Assessment of Team Projects in an Electrical Power Systems Course

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Abstract

With team-project-based courses the challenge has been assessment. Various attempts have been effective in one dimension and weak in another. Utilizing a different method, a comprehensive assessment of a team-project-course is discussed in this paper. In this 15-week course, two midterms , a final exam, and weekly 15-minute quizzes and homework assignments were administered in addition to five team projects. The relationship between students' self-reported participation level in the team projects and their grade in the exams was analyzed to assess the effectiveness of team projects in this electrical power systems course. The results of the regression analysis suggest that there is a mild relationship between students' participation level in team projects and their final exam grades. According to Bloom's paper the learning pyramid (Figure 1) indicates that we start we evaluation and end with knowledge, we can argue that the development of projects in tandem with exams and quizzes, induces students to go through all the steps indicated in the pyramid, many times without realizing the learning involved during the process. The realization occurs at the final exam, when students perform better and learned a lot more. This point will be discussed later in this paper.

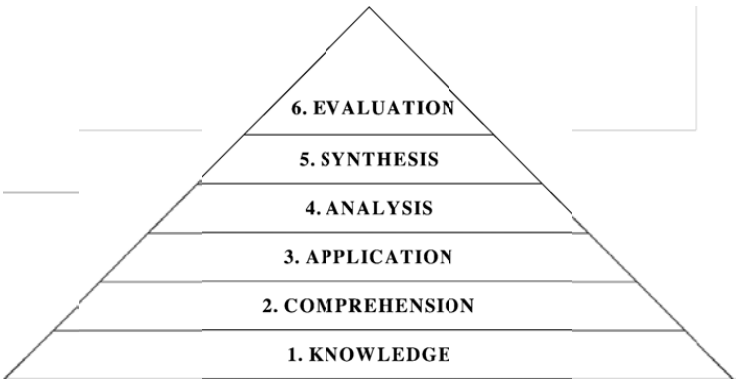

Figure 1. Taxonomy of educational objectives [4].

Introduction

The course included five projects, each of which built upon the previous one. These projects were Matlab based where a power transmission line with shunt and series compensation had to be designed for 31 ASCR conductors. The first project was a very simple calculation: A three phase transmission line reactance. The second project was the calculation of the transmission line capacitive reactance. The third one was the calculation of the ABDC parameters for the transmission line. The fourth one was the calculation of the voltage ratio and voltage regulation. The fifth one was to include compensation when required according to constraints provided. The topics covered in the first three projects were assessed in the first mid-term exam; the topics covered in the fourth and the fifth projects were assessed in the second

mid-term exam. The comprehensive final exam assessed the topics covered in all five projects. Each project had a presentation component, after which individual students filled out online questionnaires related to their participation level in their project teams. The teams remained the same throughout the semester. Total number of students was 34 with three students in each team, except two.

A regression analysis was conducted to explore the relationship between students' participation level in team projects and the grade they received for the corresponding mid-term exam. Another regression analysis was conducted to assess the degree of strength for the relationship between the average participation level of students in their teams for all projects and their final exam grade. As expected the results show that those students who participated more in the team projects, performed better in the exams. The strength of this relationship is another evidence for effectiveness of team projects in engineering education.

Procedure

Several papers [1], [2], [3] have tried to define and quantify "team projects," utilizing different names such as "collaborative learning," "project based learning (PBL)," etc. What is unique about this paper is assessing the relationship between student performance measures (exam grades) and quantitative measures of student involvement in the projects (participation level).

Below we indicate the timing and the closed loop of information that was created. After all, if we do not have feedback in the projects, the effort could have been less meaningful. Figure 2 shows the flow of activities and how the groups were moving along during projects. At the beginning of the semester groups were formed independently, that is, students choose their own team members. Three students per group were selected and the instructor did not interfere in this process. After the material for project 1 was covered, quizzed and homework related to the project were assigned and graded, project 1 was assigned and a deadline was given in mutual agreement with the class. Grades were given quite rapidly in order to maximize the feedback and at the same time several groups were selected to make a presentation (usually the best and worst project). The intention was to give ideas to students as to how to do the projects and learn from others. The instructor gave feedback to the entire class by making constructive comments to the presenters.

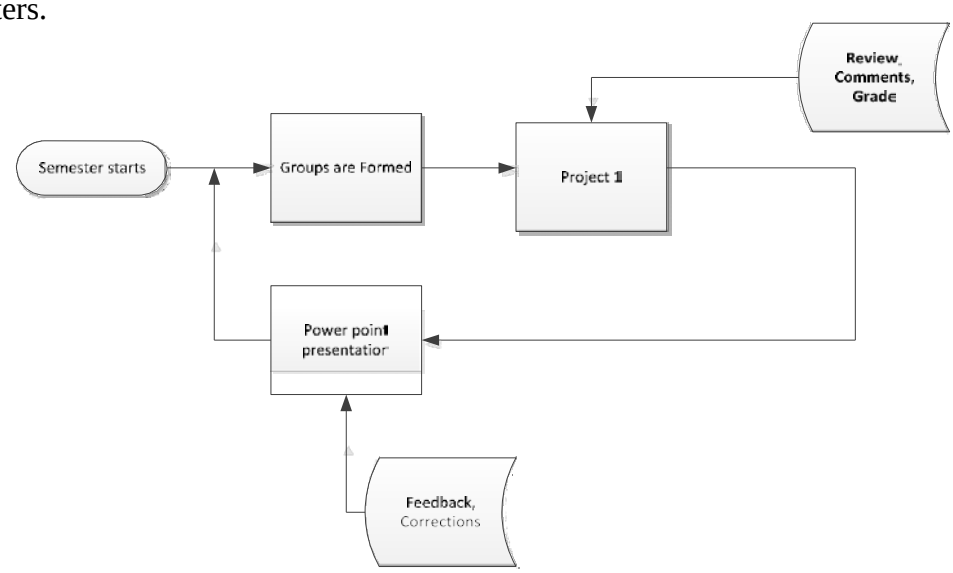

Figure 2. Visual timeline.

Project Description

Teams were provided with handouts describing the projects with simple inputs and outputs and the format for the word document report. The five projects given were:

1. Inductive reactance
2. Capacitive reactance
3. ABCD parameters
4. % voltage regulation and voltage ratio
5. Inductive and capacitive compensation

The first three projects and first four quizzes were utilized to design the first midterm. The fourth and fifth projects and the remaining six quizzes were utilized the second midterm. The final exam was comprehensive, including all projects and all quizzes. The first quiz grades suggested that students with higher participation level in the team projects might be doing better in the quiz. Therefore, an online questionnaire was created to determine the contribution to the project of each team member.

Questionnaire

This questionnaire was a tool to indicate that the student's effort was being rated by their own peers. The questions asked in the questionnaire were:

1. Please type your group's name (i.e. the cats or the fishes)
2. Type names of team members as team member 2 and team member 3 (i.e. Flash Gordon as team member 2 and Batman as team member 3, you are by default team member 1)
3. What was the percentage of your contribution to project 1 (from 0 to 100%)?
4. What was the percentage of team member 2's contribution to project 1 (from 0 to 100%)?
5. What was the percentage of team member 3's contribution to project 1 (from 0 to 100%)?

The last three questions of the project participation questionnaire allowed not only to include a student's level of participation as he/she perceived and reported it, but also to take into consideration the other two team members' perception of that student's participation level in their team. This unique approach to assessment of participation level in teamwork was useful for the analysis of the relationship between participation level in teamwork and academic performance.

Analysis

For each student the average of their participation level for each project was calculated including their self-reported level of participation and their team mates' perception of that particular student's participation. After calculating these participation levels for every student and for each project, the relationship between the level of participation and the exam grades were assessed. The relationship between the average level of participation for the first three projects and the first exam was weak (r square= 0.04). The relationship between the average level of participation for the last two projects and the second exam was also weak (r square = 0.02). However, the relationship between the average level of participation in all five team projects and the final exam was relatively stronger (r square= 0.11). Although these results do not suggest a causal

relationship, the strength of the third relationship mentioned above does suggest a potential influence of level of participation in team projects on exam grades.

Findings and Conclusions

This study supports the argument in the literature that "Team Projects" [1], "Collaborative learning" [2], and "Project Based Learning (PBL)" [3] are indeed useful in engineering education. Although not all the relationships tested in this study turned out to be as strong as expected, the presence of a relationship and its direction are evidence for the effectiveness of project based learning in groups for better academic performance. One possible reason for the weakness of these relationships is the size of the class. Therefore, the instructor intends to continue applying this type of participation level questionnaire in the future courses to increase the cases included in the analysis. Another reason for the grades to reflect the effort put in the team projects only to a certain extent might be the anomalies observed in two groups. There were two groups where one team member put a big effort and the rest of the members did not. The consequence of this approach was that the individual that put this large effort became overwhelmed and had less time to prepare properly for exams and quizzes, thus compromising their grade through the examinations. The findings of this study suggests that assessment of the relationship between quantified measures of student participation in team projects and their academic performance requires more attention, since there is a potential positive correlation between them.

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