Using Live Projects in the Classroom

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Abstract

As instructors we are always trying to improve the classroom experience, making it more interesting and meaningful to the student. Typically, I like to have team projects in our classes. In the past many of these projects were from the text or projects I have worked on in industry and have modified to fit in the context of the class. I've always wanted to use live projects in class but have been reluctant because of the issues it can present not only for myself as an instructor but also the students and project stakeholders. This past year I offered a senior level Computer and Information Technology (CIT) class that involved live projects, one internal to our campus and a second project with a local company. In this paper I will discuss how we developed and delivered the class. I will review the structure of the class along with what worked and what we would change, I will also review feedback from the students that participated in the class and the stakeholders from the two projects we chose.

Introduction

As an instructor, one of my goals is to make the classroom experience meaningful and interesting for the students. One where they can maximize their learning. Over the years I've noticed the students' interest level tends to increase whenever I'm able to bring a real life component into the classroom. In the spring 2013 semester we had several students nearing graduation needing an upper level class. It turned out most of the students had taken a variety of classes and none of the regular courses would work for all the students. We have a course CNIT 390 Supervised Practicum in the curriculum. Generally, this class is used as a service learning course, which was the original intention. The CNIT 390 is an instructor directed practicum designed to combine university study with work experience related to the Computer and Information Technology (CIT) plan of study. We had not offered the CNIT 390 course in Columbus before.

Eight students enrolled in the course. All of the students were CIT majors and either juniors or seniors. In terms of student experience it was across the spectrum. Several students had a great deal of experience having interned at a local company as programmers. Two students even had their own IT consulting company. On the other end of the spectrum several of the juniors had no experience outside the classroom.

Over the semester we had two clients volunteer to work with the CNIT 390 students. The first client was internal to Purdue. The Mechanical Engineering and Technology (MET) Department had recently set up a metrology lab on campus. The department wanted to make the lab available to local businesses. They also wanted to have a presence on the web to supply information to the public about the service they planned to provide.

The second client was the primary client for the students over the semester. The company Insul-Coustic is a company in northern Indiana that designs and manufactures custom noise and thermal products for farm, construction and industrial equipment. The company has annual revenue of five to ten million dollars and has experienced large growth over the past few years. Several of the company's processes were a combination of manual and automated operations using Microsoft Excel. Although the system worked, it had several issues and with the company experiencing strong growth they were interested in exploring options that would make the process more efficient.

Purdue Polytechnic

Purdue President Mitch Daniels introduced a plan called Purdue Moves which is a range of initiatives to enhance educational opportunities for its students among other things. Part of that Purdue Moves is a funded effort of the College of Technology called the Purdue Polytechnic Institute (PPI). PPI is aimed at transforming the college through renewed undergraduate programs, a state of the art approach to how learning occurs, applied research, and a renewed focus on workforce development. The approach taken in the CNIT 390 course falls directly in line with the values and beliefs articulated about the PPI. Among the more important points, PPI values student autonomy with their learning and believes that learning is a personal act of discovery with faculty playing the role of supporting rather than driving the students' learning. PPI also values open ended inquiries that have inherit risks and are one of the keys to learning and creativity. The PPI values intrinsically motivated students and just in time approach (learning when needed to solve a problem) as opposed to just in case (in case it might come up on a test). Finally, the PPI believes that although individual mastery is important students need to learn to collaborate as it improves individual learning. CNIT 390 aligns well the goals of the Purdue Polytechnic Institute.

Planning the Course

Delivery Format

We had several options for delivering the course, traditional, hybrid or online. I wanted to reserve a time that I could ensure that students would be available so I chose a modified hybrid class format. For scheduling, the class was set up as a traditional 3 credit hour class with time reserved on Monday and Wednesday afternoons. I did this for several reasons. First, I wasn't sure going into the class how much instruction time I would need and I wanted to be flexible. Second, I wanted to make sure students had a common time they would all be available to meet and if I went with an online class I wouldn't be able to guarantee that. Finally, I wanted to have time set aside for the clients to have meetings with students. My plan was to be flexible with my schedule and allow students and clients to control the direction of the meetings.

The basic class organization was to meet in a traditional format the first two weeks for class management that will be elaborated on later. The class would then be handled as a project with regular updates and deliverables based on a rough schedule I had developed.

Originally, we planned to have one project with Insul-Coustic and the MET project was a backup that would be utilized if there were issues with Insul-Coustic or time left over at the end of the semester. With this plan the schedule for the class was to meet the first two weeks (4 class sessions) to cover the

introduction to the class. This was everyone's first time in a class with this format, including myself. Topics such as team skills assessment, assigning team member roles, introduction to the client's company were necessary. The client wasn't present; however, I had students research the industry and company on the internet and had some preliminary information for the students from an interview I conducted before the class began. Also, about half the students had not been through our project management course so I wanted to spend some time discussing project management. Upon finishing up the introductory content my plan was for the students to work on the project as they would in industry. They would go through the System Development Life Cycle (SDLC) using a methodology of choice such as waterfall, incremental, agile, or rapid prototyping.

For the rest of the semester I outlined a basic schedule that included:

Week	**Topic**
Week 3-4	Client interviews and work on CONOPS
Week 5	Deadline Concept of Operations (CONOPS) document
Week 6-13	Scheduled updates with project manager and project work
Week 14	Project due
Week 15	Project reports and documentation due
Week 16	Project lessons learned

Role of the student, client, and instructor

After determining the class organization and basic template for the schedule it was important to determine the roles for everyone. The parties involved included the clients, students and the instructor. For the class we had two clients, Insul-Coustic and Mechanical Engineering and Technology Department. In soliciting clients I tried to find companies that would be willing to spend time with the students in their role of client on an IT project. For Insul-Coustic, one of the owners agreed to work with the students. He made space in his schedule to work as a client on a regular basis. Because the company was based in Fort Wayne (3 hours away) and the owner lives in the Indianapolis area (1 hour away), I offered to do most of the meetings electronically, via Skype, conference call, etc. However, he was very interested in participating and wanted to be physically present as often as possible and committed to tentatively be available approximately every other week and available for email contact on a regular basis. As owner he was also responsible for working with clients developing the estimates and scheduling projects which was the major component of the system that was to be developed. He was able to give the students access to others in the company that would be useful in developing the system like the Insul-Coustic (IC) IT specialist. The Insul-Coustic IT specialist is responsible for supporting the network and a host of purchased applications along with some homegrown applications and is not responsible for new development. The second client was the Site Director for Columbus and also MET professor in charge of the metrology lab. He also agreed to spend time with the students and was the person with the most knowledge of the system requirements.

Next, as instructor I had a dual role. This was my first time in a project based class. My role as instructor was to be responsible for evaluating the students for the purpose of determining a grade. In terms of the project I wanted to take a more "hands off" approach, and assume more of a guidance role. In order to do this I chose to have a role as more the person in charge of application development instead of a project manager. At first I thought I would be the project manager. However, I wanted the students to

have someone they perceive as a peer to take that role. I felt this role would allow me to guide development without getting too much into the day to day development. If I was project manager it might inadvertently discourage students from participating or expressing their opinions.

The student's role was set up as the IT group. The goal was to cover all of the functions that would be required to run through the Systems Development Life Cycle. The original thought was the course would have 4 or 5 students and that would work well with the project, big enough to perform all of the necessary functions but small enough that students had functions that they could perform. However, we ended up with eight students enrolling. This unexpected head count caused the initial plan to need modifications. There were several options as to how to handle that. First, we could have had the two teams work on the two projects separately, the Insul-Coustic project and the MET project. Having met with both clients before the start of the semester in order to get a general idea of the scope of the project I decided the IC project was much larger in scope and would require many more resources than the MET project. The MET project would require designing and building a basic webpage for the metrology lab and probably could have been handled easily by one or two students in a few weeks. The Insul-Coustic project scope would require more resources and abilities than we had available to accomplish it in a semester. What I decided to do was to create two teams initially and have them create the separate Concept of Operations Document (CONOPS). A concept of operations is a document describing the characteristics of a proposed system from the viewpoint of an individual who will use that system. It is used to communicate the quantitative and qualitative system characteristics to all stakeholders. After both CONOPS were created and reviewed by the client and instructor we would decide on the approach to the project. Based on the CONOPS that we chose to follow the class would then combine and continue with the project. My reasoning for this approach was to give everyone a chance to get a strong knowledge base for the larger Insul-Coustic project from the beginning of the semester, rather than having several students work on the MET project at the beginning of the semester and then have to catch on the primary project later. The plan for determining student roles on the project was to select two students to be project managers and then with the assistance of the instructor and students filling out a skills matrix determine appropriate roles. When the two teams combined one project manager would continue to act as project manager and the other would be the assistant project manager.

Evaluate student performance

Planning to evaluate student performance created a challenge. I wanted to make sure that everyone would be evaluated individually and since I would not be part of the day to day activities it was more difficult to ensure that occurring. What I decided to do was a combination of activities that involved not only me but the students and clients in the evaluation process. Following are items that I chose to evaluate students on:

Evaluation	**Notes**
Writing assignments	Two assignments, one due around midterm and the second at the end of the semester focusing on reflection on the project
Project update memos	One for the team delivered by the project manager, all students on the team received credit
Class assignments, homework	Activities related to the project given as assignments, such as having each student fill out project time sheets weekly
Client evaluations	Clients would provide input as to student performance

Peer evaluations	Students would provide input as to student performance
CONOPS	Evaluated by instructor and the client
Application including software and documentation	Evaluated mainly by the instructor for quality with input from the client

All of the items were given equal weight with the exception of the client and peer evaluations. They were awarded about ½ the value of the other items.

Client student interaction

It was important for the students to have access to the clients to successfully complete the project. Prior to class I interviewed both clients and specifically asked about their availability. Both Insul-Coustic and MET were very receptive to meeting with the students. Students would not be able work on site with Insul-Coustic so every effort would need to be made to maximize the time when the client was available. For MET the site director was on campus and had no semester long conflicts with the day/time that the CNIT 390 class was scheduled. The original plan was that I would schedule the Insul-Coustic client with specific dates on the calendar and then let the pace of the project dictate additional meetings. Those dates would be set up with the client as needed.

Manage Expectations

This type of class was new to the students, the clients and me, as the instructor. Managing expectations would be a necessity. First and foremost, I wanted to manage the expectations of the clients involved. To that end I met with each client before the start of class and reinforced the purpose of the project which was to give students a real project to work on. I wanted the clients to understand that the students were competent but that this was a learning experience and it might not go as expected, emphasizing we were hopeful that we would produce a product that would meet their needs but making sure they were aware that it may not live up to their expectations as well. This went over well and there didn't seem to be any issues before the start of the class. Student expectations were managed throughout the course and began with a written assignment pertaining to expectations within a project based class. In the class introduction I tried to emphasize that this was different from other classes. We were working for a client and producing a product for that client and their effort reflected not only upon themselves but on Purdue and if they weren't up to that task they should consider taking another class.

What happened – the delivery of the course

Insul-Coustic Quoting System Project

The owner of Insul-Coustic was very accessible for the students throughout the project. Early on in the project he would visit campus for meetings weekly and throughout the project came at least every other week as requested. Only a few times did he have to reschedule because of pressing issues and this might have been good for the students since this can often be an issue while working on projects in industry as well. Because of the distance the students didn't work at the IC site and met at the Purdue campus.

The scope of the project was very large and with the limited time and capabilities they had to be narrowed to develop a system to handle the quoting process. I started out having students work on the CONOPS document in two teams of four so everyone would get a feel for the company and project. The plan was for the students then to work through the Systems Development Life Cycle to accomplish the planning, analysis, design, and implementation. After the CONOPS was finished and the students were combined into one project team with the two project managers reassigned to positions of project manager and assistant project manager. The approach the students wanted to take was a similar to the Agile or a System Prototyping where the goal was to work in short cycles to get something to the user to test, use and give feedback. Based on the project, user availability and length of the class they chose to work in two week cycles, which was acceptable to the client. The student and client agreed on the scope and determined that if there was additional time at the end they could add features to the project. Based on the user requirements, the students chose to develop a web based application written in PHP, JavaScript and HTML and using MySQL for the database. As mentioned, there were eight students in class and at the beginning all eight worked on this project. The roles the students played were: one student acted as the project manager, one student as assistant project manager, two students as programmers, one student as database designer and developer and three students working on documentation and testing. In reality the two programmers ended up doing quite a bit of the design not only in the program but also with the database. As the semester progressed it was apparent that some students were being over utilized (the programmers) and others being underutilized (documentation and testing). At this point two students were pulled from this project and placed on the MET webpage project. The project was finished about one week late but I had built in a two week cushion in the semester schedule, so they were able to complete the system, documentation and training by the end of the semester.

Mechanical Engineering Technology Webpage Project

I had one potential client back out of the class project at the last minute and I wanted to make sure we had a backup plan with an additional project in case the Insul-Coustic project was complete or there were issues. Our site director in Columbus was interested in developing a website for the new metrology lab on our campus. It became apparent that students were being underutilized on the project after midterm. After confirming with the student project manager I pulled two students from the Insul-Coustic project to work on the MET webpage project. The two students chosen were the two with less experience and had been relegated strictly to testing and documentation. I was hoping to give both a little live experience as both a systems analyst and programmer. Students were in charge of determining the client's requirements and then developing the webpage while still working with myself and the original project manager. Although this was the students' first live project they were able to complete the project and documentation by the end of the semester.

Reflecting on the experience

Instructor's reflections

This has been a very eye opening experience from my perspective as an instructor. Going into each semester I try to go into the class very prepared and structured as to the learning experience. The nature of the class allowed me to prepare but obviously not be prepared for all possibilities that would arise. The class moved me to more as the phrase goes "guide on the side" approach to the class. This was especially true since I decided not to take the role of the project manager and was basically the role

of the IT manager coordinating activities. The part of the class I liked was to give the students a live project, with real goals and expectations, not just for a grade. For some students it seemed to add some excitement and heightened the activity level. The attitude was noticeably different than working on a "canned" project. Most students always try to do a good job but there seemed to be an added ownership as they were creating something that was going to be used in industry and they were not only trying to work for a grade in class but satisfy a client's requirements for a live system. Having said that not all of the students had that feeling. Some seemed to disappear in the group and even though I tried to stay on top of that, I think for some students it was a less than satisfying experience. While some of the students melted into the background others took on a strong presence and in some cases dominating so much as to not let others make meaningful contributions. As an instructor it was interesting watching the students experience some aspects of the job that normally I might have mentioned in class but they got to experience live. For instance in a class project students tend to be hand fed items they need to proceed, and IT professionals know it doesn't happen like that. They had to determine requirements and experience the unavailability of a client or cancelling a meeting at a point when they needed information to proceed. These are things that until you experience it yourself you aren't able to appreciate. Even though I try to include a few in my regular projects I don't think it has quite the same feeling. One thing I noticed students doing more of was searching the internet for online tutorials, documentation, etc. on how to accomplish certain tasks that were critical to the project. The students understood this was an unstructured assignment and realized they were not going to be spoon fed.

One area that was difficult in the class was trying to evaluate student performance and to give them a grade. With the day/time and classroom reserved the students did a lot of work in that timeframe and generally met with the client then. I attended most of those activities, but tried to give the students some space and thus I didn't feel I was able to do an adequate evaluation based on that time in the room. The client worked mainly with four students so it was impossible for him to give feedback on the students working on the project. The students did give feedback on other students and for the most part it was positive, although there were a few instances when feelings toward certain students affected an evaluation. In a similar situation with a project and scope I might be more likely to play the role of project manager to have a little better feel and control over student activities.

In both projects I was very pleased with the student client interaction. As I mentioned the clients made time for adequate interaction and to provide feedback. The students realized that clients also have their full time jobs and had to work around clients schedule and occasionally cancellations. The students handled themselves professionally. Neither client had an IT background so students got a good feel for working with non-technical clients.

Managing the expectations over the course of the project was obviously different than normal projects in class. Most have a scope that works well in the time frame of the course. In meetings prior to the start of the semester I tried to reinforce to the clients that these were students and even though they were talented for most this was their first experience and they might not get everything they wanted. Both clients were very understanding of this, especially the owner at Insul-Coustic. I suspected going into the Insul-Coustic project the scope was too large for our semester and he was very willing to do the project in phases with this semester acting as the first phase. For the students managing expectations varied widely. One student (one of the original project managers) felt the team would only be able to determine the process and develop the infrastructure (design and build the database) and sever-

al thought the team could accomplish several phases during the semester. I do think working in two week cycles seemed to help in setting realistic expectations.

Client's reflections

Prior to, during, and after the project I tried to stay in close contact with the main client the owner of the Insul-Coustic. IC did not implement the system. One of their goals of the project was to evaluate a new concept. Following the semester the client filled out a survey about the experience. Overall, the client was very pleased.

Summarizing the client's evaluation he felt the reviewed the positives of the project. Students were very interested and inquisitive in the information and project details and eager to perform tasks. The cost was minimal and gave IC a chance to evaluate a new concept without investing many resources or much time. Finally, students were dependable, skilled and worked well with staff. From a standpoint of things that could be improved, the main thing he mentioned was giving students more opportunities to work with "real" clients to have a better feel for questions to ask. Also, possibly a survey filled out by both client and students to get a better understanding of the project from the beginning. Overall, the client was very please and expressed an interest in being involved again and possibly continuing this project into a later phase.

Student's reflections

Students were polled about their experience on the project. All students that responded were pleased with their role on the project. They believed they were prepared to work on the project. Students overall felt they were utilized about the right amount of time, although there were some who felt they were over utilized and they commented some students were underutilized (I didn't get a response from those mentioned). The live project led to a lot of real world experience that would have been hard to capture in a normal assignment, this was the most commonly made comment from the students. The project gave students experience at working on various aspects of IT instead of, like in most classes where it is programming or systems analysis. Students were pleased with the setup of a student as project manager and the instructor as a guide. Students were pleased with the size of the team and didn't think it was too large. Finally, students felt both clients were easy to work with on the projects.

There were a few negative comments or suggestions about the project. On the Insul-Coustic project it would have been nice if the students could have visited the company. For members who weren't contributing, the lack of structure could be frustrating. Some students were working on parts of the project that made them feel secluded from the rest of the project. One student was disappointed the product wasn't used by the company (they were told that the project was a way for the client to evaluate a new concept).

Evaluating the course

To evaluate the course I reviewed the reflections of all participants – students, clients and instructor and the goal of the class which was to combine university study with work experience in the Computer and Information Technology (CIT) area. Comments of all participants confirmed the students were able to get work experience in IT area. Was it of equal value to all students? No, but in a traditional class-

room that would be true as well. One student put it aptly, this is not like the programming class where our first assignment is the "Hello World" program. One of the shortcomings of many of our classes is that they are focused on one aspect of the IT world such as the network, programming, system analysis, or database and even though they make mention of the other components they can't do them justice. One student specifically mentioned he thought that was the big advantage of this class. The enthusiasm of the students was evident to not only me but the client as well.

It was extremely helpful to have the clients we had. Their expectations were realistic and the time they devoted to the project was generous. I could see having some real issues if the clients had unrealistic expectations. One of the implications is that client and project selection will be important to success of the class. As an instructor I would say the class was a success. There are items that I think need to be addressed, such as the class size (or more importantly the project team size). I still believe this contributed to some students being underutilized. Also, from a class perspective I think we need to work on a way to adequately evaluate the students. Having said that I could see the class organized so that the students put time in at the client's site where the clients could also give more meaningful feedback on all of the team participants. This was not possible with the client's facility almost two hundred miles away. Another issue from a instructor's standpoint is that I don't believe I was able to guide the students as well in all facets of the project (especially the web programming component) and it might be helpful to have the class handled in a team teaching format or at least have instructors act as advisors. Overall, the class was a great success not only for the student but also for the client and will definitely be offered again on our campus.

Conclusions

The CNIT 390 Supervised Practicum was a success by all measures and all participants including students, clients and instructor. This format was a learning experience for not only the student but also the instructor. It also proved to be a positive experience for the client and one in which we can encourage more participation in the local community in the future. This would not only prove to be positive for our students and Purdue. With careful selection of clients and project scope I think we can also bring that into some of our traditional classes and capture that same enthusiasm.

References

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