Assessing Student Terminal Outcomes of Construction Management Students in Senior Project Courses Utilizing Direct Assessment Methods by Industry Sponsors and Faculty

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I. Project Description and Purpose

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. Both of these courses are used to assess students' abilities to actively participate on project teams and to assess the students' achievement of program learning outcomes.

A review of the current CM Program's SOAP described how these project courses were used as direct assessment methods. The senior project courses are listed as the second direct measurement method. This direct assessment method is described as "*the level of success they students have as the complete the course of study.*" A further review of the current SOAP presented the following concerns with using these courses as a direct assessment method:

- The senior project courses did not provide current and relevant course content that allowed students to demonstrate program outcomes listed in the SOAP;
- The senior project courses did not provide adequate methods to assess each program outcome and/or each separate learning objective of the course.

This resulted in the desire to develop a case study, which would strengthen these project courses as direct assessment methods. The first step was to select one of the senior project courses for the case study. The Fall 2010 "Sustainable Site Development and Construction" (CONST 144) course was chosen because of ongoing improvements in the course content. Specifically, the course had been recently updated to include topics on sustainability and integrated project practices in response to an increased focus on these areas within the construction industry.

The second step was to develop tools to assess student performance in this project course. The primary approach was to develop rubrics that would enable industry members to sponsor, participate, and assist in the assessment 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 could provide meaningful feedback for the students' performance and ultimately the program curriculum.

Thus the following assessment methods were created in this case study:

a) Senior Project "Grading" Rubrics for use by Faculty & Industry Sponsors:
   a. Base Rubric for application to all Senior Project Courses,
   b. Phase Rubrics specifically designed for Fall 2010 course activities.
b) Industry & Student Surveys to ensure continuous improvement of rubrics and the industry members participation.

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 was intended to establish a format that could be easily understood by some one unfamiliar with rubrics and that could be easily modified by the course instructor.

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 for grading each project deliverable. Additionally, each rubric was required to assess at least one of the program outcomes associated with the course. This was accomplished by assigning one or more of the rubric "categories" or "columns" to a specific outcome. The key goal was to create each rubric in a manner that could be easily understood by the industry and faculty member that would 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).

Each rubric was created using a Likert scale based upon the evaluators "agreement" with each statement within the rubric. This was chosen for two reasons. First, it is familiar to evaluators that have taken common online surveys. 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, question 4 of the first rubric of the semester asks if the "team effectively describes the entire team or firm" for this presentation to the "project owner".

Another benefit of using this agreement scale was that it was easy to set the acceptable range for the project teams. In all cases, the target of "Moderately Agree" (or 5.0 on a 7.0 scale) was established as the baseline for all rubrics. This then simplified comparing scores between teams at the completion of each activity.

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Figure 1. Screen Capture of Rubric for Project Presentation Deliverable

II. Project Findings

Assessment Results

Industry members were invited to participate in the evaluation of three separate team project presentations during the Fall 2010 offering of this course. At least one industry member participated in each presentation with a total of five industry members participating in this pilot study. The student presentations each assessed four primary course and program learning outcomes. The program outcomes assessed included:

- Communication – Effectively communicate in graphical, oral, and written forms common in the construction industry;
- Legal & Ethical Responsibilities – Manage a construction enterprise in an ethical manner ensuring that all legal responsibilities are withheld throughout the life of the endeavor;
- Integrated Project Practices – Demonstrate an understanding of the principles of the design process for a project and be able to manage a diverse team of designers on various projects;
- Sustainability – Become literate in sustainability and apply the principles to the design and construction process.

These outcomes were assessed using the established rubrics as described in the previous section. All three presentations assessed the communication skills of the students (primarily written and graphical) using the last three questions of each presentation. Each presentation also evaluated a specific program outcome. There were three to six questions established to evaluate the characteristics in each of these program outcome categories. As previously stated, a target "passing" value of 70% (averaging 5.0 or "Moderately Agree" on the established 7.0 Likert scale) was set for each of the outcomes.

Here is a brief summary of the results for each outcome:

1. Communication – The average score for all teams was 15.7 out of 21.0 (74.7%), with a standard deviation of 2.89 overall. This met this passing value of 70% for this outcome within the given margin of error. Additionally, all but one of the five teams met the minimum holistic score of 14.7 for this category. Here were the characteristics rated for this outcome:
   a. All team members participated in the presentation. (The holistic score for this category was 5.9 out of 7.0, with all teams scoring above the 5.0 passing level.)
   b. All team members were engaged and interested in their team's presentation. (The holistic score for this category was 4.7 out of 7.0, with only two of the five teams scoring above the 5.0 passing level.)
   c. The Powerpoint presentation and/or graphical aides were engaging and interesting. (The holistic score for this category was 5.1 out of 7.0, with three of the five teams scoring above the 5.0 passing level.)
2. Legal & Ethical Responsibilities – The teams scored an average of 22.6 out of 28.0 (80.6%), with a standard deviation of 2.14 overall. This met this passing value of 70% for this outcome within the given margin of error. Additionally, all teams met the minimum holistic score of 19.6 for this category. Here were the characteristics rated for this outcome:
   a. The team effectively identified the potential legal issues with the project site. (The holistic score for this category was 5.3 out of 7.0, with only two of the five teams scoring above the 5.0 passing level.)
   b. The team was able to address planning issues for the project. (The holistic score for this category was 5.6 out of 7.0, with three of the five teams scoring above the 5.0 passing level.)
   c. The team effectively addressed any green building code issues for the project. (The holistic score for this category was 5.9 out of 7.0, with all teams scoring above the 5.0 passing level.)
   d. The team clearly explained any potential conflicts of interest. (The holistic score for this category was 6.0 out of 7.0, with all but one team scoring above the 5.0 passing level.)
3. Integrated Project Practices – The teams scored an average of 27.9 out of 35.0 (79.6%), with a standard deviation of 1.73 overall. This met this passing value of 70% for this outcome within the given margin of error. Additionally,

all teams met the minimum holistic score of 24.5 for this category. Here were the characteristics rated for this outcome:

    a. The team effectively provides a sample of the drawings created for the project. (The average was 5.2 out of 7.0, with three of the five teams scoring above the 5.0 passing level.)

    b. The project site is designed in an interesting and well-thought manner. (The average was 5.9 out of 7.0, with all teams scoring above the 5.0 passing level.)

    c. The project site effectively showcases sustainable features. (The average was 5.5 out of 7.0, with all but one team scoring above the 5.0 passing level.)

    d. The team clearly explains the estimated cost for this phase of work. (The average was 5.8 out of 7.0, with all teams scoring above the 5.0 passing level.)

    e. The team effectively discusses the schedule for this phase of work. (The average was 5.5 out of 7.0, with all but one team scoring above the 5.0 passing level.)

4. Sustainability – The teams scored an average of 33.4 out of 42.0 (79.6%), with a standard deviation of 3.36 overall. This met this passing value of 70% for this outcome within the given margin of error. Additionally, all teams met the minimum holistic score of 29.4 for this category. Here were the characteristics rated for this outcome:

    a. The team effectively explains the total points and potential LEED certification level for the project. (The average was 6.0 out of 7.0, with all but one team scoring above the 5.0 passing level.)

    b. The team included a summary of each LEED rating category. (Sustainable Site, Water Efficiency, Energy & Atmosphere, Materials & Resources, Indoor Environmental Quality, and Innovation in Design). (The average was 5.2 out of 7.0, with three of the five teams scoring above the 5.0 passing level.)

    c. The team clearly explained each Innovation in Design (ID) credit and it's applicability to this project. (The average was 5.5 out of 7.0, with three of the five teams scoring above the 5.0 passing level.)

    d. The team is able to demonstrate the cost impact to the project for achieving this level of LEED certification. (The average was 5.9 out of 7.0, with all teams scoring above the 5.0 passing level.)

    e. The team is able to demonstrate the schedule impact to the project for achieving this level of LEED certification. (The average was 5.6 out of 7.0, with all but one team scoring above the 5.0 passing level.)

    f. The team effectively summarizes the presentation by explaining the "Triple Bottom Line" impacts of this project. (Impact on Society, Economy, and Environment.) (The average was 5.2 out of 7.0, with all but one team scoring above the 5.0 passing level.)

In summary, each the program outcomes were met based upon the holistic scores for each of the assessments conducted using the rubrics for this course. In

additionally, a majority of the teams met the minimum scores for each characteristic within the rubrics for the program outcomes. Note that these findings were a compilation of both faculty and industry members evaluations of the team presentation using the rubrics created for this case study.

One other notable finding in the case study was that there was not a significant difference in the rubric scoring between the faculty member and the industry members. The only anecdotal difference was that it appeared that the industry members started out evaluating the first teams tougher than the last teams that presented. The comments were stronger and the average scores were slightly lower, though within the overall margin of error. More study would have to be conducted to see if there is any tangible link with these differences.

Survey Results

As previously stated, an 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 easier to understand;
- The use of an iPad to "score" the student presentations saved a great deal of time when compiling the data from the rubrics;
- 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.
- Ensure that students have a copy of the rubrics prior to the assignment. This greatly increases their chances to be successful.

III. How Are We Using the Findings?

These findings are used in the overall program assessment process. Specifically, these findings were used as the direct assessment measures for the identified

program outcomes this academic year. The following program outcomes were assessed as part of the of the overall SOAP process this year:

9. Manage a construction enterprise in an ethical manner ensuring that all legal responsibilities are withheld throughout the life of the endeavor. (Legal & Ethical Responsibilities)

10. Demonstrate an understanding of the principles of the design process for a project and be able to manage a diverse team of designers on various projects. (Integrated Project Practices)

11. Become literate in sustainability and apply the principles to the design and construction process. (Sustainability)

12. Manage the safety of construction projects on a project and program basis. (Safety)

Based upon the results in this case study, all of the program outcomes were met based upon the rubrics developed. Some changes in the assessment instruments will be explored to improve upon the use of rubrics by industry members for assessing student projects. Specifically, these rubrics will be improved for implementation in future classes within the curriculum. It is envisioned that some form of these rubrics will be used to assess program outcomes in the newly created "capstone courses" (CM 180A'S' and CM 180B).

Finally, the initial results from this case study were presented at the 2011 Pacific Southwest Regional Conference of the American Society of Engineering Education in Fresno, CA.

IV. What Problems Did You Encounter and How Were They Resolved?

There were four main problems that were encountered during this case study. The first was the use of an online survey platform on an iPad (or smartphone) to collect the data. There were a couple of times when the survey form was not submitted into the system. Luckily the lost data was reconstructed from detailed notes taken by the instructor. It would appear this was due to a poor mobile connection. This was resolved by ensuring that the device was properly configured and connected to the Fresno State wireless internet.

The second problem dealt with a lack of understanding of the rubric terminology by the industry members performing the evaluations. Some of the industry members found the wording of the rubrics hard to understand. The terminology and work product expectations were better aligned with the industry members expectations by working with them more closely when revising each specific rubrics.

The third problem was the time involved in compiling and analyzing the data. The hope was that the use of an online survey tool and the iPad in class for data collection would reduce the overall time required for this assessment method. This was not the case initially. However, there was quite a bit of time saved during the Spring 2011 semester since all surveys and spreadsheets had been established during the previous case study. The hope is that this will save a lot of time in the future when analyzing this data.

Finally, the last problem was coordinating the participation of industry members. The issue of finding a suitable time industry members could participate and then working on all the logistical issues (parking codes, escorting to class, etc.) will continue to take an extra effort to be successful. The one positive is that there are always a vast number of local industry members that are interested in participating. This in itself is a very positive development.