

Work-in-Progress – Using Frequent Low-Stakes Assessment (FLA) in a First Year Engineering Class

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Abstract - The widespread use of the established pedagogical method of lecture based instruction in first year engineering (FYE) classrooms is declining in favor of more innovative effective strategies. It is more common to see novel methods that may be better suited toward communicating current curriculum. Frequent low-stakes assessment (FLA) refers to assessment methods that occur relatively often and the consequences associated with the outcome are low. For three sections of a course in an introductory engineering sequence, FLA was used as a primary form of formative assessment. It was also used as a main component of the instructional methods for the part of the course that focused on programming. An inverted- or flipped-classroom is the typical arrangement of the majority of the FYE courses at the host institution. For this study, in lieu of the standard instruction that preceded class work time, the material was often presented in a trivia-contest setting. There is a large amount of anecdotal evidence gathered from the sections that utilized trivia/activities as a form of FLA that suggest it to be an effective form of instruction. Students displayed an increased level of participation in class activities and interaction with instructional staff. More comprehensive data will be obtained as the semester ends.

Index Terms - engineering education, assessment

INTRODUCTION

“Are you ready for class today?”

It seems that even with all the resources that today’s students have access to, often times they come to class unprepared to participate in the manner that instructors expect. There never seems to be enough time over the course of a semester to cover all the material that is necessary. In attempts to reach the needs of today’s students and address the large amount of information that needs to be taught, innovative methods are increasingly being considered by educators to address these concerns. In several fields, deviation from the established lecture method of instruction in favor of more relevant pedagogy is understandably trending [1-2]. One strategy that is being employed in several First Year Engineering (FYE) and STEM classrooms is the

inverted- or flipped-classroom. With the inverted classroom, students are expected to come to class prepared and spend contact time with the instructional staff in the classroom doing meaningful activities [2]. A common problem in unsuccessful experiences with flipped-classroom applications can be attributed to students not coming to class prepared. This leads to time spent in the classroom spent on lower lever cognitive activities, and not the planned application. Flipped-classrooms have been shown to work in several areas of STEM classes, but there is limited literature on the successes in an FYE class. The authors’ experience in industry provided insight into a possible step forward in the utilization of flipped classrooms. Prior to teaching, an author spent time as an engineer in training and worked under the supervision of a licensed engineer. Regular and systematic check-ins by the managing staff helped to create a productive work environment, as well as developing the skills of the new engineers. Checking in on a regular basis allowed mistakes to be caught earlier on the in the design process, which provided learning opportunities for both the supervising and learning engineer. In a classroom setting, this practice may be considered an example of Frequent Low-stakes Assessment. Just as the supervising engineer can provide oversight in the design process, an instructor could provide similar direction to students. Having a flipped classroom seems to be an excellent setting to pilot such a practice. The emphasis on reduced lecturing and increased interactions with instructional staff will allow for instructors to assess the needs of students and address misunderstandings as they occur.

BACKGROUND

One method that may increase the success of utilizing flipped-classroom pedagogy is the use of Frequent Low Stakes Assessment (FLA). FLA refers to evaluation methods that occur relatively often and do not have very much consequence associated with the outcome. FLA is usually a method of formative assessment, and can be manifested in a variety of ways. From casual conversations with students in between classes to semester long journal reflections, FLA can be a useful tool to determine the development of students [1]. There is reason to believe that FLA can be an effective tool to use in flipped-classrooms. There is also work that suggests

more low-tech approaches to student engagement are possible methods of instruction. Low-tech refers to limited use of tools, in favor of approaches such as hand-raising and oral response instead. Low-tech solutions are easily adaptable to several types of subjects and instruction [2]. Furthermore, when such scenarios can be presented as games, it can further increase positive qualities of the learning environment. Increased motivation, attendance, and engagement were all reported to have increased when using game-design elements in an educational context [3]. Such examples suggest that an attempt to utilize FLA in a classroom does not need to be sophisticated. If done correctly, measures such as casual conversations and games may serve as useful interactions and assessments. Additionally, it is not unrealistic to expect to improve rapport with students with increased meaningful interaction.

METHODS

Over the past year FLA was included in three FYE classes. Two sections were introductory engineering courses, and the third was an introductory programming course designed transfer students. The structure of the classes in the department is in alignment with the rest of the department's approach to flipped-classroom utilization. Using the institution's learning management system, students are expected to come to class having done the preparation activities associated with the day's topic. Preparation may include such tasks as reading, quizzes, and writing assignments. After a short lecture in class, the majority of time spent in the classroom was dedicated to application of material and assignments. All materials (preparation, in class, and homework) were available to the students from the beginning of the term, and remained available to students throughout the term. The time dedicated to application in the classroom allowed for meaningful interaction between the instructional staff and students. With the quantity and large variety of material to cover, it was hard at times to gauge the level of "meaningful interaction" that was best spent on detailed instruction, as opposed to having students work in class on activities or homework. A common scenario was for students to come to class unprepared and learn the material after lecture, which is counterproductive to the intents of having a flipped-classroom.

To address such concerns, an attempt at including FLA in the form of a trivia-game was presented to the students. The implementation varied a bit across the sections, but the ideas were the same. One example of the implementation method was as follows: supplemental slides were prepared by the instructors based on the provided preparation materials. At the end of the presentation, questions were given to the class in the form of a trivia contest. A question based on the preparation material was presented, and students submitted answers for evaluation. Items were constructed to be appropriately scoped for the material but also able to be answered in a pencil and paper format. Using a low-tech approach helped to reduce concerns with students about being proficient with technology; for example, in the

programming class, students could submit a hand written response that indicated comprehension as opposed to not being able to navigate the interface in a timely manner. Student teams were to provide responses in reply to the prompts. Scores were assigned to the questions and tracked throughout the term. In journals completed by the students, reports of high levels of engagement and participation were reported by several of the students. Furthermore, tracking the results from daily trivia served as a method of formative assessment for the instructors. Performance on trivia activities was used as one indicator of subject mastery, which was used to influence scheduling of future activities.

FINDINGS

There have been preliminary, anecdotal results gathered by the authors in relation to the study. In self-reported responses, students state that the activities were received in a mostly receptive manner. The comparatively consequence-free nature of application allowed for students to make mistakes and take risks that may not usually occur when dealing with graded work. Reference [5] states when students' priority is on the outcome, then it may lead students to miss out on several learning opportunities that assessment can provide. Even a brief exercise in error analysis [6] may prove to be effective in application and retention of knowledge.

At the time of submission, a survey regarding the utilization of trivia as in class FLA has been distributed to student of the sections in question and are waiting on data collection. Thirteen items with Likert responses and one open response item ask students about experiences with trivia and activities in the classroom. TABLE 1 shows an initial summary of the results from the survey. The items were responded to using a five-point scale, ranging from 1- Strongly Disagree, to 5- Strongly Agree. Items 2 and 10 were reverse worded to help ensure validity in the instrument. At the time of manuscript submission, there were a total of 24 students from three sections who responded.

The assessment criteria used an existing framework from Suskie [7] to create a quality assessment instrument. Good assessment was described as having the following criteria: concentrating on and coming from clear and important objectives, cost effective in terms of time and money, producing accurate and truthful results, utilized, and values. These criteria were used at the foundation for item creation. Items were modeled after examples provided by reference [7] and modified to suit the setting of the study. In alignment with the first suggested criteria, class learning objectives served as a basis for item development. Once an appropriate amount of suitable items were completed, the items were grouped into the 4 additional criteria. The adapted topics that the questions were grouped into are: Cost, Results, Utility, and Value. TABLE 1/ Figure 1 shows the mean response for each item organized by course section as well as the mean score for each category. The mean score for each category can be found next to the label on the Figure. The scores for the reverse worded items have been accounted for and scores

are presented in a consistent format with the rest of the items. Multiple items helped to add to the validity

TABLE 1
RESULTS FROM SURVEY REGARDING CLASSROOM ACTIVITIES

Item Number	Item Prompt	Average Score	Standard Deviation
1	I would have liked to spend more time on trivia/activities during class time.	3.00	1.18
2	The trivia/activities took away needed time from the other elements of the class.	2.71	1.23
3	The appropriate amount of time was given for each trivia question/activity.	3.33	0.82
4	The trivia/activities were a good representation of the important concepts from class.	3.70	0.76
5	Our answers/outcomes were a good representation of my preparation done before class.	3.42	0.93
6	Our answers/outcomes were a good representation of my knowledge of the topics.	3.79	0.93
7	The trivia/activities helped me understand what areas to study for exams.	2.92	1.44
8	The trivia/activities helped me understand what topics I needed to seek help from instructors or TAs.	3.17	1.34
9	The trivia/activities were useful to having an engaging class.	3.71	1.27
10	The trivia/activities made me not want to attend class.	2.17	1.20
11	The trivia/activities were beneficial when completing class assignments.	3.08	1.18
12	The trivia/activities were beneficial when completing exams.	2.75	1.07
13	In my opinion, participating in trivia/activities was an important component of my learning.	3.17	1.23

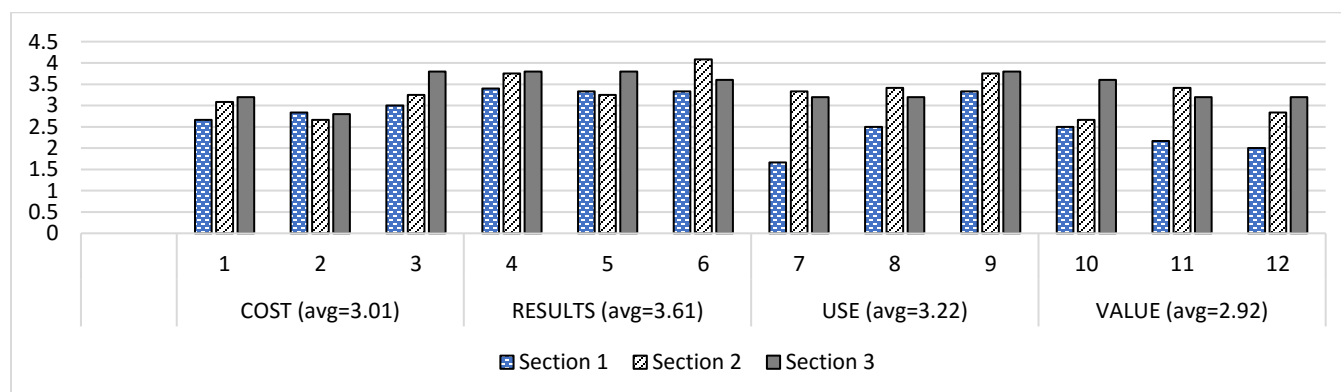


FIGURE 1
AVERAGE ITEM RESPONSE BY SECTION

of a particular category, in that multiple attempts to measure the same construct would help

DISCUSSION

Thus far, the observed responses from the students have been indicative of a positive reception. Students regularly requested the trivia and activities to be posted to the Learning Management System for personal review. In at least one section, it improved the attendance of students who learned about the perceptions of the activities from other students who regularly attended classes.

Although the N for each section was relatively low and may not be the best basis for meaningful statistical interpretations, some inferences may still be made from the data presented in Figure 1. Differences in section response tendencies are shown as well as the trends for each assessment criteria grouping. For example, Section 3 was the programming class and had a mean introductory score of 3.46 for all items, while the mean score for the introductory class

in Sections 1 and 2 was 2.99. The criteria group titled “Results” had the highest average score with 3.61. The questions in the Results group looked at various ways the information from the activities were represented. Information from the study will be used to inform future pedagogical practices in the FYE classes. Additional sections are considering including similarly formatted activities in the fall as a part of the inverted classroom.

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