

Implementation of Student Presentation-based Active Learning (SPAL) Approach in Undergraduate Engineering Curriculum

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Abstract: Active learning approaches require lots of time investment in student activities and engagement during the class period, which often leads to incomplete coverage of the course syllabus. Furthermore, it requires significant amount of time for the instructor to design and implement. To address these widely recognized inhibiting factors, we recently implemented a new student active learning approach, namely “student presentation-based active learning (SPAL)”. Under this approach, students are given a reading assignment to prepare a PowerPoint presentation on well-defined conceptual topics, questions, or chapter modules. Reading assignments on a topic are administered 1-2 weeks before covering them in the class. This allows reasonable time for the self-comprehension of the suggested material for presentation preparation. Students were expected to rehearse the presentation and be prepared to complete it in the suggested time duration. During each lecture, one group of students would present the assigned topic to the class, and their presentations were graded according to the rubric focusing on the coverage of suggested topics, quality of presentation, and after presentation discussions. Peers and instructor provided feedback about the students' presentation and unclear concepts. To understand the efficacy of

this approach, it was implemented in Mechanical Engineering Senior Capstone Project course in Fall 2016. Here the responses and insights garnered from this practice were presented, and discussion on the advantages and challenges associated with the adaptation of this approach in teaching engineering courses as compared to lecture based classroom education system.

Keywords: Learning objectives, Student presentation, Active learning

1. Introduction

A teaching approach that engages students in various active learning activities during instruction and discussion is more effective than traditional lecture based teaching . Student active learning involves students in doing things and thinking about the learning objectives and tasks they are doing. There are several strong reasons to advocate the selection of active learning based classroom teaching. An active learning approach can encompass both isolated and highly structured activities to motivate students to take charge of their deep learning. Active learning can be applied to both small and big classes . During active learning students receive frequent and immediate feedback about the depth and accuracy of the focused material. An active learning approach is very effective

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in addressing students' stereotypes and learning styles. Active learning can also be very effective in creating personal connections between students and the course material, which strongly increases the student's motivation to learn proactively. In addition to the course content, active learning develops life skills like improving subject mastery with others feedback, collaboration, and brainstorming to reach the most rational answers.

However, efficacy of a student learning approach will depend on how many elements of learning it encompass. Developing active learning approaches may be a quite a time-consuming endeavor. Faculty who are venturing into student active teaching may be daunted by the time and effort needed to master the skill. To address this issue a student presentation-based active learning (SPAL) approach has been recently developed. This paper reports our observations and findings of the adaptation of SPAL in undergraduate engineering courses.

The focus of this study is on the implementation of a SPAL teaching approach that encourages active learning by leveraging students as instructional tools to provide instruction to their peers. This approach builds on a sturdy foundation of literature to inform this approach:

1. one of the best practices in higher education to encourage effective teaching is the promotion of active learning. It can be described as a process where students are engaged with content and activities by the instructor to promote learning. The strength of active learning is that it puts more of the accountability for learning on the learners. Similarly, SPAL encourages learning accountability by involving students in the learning process to educate their peers.

2. this SPAL approach can also be likened to the flipped classroom approach combined with features of the peer interaction approach. In recent years, the flipped classroom strategy has become a popular approach educators have leveraged to improve effectiveness. It builds on the learner accountability promoted by active learning and allows students to do outside of class what they would normally do inside the classroom and vice versa. Flipped models usually use class time to engage students in activities beyond passive receipt of information. The approach provides the opportunity for instructors to better encourage student learning beyond the remembering and understanding levels of Bloom's Taxonomy. SPAL

builds on this concept of having students use time outside of class to build their knowledge about the course content and learn it to the degree that they will teach their peers. SPAL promotes the highest level of bloom (creation), but having students use what they have learned for peer instruction.

Specifically, in the proposed SPAL approach, students are given topics for a class 1-2 week before to understand by self-reading and prepare a coherent presentation for 25-30 mins duration. The students subsequently present these presentations, during a designated class. During and after the presentations instructor and peers provide feedback or ask questions to increase the impact and value. It is apparent that SPAL approach has received favorable response from most of the properties. This teaching approach enabled groups of students to prepare presentations on the critical elements of the chapter or section as assigned by the instructors to measure their comprehension of the material. Within the SPAL approach are the elements of a range of effective teaching theory and practice. The approach operationalizes the advancements in teaching to provide a practical strategy for instruction.

2. Methodology

To understand the efficacy of this approach, this approach was implemented in Mechanical Engineering Senior Capstone Project course I in Fall 2016. Prior to the implementation of this SPAL method, the senior capstone project I was taught through a traditional lecture based approach in which the following topics are covered: 1. Engineering design process; problem definition, design constraints and requirements, 2. Design process, 3. Product definition and concept generation, 4. Concept evaluation and selection, 5. Product evaluation, 6. Project definition and team selection, 8. Literature survey, alternate design solutions, 9. Preliminary design and detailed design. Just like most traditional lecture-based course, the instructor gave all the lectures, homework assignments and projects to the students and the performance of the students are graded based on their homework, project reports and other assignments.

In this new SPAL approach, although the same topics are covered, now the students become the instructors in which they will prepare and give the lecture using the materials provided by the instructor. Their grade is assessed based upon how well they have

prepared the lecture, how they understand the material and how the material is presented to the class. The students are given the opportunity to try and learn the topics before coming to the lecture compared to the traditional come-and-listen type of lecturing method. Specifically, there were 18 students enrolled in this course in Fall 2016 and six student groups of 3 students each were formed. Each group is given the same topics to cover before the lecture and they are required to prepare and present the same topic in the class time. Questions will be asked during their presentation to assess their understanding of the relevant topics. This practice was exercised throughout the semester in which the students gave presentation for 10 weeks at twice per week.

To assess the efficacy of this SPAL approach, the study is qualitative with two methods: (1) direct evaluation and assessment of the teaching practices of the students, (2) anonymous surveys of student participants using SPAL. This study is designed to collect evidence on how students who participate in SPAL have bettered their understanding of the course materials through active learning. Also, included are perceptions of the students taught using this method through the anonymous survey conducted online. It was imperative that a specified criterion be identified and employed for consistency.

1) In-class assessment method for student teaching practices

The first assessment is based upon the results collected through the evaluation form of each SPAL practice. A sample evaluation form is shown below:

Table 1: Sample SPAL teaching practice evaluation form

	A	B	C	D	F
Presentation Evaluation	(9) Excellent	(8) Very Good	(7) Average	(6) Poor	(5) Failed
1. Students provided introduction of background information					
2. Students covered the given topics of discussion					
3. The presentation has a clear organization					
4. The presentation reflected knowledge of the subject matter					

5. Students provided analysis of the key points					
6. Students answered questions from the class					
7. Presentation reflected planning and organization of the subject matter					
8. Students have fully assessed their assigned topics					
9. Students related the key topics to real-life examples					
10. Overall how would you rate this presentation					
What would you suggest to the presenters to help improve their next presentation?					

This assessment form was given to the audience for each presentation. The results obtained from this are consolidated and compared with the instructor's assessment to provide a final grade for each presentation.

1) Anonymous online survey for student teaching practices

In addition to the direct assessment of the proposed SPAL method, an anonymous survey was conducted through Blackboard. It is aimed to assess the effectiveness of this SPAL method compared to traditional lecture based teaching from the student's perspective. A sample list of survey questions is shown below:

Q1. The Student Presentation based Active Learning (SPAL) approach is a new concept to senior capstone class, do you feel that it helped you learn the main concepts and methodologies in engineering design this semester?

Q2. As a presenter, how many hours a week did you spend reviewing the course materials and corresponding chapters in the textbook before your presentation.

Q3. As a listener, how many hours a week did you spend reviewing the course materials and corresponding chapters in the textbook before your presentation?

Q4. As a presenter, was the class set up helpful in your learning of the course materials

Q5. As a listener, was the class set up helpful in your learning of the course materials?

Q6. On a scale of 1-5, where 5 is highest, I would rate this SPAL teaching practice experience as a:

Q7. Please describe your understanding of why active learning techniques are incorporated into the senior capstone class?

Q8. What was your favorite experience about this class?

Q9. What was your least favorite experience in the class?

Q10. If you could offer one suggestion for change in the SPAL practice implemented this semester, what would it be?

3. Results and discussion

Here the responses and insights garnered from this practice were presented, and discussion on the advantages and challenges associated with the adaptation of this approach in teaching engineering courses as compared to lecture based classroom education system. This paper can provide useful insights for instructors considering this approach or similar student active teaching approach in their courses.

1) Results obtained from student teaching practices

The results collected from this assessment have shown good agreement between the students' and the instructor's assessment, which indicates most of the students were able to understand the subjects of the matter through this practice. The feedback from this assessment was provided back to the student presenters. In addition, the student presenters were provided with a self-evaluation form which includes extra two questions to provide a self-assessment of their presentation and thoughts on how to better prepare for their next presentation.

The Figure 1 below shows the assessment of each student group presentation over the entire course of this SPAL practice, in which each color represents one student group.

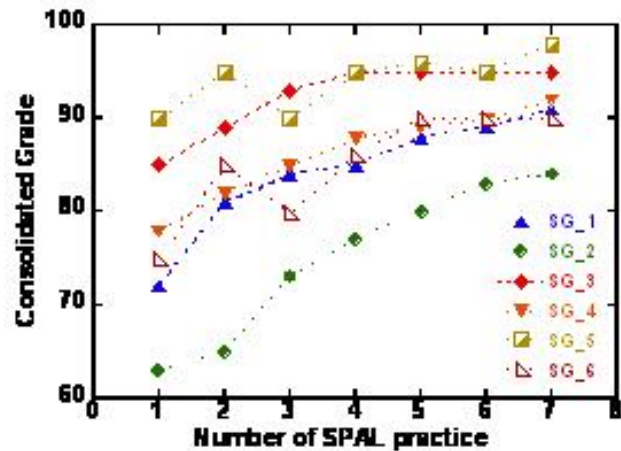


Figure 1. Assessment of student groups' SPAL practices

It can be seen from Figure 1 that while the overall grade of each group varies, all the groups have obtained a higher grade over the course of this practice. 5 out of 6 groups (i.e., 15 out of 18 students enrolled for this course) have achieved a grade over 85 and all of them have a grade over 80 at the end of this practice. It is apparent that the students not only benefit by a thorough understanding of the course materials, but also significantly enhanced their public speaking and professional presentation skills.

1) Results from anonymous survey conducted online

The responses to this anonymous survey are summarized as the following:

Q1: 90% of the students (16 out of 18 students) rated this SPAL approach "Extremely helpful" and 10% (2 out of 18 students) rated "Helpful" in helping them understand the main concepts in this course.

Q2: as a presenter, 60% of the students (10 out of 18 students) spent on average over 15 hours per week reviewing the course materials and preparing for the presentation; 30% (6 out of 18 students) spent on average between 10 to 15 hours per week reviewing the course materials and preparing for the presentation; and 10% (2 out of 18 students) spent on average less than 10 hours per week reviewing the course materials and preparing for the presentation.

Q3: as a reviewer, on average 30% of the students (5 out of 18 students) spent on average over 15 hours per week reviewing the course materials and preparing for the presentation; 30% (5 out of 18 students) spent on

average between 10 to 15 hours per week reviewing the course materials and preparing for the presentation; and 40% (8 out of 18 students) spent on average less than 10 hours per week reviewing the course materials and preparing for the presentation.

Q4: 100% of the students (all 18 students) rated this SPAL approach “Extremely helpful” in helping them understand the course materials.

Q5: 90% of the students (16 out of 18 students) rated this SPAL approach “Extremely helpful” and 10% (2 out of 18 students) rated “Helpful” in helping them understand the course materials.

Q6: 80% of the students (14 out of 18 students) gave a “5” for this SPAL experience; 20% of the students (4 out of 18 students) gave a “4” for this SPAL experience.

Q7. 60% of the students (10 out of 18 students) responded “to help understand the course materials and encourage active learning”; and 10% of the students (2 out of 18 students) responded “help them increase their grades or make the teaching more fun”; 30% (6 out of 18 students) responded “don't know but it should be useful”.

Q8. 20% of the students (4 out of 18 students) responded “discussion with classmates during the preparation of the presentation”; 30% of the students (6 out of 18 students) responded “better prepared before coming to the lecture and feel more confident in understanding the topics”; and 40% of the students (8 out of 18 students) responded “interactive discussion during the presentation helped them to better understand the topics”.

Q9. 80% of the students (15 out of 18 students) responded “takes time to prepare for the presentation assignment”; 20% of the students (3 out of 18 students) responded “some groups' presentations are not that well-organized and hard to understand”

Q10. 30% of the students (5 out of 18 students) responded “can have more than one group present each time”; 10% of the students (2 out of 18 students) responded “add a review session at the end of each lecture”.

Thus, based on the feedback collected through this anonymous survey, it has clearly indicated the advantages of implementing this SPAL approach in

upper level engineering course that it can engage students and foster active learning; over 90% the student participants highly valued this practice and 10% think this practice is helpful. On the other hand, there are still rooms to improve in implementing this practice and the following observations will be incorporated to next year's teaching practice: 1. Have more than one student group present the same topic during each lecture; 2. Incorporate a mini-review session at the end of each lecture; and 3. Regroup the students every three presentations.

4. Conclusions

Overall, this paper presented the author's first attempt to incorporate student-presentation based active learning(SPAL) approach into teaching practice of mechanical engineering senior capstone project. This study has provided the insights from both direct and indirect assessment on students who have participated in this SPAL study. According to the participants' feedback all of them find SPAL useful and 90% of them find it very useful as indicated in the response of several questions asked during this study. It is recommended that faculty members participating in the study should provide feedbacks to the students right after their teaching practice and it must also be administered for the non-presenting students. They also should use a common rubric to evaluate the student presentations and comment on student performance in their classes while providing their feedback. It may also be helpful to have more than one group presenting on same topics during each lecture, which can help both the student presenters and the audience to have a more comprehensive understanding of the topics and encourage peer learning. In summary, this SPAL approach has been designed and implemented in an upper-level engineering course to address the limitations of common active teaching approaches for the technically advanced courses where students are expected to apply advanced math and science concepts. Future studies on applying this practice to various engineering courses are urgently needed.

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