Effectively Utilizing Industry Members to Assess Student Learning Outcomes in a Senior Project Course

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Abstract

The purpose of this case study was to develop methods to effectively utilize industry members in the assessment of student performance in a senior project course. The primary approach was to create tools that allow industry partners to sponsor, participate, and ultimately assist in assessment of student teams in these courses. The secondary approach was to create and implement surveys that indirectly assess the industry's participation. Both of these methods provided meaningful feedback for the students' performance and ultimately for programmatic student outcomes.

Introduction

The benefit of involving industry members in engineering education has been well documented over the past several decades. Specifically, contemporary academic literature supports the use of industry sponsorship of senior design projects, also known as "capstone" projects (Smith, 2009). Industry sponsorship can take many forms, but most of the time this primarily entails industry members working with and/or reviewing the work of the students (O'Brien et.al., 2003). This provides an outstanding mechanism for students to collaborate with industry members on "real projects". It can also provide a way for students to receive informal feedback on their performance from their industry sponsor (Savage et.al., 2007). Despite these positive results, there remains minimal literature on the use of industry members that actively participate in formal assessment of students.

Description of the Case Study

The Construction Management Program in the Lyles College of Engineering provides students with two separate opportunities to participate in projects. The first is through a senior project course and the second is through the final capstone course in the project. Both of these courses are used to assess students' abiliies to actively participate on project teams. These courses were first reviewed in three primary steps in order to better accommodate active participation of industry members.

The first step to update this course was to identify the currency of the course curriculum. Initial research was performed to identify important issues in the Architectural/Engineering/Construction (AEC) Industry. In addition to the professional experience of the program faculty, an initial literature review showed three primary trends transforming this industry: (1) sustainable design and construction (Beheiry, Chong, and Haas

2006); (2) building information modeling (BIM) (Jones, et al 2009); and (3) integrated project delivery (Johnson and Gunderson 2008). Collectively, these trends are changing the way that industry members operate and the way that many projects are executed.

The second step of this initial research focused on current practices and trends the in delivery of senior project or capstone courses in engineering and construction programs. The literature review provided three primary practices: (1) problem based learning [PBL] (Savage, Chen, and Vanasupa 2007); (2) multidisciplinary approaches; and (3) service learning [SL] opportunities.

The final step was a review of the current CM Program Student Outcomes Assessment Plan (SOAP). The SOAP listed the "student terminal outcomes" for the Senior Project Courses: written and graphic communication, oral communication, interpersonal relationships, leadership and teamwork, independent action, problem recognition and resolution, planning/scheduling/monitoring, skills/tools/techniques, design theory and construction material applications, and computer software utilization.

The review of the SOAP also provided the basis of assessment methods for the CM Program. The Senior Project/Problem courses fall within the second direct measurement method. This direct assessment method is described as "*the level of success the students have as the complete the course of study*." A review of the most recent version of this program assessment provided the following data:

- The Senior Project Courses did not provide current and relevant course content that allowed students to demonstrate STBO's listed in the SOAP.
- The Senior Project Courses did not provide adequate methods to assess each STBO and/or each separate learning objective of the course.

Course Revision Plan

The Construction Management Program then embarked on a multiphase process to revise the curriculum and assessment issues related to the Senior Project Courses. The primary goal of this process was to restructure these (and future) Senior Project courses into sustainability focused, multidisciplinary, service learning capstone courses. The three phases of this revision process were: (1) incorporation of sustainability content and service learning into courses; (2) incorporation of industry member support and participation; and (3) incorporation of multidisciplinary learning approaches.

Phase one of this process began in Fall 2009 and continued through the following academic year (Spring 2011). Sustainability focused projects were added to the Construction Site Planning and Development course (CONST 144) during this first semester. Additionally, the course was updated to align learning objectives with the program SOAP. The program also added a community-based project as a service learning opportunity for student teams during the Spring 2010 term.

Course Revisions and Research

The next phase of the course revision was to implement industry support and to initiate industry involvement in these senior projects. This phase is critical to the transition of Senior Project Courses to true capstone courses. This will also meet the objective "***to prepare students for employment at the professional level in the discipline of construction and its related field.***" This step is critical according to Bernold (2005), stating that "it is evident that the curriculum of an engineering college should be built around an analysis of what a student needs to know to be successful in the workplace."

This phase of the transition was perhaps the most critical to the development of "real life" problem based learning projects. The goal of this phase, to prepare students for employment, utilized an integrated project approach that engaged industry members in these projects. Montoya, Kelting, and Hauck (2008) demonstrate the importance of an industry supported, integrated project approach by stating "employers and [these] graduates agree that graduates … are more productive in their entry level positions when compared to graduates instructed in the traditional model." Additionally, Smith (2009) states "active involvement of an industry sponsor serves to heighten the students interest and brings 'credibility' to the learning objectives and the learning process.

However, there is a significant, and glaring, gap in the academic literature in how to effectively use the services of industry members to assess student performance. Therefore, the focus of this case study (and this phase of the overall project) was to develop, apply, and research the affects of industry members in the assessment of student project based learning in this construction management curriculum.

Methodology

The purpose of this research project was to develop tools to assess student performance in industry sponsored capstone courses. The primary approach was to develop rubrics that will enable industry partners to sponsor, participate, and assist in assessments of student teams in these courses. A secondary approach was to create and implement surveys that indirectly assessed the industry's participation. Both of these methods will provide meaningful feedback for the students' performance and ultimately the program curriculum.

Overall, there were five primary objectives for this project:

1. Align program, industry, and course objectives
2. Align course objectives with terminal outcomes
3. Provide meaningful assessment of student activities
4. Provide effective feedback to faculty members
5. Provide supportive feedback to industry sponsors

The two assessment methods were created in this project:

a) Senior Project "Grading" Rubrics for use by Faculty & Industry Sponsors
    a. Base Rubric for application to all Senior Project Courses

   b. Phase Rubric specifically designed for Fall 2010 courses
b) Industry & Student Surveys to ensure continuous improvement of rubrics and the industry members participation

The case study involved several steps. The first step was to perform a literature review in order to determine best practices of incorporating industry participation in the assessment of student projects. As anticipated, these courses leveraged active participation into a formal support program for the Senior Project courses. For instance, CONST 144 has five (5) phases for the senior project. An industry professional, selected for their expertise in their specific area to be assessed, participated in the evaluation of the deliverables for that phase of the project.

The following step aligned the course activities (or project deliverables) with program terminal objectives. The terminal for the Senior Project courses include: (1) Written & Graphic Communication, (2) Oral Communication, (7) Problem Recognition & Resolution, (8) Planning/Scheduling/Monitoring, (9) Skills/Tools/Techniques, (12) Design Theory & Construction Materials, and (13) Computer Utilization.

The next step was to design the rubrics and surveys for the courses. The first part of this process developed a base rubric that could be utilized in all senior project courses. This rubric was also created to align with specific terminal outcomes of the Program. The base rubric established a format that could be easily understood by some one unfamiliar with rubrics and that could be easily modified by the course instructor. The base rubric can be found in Appendix A.

The Senior Project courses require students to create specific professional quality project "deliverables." Therefore, the second part was to use the base rubric format to create prescribed rubrics to grade each project deliverable. Additionally, each rubric was required to assess one of the terminal outcomes associated with the course. This was accomplished by assigning one of the rubric "categories" or "columns" to a specific outcome. As stated previously, the key was to create each rubric in a manner that is easily understood by the industry and faculty member that will be assessing the deliverable. These rubrics were developed in an online survey platform (SurveyGizmo.com) so that the data can be automatically updated. This also further simplified the compilation and evaluation of the data by the use of an iPad to assess students in "real time" during class presentations (see Figure 1 for an example).

The final step was to implement these rubrics in the Fall 2010 Senior Project courses for data collection and evaluation. The results from the rubrics were compiled for presentation to CM Program Faculty during the "Fall 2010 Course Assessment Reports Meeting".

Rubric "Scoring" Methodology

Each rubric was created using a Likert scale for the evaluators "agreement" with the statement. This was chosen for two reasons. First, it is familiar to more evaluators that have ever taken an online survey. Second, it allowed the evaluator to simply state their perception of agreement with the criteria for grading the project and/or presentation category. For example, in Figure 1, question 4 asks if the "Team effectively describes the entire team or firm" for this presentation to the "Owner". (This is the first presentation of the semester for the senior project teams.) The

evaluator can then select if they agree or disagree that the student team was able to accomplish this requirement.

The last benefit of using this scoring method is that it is easy to set the "acceptable" range for the project teams. In all cases, the target of "Agree" (or 4 out of 5 points) was the baseline. This then made comparing the scores across teams easier at the completion of the exercise. Additionally, some of the data from the questions could be used in the overall evaluation of program level learning outcomes.

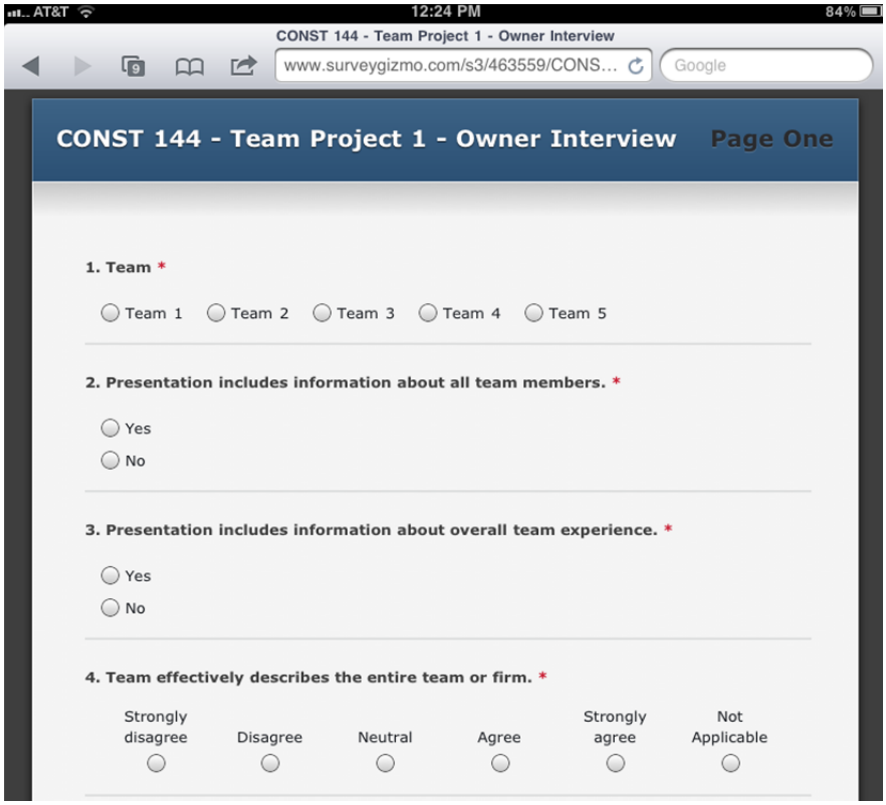

Figure 1. Screen Capture of Project Presentation Deliverable

Results and Recommendations

Assessment Results

The Construction Management Program utilizes course assessment forms to evaluate if students achieved the established course objectives. These forms use both direct (home work, quiz, and exam scores) and indirect (surveys) methods for evaluation purposes. A comparison between the case study course and previous course assessment forms was completed to see if there was any noticeable difference. Here is a brief summary of this comparison:

- There was no meaningful difference in the attainment of course outcomes for this case study compared to previous courses;

- However, students perceived that their learning improved with the additional assessment by industry members;
- Student greatly improved their presentation skills through the semester. As one student said, “this is because we knew industry members would be evaluating our performance.”

Case Study Results

As previously stated, and informal survey was formulated to assess the perceptions of industry members and students in this case study. Here is a brief summary of the results from this survey:

- The industry members truly enjoyed participating in the evaluation of students;
- The industry members requested more input on the verbiage used within the rubrics in order to make them more clear;
- The use of an iPad to “score” the student presentations saved a great deal of time when evaluating and grading the assignments;
- Establishment of the base rubric provided a good format for adapting rubrics for specific course deliverables.

Recommendations

Finally, based upon these assessment and the overall efforts during the case study, here are some recommendations for future implementation:

- Engage industry members in the creation of the evaluation criteria. This would improve the rubrics and have the industry member think about how to actually evaluate students.
- Do more research to see if there is an application for using rubrics in education.
- Ensure that students have a copy of the rubrics prior to the assignment. This greatly increases their chances to be successful.

Conclusion

This case study provided a good start in implementing a sustainable method for industry members to participate and assess senior projects. Although there was no statistical improvement in the attainment of learning objectives for the course in this case study, students perceived an improvement. Also, industry members were very interesting in the assessment aspects of the case study. I found that this made them more engaged in the course. Finally, the tools used (an online survey platform and an iPad) were effective, but not optimal. More research needs to be conducted to find tools that are truly productive.

Biographical Information

Mr. Brad Hyatt is an Assistant Professor in the Construction Management Program at California State University, Fresno. His research interests include sustainable design and construction, integrated project delivery, lean construction practices, and construction scheduling

education. Professor Hyatt is also a Registered Professional Engineer and LEED Accredited Professional with over ten years of professional experience in program and project management of facilities, engineering, and construction projects.

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Appendix A. CONST 144 – Base Presentation Rubric

Page One

1.) Team

( ) Team 1

( ) Team 2

( ) Team 3

( ) Team 4

( ) Team 5

( ) Team 6

2.) Presentation includes information about all team members.

( ) Yes

( ) No

3.) Presentation includes all required information.

( ) Yes

( ) No

4.) Assessment criteria #1 (align with terminal outcome).

( ) Strongly disagree

( ) Disagree

( ) Neutral

( ) Agree

( ) Strongly agree

( ) Not Applicable

5.) Assessment criteria #2 (align with course objective).

( ) Strongly disagree

( ) Disagree
( ) Neutral
( ) Agree
( ) Strongly agree
( ) Not Applicable

6.) Assessment criteria #3 (align with course objective).

( ) Strongly disagree
( ) Disagree
( ) Neutral
( ) Agree
( ) Strongly agree
( ) Not Applicable

7.) Assessment criteria #4 (align with assignment objective).

( ) Strongly disagree
( ) Disagree
( ) Neutral
( ) Agree
( ) Strongly agree
( ) Not Applicable

8.) Assessment criteria #5 (align with assignment objective).

( ) Strongly disagree
( ) Disagree
( ) Neutral
( ) Agree
( ) Strongly agree
( ) Not Applicable

9.) Provide additional comments and feedback.

Thank You!

Thank you for taking our survey. Your response is very important to us.