Technology in the Classroom: Using Video Links To Enable Long Distance Experiential Learning

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ABSTRACT

The experiential learning process is a method by which students learn from direct exposure to relevant applications within the discipline being taught. One way in which MIS students can benefit from experiential learning occurs when organizations in some way sponsor curricular outcomes. Sponsorship can range from classroom visits during which company representatives can provide students with perspectives on the duties and responsibilities of currently available jobs at their firm to complete participation in a particular course, which could include the assignment of a project, assistance in presenting the concepts to be studied and providing feedback on the results. For organizations located at some distance from the university, participation is generally minimal and may occur only once per year during recruiting visits. In this age of technological advancement, there is a wealth of opportunity for practitioners to play a much larger role in education and bring their experience and techniques directly to the classroom, regardless of their geographical separation from the students. Inexpensive video links can create a virtual classroom that encourages participation by organizations to take advantage of these opportunities; however, the technology is only a means to an end, which is to enhance technical education within an experiential learning framework. This paper discusses the issues that may arise in implementing a virtual classroom and the application of experiential learning in a virtual classroom that can benefit students.

Keywords: Experiential learning & education, Videoconferencing, Team teaching, Instructional technology

1. INTRODUCTION

The focus of MIS education is to learn both business and technical skills that are directly applicable on the job for which a student would be hired either after graduation or, to a lesser extent, between semesters as an intern. This post-secondary education is necessarily general in nature because of the high variability in work practices found in the companies that higher graduates; however, some specificity exists in the tools, techniques, programming languages, and DBMSs used in the classroom. The result is that MIS graduates are later trained in the specific tools, languages, DBMSs, systems analysis techniques and business processes by the company that hires them, because each firm does things differently and the more general MIS education cannot cover all specific techniques. The higher education model therefore proceeds from general to specific as the student moves from the classroom to the company as an employee, a deductive approach. Upon graduation, the firm must then train the recent hire on their specific tools and techniques, and so at this point, the education model proceeds from specific to general, an inductive approach.

But what if the model were reversed (somewhat) by allowing the firm to train students in their techniques and methods while still in the classroom? Would this benefit the student and the educational process? Would the student become more competitive upon graduation? If so, how would such a model be accommodated? The technology to accomplish this has been around for some time, but its use has been prohibitively expensive. Using more modern and less expensive technology, the virtual, real time classroom has not only become possible, it offers a richer learning experience on a much larger scale than has heretofore been offered.

This type of virtual classroom and experiential learning goes beyond what has been offered in recent history. Video links and teleconferencing have been used in the classroom, but have primarily been confined to linking prerecorded video case studies (Boling, 2007) and other students in remote classrooms (e.g., West, 2010). In the former case, teachers are able to link via a web browser to a case study found somewhere on the Internet and present this to the class, while in the latter case, classrooms located in various parts of the world are able to interact in real time with one another. Additional uses include exercises to enhance team building and interpersonal skills (Alexander & Pryor, 2009) and service-learning through the development of community projects (Hoxmeier & Lenk, 2003; Wei, et al., 2007). While these uses are appropriate, innovative and exciting for the participants, this technology has not been fully exploited to

create a virtual classroom and implement a model of experiential learning.

What role would the firm play in such a model? The purpose of this paper is to document a classroom experience and reveal the methods by which it was accomplished, highlighting the obstacles, the failures and the successes that resulted.

2. BACKGROUND

The capstone MIS course in many universities involves a group project that attempts to bring together all of the principles presented in previous courses. Students are given a project and expected to determine the user requirements and convert these into software artifacts that include a back end (the database), a front end (the user application) and any connections that are required in between. They must utilize some sort of analysis and design methodology to uncover all the user requirements and convert this into both a logical and physical design. Tools used may include integrated development environments that document all requirements, model them and convert the models into a software design that includes both the data storage techniques and the user interface (usually graphical in today's classrooms). The project is therefore non-trivial because of all of the activities that must be performed and made as realistic as is possible in the short amount of time that is available.

Projects can be created from a number of sources. Textbooks often include examples, which make good instructional assignments; local businesses may offer assistance and ask that the student teams create a web site for their firm or other such application; or teachers may invent a realistic project based on their own experience and insight (cf. e.g., Mitri, 2008). Occasionally former students get involved and provide real world projects from their own firm for the students to analyze and design (cf. e.g., Heim, et al., 2005). In some cases these projects can be transferred to the firm for production use, and so the incentive of cheap labor, the desire to make a difference at one's *alma mater*, and the ability to assess the students as potential employees become reasons why firms might be involved and to help ensure that a strong pool of job candidates will result from the degree program (Heim, et al., 2005). We now look at the case of alumni involvement and extend it so that the firm's employees become *ad hoc* instructors during the projects class. In order for this to happen, the employees need to take an active role in the classroom experience along with the students. This can be a formidable challenge for firms and employees who are located at some distance from the classroom; however, a virtual classroom with video links can be set up to allow such collaboration relatively easily and cheaply.

Tools required to link instructors and students include video links and collaboration software. Video links can be set up using any one of a number of products (many are open-sourced and therefore free) to broadcast both audio and video images over an Internet link, requiring only a web cam and a microphone at each end to complete the link. The link itself is established between computers and thus does not generate any additional charges over regular Internet connection service, and so this can be an attractive method for both parties involved. Some common products used for video teleconferencing include Cisco TelePresence, Polycom, Tandberg and Skype. Collaboration software is an optional addition, and can provide a method for the students and instructors to share screens. This is important for slide presentations and for demonstrating software programs and artifacts. Some products designed for collaboration include IBM Sametime or Team Workspace, Microsoft NetMeeting or Meeting Space, Citrix GoToMeeting and Cisco Meeting Place or WebEx. We discuss how these tools are best utilized in the Methods section.

Several alumni of a Midwestern university from a large petrochemical company expressed the interest in participating in our capstone projects class. These alumni wanted to become involved in the final stages of the education of MIS students so that they could provide additional instruction in areas that they felt were important and to have a closer look at students who might be considered for job placement within their company. However, the geographic separation between the college and the firm made it necessary to create a virtual classroom. Both the University and the firm had sophisticated video conferencing capabilities (Polycom), and the firm utilized a collaboration tool (Cisco Meeting Place) capable of screen sharing, chat windows and other features. In addition, the firm's video conferencing system allowed multiple sites to participate, so three way communications were also accommodated when needed. The video conferencing tools were used only to create a virtual classroom in which the students could see the instructors and talk directly to them in real time. The collaboration software was used for presentation purposes so that if the instructors wanted to introduce the students to a particular technology or method, the students could see it separately from the larger screen used for the virtual classroom. Later, when student teams began to produce artifacts for evaluation by the instructors, they shared their screens with the instructors and were able to demonstrate the software capability. The result was a truly virtual classroom in which both students and instructors had a clear view of each other and of the software tools needed for instruction and presentation.

The assigned professor was a 12 year veteran of MIS classroom instruction who attended each class (on the student side). This professor was responsible for keeping things on track and ensuring that all pedagogical goals were met. Because the alumni instructors were not experienced in classroom instruction, but did have good industry experience, the combination of an experienced professor and experienced alumni generated a symbiotic relationship that followed a prescribed pedagogical plan and provided real life systems development experience for the students. The teaching model formulated was based on the theory of experiential learning discussed next.

3. THEORY

Experiential learning was introduced by Kolb (1984) and has been discussed and used in the classroom in many different disciplines, especially where computers and information technology are involved. Stringer (1999) calls for more discussion and action on the subject and compares traditional

teaching models with those based on technology. Glover (1999) aligns himself with Thoreau (the 19th century philosopher who shunned nearly all technology in favor of a simple life) and seeks to rid the classroom of information technology and replace with an experience of nature. Hester and Hirsch (1999) attempted to make the computer the source of experience. The students they tested provided mixed levels of agreement with the general premise—some agreed that the computer experience was effective, while others voiced skepticism in the efficacy of the learning outcome or as an experience altogether. Within the MIS discipline, there is a large number of teaching cases that focus on the use of experience with certain examples but are not linked directly to experiential learning (e.g., Mitri, 2008, 2010; Steiger, 2009; Newby & Nguyen, 2010; Wagner & Pant, 2010). Additional work has been done in MIS that directly links the capstone, project oriented course to experiential learning (cf. e.g., Abrahams & Singh, 2010; Heim, et al., 2005).

The course was designed to follow the precepts of experiential learning initially created by Kolb (1984) and later modified by Georgiou, et al. (2008). Kolb's discourse on experiential learning has been researched significantly in the last two decades, but his original thesis of four learning modes has been largely preserved intact. Georgiou and his colleagues come from a research background in systems methodology and applied this line of thinking to experiential learning. They claim that two of the modes (reflective observation and active experimentation) identified by Kolb are actually activities that link the two actual learning modes (concrete experience and abstract conceptualization) together (Georgiou, et al., 2008). The basis of their argument is that only two of the modes actually provide learning, while the other two act as transforming processes of the knowledge gained in the other two (Georgiou, et al., 2008).

Georgiou et al. (2008) further claim that the primary purpose for the cycle of learning identified by Kolb is to include both deductive and inductive learning modes in the learning process so as to complement the beneficial effects of each. A deductive learning mode occurs when instruction is given on a concept and examples are presented to illustrate the concept. This is a general-to-specific approach as the students are instructed in general theory and then shown how the theory is applied in a specific situation. Inductive learning occurs when students are presented with problem cases for which they must identify the critical issues, determine what methods should be used to solve the problem, implement those methods and interpret the results (Georgiou, et al., 2008). This is a specific-to-general approach as students work on specific problems and must later generalize their approach to other similar problems. When used separately, both types of learning have their benefits and problems, but when combined into a systemic framework, the students are able to learn theory and apply it to practice in a way that both reinforces the theory and enhances critical thinking about it (Georgiou, et al., 2008). The combination of the two makes for a much more powerful learning experience.

A projects class that makes use of this framework would need to include both presentations in theory and commensurate practice in problem solving related to the theory (the deductive approach) as well as specific problems or projects that can be generalized to an all-inclusive conceptual framework or theory (an inductive approach). Therefore, preparatory discussions with the alumni focused on designing the course to comply with these processes. It was decided that theory should come from two sources—what had been learned in previous classes and what could be presented during the projects class itself that would delve into new and unexplored areas. The former is a natural conclusion and *raison d'étre* for a capstone course in any discipline. The latter results from the desire of the sponsoring firm to introduce its own techniques to the students and to emphasize some methods and techniques that they perceived were not covered adequately during the degree program when they were students. These included improving project management skills, increasing the importance and time spent on requirements gathering, documenting all activities, and developing, implementing and testing a post-implementation strategy. The alumni prepared presentations to cover these subjects and with the assistance of the assigned professor, scheduled salient presentations to coincide with assigned activities for the students so that students would receive instruction on specific techniques just prior to needing to use them.

4. METHODS & COURSE DESIGN

Designing the course included the following steps:

1) Determine the level of alumni involvement;
2) Establish and test a video link;
3) Establish and test the collaboration software;
4) Set the class schedule and location;
5) Determine the outcome goals for the course;
6) Evaluate and select a project;
7) Set the classroom protocol and agenda;
8) Determine how to assess and provide feedback to the students;
9) Establish a schedule and the protocol for final presentations; and
10) Provide final feedback (grades) to and obtain feedback from the students.

While these steps are not necessarily listed in temporal order, they do generally follow the sequence of the course. We now provide more details about these steps.

4.1. Alumni involvement

How much the alumni become involved in the course is a decision based upon many factors, which include their level of interest, their own work schedules, the policies of their firm and agreement by their managers and the degree to which the assigned professor wants them to be involved. At a minimum the alumni should select a project for the students and either assess the outcomes or participate in presentations of the final software artifacts produced by the students. If the alumni want more involvement than this, then the next step is to allow them to provide specific instruction on their firm's techniques and procedures and provide feedback to the students at the end of each stage of implementation. Further involvement can include acting in different roles—as users, as managers and/or as technical

assistance—and to monitor and gauge the student progress along the way.

For our class, the alumni became adjunct instructors allowing them maximum participation in the course and involvement with the students at each step in the process. Weekly meetings were held during which the instructors would present a topic of interest, make an assignment for the students to complete prior to the next class meeting and listen to each student group present on their accomplishments from the prior week. On some occasions the instructors acted as users so that the students could practice requirements gathering techniques with them, and to verify information about the project that they had already collected. During the week, the students had direct access to the assigned professor, but were restricted in their communications with the alumni instructors. No direct communications were allowed, but they were able to send a limited number of e-mails to the instructors to answer questions. This limitation was imposed to simulate working with real users who might not have the time to devote to such communications. The alumni instructors also graded each student team presentation and discussed the grade and the feedback with the assigned professor before giving it to the students. (The assigned professor actually forwarded the grades and the feedback.)

A final question regarding alumni involvement is how many alumni to include. We found that a total of six was not too many, because the work schedule of the alumni did not permit all of them to attend every class. This left an adequate number of alumni with the expertise in enough of the areas subsumed by the project so that questions could be addressed during the class session and did not need to be tabled for an answer at a later time.

4.2. Video and Software Links

Each end of the video link was set up so that a web cam and microphone system could broadcast audio and video images from the entire room. The images were projected from a central projector to a screen situated at the front of the room; audio was delivered through speakers placed in the room. The classroom used is a computer lab with a workstation at each seat. Students could log into the collaboration software, which was set up at the firm's end, and all students could see the desktop of whoever shared their screen at the time.

While the university and the firm both had video links and collaboration software, these linkages were not without problems. An audio-only teleconference was used at any time when the video was not available for one reason or another. Testing of this medium before the class begins is a requirement as valuable class time could be wasted trying to work out the problems. Collaboration software is an optional addition to the tools mix, but it accomplishes two things: first, if presentation slides, diagrams or charts are needed, the software allows all participants with computers to see it without having to switch the main presentation screen from video of the participants to the presentation; second, the students can show their results and demonstrate functionality to the remotely located instructor team and receive immediate feedback. This latter feature is what really enhances the virtual classroom and increases its effectiveness.

4.3. The Class Schedule & Setting

In a university setting the class schedule is usually taken care of well in advance of the semester during which classes are offered so that students can enroll and properly adjust their schedule. When preparing for a class of this nature, course designers should consider scheduling it during an evening so that company sponsors are able to attend without interruption of their work schedules. Also the class should be scheduled in a computer lab or classroom equipped with computers for the students to effectively interact with the instructors. If a lab is not available, students should bring laptops and have Internet access. We found that with as many as 20 to 25 students on line at a single time, our 100 Mbps local network suffered no difficulty in serving all students simultaneously and the video and audio links ran smoothly without impairment. Some students also brought laptops that connected through wireless access points that served the entire building. These links also performed well with no interruption in service.

4.4 Class Outcome Goals and Project Evaluation

The learning goals of the class may be dictated by what is already established in the course catalog, and this was certainly the case at our university; however, the assigned professor has an enormous amount of latitude in how the goals could be accomplished and which goals could be emphasized or downplayed. The basic goals were established from the description of the course: a "study of the interrelationship of organizational information systems and how these systems support managerial decision making." The learning objectives were therefore established as creating and implementing a system used to accept, modify and supply information used in a business process for decision making purposes.

To identify a project that would meet these stated goals and meet the other qualifiers required some thought. The project itself was chosen from among several alternative projects that were being considered by the firm. These projects had passed the scrutiny of a steering committee that decided they could move forward, and so the alternatives were considered potential live projects, thus adding the measure of realism that the class needed. Additional factors that were considered included: the project should be complex enough to challenge the students, but not so complex that the instructors would have difficulty in teaching it or that it could be solved and implemented within the time frame of one semester; it should include as many of the systems development components (systems analysis & design, database, end user interface and connectivity functions) as possible; and the final deliverables should be put into a form that firm representatives would be familiar with.

The project that was selected for this class involved a scheduling program that would provide information to work center leads regarding the status of current IT projects. The company felt that the information required to keep projects on track was fragmented and should be accessible in a more efficient way so that IT workers could have their assignments more effectively balanced and any projects that were approaching a deadline or could go over its estimated cost would be flagged and could then receive immediate attention. The project required the students to evaluate the

business need for the system and quantify its benefits (i.e., establish a business case to move the project forward); determine, limit and manage the scope of the project; extract and document the requirements from the users; design and build a database to store all the data; and design, implement and test a user front end to interact with the data. All activities had to be identified and documented in project management software as the project moved forward. This required an initial assessment of activities and revisions as more information was gained. Revisions included both adding or changing activities and specifying their length of time to completion and due dates.

The course content, delivery methods and responsibilities and learning objectives are summarized in table 1 below.

Content	Delivery Method	Delivery Responsibility	Learning Objectives
Project Management	Lecture, software demo, student presentations	Instructor, alumni and students	Review of PM techniques and software; How to evaluate and control activities
Requirements determination	Examples & Software demo, Interviews with users	Instructor, alumni and students	Review of systems analysis & design techniques; Use of software to document the requirements and relate them to the final software artifacts
Database design	Examples & Software demo	Instructor	Review proper database design
Front end (user interface) design	Integrated Development Environments (IDEs); student presentations	Students	Match the user interface to the requirements
Database Connections	IDEs; student presentations	Students	Learn how to perform database operations from the user interface
Software Testing	Lecture, examples, templates	Alumni and students	Learn how to create and implement a testing strategy
Final presentation of software artifact	Student presentations	Students	Improve presentation skills and present to management

Table 1. Content, Delivery Method, Delivery Responsibility & Learning Objectives

4.5 Classroom Protocol

The alumni instructors and the assigned professor created a schedule for each class period in advance. These were provided to the students on day 1, while expectations for each class were provided a few days before the scheduled class meeting. In this way the students knew generally what to expect at each class at the beginning of the term and knew the specifics of each class on a week-by-week basis. Early classes contained instructions for the students—first in general terms regarding the project itself and later in more specific terms as new concepts were introduced. Later classes contained less and less instruction and a greater focus on student activities. Thus the classes were organized so that the instructors could present new material to the class all at once during the first 45 to 60 minutes, and then each student team was given an opportunity to either present what they had accomplished the week before or was allowed to interview the instructors (who fulfilled the role of users) in order to extract requirements for the project. Each team went independently and other teams were excused to prevent unintentional cross-collaboration between teams. Teams were given 15 to 20 minutes for their presentations, and this had to be strictly enforced in order to accommodate all the teams in the time allotted. This required a bit more preparation on the part of the student teams so that they could make full use of their time.

When each team finished, the instructors asked for two specific inputs. They first looked at the team's project management activities to ensure that all activities were properly documented and were receiving the correct amount of attention so that they could be completed by their due dates. The instructors were interested in whether the students were making the correct amount of progress and this exercise helped to answer that question and reinforce to the students the importance of project management. They then asked each team member what his or her contribution to the team effort was during the past week. Each team member then had to explain his or her efforts in front of the other team members. This helped students to determine whether their work for the team was adequate or not.

If any time was left after student team presentations, the assigned professor could cover some subjects or the students could be allowed to work in their groups on the project. In the initial part of the term, most of the time was taken up with lectures and presentations, but as the projects began to advance, less and less time was spent on developing concepts and more was given to the students to work in their groups.

4.6 Assessment and Feedback

The instructors and the assigned professor met via telephone conference each week one day after the class to discuss the students' progress. One day was allowed so that the instructors would have time to come to a consensus on what they had observed, put together a set of notes containing their observations for each student group, and provide a grade for each group that was justified against the expectations that were given previously to the students. While not all of these sessions began with the assigned professor agreeing with the alumni assessments, all discussions ended in agreement as discrepancies were discussed and arguments made to justify a position. The instructor team then e-mailed their comments on each team to the assigned professor along with expectations for the next class. After minor editing, the professor forwarded the e-mail to each group, recorded the grades and posted the expectations on the class web site for the next week.

Students were given grades for nearly every class session since they were assigned some activities for each class. Only the beginning classes had no assigned student activities. In the early classes, the activities consisted of conducting interviews; in the later classes the activities consisted of presenting the results of their actions during the ensuing week.

4.7 Final Presentations

Projects of this magnitude should always be presented by the student teams so that the sponsoring firm can evaluate not only whether the students did a good job in implementing their solutions, but also to determine whether their involvement was valuable or not. Because the alumni had to obtain approval for their involvement from management, it was decided that the students should present their solutions to both the alumni instructors and to management. This raised the bar for both the students and the instructors—students were given visibility by a level of management with which they probably had not interfaced on a professional basis before, and the alumni were under pressure to ensure that the students would not only provide successful solutions, but that their presentation skills would meet company standards. This necessitated a practice session so that all the kinks in the student solutions and in their presentations were worked out ahead of time. Just as a theatrical group puts on a dress rehearsal, the student teams were asked to give a final presentation one week prior to their actual presentation to management. They were then admonished to continue to practice during the intervening week, and in some cases, to work out any bugs that might have been discovered in their project. The alumni acted as management during these practice presentations and would ask questions they thought were relevant and might be asked by their management to give the students an idea of what the interests of management might be and help them better prepare.

The other component, and probably the most difficult, in scheduling the final presentations is determining the actual dates and times that each team will present. We found that the last week of school was the optimum time for this since the presentations had to be given during the working day and it was nearly impossible to schedule all students in the final exam week; however, the other sticking point was the schedule of all the executives and managers who wanted to attend. As it was, most of the executives attended some, but not all, of the presentations. Each attendee was asked to rate the presentation along a number of guidelines, and these assessments were used in the final grade for the project solutions.

Presenting to managers marks a significant difference between an experiential model that utilizes a virtual classroom established through video links and one that is conducted on site. When guest instructors participate in a class that is on the university's site, it becomes more difficult to involve managers in any of the classroom activities, because the additional time needed just to travel to the university can be excessive. A virtual classroom removes the problem of logistics and allows managers to participate from anywhere. Because it eliminates the need for travel, the demand on the managers' time is reduced and the probability of their involvement is greatly increased. This fact may improve manager participation in a classroom of this sort even if they are located in the same city.

4.8 Final Grades and Feedback

The final grades were a composition of all weekly grades, all deliverables and an assessment of the final presentation. Deliverables included all documentation, user requirements, diagrams and models, database design and implementation, and the coding for all front end artifacts. These were assessed for completeness, functionality, robustness and performance of the solution and whether it solved the business problem. While the alumni had input on all graded items and the managers attending the final presentation also were able to critique and assess the final results, the assigned professor maintained full responsibility for assigning final grades. This was more of a legal issue than a curricular one, since most students enjoyed the support provided by the alumni and the alumni and the professor eventually agreed with all grades assigned, even if it came after some discussion.

Several forms of feedback were used to provide instruction to the students, elicit their reactions to the course and to assist them in improving their deliverables. First we gave them an initial quiz to determine their starting knowledge point. This quiz contained several questions to determine what students retained from previous courses such as systems analysis and design, database and programming concepts. An example was, "The Systems Development Life Cycle (SDLC) is divided into several distinct phases.

a. Please list those phases. If a phase has sub-phases, please list them.

b. Briefly describe the types of activities that should be conducted in each phase.

c. How much time should be spent in each phase (listed as a percentage of the overall project)?"

A satisfaction survey was administered upon completion of the course. One of the primary uses of this survey was to help the management of the sponsoring firm to evaluate the value of the course to the students.

The students were also asked to complete peer evaluations on their teammates. These evaluations were used to scale the final grade downward for any student who was deemed not to pull his own weight during the life of the

project. For most students this was not a problem; however, a few who were lacking in prerequisite skill sets (e.g., programming) were adjusted downward by a full letter grade. Many students who were lacking initially in technical skills either learned quickly how to supplement their skill sets or contributed in ways other than the more challenging portions that required programming or writing stored procedures, such as in requirements gathering, documenting the project and activities, project management or testing software artifacts.

5. RESULTS

How does one assess the results of a course like this? This has been the topic of discussion for some time (cf. Gosen & Washbush, 2004) with no real metrics having been produced. In fact we cannot determine whether experiential learning of this sort is valid and valuable any more than we can show that it is not (Kolb, 1984; Checkland, 1981). However, there are several popular metrics that can be used to "triangulate" on the result of student development (Heim, et al., 2008). These include feedback sessions, class participation, surveys, the software artifacts and all other project deliverables, presentations and peer evaluations. All of these metrics were used in this study and in addition, we have the professional judgment of the assigned professor and of the alumni instructors. While the alumni have little experience in teaching at the collegiate level, they can certainly assess student presentations, deliverables and their technical ability as reflected in the final software artifact, because they have baseline comparisons from their own work and from new hires at their organization. Another metric not mentioned here that is also in popular use is attendance. Because we required attendance at each class session, we did not include that as a viable metric for this class. We now discuss each of these metrics.

5.1 Feedback Sessions

Each student team was evaluated after their presentations or question and answer sessions each week and provided with written critiques. Theses critiques were based on how closely the student groups were able to meet the objectives set in the expectations document that was provided to them the week before. What we observed was that in some cases, students may have had some difficulty in one area or another, but became alert that such a shortcoming would be more closely scrutinized in subsequent sessions. This offered an incentive for improvement and this is what the team and the professor saw in most groups. Only one group lagged behind the others and this was a technical skills issue, but the team's final project seemed to address most of the required functionality. The team was forced to cut their losses and simply accept slightly less functionality in the end product. Overall, we judged that the students were very responsive to the feedback that we provided and seemed to learn about themselves as a result.

5.2 Class and Project Participation

One requirement that was established at the outset was that each student member of the team should take part in any presentation or question and answer session. Students quickly learned that they could be penalized for not participating and the result was that those who had not participated in one session would improve and offer some meaningful insight in subsequent sessions.

Class participation is not the only metric that we used. The alumni were not bashful about asking each member what he or she had done in the previous week to contribute to the group effort. Students were necessarily honest about their work since their teammates were sitting and listening to them, and so those who did not contribute in one week (and saw their weekly grade lowered as a result) quickly learned that contribution was a key part of their grade and they became motivated to work harder.

5.3 Surveys

We mentioned that the students were asked to complete satisfaction surveys at the end of the course, and we found that all students agreed that not only was this an interesting course, but it was both an effective and valuable method of learning. The survey was more of an opinion poll used primarily by the sponsoring firm to provide feedback to management.

While additional metrics are available, such as personality and learning style, which could be used to group students together, we made no attempt to do so, but instead grouped them on the basis of skill level. Using the course pre-test as a guide, we formed groups consisting of students with both strong and weak skill sets. We felt that such a balance among the teams would enhance the competitive nature of the class.

5.4 Project Deliverables and Artifacts

The alumni team was aware that their employer (the sponsoring firm) was in need of a method to track IT project resources more closely and they felt that the student groups could provide them with one of three outcomes: 1) several ideas for how to go about solving the problem and developing a custom application themselves, 2) an application that would solve the problem but would need some modification before it could be deployed within the company, or 3) an application that could be deployed almost immediately with very little modification needed, if any. The third option was considered the ideal and although achievable, it was not expected. The second option was considered the next best result, and so a competition was set up among the student groups to try to motivate them a little more, believing that the knowledge that their project would go on to production would be a strong motivator for the students to produce a high quality application with maximum functionality and help them strive for an application that would be complete. Two projects were chosen that would clearly satisfy option 2 above. All other student designs contributed to satisfying option 1.

All of the student projects exceeded the expectations of the alumni and the managers. About half the students created desktop applications, while the rest created web applications. All of them were tied to either an Oracle or DB2 back end, and all worked flawlessly during the final presentations. The databases were all housed on a separate server and so students were forced to code the connections so that the applications could run from anywhere and

maintain security that was safe from SQL injection, packet sniffing and other compromising actions. Because the front to back end connections were an area that the students had not yet dealt with before, they had difficulty with it, but they did solve it, and this provides a strong and convincing measure of learning achieved during the term.

The instruction team felt that the students had learned an amount that would exceed a comparable projects class based purely on a case study of the same magnitude but without the assistance of sponsoring alumni. They based this judgment on the additional amount of instruction that the alumni instructors added to the pedagogical mix. The students had to make use of methods and techniques that they had learned in previous classes and combine the previously unknown methods and techniques of the sponsoring firm. Some of these methods were challenging and included the use of the firm's templates for 1) establishing the business case, 2) documenting requirements, 3) creating a testing strategy and implementing it, and 4) documenting and managing an execution plan that would change slightly as more information became known. Because the students were able to assimilate these methods is another strong indication of the learning achieved.

5.5 Student Presentations

The students were required to present what they had accomplished each week. Their presentations were measured against a general rubric that was provided at the start of the semester and against a set of expectations that were posted the week prior. The final presentation had to be in a format familiar to the firm's managers, especially all documentation. This is why the company's templates (mentioned above) were used.

On other occasions they were required to interview the users in order to extract the functional requirements of the system, and these interviews were also graded against the same general rubric. It became clear that the students were learning about the system and how to implement it very quickly.

5.6 Peer Evaluations

Students were asked to evaluate their teammates only at the end of the term. These evaluations were confidential and had the potential for affecting a student's final grade. While Hernandez (2002) recommends that a confidential evaluation that does not count toward the students' grades also be conducted at the midpoint of the semester, we employed a different model to give the teams a sense of independence and autonomy. By asking each member to delineate his or her contribution to the group's effort in front of the other team members, we felt that students a) would provide an accurate and honest appraisal of themselves and b) would divide the work among team members equitably. Expectation a) results from the social pressure generated in a

Learning Objective	Teaching Technique	Anticipated Outcome	Actual Outcome
Project Management skills	Presentation and observation	Learn how to list pertinent activities and manage resources and schedules	Steepest learning curve: it took students a while to learn what activities to include and how to list them
Software analysis & design	Interviews, surveys, examples, discussion, work in IDEs	Students were expected to have these skills at the outset	This was the easiest part for the students; although some had difficulty learning
Database design	Examples, discussion	Students were expected to have these skills at the outset	While students had the requisite skills, most had some difficulty in properly structuring the data they were given
Perform database connections	Examples and discussion	Learn how to perform modifications of the data with a user interface and how to call and execute stored procedures	Students needed close instruction initially, but soon learned how to attach data stores to front end components such as text boxes and tables
Software coding	Use of IDEs for model and code generation, debugging and documentation	Students were expected to have these skills at the outset	While some of the software IDEs were new, all were Eclipse based and were easy for the students to assimilate
Developing a testing strategy	Lectures, examples, templates, student presentations	Students would develop a strategy that highlighted all potential problems and find fixes for each	Students created strategies that were more complete than expected
Oral and written communications	Practice throughout the semester by giving presentations and submitting written documentation	Students would learn to speak and write effectively	Students wrote reports and gave oral presentations on what they had done; they learned quickly how to improve their communications skills through feedback

Table 2. Pedagogical Comparison

group environment, while expectation b) is an application of Herzberg's (1964) two factor theory—that increasing the responsibility of workers leads to an increase in motivation.

We compared the results of the peer evaluations to the weekly self-reports and found that they were in general agreement. Students accurately described their roles and actions during the semester, based on what their peers said about them at the end of the term. Those students who were found to be loafing at the start of the term quickly learned that their grade would suffer if they did not contribute, and so they changed their behavior. Students who were weaker in technical skills often put in extra effort in the less technical aspects, such as organizing, project management and documentation.

Team dynamics were reviewed with the students each week so that each member could be exposed to the strengths and weaknesses of working with the other members in their group. In this way the students learned how to improve their own dynamics as the semester progressed—a team learning experience very similar to the model proposed by Kayes, et al. (2005). Further, we believe that the students learned better how to cope with team dynamics, were more strongly motivated to be productive and began to learn the differences between classroom and on the job environments and expectations.

5.7 Summary of Results

A summary of the learning objectives, teaching techniques and anticipated versus actual outcomes is provided in table 2.

6. DISCUSSION

The pedagogical model presented here is based on a theoretical framework rooted in experiential learning (Kolb, 1984) and in systems thinking (Georgiou, et al., 2008). It accrues certain advantages and disadvantages to the students, the instructors and the sponsoring firm, and of course, to the Professor and the University. We now discuss each of those benefits and detractors.

6.1 Benefits

6.1.1Students The students were provided with a real world problem taken from an active project in the sponsoring firm. To accomplish this task, they were also given the support of several employees of the firm who were highly qualified on all of the areas that the project would encompass. While this sort of training may be available at other universities, we have not heard of such a large amount of involvement by the alumni and the sponsoring firm in the literature. If students were to try and find (and employ) trainers who are still active members in a firm to accomplish this same type of training, the cost would be prohibitive if it was available at all. Aside from this, students began the transition from student to full time employee one semester early (while still in school).

They were trained in company techniques that complemented what they had already learned as part of the collegiate curriculum in MIS, but now they saw specific application of these techniques. Student feedback regarding the type of training and their opinions about the transition were highly positive. Examples of student comments on the course that reflect the general student sentiment included:

1) *This course provide (sic) me with real hands on experience and efficiently (sic) work at a team to accomplish a goal. Liked it a lot.*
2) *This was a great group [to] work with they made the semester very enjoyable for me.*
3) *I thought this was a good experience, but I think if I got to choose my teammates it would be more meaningful and less stressful. (Note: This student complained that two of his members were deficient in most technical skills and therefore a hindrance to the work.)*
4) *Truly enjoyed the group and the dynamic.*
5) *This is the best group project experience I have had up to this point.*

Although the project was a difficult task, a motivating factor for the students was that the alumni instructors had previously sat where they now sat in the not too distant past. These alumni had all gone through a very similar process and were now working to improve that experience for the current students.

6.1.2 Instructors The alumni instructors asked for and were given a chance to return to their *alma mater* and contribute directly to the curriculum. They seized upon this opportunity and worked hard to improve the outcome for all of the students. They were also exposed to collegiate teaching methods and it is expected that this will provide them with advantages at their firm as they train new hires. These alumni expressed satisfaction in having assisted in the course and for them, making the transition from student to teacher was especially gratifying.

6.1.3 Sponsoring Firm The company devoted a number of resources to the effort. They allowed six employees some latitude in scheduling their time in order to participate, they donated their communications and collaboration resources, and they paid for the alumni visits to the campus for a final awards banquet. The approval for the expenditure of these resources came from the Vice-Presidential level because the total cost to the company exceeded a threshold level. The benefit from their involvement came as receiving a number of potential solutions at minimal cost to a problem that needed to be solved; as the ability to evaluate students as potential new hires for an extended period of time; and as the ability to contribute to the university's curriculum through an experiential learning model.

6.1.4 The Professor One obvious advantage to the professor comes in the form of satisfaction—seeing former students making the transition from student to teacher. This can only occur if these alumni have learned the lessons from both the classroom and from the on the job training they received at their firm. They must have succeeded both when you taught them and within the business for which they now work.

Another advantage is that the professor is having someone else teach the class and observing their methods. These alumni bring a different style of teaching that helps the professor evaluate his or her own methods and find areas that can be improved. They also bring techniques of systems analysis, design, implementation and testing that they have learned and adopted at their firm and this can broaden the professor's view of the practitioner's world.

6.1.5 The University The reputation of the university is enhanced as word gets out regarding the relevance of the projects it assigns within the MIS curriculum. Employers become involved and want to offer projects and interview students prior to graduation. The students are more fully prepared for the business world having obtained this real world experience and are more competitive in the marketplace. This also helps the university's recruiting efforts as more and more pre-college students hear of the success of recent graduates.

6.2 Disadvantages & Negative Aspects

6.2.1 Students Students at times were overwhelmed with new information, especially in the first part of the term. Exposure to new methods and techniques took some time to assimilate. Students also had to plan their time so that they could also meet the expectations of the other classes in which they were enrolled, and, given the rigor of senior level courses, this was often difficult. While we cite time management as a challenge, we could also cite it as a benefit for them as it will better prepare them for the more complex activities they will face as MIS workers after graduation.

6.2.2 Instructors The alumni had to devote an enormous amount of time to preparatory work as was discussed earlier and during the semester had to devote one night per week to the virtual classroom. Occasionally they had to answer questions via e-mail from the student groups and this took away from their time on the job. Weekly teleconferences with the assigned professor were also scheduled during the work day that took away from their productive time at work.

6.3.3 Sponsoring Firm The company certainly made an investment of people, time and resources to the class, and as with any such investment, it comes with a certain amount of risk. A number of negative outcomes might have resulted, which could damage the productivity and reputation of the sponsoring firm. The alumni were therefore required to justify their involvement to their employer and identify any risks that might be encountered along with a plan for mitigating these risks. Company data was also shared with the students that had to be sanitized so that employee privacy was protected and scrutinized to prevent the leakage of any proprietary information. Violations of either of these could be very damaging to the sponsoring firm, and so close attention had to be paid to these issues. Thus the whole sponsorship represented a risky investment for the firm, and management had to ensure that safeguards were in place before the decision to sponsor could be approved.

6.3.4 The Professor An advantage cited above is that the professor now has a staff to teach his or her course; however, this does not lessen the workload, and in fact it may increase it. This situation requires more planning and foresight to ensure that everyone understands what is scheduled and why. Communications now extends to several others (the alumni instructors) in order to ensure that classroom time is not wasted and that there are no misunderstandings from either the instructors or the students. Each class period needs to be properly planned and choreographed and this is an enormous burden in excess of what a professor might normally experience. In addition, alumni with no teaching experience require constant monitoring so that focus is maintained on the learning objectives that are set at the outset.

One example of a potential misstep that the professor needed to correct occurred when the alumni decided to cancel a class in favor of a basketball game that was being played that evening. University policy prohibits cancelling courses for any athletic event, and so this was quickly added back to the schedule.

6.3.5 The University While there may be other disadvantages to the university, the only issue that surfaced for us came up during the planning phase. The firm feared that there might be some proprietary information in the data that was provided to the students and they asked for a non-disclosure agreement. University attorneys quickly explained that any such agreement with students was unenforceable. After communicating this to the alumni, the firm simply required that any confidential data be sanitized before being made available to the students. We were able to avoid this problem, but it may limit the type of project that a firm may be willing to assign to students if data cannot be sanitized easily.

7. CONCLUSIONS & FUTURE DIRECTIONS

Effectively implementing a projects (capstone) class requires attention to three specific areas: preparation, execution and assessment. These areas must be done with the assistance of the sponsoring firm and its representatives, regardless of their level of involvement. When preparing and planning this course, we found that the items that require the most attention are those that deal with:

1) Framing the project to ensure that it covers the requirements for the course and achieves its goals;
2) Setting the expectations and clearly communicating these to the students; and
3) Setting the classroom agenda and procedures to keep the class running smoothly.

Proper execution of the course is dependent upon student preparation (i.e., have they done their work and are they ready to present it?); instructor preparation (i.e., do you know what you will cover and how you will assess the students?); and the performance of the technology (i.e., do the video and collaboration links work?). Assessment is a key issue that must be discussed before-hand so that rubrics can be agreed upon and clearly stated for the students. If they don't know what you expect, then they won't know how to prepare.

In this study, the alumni were deeply involved and this required weekly discussions on progress, efficacy and improvement. The involvement was made possible through technology because the alumni were not located close to campus and this prohibited weekly face-to-face meetings. We found that two types of technology are best suited for this level of involvement—video linking and collaboration software. Video linking is a must so that students can see their instructors and get a feel for what it is like working in a corporate environment. The alumni instructors bring the company policies, procedures and climate directly to the classroom and help the students learn not just about the

technology with which they are working, but about the transition from student to full time IT employee. Collaboration software, while optional, is a convenient way to share computer screens back and forth from the classroom to the corporate site. This frees up the larger display for its intended purpose—to allow the students to see the instructors and the instructors to see the students. Items displayed on the computer screens include presentations and software artifacts that can be demonstrated, analyzed, reviewed and critiqued from a large geographical distance.

Upon completion of a video linked projects class, the reputation of the college is enhanced in two ways. First, the students become more competitive in the market because they have had practice in designing, implementing and presenting a real project to a firm that would likely use most of what the students had designed. They increase both their technical and interpersonal competence as a result of dealing directly with users, managers and technical experts. Second, other companies hear about such work and begin to offer to take part. Since completing two semesters with one firm, our college has been approached by no less than three other firms for the same purpose without solicitation. In addition, we have approached several other firms who are members of our advisory council with similar proposals and have received a substantial amount of interest.

Future modifications of our model include requiring teams to share their work. That is, for each team to complete an independent design of the project and then hand over their design plans to another team for implementation. This mirrors the way many companies work and is in consonance with the job specifications of the various types of jobs that an MIS graduate may take. A systems analyst will uncover all the system requirements and propose a solution that is handed to a programmer. The analyst may have to interface with a database administrator to determine how the data is currently stored and how this may affect a new system. Our educational curriculum is designed to train students on all positions, but in reality, their career may focus on only one. It makes sense to modularize a project so that students can get a better glimpse of how the separation of job function actually is manifested in a firm.

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