Use of Active versus Passive Learning Pedagogies in a Statics course to Address Variations in Student Performance between Course Sections

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Abstract

Three sections of an undergraduate Statics class were taught using traditional passive classroom pedagogy where students received a standard lecture presenting the material theory followed by a short example that implemented this theory. However, up through the midterm examination, the afternoon section of the course (i.e., section 3) performed consistently lower than either of the other two sections on student assessments (e.g., homework, quizzes, the first examination, etc.). Therefore, the instructor implemented an active learning strategy after the midterm exam that consisted of the instructor presenting an example relative to the lesson topic with relevant theory introduced as necessary so that students, sometimes working as individuals, other times in groups, could complete the presented scenario and/or examples. A qualitative comparison of student perceptions before and after the midterm examination illustrate that there was an influence on student performance when comparing the implemented active versus passive learning pedagogies.

Keywords

Learning Pedagogies; Active vs. Passive Learning; Statics

Introduction

The Citadel – The Military College of South Carolina Department of Civil and Environmental Engineering offered three sections of a Statics service course in the fall of 2015 to first semester sophomore mechanical engineering students. The three sections were held on Monday, Wednesday, and Friday (MWF) at 8:00 AM (section 01), 11:00 AM (section 02) and 1:00 PM (section 03). A civil engineering instructor taught all three sections using a traditional passive learning pedagogy where students received a standard lecture presenting the material theory followed by a short example that implemented this theory. However, from the start through the midterm of the semester, section 03 performed consistently lower than either section 01 or 02 on student assessments (e.g., homework, quizzes, the first examination, etc.). Potential reasons for the lower performance of section 03 included, student grade point average (GPA), timing of the third section, instructor fatigue, etc. It has been shown in the literature that the best teachers are able to adapt pedagogies that best suit the needs of the students[1]. Additionally, current research has shown that science, technology, engineering and mathematics (STEM) students perform better when exposed to active learning strategies[2]. Therefore, the instructor implemented an active learning strategy in section 03 immediately after the midterm exam for the remainder of the semester. The active learning strategy implemented began with the instructor presenting a scenario and/or examples relative to the lesson topic. Relevant theory was then introduced as

necessary so that the students, sometimes working as individuals, other times in groups, could complete the presented scenario and/or examples. Student perceptions collected at semester end through surveys and a quantitative comparison of student performance from all three sections before and after the midterm examination illustrate that there was an influence on student performance.

Implemented Learning Strategies

Students in all three sections were provided with various materials throughout the semester to facilitate learning that included: Power Point presentation handouts, learning objective handouts, exam review packets, textbook reading assignments and homework assigned after each class. A CIVL 202 Statics end-of-semester survey was administered to collect the student perceptions on the learning strategies that were employed for the duration of the semester.

Table 1 depicts the distribution of student perceptions from section 03 in response to the CIVL 202 Statics end-of-semester survey in Figure 1. The scale utilized is 1 – 5 with "1" being of no/little benefit to your learning to "5" being the greatest benefit to your overall learning. Values in the body of Table 1 represent the number of times the respective number of the scale was selected by the students (N = 21) with the "Average" column providing the weighted average of the total number of responses for each strategy. Several strategies performed as expected (e.g., exam review packets: 4.71/5.00; textbook reading: 2.67/5.00). However, it was surprising to see that, despite and increased work load, homework assigned after every class received the second highest positive response from students (4.62/5.00).

Table 1: Distribution of student perception responses to the CIVL 202 Statics end-of-semester survey (see Figure 1).

	1	2	3	4	5	Average (on a scale of 1-5)
Power Point	2	3	9	6	1	3.05
Handouts	1	0	6	7	7	3.90
Learning Objectives	1	1	4	9	6	3.86
Exam review packets	0	0	1	4	16	4.71
Textbook reading	4	7	4	4	2	2.67
Daily homework	0	0	3	2	16	4.62

Implementation of an Active Learning Session versus Passive Lecture

The switch from a passive lecture to a more active learning session that included more group work and student participation was not formally announced to the section 03 students during the semester. Students were asked as part of the CIVL 202 Statics end-of-semester survey if they preferred that the instructor begin class with (a) a lecture covering the theory on a subject and then progressing to working example, or (b) an example and then introduce the necessary theory as needed to complete the example. Preliminary results indicate that there was not a consensus between students as to which method they preferred with 42.9% preferring a traditional passive lecture format and the other 57.1% preferring a more active approach to learning. This may or may not be indicative of the efficacy of either of the two methods in transferring knowledge, but

rather it may relate back to student differences in the classroom[3, 4]. Figure 1 provides a comparison of all three CIVL 202 sections before and after the semester midterm. It is clearly seen that sections 01 and 02 performed consistently better on examinations than section 03 before and after the midterm of the semester. The active learning strategy was implemented in section 03 while sections 01 and 02 continued to receive instruction through traditional passive lecture. There was an increase in the performance of section 03 after the implementation of the active learning strategy. Section 01 actually showed a larger increase in performance than that attained by section 03 with only traditional passive lecture. However, correlation of these results of student performance may not only be attributable to the differences in teaching strategies, but may be influenced by differences inherent to the classroom. The next step will be to determine statistical significance of these results, but more data over successive semesters is needed in order to provide any reasonable confirmation of the results.

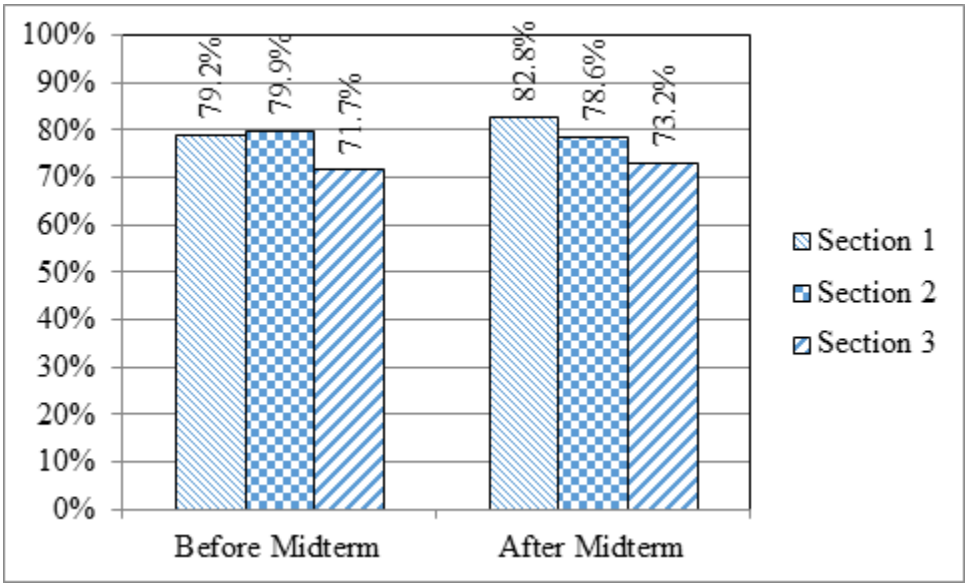

Figure 1: Comparison of CIVL 202 student average exam scores before and after the midterm.

Preliminary Conclusions

It seems evident that there is at least a positive correlation between the implementation of an active learning strategy over a traditional passive lecture as a means to increase the performance of students that exhibit a variation across course sections. However, correlation does not equal causation; and, due to myriad reasons for the variations in student performance across sections (e.g., time of course offering, instructor fatigue, student grade point averages, student differences, etc.), further investigation is warranted in an attempt to quantify the influence of this particular active learning approach on student performance. Future work will continue to collect data while attempting to quantify student differences that may be unintentionally influencing the results.

References

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