance differences between the online and in-class sections were examined as recommended by King et al (2009). In addition, trends in exam performance based upon submission order were tracked to look for systemic problems. Finally, it was hoped that students would be as satisfied with the value of the new online offering as they were for the traditional section as measured on student evaluations of instruction. Details on how these concerns were investigated and the results are discussed next.

Online vs. In-Class Performance

	In-class	Online
	Exam One	
Mean	77.1	80.4
Variance	210.9	150.6
Observations	34	37
p-value (two-tailed)	0.297	
	Exam Two	
Mean	84.2	83.5
Variance	117.2	247.0
Observations	34	37
p-value (two-tailed)	0.829	
	Exam Three	
Mean	87.3	88.3
Variance	51.6	139.4
Observations	34	37
p-value (two-tailed)	0.663	
	Exam Four	
Mean	82.8	79.8
Variance	167.4	299.5
Observations	34	37
p-value (two-tailed)	0.338	

Table 2. A comparison of exam performance between online and in-class sections.

To investigate differences in the online and in-class sections, two-tailed t-tests assuming unequal variances were performed. The null hypothesis is no difference in exam performance exists between the groups versus the alternative that there is a difference in student performance. The results for all four exams for

students during the spring 2011 semester are summarized in Table 2.

Table 2 indicates no patterns in performance of concern. Additionally, there are no statistically significant differences between the online students and the in-class students on exam performance in any of the four exams. This is a reassuring result given that different modes of instruction were used for the Excel activities in class, where online students watched the prepared videos and in-class students worked on computers in the classroom in a workshop format.

Systemic Problems

While the results in Table 2 are encouraging, given the possibility of systemic cheating that could occur because of the asynchronous nature of completing exams online, systematic patterns of performance improvement were investigated by looking at exam scores versus submission order.

In class, student files are personally collected by the instructor at essentially the same time. In addition, students complete exams with the instructor directly monitoring their activities as they complete them. Online, though, students have a window of time, usually three to four days that include a weekend to complete the exams without direct supervision.

And even though many precautions were taken and approaches developed to mitigate the likelihood of cheating, it was important to know, at the very least, if these ideas were obviously *not* being successful. Of particular concern was that the exam scores for online students might trend upwards based upon the ordering of their submission because there was organized sharing of information from the earlier students to those who waited to take the exam later.

Regression trend analyses on exam scores using submission order as the predictor variable for all four exams is illustrated in Figure 1. The visual information in Figure 1 does not indicate systematic patterns. The regression analysis mostly finds insignificant relationship except perhaps a negative one on the first exam. While the initial evidence is encouraging, it is recognized that this issue must still be improved. Increased investigation of these issues may find they lend themselves to standard computer forensics approaches instead of customized development as discussed in section four.

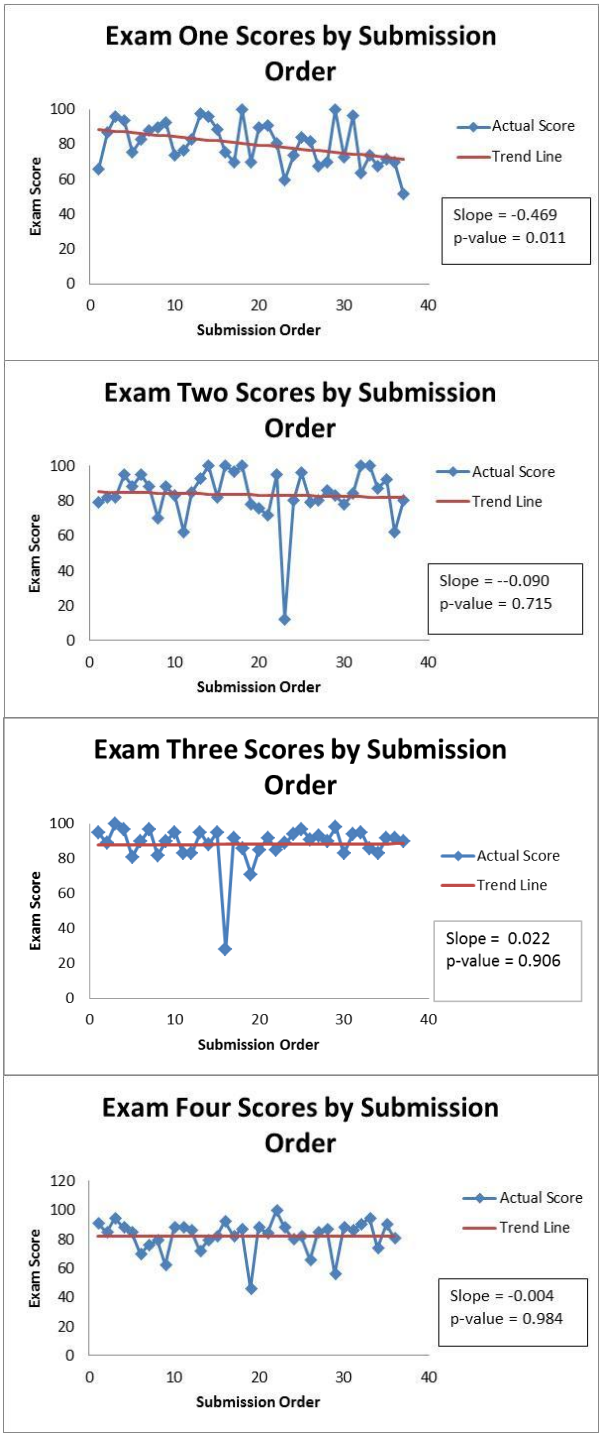

Figure 1. Trend analysis of exam score by submission order.

Student Survey of Instruction

Another important aspect of performance was student survey of instruction (SSI) results. Table 3 contains SSI results from spring 2011 in-class and online sections. Our university SSI instrument has 20 items and written comment sections. Table 3 presents six of the most pertinent questions on the survey, though the remainder of questions are similar in results. It is reassuring to see online respondents appear satisfied with the value proposition of the course and structure.

Student Survey of Instruction Statements	In-Class	Online
I learned valuable information/skills from this course	4.56	4.82
	p-value =0.632	
The structure/ organization of the course helped me learn.	4.53	4.82
	p-value =0.840	
The course materials/activities helped me learn.	4.50	4.73
	p-value =0.683	
The assignments and tests allowed me to demonstrate what I learned.	4.37	4.73
	p-value =0.589	
The instructor motivated me to think about the subject.	4.72	4.91
	p-value =0.654	
Overall, how would you rate your learning experience?	4.47	4.82
	p-value =0.534	

Table 3. Student survey of instruction (SSI) results. Scale runs from 1 (strongly disagree/poor) to 5 (strongly agree/excellent).

Online students rated the course highly on an absolute scale and in comparison to in-class students. From a statistical perspective, there is no significant difference between the evaluations of online and in-class students. It was far from clear that this kind of result could be accomplished using online videos and exams but it appears to be appreciated and endorsed by students.

Our university has an issue with feedback rates for online sections versus in-class sections, so these results should be continuously monitored and validated. Fortunately, feedback received from alumni and former OM students is overwhelmingly supportive of the approach and direction of the course, and indeed the entire business program, as other courses are being coordinated with this one for enhanced impact.

4. ISSUES FOR THE FUTURE

The online implementation of the course appears to have gone well with positive results and without unpleasant surprises or effects. It was also reassuring to see that the data does not indicate systemic academic dishonesty present, but improvement efforts on course integrity should always be a concern if not a priority. The ideas discussed below will focus on this issue but will include others as well, such as improved support services, and efficiency in the recording and producing videos.

Improved Audit Design and Forensics Data

Randomized and targeted auditing of student work is another level of security that could be added with relatively little overhead. A few students for each exam could be selected to review their work with the instructor where questions are posed to verify student understanding and performance. Skype seems well-suited for carrying out this process. Students must have a picture ID to verify their identity and the sessions can be recorded for documentation and review purposes.

In addition, increased forensics data could be collected and analyzed. IP addresses, browser characteristics, etc. could be merged into a course profile and analyzed via data mining or other approaches to look for relationships that might signal collusion.

Students will be notified of these policies in the syllabus when implemented.

Randomized Passwords, Problem Values and Structures

Collusion and other dishonesty concerns could be reduced through the use of randomized exam values. Randomized homework values have demonstrated a positive impact on OM student learning (Berardi, 2011) and it seems appropriate for the online sections. The tools developed for randomized homework values can be applied to spreadsheet-based exams and assignments. Indeed, several problem structures and examples could be created for each exam with randomization of values and passwords too. This could be implemented within an Excel file

but should be enhanced when paired with a collaborative platform like SharePoint.

Improved File Access Control

Excel workbook files have additional access controls that were not used for initial online implementation. Controls are available for when a file may be opened, how many times, and by whom. Microsoft Information Rights Management is a basic option that is free but does require Windows Live IDs. Students can use their university email addresses for Windows Live, so one benefit is instructors can use roster lists to setup access permissions. Office SharePoint services should enhance these abilities. In addition, a commercial product, LockXLS (www.lockxls.com) is another option being experimented with that shows promise.

Improved Identity Validation

Proctored exams are the gold-standard for identity validation. Outside of this, risk will always exist but currently the focus is still on working to minimize it and to identify it when it happens. Requiring proctored exams, though, is always a possibility and may be employed as a control group in a semester soon (Wellman & Marcinkiewicz, 2004).

Office Hours and Support Services

Office hours and support services through LMS offerings or via independent platforms like Skype are possible. At this point it is planned to continue with Skype, where the integration with Office programs should become deep given Skype's acquisition by Microsoft. The university specified LMS will still be used and it is hoped that the ability to develop mashup modules between the two systems is possible. Also, video conference meetings with students are being considered early in the semester in order to build more rapport and connection.

Alternative Video Content Development Platform

Video recording and production have been significant components in this initial implementation. Adobe Captivate, now available as part of the Adobe Learning Suite, is powerful with commensurate complexity and learning curve. It is excellent for spreadsheet demonstrations but competing products such as TechSmith Studio should work well too. In addition, lecture capture software (e.g., Tegrity, Panopto, Relay) should be considered for the more dynamic, changing material, such as the spreadsheet workshops.

5. CONCLUSION

The migration of a spreadsheet-intensive OM course to fully online appears to have gone well based upon student survey of instruction feedback and performance data. To accomplish this, many issues related to this migration were identified, planned for, resources developed, and then implemented. Because no LMS available met the requirements of the course, many capabilities had to be developed. Tools and techniques that have proven useful are presented in the appendices for interested instructors. Finally, several issues for the future have been identified so improvements can be realized.

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Appendix A

Course Outline

Section One--Foundations
- Ch. 1: Operations and Productivity (spreadsheet intensive)
- Ch. 2: Operations Strategy in a Global Environment
- Ch. 8: Location Strategies (spreadsheet intensive)

Section Two—Initiating and Designing
- Ch. 4: Forecasting (spreadsheet intensive)
- Ch. 5: Design of Goods and Services
- Ch. 7: Process Strategy
- Ch. 11: Supply Chain Management

Section Three—Measuring and Improving
- Ch. 6: Managing Quality
- Ch. 6s: Statistical Process Control (spreadsheet intensive)
- Ch. 16: Just-in-Time and Lean Production Systems

Section Four—Managing and Coordinating
- Ch. 12: Inventory Management (spreadsheet intensive)
- Ch. 13: Aggregate Planning
- Ch. 14: Material Requirements Planning (MRP) and ERP
- Ch. 03: Project Management (computer intensive)

Appendix B

Example Video Showing Spreadsheet Exercises

Appendix B contains is a sample video of one part of a spreadsheet exercise for online students. This video is intended to show the primary means upon which students complete the course online in a manner that mimics the workshop approach to spreadsheet implementations in-class. The file is approximately 45mb and has a password…mis34060 The link to the video is found at

https://docs.google.com/leaf?id=0BwVdy8xGa6AcNWFkZmUxM2YtNWE2OS00ZDRhLTllMTUtMGM5YzYwN2Y5ZDA3&hl=en_US

Appendix C

Exam Submission Process Trial

Appendix C contains a sample email sent to students concerning the online exam process trial that students must complete before being allowed to take the first exam. This novel exam submission process was developed because the LMS used at the university was not capable of meeting course exam needs. The process description is intended to explain the process and to set the tone concerning academic dishonesty as recommended by (Whitley and Keith-Spiegel, 2002). The link to the exam process trial email to students is found at

https://docs.google.com/viewer?a=v&pid=explorer&chrome=true&srcid=0BwVdy8xGa6AcNjRlMmU3MGEtNzI3ZC00ZTI5LThhMGItYTg2MWI4YWRhYjYx&hl=en_US

Appendix D

Using Gmail to Manage Exam Administration

Appendix D addresses the use of Gmail to manage exam administration including timing of exam completion and password distribution. This external system was developed because the LMS used at the university was not capable of meeting exam administration needs. Gmail provides robust, external backups and infrastructure at the right price. All emails are automatically forwarded directly to the instructor's university account providing a seamless connection. The file is approximately 10mb. The link to the video is found at

https://docs.google.com/leaf?id=0BwVdy8xGa6AcOWFjZWYyNzgtMjVhOC00YTY2LTgzM2EtYWY1N2QyNmRjYTk1&hl=en_US

Appendix E

Configuring Spreadsheet Tracking

Appendix E contains is a video demonstration of how to configure spreadsheet tracking in Excel and why you would want to do so. Excel tracking capabilities allow visibility into how the exam file was completed so signs of academic dishonesty, such as copying and pasting from another worksheet might be detected. The file is approximately 12mb. The link to the video is found at

https://docs.google.com/leaf?id=0BwVdy8xGa6AcM2E4N2IwNjAtYTIzNi00ZjRjLTllMGMtYzU5NDAwNmJlOGQ4&hl=en_US

Appendix F

Using Rules in Outlook for Submission Acknowledgement and Handling

Appendix F contains is a video demonstration of how to configure rules in Outlook to accomplish submission acknowledgement and file handling. Students are typically anxious to know that their submission has been received and this system does so automatically. Both client-side and server-side rules, which work with the Exchange email server even when the instructor's email client is not activated allowing acknowledgment at any time, are presented. The file is approximately 10mb. The link to the video is found at

https://docs.google.com/leaf?id=0BwVdy8xGa6AcMmJlZWExOWUtZDJiMy00Y2MzLTk5YjktMjAwZTAwYjA5NGI3&hl=en_US

A Health Informatics Curriculum Congruent with IS 2010 and IMIA Recommendations for an Undergraduate Degree

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Abstract

In addition to being a relevant program for health information technology workers, a recently proposed Health Informatics program was designed with additional objectives in mind: that the program is compatible with the IS 2010 Model Curriculum and that it satisfies the International Medical Informatics Association recommendation for undergraduate curricula. In this paper, we show that the program meets the IS 2010 guidelines based on an analysis of skill expectations for health informatics graduates. We produce a three-way mapping of IS 2010 knowledge and skill sets to IMIA learning outcomes to health informatics course sets. The program is comprised of three course sets: information systems courses, health informatics courses, and courses comprising the clinical environment. Courses in all three sets contribute skills in adequate depth with no gaps in coverage of required skills in either model. The success of the mappings indicates that health informatics should be a robust information systems program that will increase the productivity of individuals and organizations through the application of health information technology. The health informatics curriculum is largely an organizational systems-based program designed to enable new workflow models for health environments.

Keywords: health informatics, IS curriculum, IMIA curriculum, IS skills, organizational productivity, biomedical environment for IS programs, HITECH Act

1. INTRODUCTION

Health Informatics (HI) is a relatively new idea as a program within the information systems (IS) domain. We have developed a curriculum for a proposed Health Informatics degree at our university. The degree program is designed to attract new students to the information systems profession and to meet growing workforce demands in health information technology (HIT). In designing the curriculum, we consulted the recommendations of the International Medical Informatics Association (IMIA) undergraduate bachelors program (Mantas et al., 2010).

Due to the federal initiatives to significantly increase the adoption of information systems in health care, there is an urgency to make significant progress to achieve national goals of the Health Information Technology for Economic and Clinical Health Act (HITECH Act, 2009).

Workforce Needs

According to the United States Department of Health and Human Services, 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 (ONC, 2010). Driven, in part, by government incentives provided by the HITECH Act, interest has been growing among healthcare providers in implementing electronic health record (EHR) systems in their organizations. To accommodate these new enterprise-wide EHR applications, some organizations are replacing their legacy health information systems after finding that they are insufficient for their needs. These widespread investments in EHR's and other health information systems have created a shortage of personnel that are both skilled in information systems and knowledgeable about the healthcare environment (Wager, 2009).

Training programs at the collegiate level have yet to respond to these changes in the healthcare industry. The traditional training model that requires a student to choose between being a healthcare practitioner or a technologist is inadequate since, as noted "a well-trained HIT professional should have knowledge not only of information technology, but also of healthcare, business and management, and other disciplines" (Hersh, 2010 p. 198).

In order to satisfy the workforce needs created by the widespread adoption of health information technology, the Office of the National Coordinator for Health Information Technology (ONC) has created the Health IT Workforce Development Program. Through this program, community colleges and universities have received funding to develop training programs that address six workforce roles identified by the ONC. However, these training programs are not an ideal solution for new students since they focus on training existing IT and healthcare workers and are generally not available for students who don't have a degree and a minimum level of experience (ONC, 2010).

The workforce roles that have been identified by the ONC include:

- Practice Workflow and Information Management Redesign Specialist
- Clinician/Practitioner Consultant
- Implementation Support Specialist
- Implementation Manager
- Technical/Software Support Staff
- Trainer

In order to provide an ongoing supply of qualified workers, it is necessary to train new HIT workers in a program that includes skills in the use and management of information systems set in the healthcare environment, and specifically, enterprise level EHRs.

Proposed Degree Program

After reviewing multiple goals for the curriculum (Campbell et al., 2011) we are convinced that the curriculum is ABET accreditable (ABET, 2010) as an Information Systems program. See Landry et al., (2011) for a detailed analysis of the program against ABET-CAC program criteria. We further believe that that the learning outcomes of the International Medical Informatics Association (IMIA) model map well to IS skill sets described by Landry et al., 2000, and recently by Colvin (2007).

Therefore, the remaining questions we address in this paper are:

- *Is this new Health Informatics curriculum an information systems curriculum congruent with the recommendations of IS 2010 (Topi et al., 2010)?*

- *Is the proposed curriculum simultaneously congruent with the IMIA recommendations for a bachelor's degree in informatics?*

2. BACKGROUND

What is an IS Curriculum?

Ultimately, the nature and quality of any IS program will be determined by the ability of its graduates to achieve and thrive in the workplace as an IS professional. In this spirit, we accept the notion advanced in IS'90 (Longenecker et al., 1990), in IS'95 (Couger et al., 1995), in IS'97 (Davis et al., 1997), in IS2002 (Davis et al., 2002), and in IS 2010 that our graduates must be both confident and competent to execute the skills which define the profession. In addition, they should be able to continue successfully into advanced degree programs.

We feel it is important that our graduates are equipped to accomplish the mission of information systems as expressed by McNurlin and Sprague (2006): *"To improve the performance of people in organizations through the use of IT. The objective is the improvement of the enterprise, not IS, so, ideally, IS performance is based on business outcomes and business results."*

We currently have a successful IS program that is ABET accredited. In our Health Informatics program, however, we have instituted several significant changes (Campbell et al., 2011) which replace programming courses with health informatics courses and change the environment from business to a clinical environment. We argue that these changes should be compatible with ABET IS accreditation (Landry et al., 2011) and with the specification for IS 2010 (Topi et al., 2010). See discussion below.

What is IS 2010?

IS 2010 is the current version of the model curriculum for undergraduate programs of information systems. It is a systems-based curriculum developed from prior models: IS'90, IS'95, IS'97, and IS2002. IS 2010 defines a core of courses common to most degree programs, and suggests that there will be many variations among new IS programs that will determine additional courses that complete the major. IS 2010 relaxes the programming requirement of IS2002 by removing the IS2002.5 and IS2002.9 courses from the new core. It also relaxes the mathematics requirements. The program can be completed with ten courses in keeping with a business school environment.

IS 2010 utilizes three knowledge and skill areas for assessing its degree requirements (Topi et al., 2010 p. 19). We have used these definitions of the curriculum to assess our new program (See discussion below):

1.0 IS Specific Knowledge and Skills
2.0 Foundation Knowledge and Skills
3.0 Domain Related Knowledge and Skills

3. HEALTH INFORMATICS IN THE IS 2010 MODEL

IS 2010 curriculum guidelines (Topi, 2010) define an IS bachelor's degree program in terms of knowledge and skills. Also, it describes the characteristics IS graduates should possess. Furthermore, it is appropriate that there be some alignment between IS 2010 core courses and the proposed health informatics course set.

Description of How Proposed Curriculum Meets IS 2010 Requirements

Specifically, any information systems program must provide answers to the details of the three areas. The details of the specification are contained in IS 2010:

1.0 Information Systems Specific Knowledge and Skills
2.0 Foundation Knowledge and Skills
3.0 Knowledge and Skills Related to Domain Fundamentals.

It is further expected that knowledge and skills are achieved by completing certain course sequences. IS 2010 provides a relatively flat sequence of seven core courses, along with suggested electives, as an example of course sets which meet the spirit of the information systems specific knowledge skill requirements. Instead of looking at IS 2010 prescribed courses and comparing them literally to our HI courses, we chose to follow a methodology of mapping our courses to knowledge and skill expectations of the specification. Curriculum mapping has been useful for expressing knowledge and skills at different levels of abstraction and for assessing the breadth and depth of curricula. Mapping can be useful for identifying gaps in knowledge and skill areas, and demonstrating a curriculum's adherence to prescribed guidelines. IS 2010 provides three broad knowledge and skill areas for graduates. These categories are

helpful to any organization attempting to verify that its courses match the expectations of the curriculum developers.

Category 1.0 criteria are:

1.1 Identifying and designing opportunities for IT-enabled organizational improvement
1.2 Analyzing trade-offs—(alternate solutions, feasibility, use of decision criteria)
1.3 Designing and implementing information systems solutions
1.4 Managing ongoing information technology operations

Tables 1 through 8 are contained within the Appendix section of this document.

In Table 1, the courses of our degree program are mapped to the four IS specific skill categories of IS 2010. Our program uses 12 courses to attain the IS major specification. These courses contain the desired level of IS skill content.

Category 2.0 defines foundational skills that may be provided by courses other than the information system course set. IS 2010 identifies foundational knowledge and skills that are not unique to IS programs, yet which are of significant importance to IS professionals. This knowledge and skills come from general education courses and IS courses as well.

These foundational skills include:

2.1 Leadership and collaboration (teams, organizational structuring)
2.2 Communication (listening, observing, writing, presenting, and collaboration tools)
2.3 Negotiation (internal organizational, external providers, facilitation)
2.4 Analytical and critical thinking (breaking down systems, relationships, problem solving, ethical/legal implications, qualitative analysis, enhancing innovation and creativity)
2.5 Mathematical foundations (specialty related, statistics, algorithmic thinking)

Table 2 demonstrates our compliance with IS 2010 by showing foundation courses selected for the health informatics program.

Knowledge and skills related to the domain of health informatics are different from the usual IS/business environment. Table 3 details the courses relevant to the clinical domain. They involve a mix of basic medical sciences courses in anatomy and physiology, as well as a breadth of allied health introductory courses related to the clinical environment. Table 4 presents detailed descriptions of these courses so that the reader may appreciate the "ecosystem" of these biomedical specialties.

Indeed, domain skills are covered within the Health Informatics courses as well. The context of the clinical environment itself is set in the language of the biomedical sciences as well as medicine. It is not our intention to create either a medical or biomedical science degree through the courses offered. Rather, it is suggested that these courses define and encompass the areas for the IS Health Informatics Degree Program. We do not believe that the set of allied health courses are an absolute specification. Instead, we suggest that a broad selection of basic courses will provide a rich environment for the informatics professional.

What is the IMIA Health Informatics Degree Recommendation?

IS Skills		IMIA Outcomes (see Table 5)		
IS Skills - Industry Analysis (Colvin 2007)		Total Count	Count in Basic IS Courses	Count in Advanced IS Informatics Courses
1.1	Software Development	5	1	4
1.3	Database	4	2	2
1.4	Systems Integration	4	1	3
1.5	Info Security Assurance	1	0	1
2.1	Business Fundamentals	5	2	3
2.2	Individual & Teams	3	3	0
3.1	Org Sys Development	17	7	10
3.2	Project Management	1	0	1
8	Total	40	16	24

Table 0. Relationship of IMIA Outcomes to IS Skills.

Mantas et al., (2010) reports that health and medical informatics are well known areas, but federal performance requirements are placing a large demand on community, four-year, and advanced degree programs, many of which do not exist. The report contains the

recommendations of a large task force knowledgeable of the needs and requirements for health informatics programs.

Significant in the Mantas presentation is a table of knowledge and skill expectations for a bachelor's degree program. In order to understand the outcomes presented this table, we have mapped each IMIA outcomes to IS Skills (Landry et al., 2000; and Colvin, 2007). Simultaneously, we mapped the outcomes to one of the collections of courses. Table 0 demonstrates the numbers of IMIA outcomes to IS skills. Table 5 shows the mapping to both skills and course areas.

A large percentage of the total number of IS skills are supplied in the organizational systems development category, business fundamentals and database categories of skills. In addition, there are more objectives focused in the advanced area of the curriculum. The level of expected skill is higher in more advanced courses.

Table 6 represents IMIA outcomes from the basic information systems area while Table 7 shows the outcomes associated with the advanced IS skills. Clearly the more advanced outcomes result from the more advanced section of the curriculum. Using the depth levels of the IMIA model, application skills are reached in the advanced courses. The lower level courses introduce materials (note the outcomes with level 1 and 2 skills) whereas the upper level outcomes (levels 2 and 3) occur primarily in the advanced courses.

Interestingly, Table 8 shows that the clinical disciplines also furnish material directly related to the IMIA as well as the IS skill outcomes.

While we might have tried to map the IMIA outcomes to individual courses, we argue that the courses are already known (to us and ABET). We were not starting at the beginning to design new courses. Rather, we feel that in aggregate, each course set must eventually satisfy the IMIA outcomes, as well as the skills.

Benefits for Students and Programs

It is our perception that the Health Informatics program will afford new opportunities for our students. Allied health and nursing students who are interested in information systems will have a simple migration pattern to this degree program. They will stand a great chance of being hired because of their joint clinical and information systems specialties.

IS students who have an interest in health care will receive specialty training appropriate to their being productive in a clinical environment. In our area we can place students we graduate, and they will be able to pursue meaningful careers.

Drawbacks for Students and Programs

Some students may be more interested in the technological side of health informatics but uncertain of their commitment to working in the healthcare domain. These students may choose to either major in HI or IS. If they enroll in HI, they may add courses in application development and/or business. This route is a good one, particularly if they already have completed or nearly completed the clinical environment. The second option would be to enroll in the existing IS program, where they might also choose the health informatics certificate by completing the four course sequence in HI. This second option is a better fit with HIT workforce needs for software engineers.

If a traditional IS student wished to achieve the informatics degree, they may have elected biomedical science courses they really did not appreciate. Their fallback position will be to add business courses (2 courses) and programming (3 courses) for which they may spend additional time.

4. DISCUSSION

Our analysis of our proposed program reveals that the Health Informatics program is an IS degree program fully compatible with the IS 2010 guidelines. It also is very clear, because of the clinical environment requirement for the Health Informatics degree, that the junior year becomes determinant for course selection and commitment by students.

Our proposed clinical environment gives a very rich eco-system of courses for the future Health Informatics professional. With a firm understanding of the work environment, enterprise exposure to information systems relevant to electronic medical records, and experience developing work-flows involving patient care, our graduates will be more

professionally prepared for the HIT workforce than a traditional IS graduate.

Our clinical environment was chosen by studying the first courses of the many disciplines that make up our Allied Health and Nursing Colleges. We are not committed to a specific set of courses. At our institution, the department of Biomedical Sciences offers two introductory courses that have no biology or chemistry prerequisites. These courses are used by Allied Health professions departments. This special relationship makes it easy for our Health Informatics students to take a laboratory science that is general, yet focused in a direction preliminary and prerequisite to the clinical environment courses we have selected.

Our proposed program is structured to prepare graduates to be able to "hit the ground running" without a health science degree background and experience of on the job training that might otherwise be necessary for an IS graduate. While traditional IS graduates could overcome the limitations of not knowing the environment of the Health Informatics discipline, they would be at a disadvantage in this increasingly important biomedical environment.

It was interesting that the IS skills map to the IMIA outcomes. The reality of the mapping suggests how the clinical environment plays an important and significant part in understanding the relative richness of the skills and outcomes. Likewise, that the IS skills can be mapped to the IMIA BS requirements, supports the strong relationship of the HI model to the IS profession.

Mapping to both IS and HI model curricula at once enables a richer evaluation of our proposed program than if we had mapped to one or the other, or both separately. In effect, the triple-mapping enables a kind-of cross-checking to take place. A mapping decision might result in a confirmation of the relationship between two skills, or else point out a contradiction that leads to further analysis. Such an analysis was useful for us in making decisions to include or exclude courses in the proposed HI program. We have not validated our mappings at this time; we expect to go to this step within the next year, particularly as we expect to develop a standardized exam to measure program and individual success.

An additional design criterion we imposed upon ourselves was to allow for degreed Nursing or other Allied Health professionals to take our Health Informatics courses with no additional prerequisites. The five HI courses and be elected by a health care professional, and when completed will result in a Certificate in Health Informatics. We have elected to take this approach based on the recommendations of EHR vendors in our area who are willing to hire immediately our certificated individuals into meaningful careers. Normally, assumptions are made about the necessity for programming and other IS skills as prerequisite to systems analysis and database courses. However, we are confident that a mature individual can complete these more "advanced courses" with no additional prerequisites. Indeed we have experience in the success of such individuals. In fact, some of the highest scores in these classes have come from several nurses who have scored on top of the class!

5. CONCLUSIONS

We have presented the details of a Health Informatics program, and have shown, using the technique of curriculum mapping, that it covers the breadth and depth of knowledge and skills of an IS program within the guidelines of IS 2010. Further, we have shown that the same program maps well to the International Medical Informatics Association outcome criteria for a bachelor's degree in Health Informatics. In addition, we feel based on input from our advisory group that graduates of the degree will find it possible to work in the informatics field or go on for additional graduate studies.

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Appendix

IS 2010 Program Knowledge and Skills Produced by Courses

Knowledge and Skills Criteria

1.1 Identifying and designing opportunities for IT-enabled organizational improvement
1.2 Analyzing trade-offs—(alternate solutions, feasibility, use of decision criteria)
1.3 Designing and implementing information systems solutions
1.4 Managing ongoing information technology operations

IS Knowledge and Skills Criteria > **IS Courses in Degree Program**	1.1	1.2	1.3	1.4
CIS 245- IS in Organizations	*	*		
CIS 272- Systems Organization	*	*		
CIS 321- Data Communications & Networking	*	*		
CIS 324- Database Design	*	*	*	
CIS 360- Analysis and Design	*	*	*	
ISC 462- IS Strategy and Policy	*	*	*	*
CIS 495- IT Project Management	*	*	*	
HI 300- Health Informatics Clinical Environment	*			
HI 410- Health Informatics	*	*		
HI 450- Health Systems Analysis and Design	*	*	*	*
HI 455- Health Decision Support Systems	*	*	*	
HI 496- Health Informatics Internship			*	*

Table 1: Providing Skills Through IS Course Work as Specified by IS 2010

	-------Skills Produced by Courses-------				
Foundational Skills Criteria 2.1 Leadership and collaboration (teams, organizational structuring) 2.2 Communication (listening, observing, writing, presenting, and collaboration tools) 2.3 Negotiation (internal organizational, external providers, facilitation) 2.4 Analytical and critical thinking (breaking down systems, relationships, problem solving, ethical/legal implications, qualitative analysis, enhancing innovation and creativity) 2.5 Mathematical foundations (specialty related, statistics, algorithmic thinking)	2.1	2.2	2.3	2.4	2.5
EH 101- Composition I		*			
EH 102- Composition II		*			
CA 110- Public Speaking		*			
MA 112 or higher				*	*
MGT 345 Statistics 1				*	*
MGT 355 Statistics 2				*	*
PSY 120 General Psychology		*	*		
ISC 360 Analysis and Design	*	*	*	*	
ACC 211 Accounting Principles I	*	*			*
MGT 300 Management Theory and Practice	*	*			
ISC 462- IS Strategy and Policy	*	*	*	*	
CIS 495- IT Project Management	*	*	*	*	
HI 300- Health Informatics Clinical Environment	*	*	*	*	
HI 450- Health Systems Analysis and Design	*	*	*	*	*
HI 455- Health Decision Support Systems	*	*	*	*	*
HI 496- Health Informatics Internship	*	*	*	*	*

Table 2. Courses that Supply Foundation Skills for the Health Informatics Program.

Domain Skills Produced by Courses

3.1 Basic Medical Sciences
3.2 Health Informatics Clinical Environment
3.3 Health Informatics Courses

IS Courses in Degree Program / **IS Skills Criteria**		3.1	3.2	3.3
3.1	BMD 114 Human Anatomy and Physiology I	*	*	
	BMD 115 Human Anatomy and Physiology II	*	*	
	BMD 210 Infectious Diseases in Health Care	*	*	
3.2	NU 311 Clinical Nursing Skills		*	
	NU 325 Health Assessment		*	
	HSC 342 Clinical Pharmacology		*	
	RAD 101 Principles of Radiographic Exposure		*	
	OT 201 Introduction to Occupational Therapy		*	
	CRC 330 Cardio-respiratory Care Assessment		*	
3.3	HI 300- Health Informatics Clinical Environment		*	*
	HI 410- Health Informatics		*	*
	HI 450- Health Systems Analysis and Design		*	*
	HI 455- Health Decision Support Systems		*	*
	HI 496- Health Informatics Internship		*	*

Table 3. Courses that Define Domain Skills for the Health Informatics Program

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
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 Cardio-respiratory 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.
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.
MGT 325 Operations Management	Addresses concepts, problems, and managerial approaches applicable to the management of manufacturing and service operations. The course will examine the strategic and tactical considerations that are involved in creating a systematic framework that supports the creation of competitive advantages through effective operations and the production of high quality products. Topics covered include the role of operations in the overall organization, operations strategy development and implementation, product design and process selection, location and capacity planning, facilities' layout, quality management, inventory management, production planning, scheduling and control, and project management. An important component of the overall course is the incorporation of computer applications for problem solving and decision making in operations.

Table 4. Course Descriptions Demonstrating a Clinical Environment for Health Informatics

Information Systems Skills (Colvin, 2007; Landry et al., 2000)		International Medical Informatics Association (IMIA) Expected Skills for BS Degree in Informatics (Mantas et al., 2010)		IMIA Skill Level	3--NatSci/Math 5-PreMajor CE-ClinicalEnv IS-Area HI-HealthInfo
1.1	Software Development	3.01	**Basic informatics terminology** like data, information, knowledge, hardware, software, computer, networks, information systems, information systems management	3	IS
1.1	Software Development	3.04	Methods of **practical informatics**/computer science, especially on programming languages, software engineering, data structures, database management systems, information and system modeling tools, information systems theory and practice, knowledge engineering, (concept) representation and acquisition, software architectures	3	IS
1.1	Software Development	3.10	**Mathematics:** algebra, analysis, logic, numerical mathematics, probability theory and statistics, cryptography	2	3
1.1	Software Development	1.05	**Information literacy:** library classification and systematic health related terminologies and their coding, literature retrieval methods, research methods and research paradigms	2	HI
1.1	Software Development	3.14	Usability engineering, **human-computer interaction**, usability evaluation, cognitive aspects of information processing	2	IS
1.3	Database	1.11	Appropriate documentation and **health data management principles** including ability to use **health and medical coding systems,** construction of health and medical coding systems	3	HI
1.3	Database	1.12	Structure, design and analysis principles of the **health record** including notions of data quality, minimum data sets, architecture and general applications of the electronic patient record/electronic health record	3	HI
1.3	Database	1.16	**Ethical and security issues including** accountability of health care providers and managers and BMHI specialists and the confidentiality, privacy and security of patient data	2	5
1.3	Database	1.14	Principles of **data representation and data analysis** using primary and secondary data sources, principles of data mining, data warehouses, knowledge management	2	CE
1.4	Systems Integration	3.07	Methods of **interfacing and integration** of information system components in health care, interfacing standards, dealing with multiple patient identifiers	2	HI
1.4	Systems Integration	1.10	Methods and approaches to **regional networking and shared care** (e-Health, health telematics applications and inter-organizational information exchange)	2	IS
1.4	Systems Integration	3.06	Methods of **technical informatics**/computer science, e.g. network architectures and topologies, telecommunications, wireless technology, virtual reality, multi-medias	2	IS
1.4	Systems Integration	3.13	Basic concepts and applications of **ubiquitous computing** (e.g. pervasive, sensor-based and ambient technologies in health care, health enabling technologies, ubiquitous health systems and ambient assisted-living)	1	HI

1.5	Info Security Assurance	3.05	Methods of **theoretical informatics**/computer science, e.g. complexity theory, encryption/security	2	HI
2.1	Business Fundamentals	2.04	**Organization of health institutions** and of the overall health system, inter-organizational aspects, shared care	3	CE
2.1	Business Fundamentals	1.08	**Management of information systems** in health care (health information management, strategic and tactic information management, IT governance, IT service management, legal and regulatory issues)	3	HI
2.1	Business Fundamentals	1.09	Characteristics, functionalities and examples of **information systems to support patients and the public** (e.g. patient-oriented information system architectures and applications, personal health records, sensor-enhanced information systems)	2	HI
2.1	Business Fundamentals	1.07	**Architectures of information systems** in health care; approaches and standards for communication and cooperation and for interfacing and integration of component, architectural paradigms (e.g. service-oriented architectures)	2	IS
2.1	Business Fundamentals	2.05	**Policy and regulatory frameworks** for information handling in health care	1	CE
2.2	Individual & Teams	3.02	**Ability to use personal computers,** text processing and spread sheet software, easy-to-use database management systems	3	5
2.2	Individual & Teams	3.03	**Ability to communicate electronically,** including electronic data exchange, with other health care professionals, internet/intranet use	3	5
2.2	Individual & Teams	1.04	**Use of personal application software** for documentation, personal communication including Internet access, for publication and basic statistics	2	5
3.1	Org Sys Development	1.06	Characteristics, functionalities and examples of **information systems in health care** (e.g. clinical information systems, primary care information systems, etc.)	3	HI
3.1	Org Sys Development	3.08	Handling of the **information system life cycle**: analysis, requirement specification, implementation and/or selection of information systems, risk management, user training	3	HI
3.1	Org Sys Development	3.12	Methods for **decision support** and their application to patient management, acquisition, representation and engineering of medical knowledge; construction and use of clinical pathways and guidelines	3	HI
3.1	Org Sys Development	3.11	**Biometry, epidemiology,** and **health research methods**, including study design	2	5
3.1	Org Sys Development	1.13	**Socio-organizational and socio-technical issues,** including workflow/process modeling and reorganization	2	CE
3.1	Org Sys Development	2.03	Principles of **clinical/medical decision making** and diagnostic and therapeutic strategies	2	CE
3.1	Org Sys Development	2.07	**Health administration, health economics,** health quality management and resource management, patient safety initiatives, public health services and outcome measurement	2	CE
3.1	Org Sys Development	1.02	**Need for systematic information processing** in health care, benefits and constraints of information technology in health care	2	HI
3.1	Org Sys Development	1.03	Efficient and responsible **use of information processing tools,** to support health care professionals' practice and their decision making	2	HI
3.1	Org Sys Development	1.17	**Nomenclatures, vocabularies,** terminologies, ontology's and taxonomies in BMHI	2	HI

3.1	Org Sys Development	1.19	**Evaluation and assessment** of information systems, including study design, selection and triangulation of (quantitative and qualitative) methods, outcome and impact evaluation, economic evaluation, unintended consequences, systematic reviews and meta-analysis, evidence-based health informatics	2	IS
3.1	Org Sys Development	2.01	Fundamentals of **human functioning** and biosciences (anatomy, physiology, microbiology, genomics, and clinical disciplines such as internal medicine, surgery, etc.)	1	CE
3.1	Org Sys Development	2.02	Fundamentals of **what constitutes health,** from physiological, sociological, psychological, nutritional, emotional, environmental, cultural, spiritual perspectives and its assessment	1	CE
3.1	Org Sys Development	2.06	Principles of **evidence-based practice** (evidence-based medicine, evidence-based nursing, …)	1	CE
3.1	Org Sys Development	1.01	**Evolution of informatics** as a discipline and as a profession	1	HI
3.1	Org Sys Development	1.18	Informatics methods and tools to **support education** (incl. flexible and distance learning), use of relevant educational technologies, incl. Internet and World Wide Web	1	HI
3.1	Org Sys Development	1.15	Biomedical **modeling and simulation**	1	IS
3.2	Project Management	3.09	Methods of **project management and change management** (i.e. project planning, resource management, team management, conflict management, collaboration and motivation, change theories, change strategies)	3	HI

Table 5. Mapping of IMIA Outcomes to Health Informatics Program Areas, and to IS Skills

Courses that Satisfy the Information Systems Area
ISC 245 Information Systems in Organizations
ISC 272 Systems Architecture
CIS 321 Data Communications and Networking
CIS 324 Database Design, Development, and Management
ISC 360 Information Systems Analysis and Design (W)
ISC 462 Information Systems Strategy and Policy

International Medical Informatics Association (IMIA) Expected Skills for BS Degree in Informatics (Mantas et al., 2010)		IMIA Skill Level	Information Systems Skills (Colvin, 2007; Landry et al., 2000)	
1.07	**Architectures of information systems** in health care; approaches and standards for communication and cooperation and for interfacing and integration of component, architectural paradigms (e.g. service-oriented architectures)	2	2.1	Business Fundamentals
1.19	**Evaluation and assessment** of information systems, including study design, selection and triangulation of (quantitative and qualitative) methods, outcome and impact evaluation, economic evaluation, unintended consequences, systematic reviews and meta-analysis, evidence-based health informatics	2	3.1	Org Sys Development
1.15	Biomedical **modeling and simulation**	1	3.1	Org Sys Development
3.01	**Basic informatics terminology** like data, information, knowledge, hardware, software, computer, networks, information systems, information systems management	3	1.1	Software Development
3.04	Methods of **practical informatics**/computer science, especially on programming languages, software engineering, data structures, database management systems, information and system modeling tools, information systems theory and practice, knowledge engineering, (concept) representation and acquisition, software architectures	3	1.1	Software Development
3.14	Usability engineering, **human-computer interaction**, usability evaluation, cognitive aspects of information processing	2	1.1	Software Development
1.10	Methods and approaches to **regional networking and shared care** (eHealth, health telematics applications and inter-organizational information exchange)	2	1.4	Systems Integration
3.06	Methods of **technical informatics**/computer science, e.g. network architectures and topologies, telecommunications, wireless technology, virtual reality, multimedia	2	1.4	Systems Integration

Table 6. Courses, IMIA and IS Skills for the Health Informatics Information Systems Area.

Courses That Satisfy the Health Informatics Area

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

International Medical Informatics Association (IMIA) Expected Skills for BS Degree in Informatics (Mantas et al., 2010)		IMIA Skill Level	Information Systems Skills (Colvin, 2007; Landry et al., 2000)	
1.08	**Management of information systems** in health care (health information management, strategic and tactic information management, IT governance, IT service management, legal and regulatory issues)	3	2.1	Business Fundamentals
1.09	Characteristics, functionalities and examples of **information systems to support patients and the public** (e.g. patient-oriented information system architectures and applications, personal health records, sensor-enhanced information systems)	2	2.1	Business Fundamentals
1.11	Appropriate documentation and **health data management principles** including ability to use **health and medical coding systems,** construction of health and medical coding systems	3	1.3	Database
1.12	Structure, design and analysis principles of the **health record** including notions of data quality, minimum data sets, architecture and general applications of the electronic patient record/electronic health record	3	1.3	Database
3.05	Methods of **theoretical informatics**/computer science, e.g. complexity theory, encryption/security	2	1.5	Info Security Assurance
1.06	Characteristics, functionalities and examples of **information systems in health care** (e.g. clinical information systems, primary care information systems, etc.)	3	3.1	Org Sys Development
3.08	Handling of the **information system life cycle**: analysis, requirement specification, implementation and/or selection of information systems, risk management, user training	3	3.1	Org Sys Development
3.12	Methods for **decision support** and their application to patient management, acquisition, representation and engineering of medical knowledge; construction and use of clinical pathways and guidelines	3	3.1	Org Sys Development
1.02	**Need for systematic information processing** in health care, benefits and constraints of information technology in health care	2	3.1	Org Sys Development
1.03	Efficient and responsible **use of information processing tools,** to support health care professionals' practice and their decision making	2	3.1	Org Sys Development
1.17	**Nomenclatures, vocabularies,** terminologies, ontology's and taxonomies in BMHI	2	3.1	Org Sys Development
1.01	**Evolution of informatics** as a discipline and as a profession	1	3.1	Org Sys Development
1.18	Informatics methods and tools to **support education** (incl. flexible and distance learning), use of relevant educational technologies, incl. Internet and World Wide Web +	1	3.1	Org Sys Development
3.09	Methods of **project management and change management** (i.e. project planning, resource management, team management, conflict management, collaboration and motivation, change theories, change strategies)	3	3.2	Project Management
1.05	**Information literacy:** library classification and systematic health related terminologies and their coding, literature retrieval methods, research methods and research paradigms	2	1.1	Software Development
3.07	Methods of **interfacing and integration** of information system components in health care, interfacing standards, dealing with multiple patient identifiers	2	1.4	Systems Integration
3.13	Basic concepts and applications of **ubiquitous computing** (e.g. pervasive, sensor-based and ambient technologies in health care, health enabling technologies, ubiquitous health systems and ambient assisted-living)	1	1.4	Systems Integration

Table 7. Courses, IMIA and IS Skills for the Health Informatics Environment

Courses that Satisfy the Clinical Environment
BMD 210 Infectious Disease in Health Care Environments
NU 311 Clinical Nursing Skills
NU 325 Health Assessment
HSC 343 Clinical Pharmacology
RAD 101 Principles of Radiographic Exposure
OT 201 Introduction to Occupational Therapy
CRC 330 Cardio-respiratory Care Assessment Skills
MGT 300 Management Theory and Practice
MGT 325 Operations Management

International Medical Informatics Association (IMIA) Expected Skills for BS Degree in Informatics (Mantas et al., 2010)		IMIA Skill Level	Information Systems Skills (Colvin, 2007; Landry et al., 2011)	
2.04	**Organization of health institutions** and of the overall health system, inter-organizational aspects, shared care	3	2.1	Business Fundamentals
2.05	**Policy and regulatory frameworks** for information handling in health care	1	2.1	Business Fundamentals
1.14	Principles of **data representation and data analysis** using primary and secondary data sources, principles of data mining, data warehouses, knowledge management	2	1.3	Database
1.13	**Socio-organizational and socio-technical issues,** including workflow/process modeling and reorganization	2	3.1	Org Sys Development
2.01	Fundamentals of **human functioning** and biosciences (anatomy, physiology, microbiology, genomics, and clinical disciplines such as internal medicine, surgery, etc.)	1	3.1	Org Sys Development
2.02	Fundamentals of **what constitutes health,** from physiological, sociological, psychological, nutritional, emotional, environmental, cultural, spiritual perspectives and its assessment	1	3.1	Org Sys Development
2.03	Principles of **clinical/medical decision making** and diagnostic and therapeutic strategies	2	3.1	Org Sys Development
2.06	Principles of **evidence-based practice** (evidence-based medicine, evidence-based nursing, …)	1	3.1	Org Sys Development
2.07	**Health administration, health economics,** health quality management and resource management, patient safety initiatives, public health services and outcome measurement	2	3.1	Org Sys Development

Table 8. Courses, IMIA and IS Skills for the Health Informatics Clinical Environment.

Implementation of a Distance MS-CIS Program: Lessons Learned and Principles for Success

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Abstract

The Master of Science in Computer Information Systems (MS-CIS) program at Colorado State University (CSU) was one of the first in the country when it was established in 1967 according to the model provided by the Data Processing Management Association (DPMA). Beginning in 1967, CSU initiated delivery of its MBA at a distance and graduated the first student in 1972, thus, making it the first and most senior program in the US. In 1992 a Computer Information Systems (CIS) concentration was offered in the distance MBA, though many challenges were faced due primarily to the distribution of the necessary software (IEF by Texas Instruments). The concentration was discontinued in 1995 due to difficulties associated with installation of the complex IEF software on distance student computers. Fall 2010 saw the rollout of the entire MS-CIS program consisting of 5 courses in the fall, 4 courses in the spring and the remainder during summer 2011. The purpose of this paper is to share lessons learned in terms of university and college approval, development and deployment. Surprisingly, many lessons may appear to be counter-intuitive and, yet, are critical to the success of the distance program.

Keywords: distance education, distance learning, distance MS-CIS program, lessons learned

1. PROGRAM DESCRIPTION AND BACKGROUND

Distance education programs have been growing at a tremendous rate as state educational budgets are being cut. Each has a different template but most can be fit into a general five stage model (Taylor, 2000). Our MS-CIS program is classified as fourth generation employing a flexible learning model using a variety of technologies. In addition, many institutions are undergoing transformation as distance programs influence those that are residential.

The MS-CIS program (Colorado State University, College of Business, 2011) at CSU follows the university requirements for a 30-credit Masters of Science degree which consists of either a professional paper or a thesis completed under the direction of a three member faculty committee. This later requirement is met with CIS695 for three credits. Table-1 shows the required course work for the program, though not in sequence, and the level of technical content for each course:

The MS-CIS program is offered flexibly over one-year, two-year, and three-year periods, however, students often elect a different duration depending on their needs. Table-2 provides an example of a three-year schedule along with examples of the technologies covered. Surprisingly, 20% of our students, principally those changing a career to CIS, complete the program in one year.

Course Number	Course Title	Technical Level
CIS600	IT Project Management	Low
CIS601	Enterprise Computing and System Integration	Low
CIS605	Business Visual Application Development	High
CIS606	Software Development Infrastructure	High
CIS610	Software Devel-opment Methodology	Low
CIS611	Object Oriented Systems	High
CIS620	IT Communications Infrastructure	High
CIS655	Business Database Systems	Low
CIS665	E-Business Application Technology	High
CIS695	Professional Paper or Thesis	Low/High
CIS370	Business Intelligence (optional)	Low

Table-1: MS-CIS Program Courses and Technical Content

The distance delivery of both MBA and MS-CIS courses is based on a residential class that runs in parallel and for which audio and video is captured during the residential component. Within 24 hours, but often within 12 hours, the material is posted for download or streaming from a server. In some cases (primarily military), we will provide DVDs. Exams, homework and projects are the same, however, there is often a one week delay between distance and residential classes due to a short delay in content delivery. Presentations by distance students are routinely captured and shared with other students in the distance program as well as those in the residential program.

Figure-1 shows the central control room into which feeds from each of the eight video classrooms is routed (note the eight conduits at the top left). This centralization allows a much more scalable allocation of personnel as the number of distance classes increase across programs in the college. Each classroom has three cameras plus video capture of the computer monitor, hence, the columns of 4 monitors mounted on the back wall.

Semester	Course Number	Content
Fall		
	CIS605	Visual Basic
	CIS606	Computer architecture
Spring		
	CIS620	Networks
Fall		
	CIS601	ERP using SAP simulation
	CIS610	Development lifecycles and software testing
Spring		
	CIS611	Java programming
	CIS655	MS SQL Server
Fall		
	CIS600	MS Project 2010
Spring		
	CIS665	HTML, ASP.Net, PHP
	CIS695	Professional Paper or Thesis

Table-2: Example Three-Year MS-CIS Program and Technologies Covered

Figure-1: Video Control Room

Figure-2 is a screen capture of BizCast as it is displayed on a distance student's computer and

consists of video of the instructor or students as determined from the control room and course materials. BizCast is based on Mediasite by Sonic Foundry, (Sonicfoundry, 2011) a global leader for enterprise webcasting, lecture capture and knowledge management. Students have a great deal of control of their personalized presentation and may skip forward or backward and play at different speeds (1.5X is a common practice). For students requiring signing accommodation, a third window can be added. Obviously, this also necessitates a capture of the signer from one of the cameras. Surprisingly, this has worked quite well.

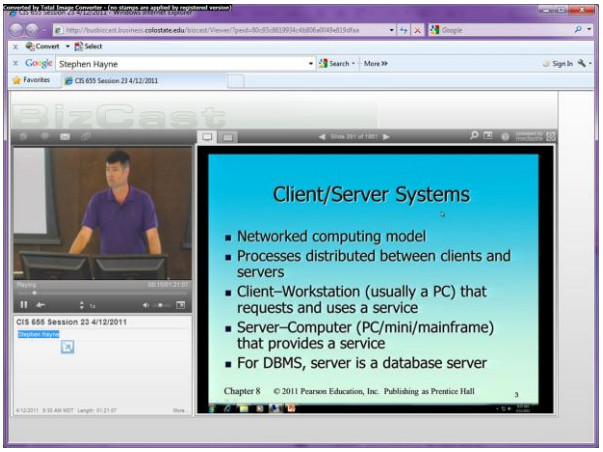

Figure-2: BizCast Environment

These courses vary a great deal with respect to the volume and type of required support, either in the residential program or at a distance. All require homework, projects, and some require collaboration as well as access to specialized software. The latter is the greatest challenge at a distance and in particular CIS 605, 606, 611, 620, 655 and 665 are technologically intensive.

2. TAXONOMY OF LESSONS LEARNED

CSU is a Land-Grant institution and has a long history of traditions and administrative structures, in addition to strong faculty governance. The faculty owns the curriculum, but not most administrative prerogatives. Approval of the distance MS-CIS program required a great deal of time and effort, both within the college and at the university level.

The lessons learned will be put into three categories and are not in sequence based on importance or effort. The categories are: administrative; faculty incentives and effort; marketplace. Each lesson will be identified and discussed within this framework.

Administrative:

There are six important lessons learned in the administrative category. In some ways these may take time and/or resources to handle properly, but the outcomes are clear, and in general, more predictable. Faculty is not involved in a significant way.

- **Immediate, full deployment –** There was a great deal of pressure from the faculty to ease into the program by rolling out courses over a two or three- year period. Though taking this approach was considered, it was decided that due to number of students who wish to complete the program in a year (approximately 20%), that an immediate offering of all classes scheduled during fall and spring semesters was the best approach. In retrospect, this worked far better than anticipated because the participating faculty all faced the same challenges and issues and assisted one another in their concurrent implementation of classes. The amount of cross-faculty assistance was remarkable both in terms of volume and creativity.

- **Common story of program justification –** There are many myths associated with distance delivery, including difficulty in doing research, managing collaboration among students, as well as increased workload. Some faculty contended that they would not have enough time to do research with the anticipated additional workload of preparing for distance classes, and that the distance medium was not suited to teach and do research. Collaboration also was claimed to be a problem at a distance. Evidence we have from our distance MBA contradicts all three of these myths. In addition, having stored distance program materials available for residential students who wish to make up a missed class is very beneficial.

- **Academic hurdles –** The approval process required to obtain permission to offer an existing course at a distance is quite time consuming as it must be voted on at the departmental, college and university levels. The latter has multiple signoffs from the following: The Institute of Learning and Teaching (pedagogy); Division of Continuing

Education (administrative); Faculty Council Curriculum Committee (academic). This process can easily take a year and must be completed prior to a course offering. We completed this in four months. Slowly, our conservative academic culture is beginning to realize the importance of doing things differently, better and more responsively.

- **Scalability** – Many distance programs have requirements that do not scale as enrollments increase. Currently we have 500 to560 students per class in our distance MBA. Our MS-CIS is in a position to handle large numbers as well through the use of Distance Section Coordinators (DSCs) who take care of all email, and other types of student interaction, formatting and posting of materials, administration of exams and grading. Each DSC is under contract that imposes responsibility for responsiveness to student and faculty demands. For large classes, these positions are arranged by time zone to facilitate more local interaction. As numbers increase beyond some yet not reached threshold, Senior DSC's may be recruited so that faculty members will not be required to manage as many support personnel. Each DSC is responsible for approximately a 40 student section, and for large classes, these are assigned according to time zone.

- **Quick resolution of technical issues**– It's both irritating and unproductive to have technical needs for the classroom unmet during the semester. Residential students are somewhat understanding to a point; distance students will not tolerate such disruptions for long. This is likely due to paying a premium for the tuition, but also may be due to not hearing an off-line explanation of why maintenance has been delayed. In addition, if a technical difficulty is encountered during a class that is digitally captured, one cannot conveniently reproduce the classroom experience. We have a support staff assigned responsibility for classroom technology but the MS-CIS has required additional support for software used by our students.

- **Distance Section Coordinators** - The MS-CIS is different from the MBA with respect to specialized software competencies and we expect to add Technical Section Coordinators (TSC) as a support vehicle to accommodate this need. The TSCs will add specialized technical support for our classes that have a high technical component as shown in Table-1. It has become obvious that a lecture class, as is typical in an MBA program, doesn't place nearly the demand on delivery as does one with a large technical component. We use VM-Ware and McCabe's software in our classes, both of which require significant technical support for delivery on-campus and at a distance.

Faculty Incentives and Effort:

This category of five lessons is far more subtle and risky in terms of outcome. In a sense, all deal with getting faculty to do something that they are unlikely to have done on their own, but which is in their best interest and that of the department and college.

- **Muted distinction** – It is difficult to make a distinction in student's expectations between residential and distance delivery. Faculty require the ability to treat all students on a uniform platform, perhaps with the exception of assignment due dates, if there is a delay in the delivery of the distance material. We, therefore, provide grading assistance for both the residential and distance sections of a class, allowing a consistent expectation of returned graded assignments. Also, residential students should have a consistent and high expectation of faculty preparation, and the formality of distance delivery encourages this.

- **Honoring faculty optionality** – Most chairs of academic departments attempt to assign classes based on interest, expertise and convenience. For residential programs, faculty understands that classes must be taught and are part of their workload assignment. When distance classes are added, the subject of optionality of teaching is an issue. It may only take one or two faculty to prevent the delivery of a program if they choose not to participate. A clear workload document stating distance participation would clearly assist in this regard. Without it, however, one may need to schedule around the non-participating faculty. In our case, we needed to reassign a class to someone willing to take on both the residential and distance components.

- **Not a substitute for research** – A common question has been whether a faculty member will be expected to do less research if they participate in distance delivery. The answer is an emphatic no. As a Carnegie 1 research institution, faculty is held to a high standard of scholarship. There seems to be a myth that distance participation takes a tremendous amount of time and therefore research productivity will necessarily be reduced. Experience in our distance MBA is that our best instructors also have been our most productive researchers. Each will admit to additional workload during the first semester of offering a distance class but reasonable time for both after the first semester.

- **Respect for faculty workload** – It is clear that distance delivery consumes more resources thus justifying higher costs being transferred to students through tuition. Much of this work, however, can be well accomplished with some combination of student and professional assistance for material preparation, grading, posting of materials, exam administration and other forms of support. One of the areas we are still perfecting is the provision of technical assistance with entry level programming. For this purpose, we have established a help center accessible by both residential and distance students fully staffed by student assistants. This center also provides the student assistants an opportunity to gain valuable experience as they respond to the variety and number of calls received.

- **Shared benefit with accountability** – There is a potential shared benefit to the university, college, department and the faculty member involved in the distance program. The revenue stream, based on $660/credit is split 12% to the university (10% to the University, 2% to the Division of Continuing Education), and the remaining 88% to the department, for a three-year period, at which time the college will have a negotiated revenue stream. Even at this point, however, most revenue will be directed to the department. Table-3 shows an example of the revenue stream associated with the distance program for different levels of enrollments. The dean has been supportive of the department retaining a very large portion of this revenue in support of travel, research and other initiatives. Our intent as a department is to direct a portion to faculty in support of research, much of which may be done on salary during the summer. We are still considering how to make this assignment of revenue both transparent and yet serve as an incentive for research and publication in premier and high-quality journals.

Marketplace:

These three lessons may well be important for residential programs in small measure, but are critical for those at a distance. Historically, it could be argued that many information systems departments do not pay attention to these.

Course Enrlmts	Revenue/ Course	University Split-12%	College Split-88%	DSC Cost	Net Revenue
100	198000	3960	194040	9000	185040
150	297000	5940	291060	18000	273060
200	396000	7920	388080	18000	370080
250	495000	9900	485100	27000	458100
300	594000	11880	582120	27000	555120
350	693000	13860	679140	45000	634140
400	792000	15840	776160	45000	731160
450	891000	17820	873180	54000	819180
500	990000	19800	970200	54000	916200

Table-3: Revenue Split Examples

- **Marketing message and responsiveness** – A consistent and responsive message is needed to all potential students from the first point of contact, through admissions, coursework and graduation. Promotion of the program through any and all appropriate channels should be considered. Growth of the program will be significantly slowed if one simply waits for students to show up, as is so often the case with a residential program. All materials, on-line or in print, must be consistent. Not only does this take a great deal of work, it may also require outside assistance from professionals. Web site search ranking is an excellent example of a specialized area of importance.

- **Positioning of program** – A distance marketplace may well be different than the one for residential students. For the most part, residential programs are populated by those that are close to campus from a geographic perspective. This attraction, or restriction, depending on one's point of view, no longer applies at a distance. Rather,

other factors such as service and/or unique positioning of the program are likely to be more relevant to the marketplace. For the MS-CIS program, 50% of our students enroll to obtain an academic credential to enter the information systems job market. The other 50% of students want to update their skills to better serve their current employment. Our program has been specifically designed to accommodate both objectives without layering a great deal of undergraduate prerequisite work for those who wish to enter the field for the first time.

- **Market opportunities** – Initially we believed that most students would come to us from out-of-state locations, principally where no other reasonable educational opportunities existed. We have been quite surprised, and find that we are attracting local, in-state and out-of-state students in cities that have excellent alternative educational opportunities. Many examples can be cited, but a surprising number of students are close to campus but too busy for a traditional residential program. International opportunities also exist. Though we have several students outside of the country, beginning summer 2011, we have launched a certificate program with several campuses in India. The certificate can be used both as a stand-alone program for students seeking only 9 credits of coursework and without the necessity of gaining admission to a full MS-CIS program. Some may wish to obtain both, and for those, the certificate serves as a qualifier for graduate admission. At the present time we expect to have 25 students in this program.

3. CONCLUSIONS

There have been a number of surprises during the first year of the program including the relative ease with which we have accomplished the construction and deployment of the coursework. Frankly, a great deal of difficulty with complaints from both faculty and students was anticipated. Neither has been a problem to a greater degree than those we face in our residential programs.

The second surprise is how well the faculty has worked together to solved the inevitable problems that have arisen, rather than complaining amongst themselves. There is a great deal of pride in the accomplishment of the work that has been completed and the likely continued refinement of the program as we enter its second year.

Thirdly, it is refreshing to have access to a revenue stream that may be tapped to solve problems in both residential and distance programs as well as to support research. The challenge here is being both transparent in allocation of this resource and effective in promoting the mission of the college and the department.

The largest challenge has been the administrative burden on the department. Most academic departments are not organized to operate a business, and in many areas, do not have the expertise. Fortunately, we have access to some centralized resources for marketing, recruitment and material development which we are required to support financially. One of the challenges we didn't anticipate was the time requirement of responding to student information requests. The Customer Relationship Management (CRM) is a critical component of our business and we have become increasingly dependent on it. Many other opportunities exist that will be explored as the program is refined. Some of these are:

- **International offerings –** Though we have begun with both certificate and full MS-CIS offerings in India, China and Brazil also appear to be attractive. The business model used must be adjusted accordingly to fit each of these marketplaces.

- **Specialized concentrations within the Distance MBA –** Project management, including PMP (Project Management Professional) certification and business intelligence are both a good fit and are likely to be popular.

- **Use of mobile platforms –** iPad and similar devices can be used to deliver content effectively for those on the move.

- **Complete asynchronous delivery to select audiences –** This is a big step and one that will require caution but may be significant for some market-places.

In short, we are off to a good start, but there is still a great deal of work ahead.

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Multiple Submissions and their Impact on the 'Path of Learning'

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Abstract

Learning theory from the 'behaviorist' camp suggests that quick feedback on a stimulus (problem) followed by repetition (resubmission) will increase student learning. To test this assumption an experiment was conducted. In an introductory management information system class students were given the opportunity to submit several skill-building project assignments prior to the due date. These submissions were graded promptly and feedback was provided. Students could then re-submit the project for final grading upon the actual due date. Data that were collected from a total of 159 students on three different database and spreadsheet skills indicate that there is a relationship between the choice of a student to take advantage of pre-grading and the grade on a subsequent test that assesses similar skills as in the project assignments. However, the relationship is not immediate, but it appears that students need to follow a 'path of learning' in order to achieve a higher level of understanding, whereby prompt and constructive feedback can play an important role.

Keywords: pedagogy, learning theory, feedback, computer literacy

1. INTRODUCTION

As introductory class sizes increase and more classes move to the web or a blended delivery method, building more learning options independent of the instructor are needed. Instructors have moved from the 'Sage on the Stage' to instructors who need to guide students to self-directed learning opportunities. (King, 1993; Jones, 1999).

A particular challenge for instructors of introductory computer literacy courses is to provide the appropriate level of hands-on skill assignments with clear feedback, followed by an opportunity for the students to learn from their errors. Unfortunately, students often only receive a grade and some minor comments as feedback, and no option is given to correct the errors and learn from them.

Learning theory suggests that increased learning will occur with additional stimuli and responses

(Gagne, Briggs and Wager, 1992). Even though there are several studies in pedagogy and psychology disciplines addressing this argument, they fail to address the validity of this theory in teaching skills.

This study investigates the results on 'learning' of providing students the opportunity to submit their assignments (database or spreadsheet) in advance of the due date (pre-grading). Students then received some high-level of feedback and were given the option to re-submit an updated assignment prior to the final due date. We expected that if students could 'correct' their errors before moving on to the next assignment or concept, learning from feedback would occur. In the current paper, we describe the experiment and its results, in an effort to address the following research question: **Does pre-grading followed by prompt feedback support student learning?**

In the following, we first provide an overview of the relevant literature on learning as a background to our study. We then describe the experiment, analyze and discuss the data that we collected, and draw conclusions.

2. BACKGROUND

Student success is influenced by the ability of the educator to present new information and to evaluate student understanding of the information. This process requires the student to learn the material covered by the educator.

Based on behavioral learning theory, Gagne et al. (1992) proposed several design principles for effective instructional courses, including contiguity, repetition, and feedback. Contiguity is the concept that the feedback should follow the response without delay. The longer the delay of the feedback to a learning stimulus, the less is the likelihood of correct answers to future similar questions. The second principle of repetition states that practice strengthens learning and improves a learner's retention. Gagne et al.'s (1992) conceptual framework of cognitive learning includes nine conditions for learning:

1. Gaining attention (reception)
2. Informing learners of the objective (expectancy)
3. Stimulating recall of prior learning (retrieval)
4. Presenting the stimulus (selective perception)
5. Providing learning guidance (semantic encoding)
6. Eliciting performance (responding)
7. Providing feedback (reinforcement)
8. Assessing performance (retrieval)
9. Enhancing retention and transfer (generalization)

The results of subsequent research studies suggest that responding (#6) and reinforcement (#7) are the events most directly connected to student success (Martin, Klein & Sullivan, 2007).

Murray (1998) encouraged a teaching style based on drill/rote learning and memorization, whereby modules should be built with many exercises that are example-driven. The principle of feedback requires that instructors inform the learner about whether an answer was correct or incorrect. In the case of an incorrect answer, feedback should include a new path to solve the problem. This new path could be a hint at the correct answer, a restatement of a prior fact, or even a new example that is less complicated (Uden and Beaumont, 2006). In addition, feedback to indicate that an answer is correct is suggested to be just as important as feedback on incorrect answers.

Orientation and recall is defined as a process where learning involves the synthesis of prior information that must be recalled to short-term memory (Uden and Beaumont, 2006). Similarly, there is a school of thought that learners construct knowledge by making sense of experiences in terms of what is already known (Eugenia, 2010).

In the framework of cognitive learning, responding is required from learners after they have been given sufficient material to comprehend an objective (Tomei, 2008). In particular when practice is included in a lesson, an *active* response to the material may be expected from the student. For example, following a database lesson, responding might require a student to create a query that will count the number of records in a table in order to demonstrate the comprehension of this newly introduced concept.

Given that responding can reinforce students' understanding, researchers have suggested that effective practice should parallel the assessments that are used to test the skills and

knowledge reflected in an objective (Reiser and Dick, 1996).

The current study builds on Gagne et al.'s (1992) framework. We focus on response and reinforcement as key learning components, as we investigate how hands-on skills could be taught more effectively. We trust that the knowledge gained from our study provides valuable insight for instructors, particularly those teaching online web-based courses.

3. EXPERIMENTAL DESIGN

For the experiment, we collected data in five sections of an introductory information systems course that included a number of computer literacy assignments and that were taught by two different instructors. Students were given the option to submit a number of skill-building assignments prior to the due date for pre-grading. Each assignment represented a new concept or advanced computer skill that was introduced in class prior to the assignment. Specifically, the following three skills provided the basis for our dataset:

1. Create a database with queries and multiple relationships between tables, using Microsoft **Access**;
2. Create a spreadsheet with multiple scenarios, using Microsoft Excel **Scenario Manager**;
3. Create a spreadsheet looking for an optimal solution, using Microsoft Excel **Solver**.

Following optional pre-grading and re-submission, a final grade for each project was assigned after the project due-date. The learned skills were then assessed with a hands-on portion of a comprehensive test that was given later in the semester. Figure 1 details the steps for each skill concept, whereby the shaded areas and bold text refer to data points that we recorded for the current study.

For the research model (Figure 2), we use the grade on the hands-on test as the main dependent variable and representing the level of understanding that a student has achieved with respect to a certain skill at the end of the course module. While we did not administer an entry-level test to assess a student's initial level of knowledge, we assume that the grade in the hands-on test is a good indicator for the extent to which a student who completes the course possesses the skills and knowledge that the course was intended to provide.

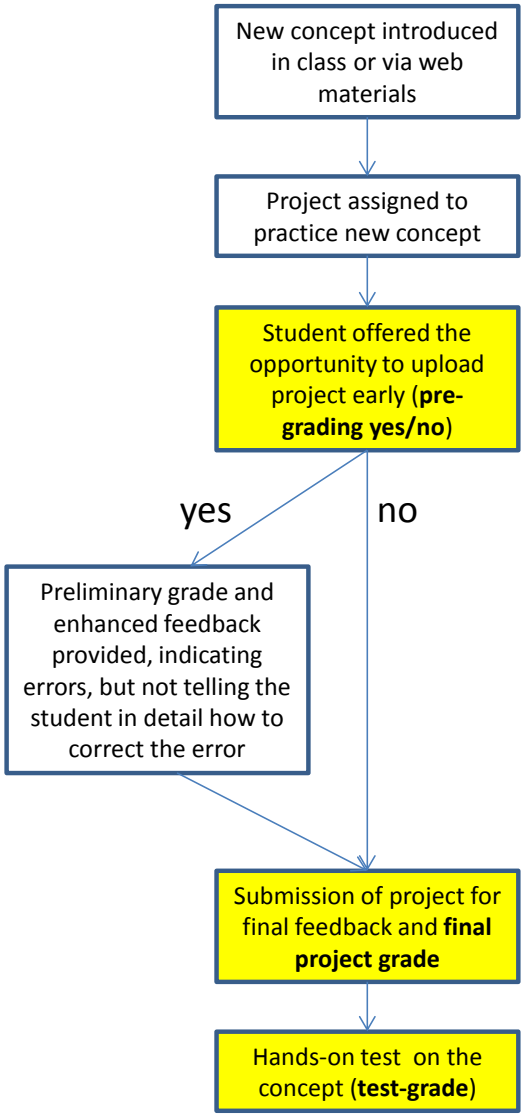

Figure 1: Teaching and Grading Process (Experiment setup)

In order to address our research question and to assess to what extent pre-grading can indeed enhance learning, and thus lead to a higher level of understanding, we wanted to find out whether there is a statistically significant link between pre-grading (yes/no) and the result of the hands-on test. In addition, we were also interested in the role of the final project grade as an intermediary step toward the hands-on test. Consequently, we analyze our data to test the following three hypotheses:

H1: Pre-grading (yes vs. no) is associated positively with the final project grade.
H2: The final project grade is associated positively with the grade in the hands-on test.
H3: Pre-grading (yes vs. no) is associated positively with the grade in the hands-on test.

In order to account for systematic differences between sections and instructors, we also include the instructor as a control variable in the model (Figure 2).

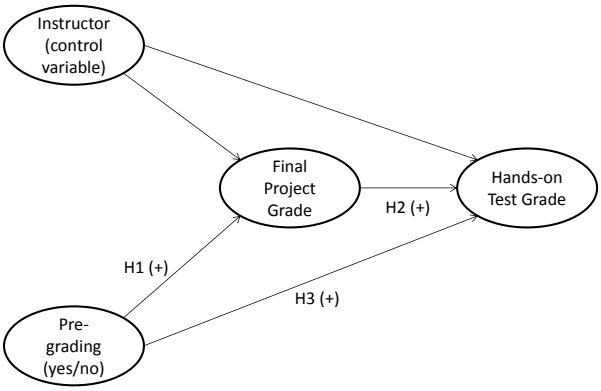

Figure 2: Research Model

4. DATA ANALYSIS

Data were collected from a total of 159 undergraduate students in an introductory information systems course, who were taught three computer literacy skills (Access, Scenario Manager, and Solver). The students represent a total of five sections in fall 2010 and spring 2011 that were taught by two instructors. One session was taught online, all other sessions were taught in the classroom. For each student, the collected data indicated (1) whether the student had taken the opportunity of pre-grading (yes/no) for a particular skill assignment; (2) the final project grade; and (3) the grade in the associated hands-on test.

To account for individual differences in teaching style, course structure, and details on projects, tests and grading schemes, we controlled for the instructor as a fourth variable in our analysis. The differences between the sessions of an individual instructor were not included in the analysis as these tend to be smaller than the differences between individual instructors (an assumption that was also confirmed by additional data analyses not reported here).

Each dataset pertained to a particular skill concept (Access, Scenario Manager and Solver), and was analyzed separately. After an initial review of the data we dropped records with grades of 0% or 1% for a project and/or hands-on test, because we assume that those results reflect a conscious choice of the students not to submit a particular assignment (e.g., after assessing their overall grade-related standing), rather than the level of student understanding. The resulting sizes of the three data samples were thus n=153, n=143, and n=144 for the Access, Scenario Manager and Solver skills respectively. Table 1 provides a descriptive summary of the data. Student participation in the pre-grading option ranged from 58% to 85%.

Table 1: Descriptive Statistics

Skill Concept sample size (n)		**Access** n=153	**Scenario Manager** n=143	**Solver** n=144
Pre-grading Yes		85%	58%	74%
Project Grade	Min	42.50	3.00	31.00
	Max	100.00	105.00	100.00
	Mean	93.94	84.28	92.06
	Std Dev	10.08	25.21	12.02
Test Grade	Min	73.00	2.00	8.00
	Max	100.00	100.00	100.00
	Mean	97.22	84.12	90.89
	Std Dev	4.46	21.92	12.72

Subsequent data analysis was performed using the structural equation modeling (SEM) approach with WarpPLS 2.0 software that applies the partial least squares (PLS) technique (http://www.scriptwarp.com/warppls). SEM is a second generation statistical method that, in contrast to regression, allows for the simultaneous assessment of multiple independent and dependent constructs, including multi-step paths (Gefen, Straub, and Boudreau, 2000). PLS was considered an appropriate method to test the research model because there is a broad agreement among scholars that PLS is well suited for exploratory research and theory development (in contrast to theory testing), which is the case in the current research study. Given that all of the variables in the research model included only one indicator, it was not necessary to assess the validity of latent variables. Instead, we could immediately proceed to test our hypotheses with the structural model.

As is indicated in Figures 3 to 5, we found comparable results for all of the three skill

concepts of Access (Figure 3), Scenario Manager (Figure 4), and Solver (Figure 5). In all three datasets, H1 was confirmed at high levels of statistical significance, whereas H2 was confirmed at high to marginal levels of significance. Support for H3 was either marginal or non-significant. The instructor variable played a significant role in all three datasets. Even though the indicators of fit between the model and the data were acceptable to very good for all three datasets, some R square values, in particularly for the test grades were below 10%. Details follow:

Skill 1: Access

For the first dataset (Access) the model fit with the data was very good:

- Average Path Coefficient (APC)=0.165, P=< 0.001
- Average R-Squared (ARS)=0.126, P=0.002
- Average Variance Inflation Factor (AVIF) =1.091, Good if < 5

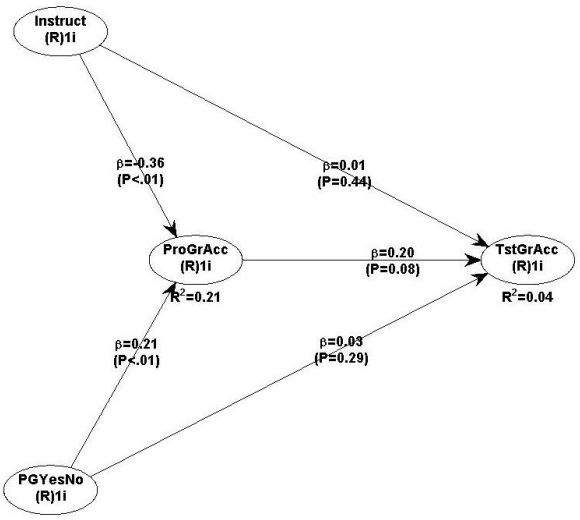

Figure 3: Results for Skill 1: Access

We found H1 to be supported with a significant path (p<.01) between grading and project grade. H2 was marginally supported with a path between project grade and test grade that is significant at p=0.08, and we also notice a low R square (0.04) for the test grade. It is the combination of the two paths (1) pre-grading/project grade, and (2) project grade/test grade that we refer to as the 'path of learning' in the reminder of the paper. H3 was not supported for the Access skill. With respect to the control variable (instructor), we found the association between instructor and project grade to be significant below the 1%-level, whereas the association between instructor and test grade was non-significant (Figure 3).

Skill 2: Scenario Manager

For the second dataset (Scenario Manager), the model fit with the data was again very good:

- APC=0.213, P=<0.001
- ARS=0.130, P=<0.001
- AVIF=1.051, Good if < 5

We found H1 and H2 to be supported with paths that were statistically significant at or below 1% indicating support for the path of learning. H3 was supported marginally at the 6%-level of significance. In addition, we found both paths between instructor and project grade and between instructor and test grade to be significant at below 1% (Figure 4).

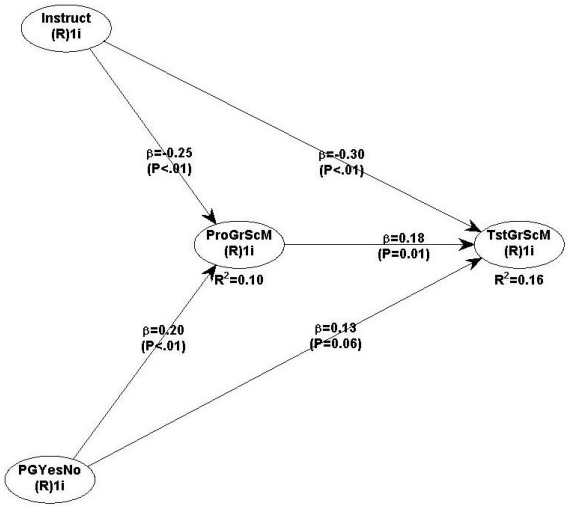

Figure 4: Results for Skill 2: Scenario Manager

Skill 3: Solver

For the third dataset (Solver) the indicators of model fit with the dataset were very good for two out of three indicators (APC and AVIF), but the ARS value was marginal:

- APC=0.165, P=<0.001
- ARS=0.095, P=0.102
- AVIF=1.045, Good if < 5

Again, we observed the path of learning in the form of strong support for H1 (p=0.01) and

acceptable support for H2 (p=0.05), whereas H3 was not supported. And again, the association between instructor and project grade was significant at below the 1%-level of significance, whereas the association between instructor and test grade was not significant. As reflected in the marginal ARS, the R square values for both dependent variables were around 10% (Figure 5).

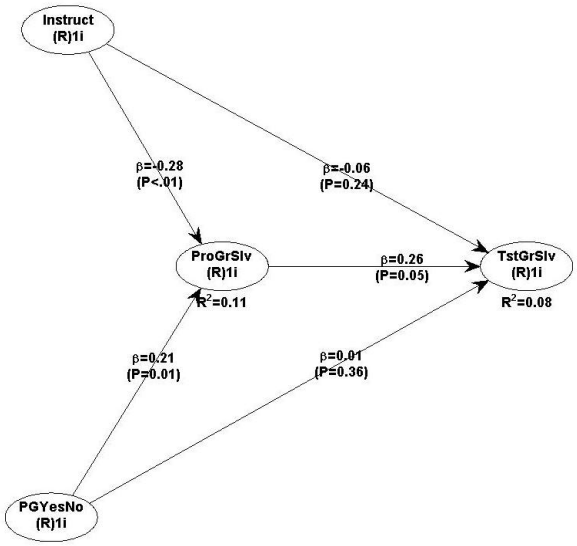

Figure 5: Results for Skill 3: Solver

5. DISCUSSION

In all three of our datasets, we found strong positive associations between pre-grading (yes vs. no) and final project grade (H1) and strong to acceptable support for the associations between final project grade and test grade (H2). The direct associations between pre-grading (yes vs. no) and the test grade were weaker if they were statistically significant at all (H3).

As a main outcome of our study, our data indicate considerable support for the 'path of learning' between pre-grading, project grade, and test grade independent of assignment and number of students who participated in pre-grading. It appears that the path of learning requires two steps and cannot be shortened: Students who submitted an assignment for pre-grading were as such not more (or less) likely to achieve a good grade in the hands-on test than students who did not take this opportunity (and vice versa). We suggest that students need to take the feedback that is provided in the pre-grading comments serious, and that they subsequently have to make an effort to submit a high-quality project for a good final project score. It is this intermediate step of learning that – according to our data – is associated with higher grades in the concluding hands-on tests, thus, signaling higher levels of understanding and learning.

Several additional issues, however, warrant discussion. First, our results reflect a considerable amount of noise in the data, as indicated in the limited R square values, in particular for the hands-on test results. Although we do have statistical support for H1 and H2 that are supported by overall acceptable levels of model fit, there appears to be a need to examine additional variables for a deeper understanding of the domain.

For example, our data showed some highly significant associations between instructor and grades, in particular project grades. These associations most likely represent differences in grading practices but could also be an indicator of other factors, such as teaching effectiveness. At the beginning of the semester, the two instructors who participated in the experiment coordinated their skills assignments and hands-on tests to some degree to ensure structural comparability of the resulting data. Both instructors also used the same online system for grading (Matthews and Janicki, 2010). Despite these interactions, however, a number of differences remained, for example regarding the structure of the syllabus, individual teaching styles, project and test instructions, and grading rubrics. The format of delivery also varied as one of the five sections was taught online. To gain additional insights about the role of the instructor, an alternative analysis of the data was conducted where we measured the strength of moderated links between the instructors on the one hand, and the associations between pre-grading, project grades and test grades (H1-H3) on the other hand. The specific purpose of the alternative analysis was to find out whether the path of learning differed in strength between instructors, but the results of the analysis were not meaningful. Based on these mixed results, we suggest that it is necessary to examine in more detail the role of the instructor in future studies.

Another issue to consider is whether we are witnessing a situation where the smarter students were the ones who primarily took advantage of the path of learning. The data

show that the seemingly most difficult skill based on instructor experience and as measured by average grades (Scenario Manager), had the lowest percentage of students who submitted their projects for pre-grading (Table 1). Beyond this result, however, we did not have the opportunity to collect data on previous skills and the knowledge that students brought into the course, or on their overall grade level averages. We were surprised to find consistently significant associations between pre-grading (a choice made by the students) and the grades for projects and tests (H1 and H2). Given the limited statistical evidence that pre-grading alone resulted in high test scores (H3), we suggest our data to indicate that learning occurs along a pre-defined path, largely independent of a student's previous knowledge. While we cannot answer the question of whether smarter students benefitted more (or less) from pre-grading than students that were less smart, we found pre-grading to play an important role along the path of learning. We suggest that it may be up to the individual instructor to encourage all students in a class to take the opportunity for pre-grading (followed by efforts to submit a high-quality final project), given its critical role as part of the learning process.

6. CONCLUSIONS AND OUTLOOK

In the current paper, we set out to address the research question of whether pre-grading followed by prompt feedback can support student learning. Based on the data that we collected for three different skills that were part of an introductory information systems course taught by two different instructors, we suggest the following answer to our question: yes, pre-grading can support student learning, as long as a student takes the feedback from pre-grading seriously and makes an effort to subsequently submit a high-quality project.

Pre-grading alone does not seem to guarantee learning, as measured by hands-on test results, but pre-grading can help to increase the likelihood of a student submitting a high-quality project as part of the learning process. We suggest that our data provides evidence for a path of learning that includes three elements: (1) early submission of a project for pre-grading and prompt feedback; (2) preparation of a high quality project based on the early feedback for final project submission; (3) preparation for hands-on test based on feedback on the final project. Each step along the path is important to help a student learn and achieve a high level of understanding (test grade).

Before we conclude the paper, a couple of limitations and avenues for future research should be emphasized. As mentioned previously, our study is limited in its ability to determine exactly how much learning has occurred during the course, mainly because of the fact that skills were not assessed prior to the course. In addition, we could not fully explain the role of the instructor and also have no explanation for a considerable amount of noise in our data.

The former limitation means that we have not addressed in detail how learning actually occurs along the identified path of learning, and what factors may be particularly helpful in addition to pre-grading. While the focus of the current study was on the general role of pre-grading as part of the learning process, a better understanding of what actually happens along the path of learning should be considered an important extension of our work. In order to help instructors better structure their courses, it would be beneficial to have a deep understanding about what types of learners pre-grading can best support, as well as what groups of students are most prone to following the suggested path of learning. In this context, and as we discussed above, the role of the instructor and possibly other factors, need to be explored more deeply as well.

Another extension of our study could be to extend the path of learning to series of related assignments and projects. In some cases, more than one assignment might be given throughout a particular course module. It would be interesting to see to what extent the path of learning can be traced between assignments, which could again be helpful for course structuring and course management.

Lastly, it will be important to explore the boundary conditions of our findings and determine generalizability and applicability of the path of learning to other types of assignments, students and learning environments. While the results of our analysis were comparable across assignments and sections, and the path of learning was quite evident in the current study, the question remains, what factors in particular contributed to the similarity of the outcomes, and what factors might have obscured or even obstructed the path of learning. Only if we understand not only

the key aspects of the path of learning but also its limitations, can we truly move forward in our continued quest to help students learn.

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Fusing Communication and Writing Skills in the 21st Century's IT/IS Curricula

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Abstract

Written and oral communication has been listed as the top explicitly requested skill by employers for a long time. Despite pressure from industry, the gap still exists between the expectations and average written and oral communication skills of current information technology/information systems graduates. This paper addresses the above issues and discusses incorporating written communication requirements into today's information technology curriculum. Drawing from the nation-wide university initiative of "Writing Across the Curriculum" (WAC) in the 1980s, our university's "Writing Intensive (WI)" course requirements are reviewed. The paper covers the rationale and strategy used to convert three existing courses in our Information Technology (IT) program into WI courses to meet university writing requirements. Furthermore, the paper discusses faculty preparation, and some lessons learned. The study gives pragmatic guidance for educators in the information technology discipline who want to enhance the writing and communication skills of their students.

Keywords: writing across the curriculum, IS/IT curricula, writing intensive, communication and writing skills

1. INTRODUCTION

Surprisingly, as early as a century ago, many engineering industry representatives recognized that the graduates they were hiring lacked writing skills. In response to a survey, employers wrote that they believed that recruits "did not have adequate English skills to perform their work" (Kynell, 1995, p91). Ninety years later, based on a survey conducted by the National Society of Professional Engineers in 1991, the same issue still haunted the industry. In this survey, practitioners from the engineering and technology fields called for educators to provide "more instructions in written and oral communications" (Landis 1995). Also in a recent study (Carter, 2011), the authors examined employment advertisements for software engineers from fifty companies on the website Monster.com. Written communication was listed as the top explicitly requested skill by employers pointing to the importance of writing skills today.

The problem however is not just in engineering or in technical fields such as computer science (CS), information technology (IT), and information systems (IS). In 2006, the Conference Board and the Partnership for 21st Century Skills reported on a survey of some 400 employers in the United States (The Conference

Board, 2006). The survey set out to identify how these employers viewed new entrants into the workplace. They reported that over a quarter (26.1%) of the new entrants were seriously deficient in writing in English and in written communication such as writing memos, letters and complex technical reports. Writing was one of the important applied skills mentioned, along with critical thinking, problem solving, oral communication and teamwork.

Academic organizations like the Association of Computing Machinery (ACM), Computing Sciences Accreditation Board (CSAB), and ABET (formerly the Accreditation Board for Engineering and Technology) have updated their requirements to emphasize the importance of written skills (Dugan & Polanski, 2006). In addition, the topic of teaching writing in information technology/systems classes has continued to draw attention from educators in the discipline (Gersting & Young, 2001; Hoffman, Dansdill, & Herscovici, 2006). This paper aims to address some of the issues and discuss how to incorporate written communication requirements into the IT/IS curriculum. The paper provides pragmatic guidance for educators to enhance their students' writing skills as they enter the competitive workplace.

Drawing from the nation-wide university initiative of "Writing Across the Curriculum" (WAC) in the 1980s, the authors examined the current implementation of WAC in various universities, including their university's "Writing Intensive (WI)" course requirements. The authors discuss the strategy to convert existing courses to WI as well as some lessons learned by teaching these WI courses.

2. WRITING ACROSS THE CURRICULUM

It has long been realized that writing needs practice. As a response to undergraduate students' lack of writing proficiency throughout the university curriculum, WAC programs emerged in the 1980s. Many universities, large and small, now offer these programs and they generally recognize the following tenets for writing as:

- It is the responsibility of the entire academic community with variability among disciplines;
- Instruction must be continuous during all four years of undergraduate education;
- The process must be understood by faculty in all disciplines, particularly as it relates to the workplace;
- It promotes learning and other 21st century skills (critical thinking, oral presentation, and teamwork) (Warner, 2008).

Many universities make extensive resources available to support college writing programs. One of the most prominent programs is the Purdue Owl Project (owl.english.purdue.edu), a comprehensive guide to writing. They offer over 200 free resources to support student writing and their resources are widely recommended by other universities, including our own.

In the early and mid 1990s, there was a flurry of papers at SIGCSE Technical Symposia on the topic of writing across the CS curriculum (Falconer & Katz, 1992; Fell, Proulx, & Casey, 1996). These papers present ideas for writing assignments, the need to improve faculty skills to give and grade these assignments, and the need for resources to support student learning in the process. However, since then there have been few papers addressing the practical issues, experiences, or lessons associated with the WAC initiatives in the computing or IT/IS discipline. One of the exceptions is Hoffman, Dansdill, & Herscovicis' study (2006) where the authors discussed WAC in relation to CS. However, the IT/IS discipline is not a static field as it never stops evolving with the dynamic nature of social as well as technological advancement. Therefore, there is a continual need to evaluate where and when writing can be reinforced in the changing curriculum. In many cases, there appears to be a gap between the theory behind the WAC initiatives and actual implementation. Thus, this study focuses on how to transform existing IT/IS courses to be writing intensive, which differentiates this paper from others.

3. THE UNIVERSITY'S WRITING INTENSIVE (WI) REQUIREMENTS

The authors teach in a private liberal arts university, therefore, the students majoring in the IT program not only need to fulfill the requirements of the major, but also the liberal arts core and other university requirements. There has always been a writing component to the liberal arts core (EN 101 Composition I and EN 102 Composition II). Students take a directed self-placement test when they enroll at

the university and according to these test results, either take EN101 or developmental English. Additional writing was assumed to occur in the discipline but there was no formal requirement. In fact, there were no courses in the IT/IS where the EN101 or EN102 requirement was a prerequisite. In 2008, the Liberal Arts Core was modified, which resulted in a university writing intensive (WI) requirement for all undergraduates. It required three designated WI courses, in addition to the existing Liberal Arts Core requirement of the written communication sequence. Each discipline was to include in their program a sophomore, junior and senior course, either in the discipline or as part of the liberal arts core requirements, for example in history, English literature or religion. These courses were to be required of all students graduating at Marymount and should not be transferred in from another institution unless a similar writing requirement could be documented.

For the IT/IS program, keeping in mind the needs of employers and potential accreditation, we decided to modify three existing information technology/systems courses to incorporate the writing-intensive requirements. The IT students are, in general, not high performers in the existing liberal arts core courses. Writing in those disciplines also focuses more on "creative" writing while IT students need to communicate observations and facts such as in a requirements analysis document.

4. CREATING THE WI COURSES

The university required a minimum of 4,000 words (16 pages) of revised writing for each WI course. This could be broken down into multiple pieces. Students are required to refine their thinking, submit drafts and respond to instructor and/or peer feedback. The writing objectives were to be specified separately from the course objectives in the syllabus and the university specified the following student writing outcomes for WI courses (Refer to the website for more details):

- Producing written work appropriate to the discipline through a process that involves drafting and revision based on feedback;
- Developing focused texts that address a specific audience, move effectively between general and detailed, make good use of sources, and engage ideas without distortion;
- Producing texts that show careful attention to fluent sentence structure, grammatical correctness, and proper documentation; and
- Identifying a suitable subject for scholarly inquiry, analyzing appropriate source materials, and supporting a focused argument in a clear and coherent product.

How to get started on this daunting task? To learn more about how other programs were attacking the subject, one of the authors (as the department chair) volunteered to be the school's representative on the Presidential Liberal Arts Core (LAC) Committee, the university-wide committee that reviewed and approved new writing-intensive courses. This provided valuable background information on which courses were selected, how the writing process was implemented, how assignments were selected, and so forth. Understanding this, the department looked at its curriculum and identified the following three courses for conversion to the writing-intensive format:

1. IT210, Software Engineering, a sophomore course covering the entire systems life cycle including requirements definition, a key writing need;
2. IT355, Software Testing, Documentation and Quality Assurance, a junior course that included a variety of written assignments, from a user manual to a testing report with technical writing a major focus of the course;
3. IT489, IT Capstone Project, a senior course that can be satisfied by a research project or a service project, both involving documentation from the project proposal to the final project report.

Some instructions regarding writing for the IT/IS field are common including (Dugan & Polanski, 2006):

- Give assignments a real world context to demonstrate that writing is important in the field;
- Show parallels between the writing process and the software development process; and
- Require revision and conduct peer review of assignments.

These guidelines were used to revise the courses. Initial revisions of these syllabi and corresponding assessments were submitted to the LAC committee for approval. Minor changes were requested as necessary to meet the

requirements. Later in the paper, we focus on the rationale of transforming these IT major courses to meet the WI requirements, while also teaching the content.

5. FACULTY TRAINING

All faculty members, full-time or adjunct, are required to attend a mandatory series of two-part workshops to share best practices before teaching any WI class. Each person attending the training was given a copy of a book on integrating writing in the classroom (Bean, 1996) and asked to bring copies of their approved WI syllabus and at least one proposed assignment. Attendees in each session were from a variety of disciplines allowing faculty to share experiences across the disciplines. Participants also took an online survey about their beliefs and practices about the teaching of writing. The facilitator for the workshop was the university's writing specialist, hired specifically to help the university to implement the WI program.

After an initial review of the writing process, the first session focused on making writing assignments "purposeful, transparent, and engaging" within the discipline and how to respond effectively and efficiently to student writing. Skills learnt from this session included writing clear assignments and how to conference effectively with the student writer. The second session focused on ways to enhance peer review, both in and out of the classroom. The writing specialist facilitated the pooling of ideas for informal writing/revising exercises and links to external resources to support a student's self-help. This session also addressed the special needs of nonnative speakers and students with learning disabilities or poor academic preparation.

After the workshops, participants were surveyed and all participants felt more knowledgeable about the writing process and better prepared to teach the WI courses in their own disciplines. They each revised and refined their class assignments to reflect the integration of specific WI requirements with the content, particularly the draft, review, and final process.

6. THREE CASES

This section includes three cases, each developed around a course being transformed to WI.

Case 1: Software Engineering

IT 210, Software Engineering, is designed to expose students to the entire system life cycle, including requirements analysis, system analysis and design, software development and acquisition, system integration, and system maintenance. It emphasizes that requirements analysis is one of the most important communication channels between software engineers and the clients.

In the course, students are evaluated on the basis of four writing assignments and a comprehensive written project. All the writing assignments are designed to emphasize as well as improve students' writing skills, critical thinking, team communication skills, and professionalism. The four writing assignments and the project involve selection of particular techniques to solve specific problems in the software engineering field. For each, students need to submit a draft document in compliance with the documentation standards dictated by the instructor. All the drafts must be received by the instructor on the due date and the final versions of the assignments are not graded if students do not submit the drafts on time. The draft documents are reviewed by the instructor and by other students in the class. Students must use comments from this review process to prepare the final documentation. The following figure shows the assignments title and length requirements.

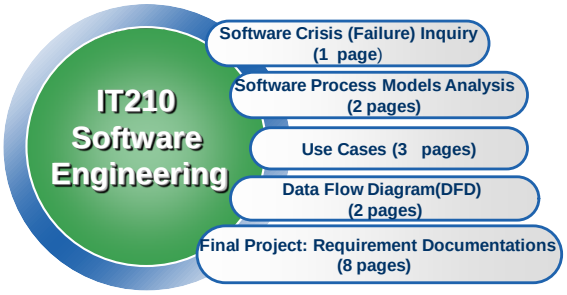

Figure 1 IT210 Writing Assignments

Based on the general advice offered by many researchers, some instructions regarding writing for the computing field are common (Dugan & Polanski, 2006):

- Give assignments a real world context to demonstrate that writing is important in the field;

- Show parallels between the writing process and the software development process, for example, how poor requirements lead to poor software; and
- Require revision and conduct peer review of assignments

To demonstrate that writing is important in industry, the assignments were designed to address real-world scenarios. One sample assignment is shown in Figure 2.

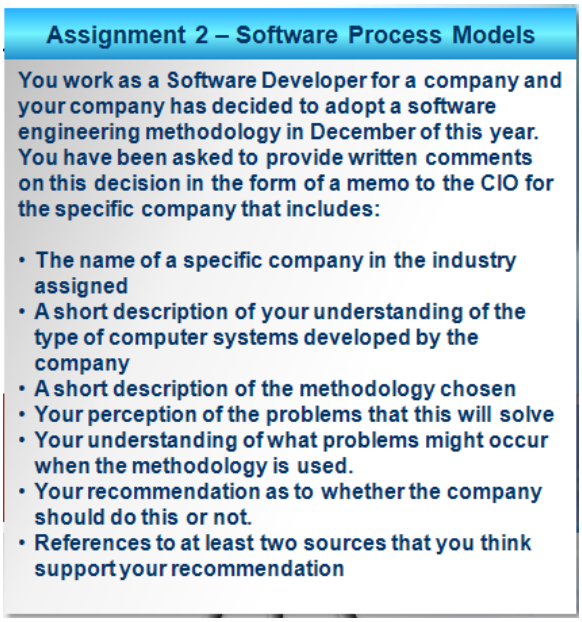

Figure 2 IT210 Sample Writing Assignment

The concept of "peer review" was introduced and the instructor discussed how to perform a good peer review, and led a brief discussion as for why this process is important. The peer review itself was not graded as it is subjective but feedback was given and feedback did improve with practice. Students were given several examples of "constructive criticism" and encouraged to examine their peer's writings critically as well as collegiately. Each student's writing work, with the identity removed, was assigned to two reviewer students as a group. The two reviewers discussed pros and cons for the assigned work and wrote their feedback together. All the peer-review process was implemented through discussion boards on the Blackboard system.

Case 2: Software Testing, Documentation and Quality Assurance

IT355, Software Testing, Documentation, and Quality Assurance, also includes practical experiences with preparing documentation in each phase of the system life cycle. It covers knowledge and skill of software testing, which is much requested by potential employers. The summary is shown in Figure 3.

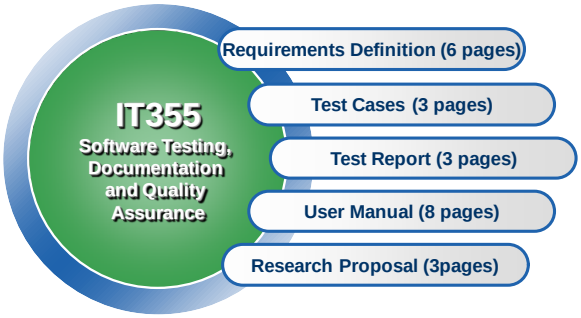

Figure 3 IT 355 Writing Assignments

The first four assignments are based on a simple application built by a graduate assistant: a GPA calculator. Specific errors were built into the software so that students had information to analyze and report. The fifth assignment focused more on the research aspects of writing and students were assigned an advanced topic in software testing (e.g., testing in the cloud) and asked first to do a short literature review. Based on that, they wrote a proposal to a grant-awarding organization to obtain funds for the research. APA format was specified. The instructor used National Science Foundation (NSF) guidelines in reviewing the proposals. All five assignments were subjected to a draft, review and final process. The second assignment, the test cases, was subject to peer review by the students.

There were concerns when first teaching the class as to how the students would perceive writing in a technical class. The writing specialist was asked to attend a class in the first week and independently introduce the university's WI focus. This was extremely useful in setting the tone for the rest of the course. As identified by use of the same writing rubric throughout the course, students definitely improved their writing skills but found it difficult to be critical of each other's work in the peer review process as comments were sparse. However, it is important

to note that these students had not taken IT210 before it became writing intensive.

Case 3: IT489: IT Capstone Course

The assignments for this course are shown in figure 4.

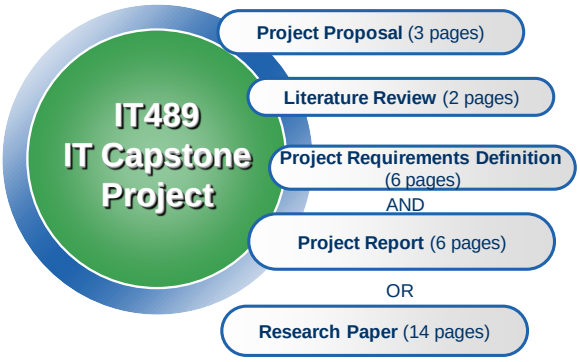

Figure 4 IT 489 Writing Assignments

The IT program requires all students to do both an internship in the field (6 credits) and a final project in their senior year (3 credits). The capstone can either be a project for a client or a research project. In both cases the student is required to develop a number of high-quality documents, following the draft, review and final process used in previous courses. Students are also required to present the results of their work to a panel of faculty and other students. They are encouraged to think of the documents produced as a "portfolio" to be given to potential interviewers during a job interview. Again, the existing students have not yet had the benefit of the other two classes, and we have deferred evaluation until this occurs. However, the students were exposed to literature research. Faculty had to address plagiarism in depth as students tended to cut and paste from these literature sources.

There is no doubt that the use of computers has made academic dishonesty easier (Austin, Baldwin, Li, & Waskett, 2000). The university has a strict policy on academic integrity and all students were required to take a tutorial on the subject. The library staff also held sessions to reinforce originality in writing. Finally, the plagiarism detection tool TurnItIn (see www.turnitin.com) was used to validate their final report.

7. CONCLUSION

Nearly a century after it was first identified as an issue (Kynell, 1995), many IT/IS educators still find it challenging to impart the skill of "writing" in their teaching. In this digital age, our students read more online than ever before. Many lack an understanding that the "creative" elements (for example, good writing and the peer-review process) are independent of the final display media (print or on-line). We believe that educators hold the key to impart the significance of writing to students, whether they intend to go to graduate school or to work in the field. Our experience shows the potential value of teaching students about writing, within the discipline. More data needs to be collected as students cycle through all three courses. It is important that writing is taught as a natural part of the information technology/systems curriculum and students are given multiple opportunities to learn the writing process and to practice and improve. In addition, faculty must be given the training and tools to support this initiative.

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Teaching Case

A Database Design and Development Case: Home Theater Video

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Abstract

This case consists of a business scenario of a small video rental store, Home Theater Video, which provides background information, a description of the functional business requirements, and sample data. The case provides sufficient information to design and develop a moderately complex database to assist Home Theater Video in solving their management problem. Students should be able to create an Access database, populated with data, develop a series of queries, forms, reports, a switchboard, and execute pivot tables that satisfy the functional requirements given by the video store. Teaching notes containing suggested implementation guidelines, suggested deliverables, and the resulting database containing the required queries, forms, reports, switchboard, and pivot tables are provided.

Keywords: database design, database development, MS Access, pivot tables, project case

1. CASE SUMMARY

Home Theater Video, a small video rental store, is faced with the challenge of tracking the rental/sales of DVDs and movie information requested by their customers. Management has realized that the current method of using spreadsheets will no longer be feasible to address their needs of maintaining data and searching for information. Home Theater Video has decided to enter the age of maintaining information in a database to provide adequate support to their customers when searching for a movie/actor, managing customer rental transactions, and support of their back-end processes.

2. FUNCTIONAL REQUIREMENTS

The owner of Home Theater Video (HTV) recognized that prior to the design of the database he would have to collect the functional requirements of the video store to develop a tracking and payment system. After interviewing customers and employees of their needs, he prepared a functional requirements report. The report includes a sample of the data required for the system and the specifications that are needed to develop the database system. Below is the detailed HTV Functional Requirements Report.

Database Requirements

HTV has over 3,000 DVDs that they need to track. Each of the DVDs is assigned a unique number. For each movie, we need to know its title and category (e.g. comedy, suspense, drama, sci-fi). Below is the list of movie categories we use (Appendix Table 1). HTV would like to assign each movie category a unique code, which is included in the list.

HTV gives each movie title a specific id and tracks which movie is recorded on each DVD. HTV also collects the year and rating of each movie. Videos are only stocked in DVD format. We always stock at least one DVD for each movie we carry, but for many of our more popular movies we stock multiple DVDs of the same movie. Each DVD contains a single specific movie. We don't have any movies that require multiple DVDs. The rental fees for our videos vary by the rental code we assign them, please see Table 2 in the Appendix for details. The movies are rented for a 5-day period. A late fee of $1.00 accrues for each day a video is returned after the due date.

HTV customers frequently ask for movies starring specific actors. Tom Hanks and Nicole Kidman are always popular. So they would like to keep track of the leading actors appearing in each movie. Not all of our movies have leading actors, documentaries for instance. Customers like to know each actor's "real" birth name and date of birth. We track only actors who appear in the movies in our inventory and there is no need to differentiate between actors and actresses. By the way, the Screen Actors Guild does not permit two actors to have the same studio name and the studio name never contains a middle name or initial. We would like to search for an actor by their full stage name. There is also no need to have separate fields for their first, middle, and last real names. We are currently using a spreadsheet to keep track of our videos. We have provided a sample report, Sample Movies, for your review in the Appendix Figure 2. All the data we need to track regarding our movies and DVDs is included on this spreadsheet.

There are several thousand customers. We only rent videos to people who have joined our "video club." To belong to our club, they must have good credit. For club members, we'd like to keep their first and last name, current phone number, and current complete address. Of course, each club member has a membership number. The customer list is currently managed with a spreadsheet and a sample for your review is provided in Appendix Table 3.

HTV needs to track the videos each customer currently has checked out, as well as a complete history of the videos each customer has rented. They also would like to track video rental revenue, and late fees collected, - this is to be maintained in a separate details table. A customer may check out multiple videos at any given time. In addition, Home Theater Video would like to track customer payments to maintain the video rental sales. Also, the customers have different payment options. Each Transaction may be paid by Credit Card, Cash, or Check. A small sample of the necessary transaction data is provided for your review below (Appendix Table 4).

For each employee, HTV would like to maintain his or her first and last name, email address, and home phone. A sample of employees is provided in the table below (Appendix Table 5). It is important to HTV to not only track the employee information but also their video sales.

Queries Requirements

As HTV's data collection grows in size, it is important for management and staff to extract or filter information to answer questions. HTV will require a variety of queries to extract information from the database. We have determined that the initial set of queries is to include the following:

Movies Before 2004. What movies released before 2004 does Home Theater Video stock? Display Movie Id and Title.

Membership List. A membership list that displays the member's membership number, last name and first name separated by a comma and a space. Label the column headings as follows: Membership Id and Member's Name.

Actors Using Real Name. List the actors whose studio name is the same as their real name. Label column: Actors Using Their Real Name. The query is to be sorted by the actor's name.

Actors Age. List an actor's studio name, date of birth and age. Sort the list by age with the oldest appearing first on the list. Label the columns: Actor, Date of Birth, and Age.

Fantasy DVDs. What fantasy DVDs does Home Theater Video have? Display Movie Id, Title, and Rating.

Movie Rental Categories. Create a listing of Home Theater Video's movies and their respective rental category. Display Movie Id, Movie Title and Rental Code Description. Sort the list by Rental Code (not description).

Price List. List the individual DVD prices for Home Theater Video. Display DVD Number, Movie Title, Movie Category, Rating, and Rental Price. Use user-friendly column headings. T he rental price is to be formatted as currency. The price list is to be sorted by movie title and category. The output is not to word wrap.

Rental Fee Stats. Create a query to display the minimum, maximum, and average rental fee for each movie category. Be sure to format the appropriate columns as currency and label the columns appropriately.

Actors in War Movies. A listing to display the actors that star in war movies. Display Actor's Stage Name and Movie Title. Sort by Actor.

DVDs Currently Rented. (a) The query is to display the DVDs that are currently rented by members. Display DVD number, Membership ID, Movie Title, Member First Name, Member Last Name, Rental Date, and Date Due. Sort the query by Date Due. Name this query *DVDs Currently Rented*. (b) Modify the query again, this time sort by Member's Last Name. Save this query as *DVDs Currently Rented by Member's Name*.

Daily Revenue. This query is to display the daily revenue by day. Display Rental Date, Total DVD Rental Revenue, Total Collected Late Fees, and Total Revenue. Total Revenue is the sum of DVD Rental Revenue and Collected Late Fees. Collected Late Fees need to be associated with the Returned Date. Sort the query by rental date.

Member Revenue. This query is to list the revenue received by member. Display Member Last Name, Member First Name, Total DVD Rental Revenue (Total Revenue is the sum of DVD Rental Revenue and Collected Late Fees), Total Collected Late Fees, and Total Revenue.

Payment Completed. This query is to display all the DVDs that have been paid completely (balance of zero). Display DVD number, Member Last Name, Member First Name.

Employee Sales. This query is to display total sales by employees. Display Employee's Name (written as: Employee Last Name, Employee First Name), Total DVD Sales. Sort by highest sales generated.

All query column headings are to be clear, concise and accurately describe the contents of the column to the average user. Only universally accepted abbreviations are to be used. All queries, when printed out, should fit on standard 8 ½" by 11" paper when printed in landscape mode. The queries are to be named as they are listed above.

Forms Requirements

HTV needs several user-friendly forms so that our employees and administrators are able to enter data into the database. Some forms will be just data entry forms, these are merely replications of the information in the databases; other forms are needed to combine data from multiple tables. Our management team has provided the following functional requirements for Home Theater Video's input and application forms.

Input Forms

Input forms are to allow our employees to enter, edit, or query data in the given table. These forms are to be columnar type forms that display data or allow for input of one record at a time. The forms are to be user friendly with all the field labels consisting of user-friendly descriptive names.

Input/Query forms are to be developed for the following tables:

- Actor
- Membership (Customer Information)
- DVD
- Movie
- Movie Category
- Performance (What actors appear in which movies?)
- Rental Category
- Payment Methods

Application Forms

Current Rentals. This form is to display the DVDs that are currently rented by a given member. The form when properly formatted is to display the Membership ID and Member's Name at the top of the form in columnar format. The DVD Number, Movie Title, Rental Date, and Due Date are to be in tabular format below the member information. The tabular portion is to display all of the DVDs currently rented for the member displayed in the columnar section in the

top portion of the form. This form is intended to be a query only form and will not be used to input data.

Actor Performances. Home Theater Video wants to use this form to respond to requests by members inquiring about the movies in which a particular actor has appeared. The top portion of the form is to be in columnar format and include the actor's stage name, real name, and date of birth. The lower portion of the form is to include the Movie Name, Rating, Year Released, Movie Category Description, and Rental Fee. This portion of the form is to be in tabular format. This form is intended to be a query only form and will not be used to input data.

DVD Rental Data Entry. The purpose of this form is to allow for the data entry or querying of DVD Rental data by member. The form is to be divided into two sections. The first section is to display member related data: Membership ID, Member's First Name, and Member's Last Name. The second section is to allow for the display of past rentals as well as the entry of new ones. This section is to include the following fields: Membership ID, DVD Number, Rental Date, and Rental Fee. The bottom portion of this section is to contain a textbox that keeps a running total of the member's rental fees. This field should look like a total field on a report and appear under the rental fee column and be labeled: Total Rental Fees.

Payment Forms. Home Theater would like to display a screen that allows for the data entry or querying of payment information. The form is to include member and rental transaction information. Display member related data: Membership ID, Member's First Name, and Member's Last Name (make these so users may not make changes to it, a query only query). The display of transaction and payment information should include the following fields: Rental Date, DVD Number, Movie Title, Rental Fee, Sales Tax, Total Amount Due, Date Due, Payment Method, Payment Date, and Payment Amount. The Payment Method should be a drop down box with options. The Total Amount Due should be a calculated field based on the rental fee and sales tax. The sales tax rate is 8%.

Report Requirements

There are several initial reports required by the HTV management team. The individual report specifications appear below. All sub-totals should have a line above the subtotal and the grand total should have a double line above the total. The sub-totals and grand totals are to be appropriately labeled with descriptive labels appearing immediately to the left of the totals.

Membership Report. This report is based on the Membership List Query and is to display each member's Membership ID and Name (last name and first name separated by a comma). Sort the report by Membership ID.

Movie Rental Categories Report. This report is based on the Movies Rental Categories Query. The report is to display the Rental Code Description, Movie Title, and Movie Id. The data is to be grouped by Rental Code Description. The report is to be sorted by Rental Code Description and Movie Title.

DVDs Currently Rented Report. This report is based on the DVDs Currently Rented Query. The report is to display Date Due, Membership ID, Member's Last Name, Member's First Name, DVD number, Movie Title, and Rental Date. The report is to be grouped by Due Date and Membership ID. All of the member information for a specific member is to appear on the same line. Sort the report by Date Due, Membership ID, and DVD Number.

Daily Revenue Report. The Daily Revenue Query forms the basis for this report. Display Rental Date, Total DVD Rental Revenue, Total Collected Late Fees, and Total Revenue. Group the report by month. All revenue columns are to be totaled by month and for the full report. Sort the query by rental date.

Daily Detailed Rental Category Report. Create a report to display detailed daily revenue by rental category and movie. Display Rental Date, Rental Category Description, Movie Title, and Total Rental Fees by Title. Group the report by Rental Date and Rental Category Description. Total the Rental Fees by Rental Category, Rental Date, and the full report.

Switchboard Requirements

HTV management wants to create a system that any of the employees can use, where they are not required to know the specific tables or queries to gather or input information. A menu system in which employees can easily access forms and reports will assist in the cohesiveness and accuracy of data. Below are the minimum

requirements for the switchboard that HTV needs.

The database is to have a menu system designed for our everyday users. The menu is to be user-friendly and contain selections for all the forms and reports. Home Theater Video company colors are red, black and gray. The management team would like to use either the Metro or Technic AutoFormat Style and wants to see the HTV logo (see Figure 1) on the switchboard, forms, and reports.

Figure 1. Home Theater Video Logo

- The menu is to be executed automatically when the database is opened and the database window is to be displayed in the background.
- The menu is to contain an exit selection that will exit the database application.
- Two Main Menu Options - One for employees/management and the second for customer information.
- Within the Employees/Management Switchboard, two sections exist in this Switchboard – Forms and Reports. These sections should include the following:

Employees/Management Switchboard

Enter/View Information Forms. This main link will give Home Theater Rentals access to submit or view information in the different tables. Links should be created with the following labels:

- Enter/View Actor Information – link to Actor Input form
- Enter/View Employee Information – link to Employee Input form
- Enter/View Movie Information – link to Movie information including DVD Number
- Enter/View Rental Category Information – link to Rental Category Information
- Create a link to query only forms for the Current Rentals and Payment Forms application forms. Name the links: Current Rentals Form and Payment Process Form

Reports. Create a link to all five of the reports created earlier

Customer Information Switchboard

Customer Information. Create a link to the customers input form. This should be an input only form.

Membership Rentals. Create a link to the current rentals form. This should be a query only form.

Actor Performances. Create a link to the actor performances form to allow customers to review which movies their favorite leading actors have performed in. This should be a query-only form.

Each part of the switchboard should be user friendly. Therefore, there should be an easy way to move in and out of menu selections. Also, HTV would like to have exit buttons on the forms and reports to close them properly.

Pivot Table Requirements

Home Theater Video would like to use the information in the database to discover trends among their rentals. In particular, the management team would like to know which employees are making the most sales and which movies in which categories are generating the most revenue.

Based on the Home Theater Video database, create two queries in MS Access to export to MS Excel. The output of each query should provide HTV with information to determine (1) each employee's total sales by rental category and by day and (2) each movie rental by movie category and by month. Next export the query output into Excel and create the pivot tables that display (1) each employee's total sales by rental category and by day and (2) each movie rental by movie category and by month.

3. DELIVERABLE REQUIREMENTS

Deliverable One

Create the database structures (tables and relationships) necessary to meet the functional requirements as set forth by Home Theater Video's management. Create meaningful column names when creating your tables. The data types and sizes should be appropriate for the data as described in the scenario. The

tables are to be populated with the data contained in the Home Theater Video functional requirements.

Deliverable Two

Create the queries, forms, and reports as discussed in HTV's functional requirements. All developed queries are to use only the tables or other queries necessary to make the query fully functional. You are to incorporate the Home Video Theater logo into your forms and reports.

Deliverable Three

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Develop two additional user-friendly forms for the employees at Home Theater Video. Insert additional data using these forms to demonstrate how the employees will use these forms to enter new data into the database. Create the navigational menu, as set forth in the HTV functional requirements, to navigate between all forms and reports.

You are to create the necessary pivot tables that meet HTV's functional requirements to assist management in understanding Home Theater Video business trends

Editor's Note: Instructor notes for this case may be found at: http://csbapp.uncw.edu/edsig

APPENDIX

Table 1. Movie Categories

Code	*Category Name*	*Code*	*Category Name*	*Code*	*Category Name*
ADV	Adventure	FNT	Fantasy	SFI	Science Fiction
ANM	Animation	HOR	Horror	SHK	Shakespeare
BIO	Biography	HST	History	SPT	Sports
COM	Comedy	MUS	Musical	SUS	Suspense
CRM	Crime	MYS	Mystery	THR	Thriller
DOC	Documentary	POL	Political	WAR	War
DRM	Drama	RLG	Religious	WST	Western
FAM	Family	RMC	Romance		

Table 2. Rental Categories

Rental Code	*Description*	*Rental Fee*
CH	Current Hit	$3.50
CR	Current Release	$3.00
PP	Popular	$2.50
NR	Normal	$2.00
SP	Special	$1.00

Table 3. Sample Customers

Home Theater Video
Sample Customers

Membership Id	First Name	Last Name	Address	City	State	Zip Code
WELLA01	Charles	Wellard	2809 Linden Street, Townhouse #3F	Winston-Salem	North Carolina	27104
WELLA02	Paula	Wellard	185 Washington St	Clemmons	North Carolina	27127
STOVE01	Lee	Stover	888 Flower Crt.	Winston-Salem	North Carolina	27104
BALLE01	Steven	Ballenger	333 Lake Drive	Winston-Salem	North Carolina	27106
BALL01	James	Ball	123 North Rideout Rd	Clemmons	North Carolina	27127
BISHO01	Lee Ann	Bishop	723 McCormick Ave	Winston-Salem	North Carolina	27106
LINK01	Stephen	Link	1023 West Embassy Drive	Washington	District of Columbia	20036
SPARR01	Mary	Sparrow	456 Whitesburg Road, Apt. 200	Winston-Salem	North Carolina	27104
LINGE01	Bruce	Lingenfelter	56 Charles Drive	Clemmons	North Carolina	27127
SMITH01	Phil	Smith	44 Maynard Drive, Flat #2C	Winston-Salem	North Carolina	27104
GULED01	Sherly	Guledge	777 Monroe Road	Pfaff Town	North Carolina	27040

Table 4. Sample Rentals

Movie Title	DVD Number	First Name	Last Name	Rental Date	Due Date	Date Returned	Rental Fee	Collected Late Fees	Accrued Late Fee	Total	Employee ID	Payment Type
Catch Me If You Can	133	Lee Ann	Bishop	2/1/2011	2/6/2011	2/5/2011	$ 2.50			$ 2.50	305	credit card
Harry Potter and the Prisoner of Azkaban	126	Lee Ann	Bishop	2/1/2011	2/6/2011	2/5/2011	$ 3.50			$ 3.50	305	credit card
Harry Potter and the Prisoner of Azkaban	128	Lee	Stover	2/2/2011	2/7/2011	2/10/2011	$ 3.50	$ 3.00		$ 6.50	305	cash
Million Dollar Baby	137	Lee	Stover	2/2/2011	2/7/2011	2/10/2011	$ 3.50	$ 3.00		$ 6.50	305	cash
Master and Commander	124	James	Ball	2/3/2011	2/8/2011		$ 2.00		$ 7.00	$ 9.00	301	cash
Master and Commander	125	Stephen	Link	2/3/2011	2/8/2011	2/6/2011	$ 2.00			$ 2.00	302	cash
Ray	149	Sherly	Guledge	2/3/2011	2/8/2011		$ 2.50		$ 7.00	$ 9.50	303	cash
Ray	148	James	Ball	2/3/2011	2/8/2011		$ 2.50		$ 7.00	$ 9.50	304	cash
Harry Potter and the Prisoner of Azkaban	127	Phil	Smith	2/4/2011	2/9/2011	2/7/2011	$ 3.50			$ 3.50	305	check
Hotel Rwanda	145	Paula	Wellard	2/4/2011	2/9/2011	2/14/2011	$ 3.00	$ 5.00		$ 8.00	302	cash
Cold Mountain	119	Lee Ann	Bishop	2/5/2011	2/10/2011	2/6/2011	$ 2.00			$ 2.00	302	cash
Harry Potter and the Prisoner of Azkaban	126	Charles	Wellard	2/5/2011	2/10/2011	2/8/2011	$ 3.50			$ 3.50	302	cash
Million Dollar Baby	136	Steven	Ballenger	2/5/2011	2/10/2011	2/8/2011	$ 3.50			$ 3.50	304	credit card
Spanglish	140	Steven	Ballenger	2/5/2011	2/10/2011	2/8/2011	$ 2.00			$ 2.00	304	credit card
Spider-Man 2	141	Bruce	Lingenfelter	2/5/2011	2/10/2011	2/10/2011	$ 3.50			$ 3.50	304	cash
The Lord of the Rings: The Two Towers	103	Bruce	Lingenfelter	2/5/2011	2/10/2011	2/10/2011	$ 2.50			$ 2.50	304	cash
Master and Commander	125	Phil	Smith	2/6/2011	2/11/2011	2/7/2011	$ 2.00			$ 2.00	305	check
Priates of the Caribbean	112	Mary	Sparrow	2/6/2011	2/11/2011		$ 2.50			$ 2.50	305	cash
Million Dollar Baby	136	Stephen	Link	2/8/2011	2/13/2011	2/11/2011	$ 3.50			$ 3.50	301	credit card
Priates of the Caribbean	115	Stephen	Link	2/8/2011	2/13/2011	2/11/2011	$ 2.50			$ 2.50	301	credit card
Spider-Man 2	142	Stephen	Link	2/8/2011	2/13/2011	2/11/2011	$ 3.50			$ 3.50	301	credit card
The Green Mile	111	Steven	Ballenger	2/8/2011	2/13/2011	2/11/2011	$ 2.00			$ 2.00	303	cash
The Lord of the Rings: Return of the King	121	Steven	Ballenger	2/8/2011	2/13/2011	2/11/2011	$ 2.50			$ 2.50	303	cash
The Terminal	138	Charles	Wellard	2/8/2011	2/13/2011		$ 3.00		$ 2.00	$ 5.00	304	check
Spider-Man 2	143	Lee	Stover	2/10/2011	2/15/2011		$ 3.50			$ 3.50	302	credit card
							$ 70.50	$ 11.00	$ 23.00	$ 104.50		

Table 5. Employee Information

Employee ID	*Employee Name*	*Email*	*Phone*
300	Rob Mason	rmason@video.com	336.559.5656
301	Pamela Anderson	panderson@hometheatres.com	336.456.4567
302	Sheree Todd	stodd@hometheatres.com	336.214.3698
303	Mike Thompson	mthompson@hometheatres.com	336.789.4563
304	Marie Saunders	maries@hometheatres.com	336.123.4567
305	Matt Saunders	matts@hometheatres.com	336.258.3698

Figure 2. Home Theater Video Sample Movies

DVD Number	Movie ID	Movie Title	Rental Category	Movie Year	Movie Category	Rating	Leading Actor	Actor Real Name	Birth Date	Lead Actress	Actress Real Name	Birth Date
101	1001	The Lord of the Rings: The Two Towers	Popular	2002	Fantasy	PG13	Elijah Wood	Same	28-Jan-81	Cate Blanchett	Catherine Elise Blanchett	5/14/1969
102							Ian McKellen	Same	25-May-39			
103							Sean Astin	Sean Patrick Duke	25-Feb-71			
104												
105												
109	1002	The Green Mile	Normal	1999	Drama	R	Tom Hanks	Thomas Jeffrey Hanks	9-Jul-56			
110							Michael Clarke-Duncan	Same	10-Dec-57			
111												
106	1003	Mystic River	Normal	2003	Crime	R	Sean Penn	Same	17-Aug-60	Marcia Gay-Harden	Same	8/14/1959
107							Tim Robbins	Timothy Francis Robbins	16-Oct-59			
108												
112	1004	Pirates of the Caribbean	Popular	2003	Fantasy	PG13	Johnny Depp	John Christopher Depp II	9-Jun-63	Keira Knightley	Same	3/16/1985
113							Geoffrey Rush	Same	6-Jul-51			
114												
115												
116												
117	1005	Cold Mountain	Normal	2003	War	R	Jude Law	David Jude Law	19-Dec-72	Renee Zellweger	Same	4/25/1969
118										Nicole Kidman	Same	6/20/1967
119												
120	1006	The Lord of the Rings: Return of the King	Popular	2003	Fantasy	PG13	Sean Astin	Sean Patrick Duke	25-Feb-71	Alexandra Astin	Same	11/27/1996
121												
122												
123												
124	1007	Master and Commander	Normal	2003	Adventure	PG13	Russel Crowe	Same	7-Apr-64			
125							Paul Bettany	Same	27-May-71			
130	1008	Spider-Man	Popular	2002	Science Fiction	PG13	Tobey Maguire	Tobias Vincent Maguire	27-Jun-75			
131												
126	1009	Harry Potter and the Prisoner of Azkaban	Current Hit	2004	Science Fiction	PG	Daniel Radcliffe	Same	23-Jul-89	Fiona Shaw	Fiona Mary Wilson	7/10/1958
127							Richard Griffiths	Same	31-Jul-47			
128												
129												
132	1010	Catch Me if You Can	Popular	2002	Crime	PG13	Martin Sheen	Ramon Antonion Gerard Estevez	3-Aug-40			
133							Leonardo DiCaprio	Leonardo Wilhelm DiCaprio	11-Nov-74			
134							Christopher Walken	Ronald Walken	31-Mar-43			
135							Tom Hanks	Thomas Jeffrey Hanks	9-Jul-56			

Figure 2. Home Theater Video Sample Movies - continued

DVD Number	Movie ID	Movie Title	Rental Category	Year	Movie Category	Rating	Leading Actor	Actor Real Name	Birth Date	Lead Actress	Actress Real Name	Birth Date
136	1011	Million Dollar Baby	Current Hit	2004	Sports	PG13	Clint Eastwood	Same	31-May-30	Hilary Swank	Same	7/30/1974
137							Morgan Freeman	Same	1-Jun-37			
138	1012	The Terminal	Current Release	2004	Comedy	PG13	Tom Hanks	Thomas Jeffrey Hanks	9-Jul-56	Catherine Zeta-Jones	Catherine Jones	9/25/1969
139												
140	1110	Spanglish	Normal	2004	Comedy	PG13	Adam Sandler	Same	9-Sep-66			
141	1119	Spider-Man 2	Current Hit	2004	Science Fiction	PG13	Tobey Maguire	Tobias Vincent Maguire	27-Jun-75	Kirsten Dunst	Same	4/30/1982
142												
143												
144	1143	Hotel Rwanda	Current Release	2004	War	PG13	Don Cheadle	Donald Frank Cheadle	29-Nov-64	Sophie Okonedo	Same	3/26/1968
145							Nick Nolte	Nicholas King Nolte	8-Feb-41			
146	1206	The Polar Express	Popular	2004	Animation	G	Joaquin Phoenix	Same	28-Oct-74			
147												
148	1213	Ray	Popular	2004	Biography	PG13	Jamie Foxx	Eric Marlon Bishop	13-Dec-67			
149												
150												