

AC 2008-525: ALGORITHM FOR DEFINING STUDENT ENGAGEMENT

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Algorithm for Defining Student Engagement

Abstract

The mission of the Western Kentucky University Electrical Engineering Program is to produce graduates who have been engaged in a variety of project experiences throughout the curriculum. Several assessment measures have been employed to determine that the mission of the program had been achieved. An algorithm has been developed to design an engagement index for students by assigning point values to various engagement experiences. The scores of the index were compared to the assessment results to determine if the algorithm is an effective predictor of satisfying the program mission and ultimately ABET Criteria 3 A-K.

Introduction

An emphasis of Western Kentucky University (WKU) is student engagement which is defined in a variety of ways by different groups across campus. The Department of Engineering at WKU houses three ABET accredited programs and has a mission of project-based engineering education. In the Department of Engineering, student engagement is achieved through project-based activities.

The Electrical Engineering (EE) Program is one of the three majors in the department. The mission of the EE program is to build a foundation of knowledge in electrical engineering by integrating a variety of project experiences at every level throughout the curriculum.¹ The mission statement and desired qualities of graduates of the EE program directly support the ABET Criteria 3 A-K.² Throughout the curriculum, EE students are provided many opportunities to grow in the various roles of engineers.

Several assessment measures have been employed to determine that the mission of the EE program has been achieved. However, it is desired to show that more engaged student are better prepared student in terms of ABET Criteria 3 A-K. Correlations between faculty perception of student competency on program outcomes and objectives, student perceptions, and student grade point average have been determined.³ A simple algorithm has been developed as a predictor for student engagement based on various engagement experiences.

Engagement Algorithm

An algorithm has been proposed to measure student engagement by assigning point values or weightings to various assessment measures. It is desired to determine whether or not this algorithm is an effective measure of engagement. The algorithm combines faculty perception, student participation, and student self perception. The formula for calculating the engagement index is as follows:

$$\begin{aligned} \text{Engagement Index} &= K_1 * \text{participation score} + \\ &K_2 * \text{faculty assessment score} + \\ &K_3 * \text{student self-assessment score} \end{aligned}$$

where K_1 , K_2 , and K_3 are weighting constants. Each of the components of the equation has maximum values of 3.0 and minimum values of 0.0. For the algorithm, the maximum achievable score is three. A highly engaged student is defined as a student who mostly ranks in the upper third of students and therefore the range of scores is between 2.00 and 3.00. A marginally engaged student is defined as a student who mostly ranks in the middle third of students and therefore the range of scores is between 1.00 and 2.00. A non-engaged student scores less than 1.00.

In order to initially compare the proposed algorithm, data which included faculty assessment of engagement using the engagement rubric discussed below, student self assessment using select questions from the National Survey of Student Engagement (NSSE) instrument, and student participation in engineering activities was obtained about graduates of the program. The data was then used to calculate scores for each assessment measure as discussed below.

Engagement Rubric

Student engagement is defined in this particular department as active participation in project experiences. In order to assess student engagement, a set of characteristics that describe an engaged student in the WKU EE program were written and are shown below:³

- Actively participate in project assignments with enthusiasm;
- Exhibit self-motivation in project assignments with enthusiasm (versus waiting on specific guidance from faculty);
- Participate in extracurricular project activities;
- Desire to learn the art of engineering rather than simply earning grades; and
- Embrace project experiences as vital to their educational experience.

These characteristics were based on the role of the student in a project based curriculum. Faculty ranked students on their perception of student engagement in engineering projects using the statements above in a rubric³. The faculty ranked the students according to the top third, middle third, and bottom third performance on each point. Students who were ranked in the top third received a rubric score of three while student who ranked in the lowest third received a rubric score of one. In order to obtain a score for this assessment measure, the scores for each student were averaged for each of items above.

Student Participation in Engineering Activities

Many of the opportunities for engagement occur outside of the classroom and it is important to recognize this activity in the engagement algorithm. It was decided that the following activities were valuable engagement activities:

- Extracurricular engineering projects with faculty or staff;
- External engineering projects through coops or internships; and
- Involvement with the IEEE autonomous robot project.

Students were scored on a scale from 3.0 for being highly involved in an activity to 0.0 for no involvement. In order to obtain a score for this assessment measure, the participation activities were weighted as follows:

- 25% participation in extracurricular engineering projects
- 25% participation in external engineering projects
- 50% participation in WKU IEEE branch

Participation in IEEE was weighted more than the other activities since it was a major activity promoted by the program and was more readily available to students.

Student Self Perception

One method used by the university to measure engagement is the NSSE which is administered to each freshmen and senior student. The NSSE instrument is essentially a series of questions created to determine student perception of their engagement during their higher education experience. NSSE is described as a method for determining “level of academic challenge, active and collaborative learning, student-faculty interactions, enriching educational experiences, and supportive campus environment.”⁴ The NSSE instrument poses questions that allow students to rate themselves on activities that relate to the specific academic program, the resources that the university offers, and other activities present on campus.⁵

In order to determine student perceptions about engagement, NSSE items were chosen that specifically related to student engagement as defined for the EE program. These items are listed in Table 1 below.

Table 1: NSSE Questions in Support of Engagement

NSSE Questions	NSSE Number
Practicum, internship, field experience, co-op experience, or clinical assignment	7A
Work on a research project with a faculty member outside of course or program requirements	7D
Study abroad	7F
Independent study or self-designed major	7G
Culminating senior experience (capstone course, senior project or thesis, comprehensive exam, etc)	7H

The students were asked to respond to the following question:

“Which of the following have you done or do you plan to do before you graduate from you institution?”

for each of the items above with the following answers and associated scores:

- done (3.0);
- plan to do (2.0);
- do not plan to do (1.0), and
- have not decided (0.0).

Student perception of engagement competency was determined by response to select NSSE questions. Scores were generated by equally weighting all four components of the algorithm.

Results

The weighting constants originally proposed were an equal weighting of all three assessment measures: faculty perception of student engagement, student participation in engineering activities, and student self assessment. The results for a sampling of students are shown below in Figure 1. In general, the faculty assessment of student engagement is greater than or equal to the other measures of assessment. It should be noted that faculty also consider classroom engagement as part of their assessment which could cause higher scores. The student self-assessment and participation scores appear to be much closer in range than with the faculty assessment scores.

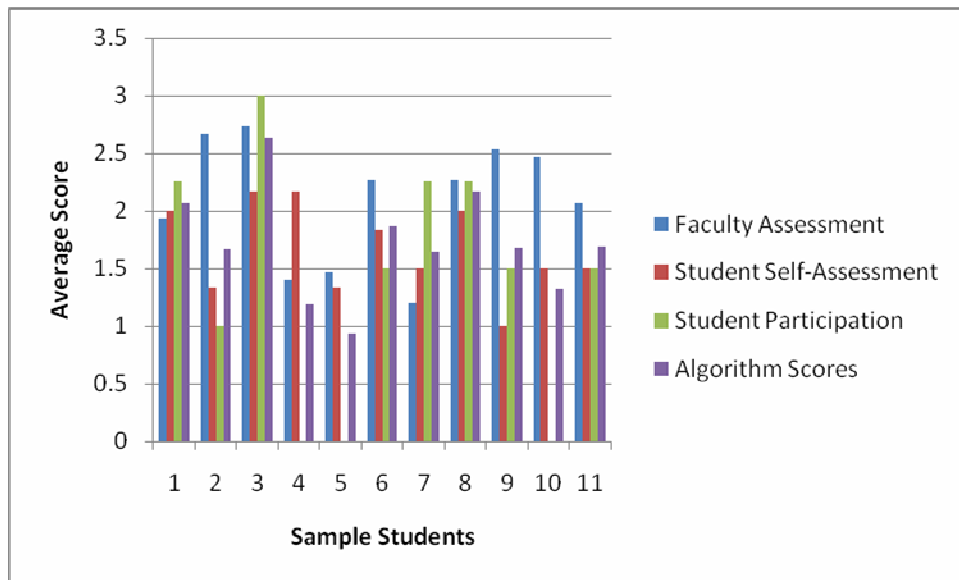


Figure 1: Graph of Results for Sample of Students

To further compare the results of the algorithm, the average scores for assessment measures were computed. The results discussed above are apparent when comparing the averages in the table below.

Table 1: Average Scores for Assessment Measures

Assessment Measure	Average Score
Faculty Assessment	2.09
Student Self-Assessment	1.667
Student Participation	1.38
Engagement Algorithm	1.71

Validity of Engagement Algorithm

As noted previously, student engagement is defined in this situation as fulfillment of the programmatic mission of project-based education. Thus engaged students will actively participate in project activities within and outside of the classroom. In order to determine the validity of the algorithm presented, the results will be compared to previous work in this area.

An assessment study was done of the correlation between faculty perceptions of student competency on the program outcomes and objectives, student perceptions, and student grade point average.³ In this study, faculty and student perceptions of engagement were also examined. The results of this study directly relate to the work in this paper. During the study the following results were found³:

- The faculty perceived that an engaged student fulfilled the program objectives.
- The faculty perceived that engaged students met the program outcomes and the ABET Criteria 3 A-K.
- There was a very high correlation between faculty perception of student competency in program outcomes and faculty perception of student competency in objectives.
- There was a high correlation between faculty perception of student competency in program objectives and outcomes with student GPA.
- Faculty and student perceptions of outcomes and objectives were different.
- Student GPA was not a good indicator of student engagement.
- There was some correlation between student self-assessment and faculty assessment of student engagement.

The WKU EE program outcomes and objectives not only fulfill the ABET requirements but also support the program mission.¹ From the previous study, it can be concluded that there is a strong correlation between student engagement and fulfillment of the program outcomes, program objectives, and thus program mission. Therefore if a student is engaged, then they will likely satisfy the program outcomes and objectives. From the results above, most of the algorithm scores for the sample students were above the measure established as highly engaged with the average algorithm score at 1.71. Since the majority of the sample is highly engaged as defined by the algorithm and it has been shown that engaged students fulfill the program outcomes and objectives, the algorithm appears to be a predictor of student competency on program outcomes and objectives.

Conclusion

A simple algorithm was developed as a predictor for student engagement based on faculty perception of student engagement, student participation in engineering activities, and student self assessment. It was determined that a student who is engaged through the engagement algorithm also satisfies the mission of the program and ultimately the assessment plan for the program. For future work, more student samples will be considered and other methods of assessment will be considered for the algorithm. It is hoped that in the future this algorithm can be used as a part of the assessment plan for the WKU EE program.

Bibliography

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