Using Real-World Team Projects: A Pedagogical Framework

Mike Leih (Point Loma Nazarene University)

Mike Leih holds a Ph.D. in information systems and technology from Claremont Graduate University and an M.S. in computer science from California State University Fullerton. His industry experience includes over 25 years in IT, holding positions in systems administration, application development, business analysis, project management and director of information technology. His research interests include IT governance, systems development practices, and technology course development.

Abstract

The use of team projects in a program capstone course for computer science or information systems majors has been a popular method for reinforcing and assessing program learning objectives for students in their final semester. Using real-world group projects as a learning activity is an excellent pedagogical approach in helping students develop critical thinking, team work, real-world problem solving, and communication skills. However, real-world group projects also provide many challenges to both the instructor and students alike. Instructors or students must find real-world projects appropriate for the learning objectives in the course. Instructors must determine how to provide teams with appropriate learning activities and provide effective feedback to reinforce learning objectives while fairly assessing project deliverables to individual team members. Students must find a common time to work together and learn to appropriately delegate project activities so each student fairly participates in the project. Finally, real-world projects have the real risk of failing due to circumstances outside the control of the instructor and students.

Papers have been presented in the past describing methods to address these challenges and successfully use real-world team projects. This paper gives a summary of these methods and presents a successful and practical approach that has been used for the past seven years in an Information Technology program capstone course. This framework is based on traditional project management methodologies which allow students the opportunity to successfully meet learning objectives even if the project success factors are not met.

1 Introduction

There are many excellent published articles demonstrating the effectiveness and benefit of using real-world team based projects as a major assignment within a course. These real-world team based projects can take the form of a service learning project, student consulting project, pilot project, or one of many other names to describe the engagement of students to complete a project whose origin is initiated by someone other than the student or instructor. Kolenko et al. describe their success of using service learning projects in a management course as a way to enhance the student's intellectual and moral aptitude. [4] Hatteche and Clayton describe how they successfully utilized service learning projects to have students develop websites and establish community partnerships with the university. [2] Heriot et al. write about their case study explaining how they used student consulting projects in a production management course to achieve high student engagement and reinforce student learning outcomes in their academic program. [3] Maloni et al. document how they used cross functional teams from multiple courses to provide students with a lifelike replication of what they can expect as systems analysts in the

professional world. [5] Finally, Dixon provides another example of using service learning projects to provide students an experiential learning opportunity to enhance team skills and project management understanding. [1] These articles are only a few of the documented cases where real-world team based projects have proven to be a successful approach to improve student learning outcomes.

Although these articles demonstrate the advantages real-world team projects can bring to the classroom, many courses avoid using them due to the many challenges that come with utilizing real-world projects as a course assignment. Some of the challenges associated with these types of assignments are:

1. Finding appropriate real-world projects for the course and matching the student's skill level.

2. What to do when projects fail to meet initial objectives due to circumstances outside of the student's or instructor's control.

3. Projects that have an inappropriate scope for a given course or that experience significant scope creep during the course.

4. Dealing with team conflict among students.

5. Unbalanced team member effort where one or two team members complete most of the project work while other students have little or no project involvement.

6. Assessing and grading individual students fairly on the results of a team project.

This paper is intended to provide instructors a pedagogical framework to address these challenges in an Information Systems or Computer Science course. The framework is based on my experience using real-world team projects in an Information Technology capstone course for seven years and the published results of other instructors who have successfully utilized real-world team projects in their courses. The framework mimics the approach used in the traditional project management paradigm, which provides distinct project phases and deliverables, a team based development methodology, and regular progress check points. The framework also provides another opportunity to reinforce project management skills while providing students the challenge and experience of working on a real-world team project.

2 Pedagogical Framework Overview

The pedagogical framework consists of a set of strategies to help avoid the risks associated with real-world team projects and to allow students to meet the assignment learning objectives even if the main project deliverable fails. The strategies associated with this framework are as follows:

1. Find projects using prayer, professional networks, and local non-profits.

2. Evaluate and approve project scope before project start.

3. Use short time lines for project phases.

4. Utilize many-small process deliverables throughout the project.

5. Utilize small teams.

6. Have weekly project status update meetings.

7. Require weekly team activity reports.

8. Leverage traditional waterfall project management methodologies and deliverables.

3 Finding Projects and Building Teams

Finding appropriate real-world team projects is the first challenge in using them in a course. Depending on the experience of the students in the class, length of the course, and the types of skills students have, the instructor may choose to find and assign projects to project teams, or have student teams find their own projects. I recommend project assignments last between 5 to 7 weeks (the details regarding this recommendation are discussed later in this paper) so if the class is a traditional 15-week semester and the experience and skill level of the students is advanced, the instructor can have the student teams find their own projects. However, if the course is shorter in duration or the overall experience of students in the course is limited, then I recommend the instructor find the projects prior to the start of the course and assign them to the project teams based on the team's skill set.

Whether students find their own projects or the instructor finds the project for them, I recommend leveraging the following strategies. First, pray. Ask God to bless the class and the students as the instructor prepares for the course. Ask God to provide opportunities for the students to be a blessing to someone outside of the course as they learn through the project activities. I have often been amazed at the opportunities and impact the real-world projects have had on both the students and the organization being served. Second, the instructor should use their professional network. I have found many good projects by posting a request on LinkedIn or by sending out an e-mail to colleagues. I ask companies to provide me their "number 11" on their top 10 list of technology projects. Something they would like to get done, but don't have the resources to initiate it. Finally, send an e-mail to local non-profit organizations asking if they have any technology needs the students can provide to them. As a final recommendation, the instructor should avoid using their own personal projects. This limits the learning experience of the students as the instructor tends to be more available to students and makes project requirements more clear than typical outside clients.

In general, as the instructor, I have had more success finding the projects for the students rather than requiring the students to find their own projects. This approach provides me the opportunity to initially evaluate the project scope to ensure the requirements will be challenging enough for the students to gain the learning objectives in the course, while keeping the project scope within the student's ability and the time constraints of the course. This also allows me to have an initial conversation with the project sponsor (the client) to ensure they will have the time needed each week to engage with the students to provide and clarify project requirements and to evaluate and test project deliverables.

Project teams can be established either before or after the projects are identified and can either be self-selected by students or assigned by the instructor. I have the most success assigning the project teams as the instructor after the projects have been identified. I have asked students for resumes highlighting their technology skills and experiences and have used those resumes to create project teams that best meet the needs of the project. Another approach in creating project teams is to build them based on GPA where the first three students with the highest GPA are placed on the first team and next three students are placed on the second team, continuing until all students are placed. This approach helps reduce the

likelihood of one student doing the majority of the work, while the remaining team members do minor tasks.

4   Project Properties

When considering real-world team project, it is recommended the projects have the following properties:

1. The project has a clear set of deliverables.

2. The project sponsor (the client) has the time to commit to the project.

3. Major risk factors can be identified and mitigated.

4. The project has no more than one major risk factor.

5. The project duration is between 5 and 7 weeks.

6. Team size is between 3 and 4 students.

7. Total project effort is between 75 to 150 hours.

Clear Set of Deliverables: Having a clear set of project deliverables and project scope helps the project sponsor and the project team to carefully consider what the final project solution should be. Many sponsors have a general idea of what they would like, but requiring a detailed list of project deliverables establishes a clear understanding of project scope and provides the foundation to estimate project effort and successful project completion. Having a clear set of project deliverables is also required to leverage the traditional "waterfall" project management approach. Although agile project management has gained wide acceptance in industry, the traditional "waterfall" approach is more appropriate for students working on their first real-world team project. It provides greater predictability and control and is more easily understood when compared to an agile project management approach. [6]

Project Sponsor has Time: Ensuring the project sponsor has the time available to work with students is important to establishing the communication expectations of the project. Whether the instructor finds the projects for the students or the students find their own projects, it is important to be very clear with the project sponsor at the beginning of the project that they will need be available each week to engage with the students. In addition, the instructor will need to teach and train students to respect the time they do have with their project sponsor. They must be taught to act with professional comportment when communicating or meeting with their project sponsor. Students should have questions prepared beforehand, to be early to meetings, to dress appropriately, and to respect time constraints. I have used a "letter of understanding" which highlights these expectations and have both the project sponsor and the project team sign it to emphasize this principle.

Major Risk Factors: The instructor will need to help the project sponsor and the project team to identify any major project risks. These risks could include; lack of commitment or availability from the project sponsor to work on the project during the project execution, the implementation of new technology, high estimated project cost, high potential of student distraction (such as athletics or extracurricular activities) or any other high risk element. As project failure tends to grow exponentially with the number of high

risk elements, it is recommended teams avoid any project that has more than one identified major risk factor.

Project Length and Team Size: Finally, I recommend the instructor limit project time frames from 5 to 7 weeks and project team sizes to 3 or 4 students. The reason for the short project time frame is to help limit project scope, to keep the project sponsor engaged in the project, and to allow students to better experience the full project life cycle over a shorter time period. When real-world team projects are longer, the risk increases that the project sponsor will need to disengage due to urgent business demands or the team will lose a high level perspective as they get distracted with other school activities. Having a small team size also helps control project scope and reduces the risk of one or two students "free-riding" on the project as others do the majority of the work.

5   Project Management Class Activities

Each week, student teams should submit a written project status update document, project deliverables and present their project status update to the class. The written project status update document and the team project status update presentation should contain the following elements.

1. A team activity report.

2. A dashboard or high level project status document containing the following:
   (a) The name of the project, the project team and the report date.
   (b) The overall status of the project (red, yellow or green).
   (c) The status of the project scope (red, yellow or green).
   (d) The status of the project schedule (red, yellow or green).
   (e) A list of risks, issues and concerns and their respective mitigations.

3. A review of the project task list and timeline.
   (a) Completed tasks.
   (b) Late tasks.
   (c) Upcoming tasks.
   (d) Who is assigned to each task.
   (e) Estimated task duration.

4. A review of any project deliverables due for the given week.

5. Team meeting minutes.

6. Questions and answers with the entire class.

Team Activity Report: The weekly team activity report is a simple report listing all the team member names, what project related activities they worked on during the past week and the amount of time they spent on each activity. Although this is a self-reporting team report and students misrepresent their actual effort, it does help to hold each team member accountable for working on the project each

week. If a team member reports limited or no activity for a given week, it provides an opportunity for the instructor to question the team regarding the disproportionate effort on the project and adjust team points for a given individual if the team member is not fairly participating in the project.

Project Status Dashboard: The project dashboard document is a single page report showing the overall status of the project and any risks, issues or concerns pertaining to the project. This document helps teach the students to be concise and clear about the overall status of the project and provide the major risks relating to the projects. Teams should be encouraged to display this document during the project status presentation and respond to questions from the rest of class regarding the status of their project. It is good to challenge students about optimistic status indicators and to bring up project risks the students might be overlooking due to lack of experience.

Project Task List: The task list can be represented as a simple list of tasks in a document or spreadsheet, or be as formal as work breakdown structure in a Gantt chart. Students should provide as much detail as possible in the task list. This helps the team to distribute the workload of the project among the team members and keep track of all details that need to be completed as part of the project. It can be effective for the entire class to review each team's task list and to recommend adding tasks are missing and to see what other teams are doing to gain ideas on task items might be missing from their own project plan.

Project Deliverables: The project team should present any project deliverables due for a given week and respond to questions and comments from the rest of the class. It is recommended the instructor require one or two questions from the class during project status update presentations. This encourages students to stay engaged while other teams are presenting. It also helps teach the team presenting how to consider questions and respond to them. The presentation of project deliverables also helps hold teams accountable to move forward with their project each week and gives other teams an opportunity to learn from any quality work being presented.

Team Meetings: Project teams are encouraged to meet outside of class and required to provide team meeting minutes as part of their weekly status report documents. Meeting minutes should include when and where the team met, who was in attendance, what was discussed and what decisions were made. It should also include the time and location of the next team meeting. This encourages teams to formalize team meetings and to develop planning skills. If time permits, class time can also be used for short team meetings. This allows the instructor an opportunity to meet with teams and answer any questions the teams might have.

6 Project Schedule and Deliverables

The following is a suggested schedule for a six-week project time line and their respective deliverables for a typical technology project. This schedule assumes the projects have already been identified, evaluated and selected and project teams have already been established.

Week 0: The week before the project starts

1. Establish teams and assign team projects

Week 1

1. Project requirements document draft
2. Weekly status update reports
3. Project schedule and task list

Week 2

1. Final project requirements document
2. Project design documents draft
3. Updated project schedule and task list
4. Weekly status update reports

Week 3

1. Final project design documents
2. Project solution prototype
3. Updated project schedule and task list
4. Weekly status update reports

Week 4

1. Project testing plan draft
2. Project implementation plan draft
3. Project solution prototype update
4. Updated project schedule and task list
5. Weekly status update reports

Week 5

1. Final project testing plan
2. Final implementation plan
3. Project documentation and training material draft
4. Project solution prototype update
5. Updated project schedule and task list
6. Weekly status update reports

Week 6

1. Final product solution demonstration
2. Final project documentation and training material
3. Customer acceptance and sign-off
4. Weekly status update reports

The following provides a short description of each of the project deliverables referenced above. Providing examples or templates is the most effective way to teach students about what should be expected. Having students submit a draft provides the instructor and the class the ability to provide feedback on the draft document before the final document is submitted. Many of these documents can be fully developed regardless of how effective or complete the final project solution is when submitted or if the project sponsor chooses not to implement the project solution. This allows students to meet the learning objectives of the assignment and earn the majority of the points available even if the final project solution is not completed or implemented due to circumstances outside the control of the student or instructor.

Project Requirements Document: This document might contain many project initiation elements, such as the project charter, project scope, project assumptions, and requirement details. The level of detail and the amount of information here should be adjusted to meet the needs of the course and scope of the project.

Project Design Documents: These documents can be a collection of user interface designs, detailed descriptions of project solution elements, database design diagrams, network design diagrams, or any number of design elements. This collection of documents will vary greatly depending on the type of project solution required. The instructor should work with each team to establish expectations and provide directions to students.

Project Solution: The solution can be presented in numerous ways depending on the type of project being worked on. However, prototypes of the solution can often be submitted as a document with screen captures, source code, pictures and other graphics along with descriptions of the solution. The final solution submission can also be a document, in the case of a network implementation or computer server installation, or be the final product, such as a source code, in the case of a software project or website development project. The instructor should give each team specific instructions on what is expected for their given project.

Project Testing Plan: A detailed plan on how the solution will be tested to ensure it meets all project requirements. This can be a narrative of the testing processes needed, along with a check list of testing items or testing scripts. The completed test plan, showing all tests completed and passed, should be submitted with the final project documentation.

Project Implementation Plan: This document should describe the processes and procedures needed to move the project solution from the development and testing phase into a production phase. This document is often shorter than other project deliverables, but it does help the students think through what needs to occur to deliver and implement a project solution.

Project Documentation and Training Material: These documents should contain design and development notes, any necessary account or password information, any upgrade and maintenance items to support the project solution and training material on how to use the project solution. These documents will vary depending on the type of project solution being developed, so the instructor should provide specific direction to each team on what is expected.

The point value and level of detail for each of these project deliverables should be established based on the type of course being offered and emphasis the instructor wants to give to various learning objectives. Additional documents can be added or suggested documents can be removed to further emphasis learning objectives.

7 Conclusion

The framework and approach described in the paper is based primarily upon my own trial and error experience as I used real-world team projects in my courses over a seven-year period and upon the published experiences of other teachers using similar assignments. The overall framework should also be adjusted to meet the needs of the course. Even when using the framework, utilizing real-world team projects remains a challenging venture. However, with careful planning, a willingness to make adjustments throughout the project life cycle, and working closely with project teams, these challenges can be managed and students will experience a rich learning activity.

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