AC 2010-2055: IN-PERSON VERSUS SYNCHRONOUS REMOTE DELIVERY OF MECHANICS LECTURES

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In-Person versus Synchronous Remote Delivery of Mechanics Lectures

Abstract

The author divided two classes of mechanics students into two approximately equal groups. One group received lectures in-person while the other group received the lecture synchronously and remotely over the internet from an adjacent classroom. Students were randomly assigned to each group. Two different lectures were performed in this manner with each of two classes with students randomly assigned to the two groups each time. Students were pre and post-tested by survey. The students attempted to answer questions involving basic linear and angular impulse and momentum questions. They were also surveyed as to their perceived understanding of the material addressed in the survey and their willingness to have their responses included in the study being performed.

Introduction

The author is an instructor for a university that provides classes in the traditional classroom lecture format as well as streaming the same lecture synchronously over the internet to students off-campus. A brief experiment was devised in an effort to determine if there was a measurable difference between the performances of the students receiving the lecture in-person versus remotely over the internet. The literature confirms that technologically delivered courses can be as effective as lecture methods of instruction[1,2,3] though it also shows a bias against remotely delivered classes[4]. The author has heard negative remarks about remotely delivered courses. The author desired to know if his particular method of instruction would show a measurable difference in student outcomes regarding the two aforementioned delivery formats. The study covered two consecutive semesters of a course covering both statics and dynamics.

Methodology

A survey was devised consisting of ten questions. Quantitative and qualitative methods were employed in the study[5]. Eight quantitative questions were devised by the author. Four multiple choice questions addressed basic linear impulse and momentum concepts. Four multiple choice questions addressed basic angular impulse and momentum concepts. The ninth was a qualitative Likert-type question and asked the students to rate their perceived preparedness to answer the eight linear and angular impulse and momentum questions. The final question asked if the student was willing to have their responses included in a study. The same ten questions were administered three times to each semester.

Three copies of each survey were stapled together and were assigned a random number using a random number generator. Each of the three copies was labeled with the same random number to track changes in individual responses. The exercise was performed during two consecutive semesters of a combined statics and dynamics class. A total of fifty students were present for the study. The instructor was blind to which student received which survey number. Students were told to not put their name on any page to ensure anonymity in an effort to minimize student

anxiety, increase cooperation and keep the study double blind. The question asking for the student's permission to be included in the study was included out of consideration for the student and in an effort to give the student a sense of control over a potentially stressful situation and to hopefully increase the chances that they would not fake their answers as a protest to a possibly unwanted exercise and jeopardize the results of the study. Participation was voluntary.

The survey was administered and collected initially at the start of the class session before any intervention was performed. Students with odd numbered surveys were asked to accompany the instructor to an adjacent classroom where a brief lecture regarding linear impulse and momentum was performed in front of the students with odd numbered surveys and broadcast via the web to the original classroom to the students with even numbered surveys. The survey was then administered for the second time to all the students. Students with surveys labeled with the lower half of the numbers were asked to accompany the instructor to the adjacent classroom where the instructor administered a brief intervention regarding angular impulse and momentum which was broadcast back to the original classroom to the students with surveys with the upper half of the numbers. The students were assembled back to the original classroom and the survey was administered and collected a third time. The total time for the entire exercise was approximately twenty minutes for the first semester and thirty minutes the second semester. Some students had difficulty completing the questions in a timely fashion even after being assured that the answers did not count towards their grade and would be either readily apparent or a matter of taking a best guess. An earlier version of the survey included more involved questions which made the survey impossible to administer in one class session. Future versions may need to have a time limit imposed.

The student demographics consisted of forty-five males and five females. No background survey was conducted to determine gender though prior knowledge was addressed by the pretest. Thus gender was not accounted for though it has been shown to affect performance in technical classes[6]. The randomization should have helped eliminate the gender bias.

The students were not aware of the nature of the study. The questions were multiple choice with only one correct answer and could be graded objectively. Therefore the study was double blind. A z test for difference in proportion was performed on the multiple choice questions. The Likert-type question regarding perceived preparedness was quantified by coding responses as follows: Strongly agree was assigned a 1, agree a 2, neutral a 3, disagree a 4, and strongly disagree a 5. A one sample t test was performed on the differences in the ratings for individual data. Pearson's correlation coefficient was determined between the individual student performances for all eight questions and the individual student perceived perception of understanding.

Results

Three students chose to not have their responses included in the study. Eight students did not complete or return all sections of the survey and their answers were not included in the analysis. That left thirty-nine students that were used for the analysis. Table 1 shows the proportion of correct answers for each of the first eight questions. One or both of the interventions resulted in a statistically significant difference in the proportions of correct responses for each question for

the total sample of students that completed all three surveys and chose to have their answers included in the study. Table 2 shows no statistically significant differences were found between the proportions of correct responses between the students that received the lecture remotely versus in-person.

Table 1: Proportion of correct responses and statistical significance between pretest and after both interventions proportions for all 39 participants

Question Type/Number	Pretest	Post linear intervention	Post angular intervention	Statistical significance
Linear 1	.26	.90	.87	p<.001
Linear 2	.41	.84	.74	p<.01
Linear 3	.36	.70	.85	p<.001
Linear 4	.49	.85	.84	p<.01
Angular 1	.24	.47	.65	p<.001
Angular 2	.36	.18	.58	p<.001*
Angular 3	.24	.57	.72	p<.001
Angular 4	.24	.29	.69	p<.001

*Comparison for angular 2 question was performed between post linear and post angular intervention proportions.

The change in response to the perceived preparedness question between subsequent completions of the survey was statistically significant as determined by a t test for the difference in means (p<.01). Chart 1 shows the responses from each survey for the perceived preparedness question.

Table 2: Proportion of correct responses In-person/Remote (n=15/n=24)

Question Type/Number	Pretest In-person/Remote	Post linear intervention In-person/Remote	Statistical significance**
Linear 1	.20/.29	.87/.96	NS
Linear 2	.33/.46	.87/.88	NS
Linear 3	.27/.46	.67/.71	NS
Linear 4	.53/.46	.87/.71	NS
Angular 1	.27/.21	.60/.38	NS
Angular 2	.40/.38	.20/.21	NS
Angular 3	.33/.17	.60/.58	NS
Angular 4	.40/.13	.20/.33	NS

**NS=no statistical significance found between in-person and remote proportions

A correlation analysis was performed on the perceived preparedness and total number of correct answers for individual students. Pearson's correlation coefficient, r, was determined to be 0.53. Guidelines for determining the strength of correlation in educational research is[7]: weak (r = ±0.10), moderate (r = ±0.30), and strong (r = ±0.50). Based on these criteria there was a strong relationship between the responses to the perceived preparedness and the proportion of correct answers. The first semester data showed statistically significant difference between the perceived understanding of the material for the remote versus in-person lecture but this difference did not remain significant when the second semester data was incorporated into the analysis. Chart 2 shows the increase in self-rated understanding for the first, second and both semesters. The

significant increase in understanding can be seen in the first semester, but reverses in the second semester.

Chart 1
Distribution of all responses to: I understood the class material addressed in these questions. (n=39)

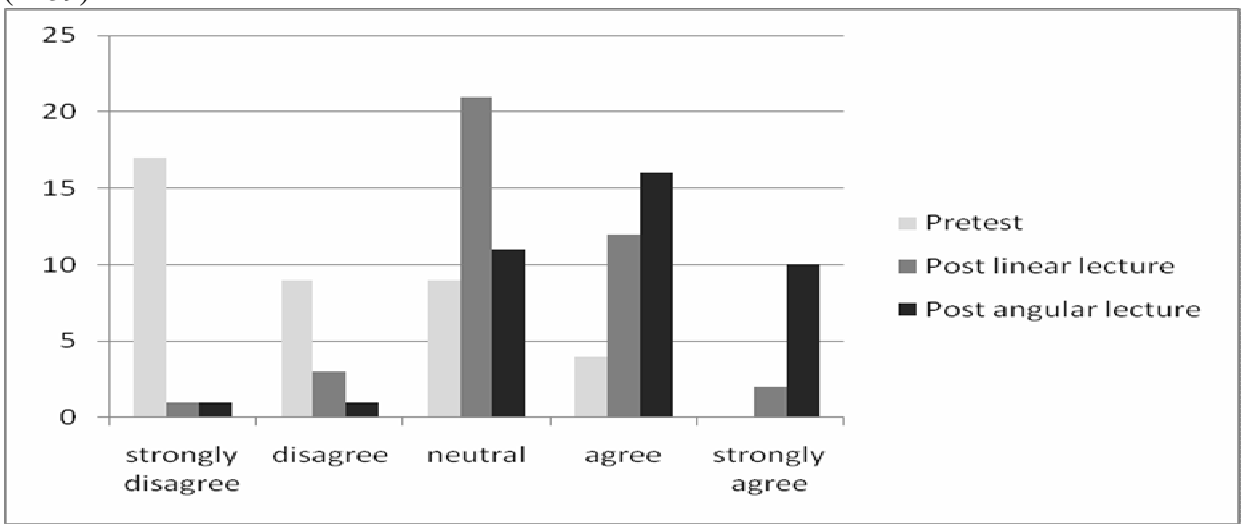
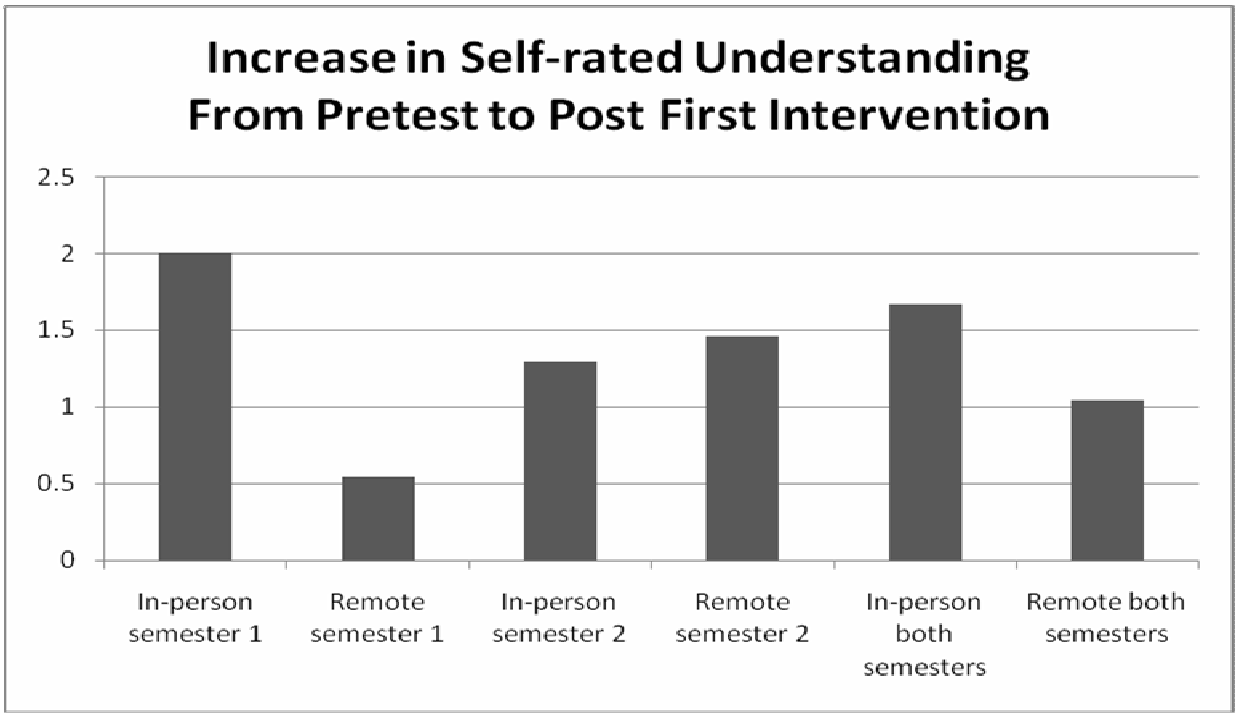


Chart 2



Concluding Remarks

The interventions had a significant impact on the proportion of correct answers for each of the eight questions addressing linear and angular impulse and momentum. There was no significant

difference found in this brief study between the students that received the lecture in-person versus remotely. A larger sample size might yield different results.

The students' self ratings of their understanding had a strong correlation with their ability to correctly answer technical survey questions. The students seem to learn just as well by remote lecture and this should be realized with the strong correlation shown by their capabilities to self rate. A follow up study including more qualitative data might shed light as to the particular reasons why there seems to be a negative bias with some students against remotely delivered lectures. The reasons may or may not correspond to those found previously[4] and their cause may possibly be eliminated or minimized.

A byproduct of the study regards a difference in linear versus angular correct answer proportions. Table 1 shows the final proportions for the angular questions to be consistently lower than the linear questions and that additional effort may need to be placed on angular concepts.

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