

Evidence that Adaptive Online Textbook Utilization May Lead to Higher Grade Performance

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Abstract: The new generation of online college textbooks (e-Texts) usually include several tools to help track student performance. However, at this early stage of the technology, it is still unclear what benefits (or detriments) e-Texts provide to students. Furthermore, it is unclear what the best implementation practices might be for faculty who may have e-Text options. This study investigated how the time students spent reading an e-Text impacted their overall grades in a freshman mechanical engineering course. The course in question, MECH105: Problem Solving, is required for all Colorado State University freshman. Data was collected on the amount of time students spent with assigned e-Text readings. The average amount of time students spent reading the textbook throughout the semester was 354.8 minutes. Students were split up into two populations, low time commitment (LTC) if they spent less than the mean time reading and high time commitment (HTC) if they spent more than the mean time reading. Results indicate that the average overall grade for HTC students was 86.3% which was statistically significantly higher than the average overall grade for the LTC students which was 83.4% ($p = 0.0404$). The author acknowledges several limitations with this study and welcomes discussion. The first limitation is that the time statistic may not accurately represent student effort towards reading. It is impossible to know if students were actively reading or simply had a web browser tab open. Secondly, it is the author's opinion that the median time of 343 minutes reading throughout the semester is disappointingly low considering there were 15 chapters assigned. This equates to approximately 23 minutes per chapter. However, this short study does indicate that students who spend more time reading e-Texts are likely to score more points overall.

INTRODUCTION

Although the classroom is a dedicated place of instruction, student learning clearly extends beyond the classroom. Textbooks have traditionally played an important role to facilitate this type of outside the classroom type of learning. Although educators clearly find value in reading textbook material as a supplement to lecture time, evidence has mounted that suggests it is increasingly common for students to ignore readings.[1], [2]

There have been advances in technology, specifically the creation of electronic online college textbooks (e-Texts), that have provided instructors with new tools to encourage students to read and comprehend the material assigned to them. There is some evidence that suggests that e-Texts can enhance the student learning experience [3] and lead to higher rates of reading [4]. However, it has also been shown that even when made a course requirement, not all students will use e-Texts and one study showed them to have no effect on overall course grade or passing rate [5]. Overall, there is no consensus as to the effectiveness of e-Texts and as publishers continue to push towards these modes of content delivery, it is clear that more research needs to be done to make definitive statements about the efficacy of these tools.

LearnSmart is a tool developed by McGraw Hill that combines properties of an e-Text and an interactive and adaptive learning platform. As students read the text, LearnSmart will periodically pause the reading and ask questions of the students to gauge their comprehension. LearnSmart has been shown to improve students perceived competency[6] but it is unclear if it actually leads to improved student outcomes. This short paper presents an assessment of a specific e-Text tool, LearnSmart, in the context of overall course grades.

METHODS

Data were collected from 201 students (n=201) enrolled in MECH105: Engineering Problem Solving at Colorado State University in the Spring 2018 and Fall 2018 semesters. Students were assigned 15 chapters of e-Text readings from Applied Numerical Methods with MATLAB by Steven Chapra which counted towards 15% of their final grade. Information was automatically collected by the e-Text on how long the student spent reading the book and their final course score. No other information was collected on the students to protect their anonymity.

MATLAB and the accompanying Statistics Toolbox were used for data analysis. First, a boxplot of the Time Spent Reading was created to get a feel for the variance of the data. Next, a linear regression analysis was performed to determine if a linear relationship existed between the final course grade and the time spent reading the book. The average amount of time students spent reading the e-Text was computed and students were split into two groups. The low time commitment group (LTC) spent less than the mean time reading and high time commitment group (HTC) spent more than the mean time reading. Finally, two-sample unpaired t-tests were performed to test the mean time reading and the final scores between the LTC and HTC groups. The MATLAB live script .mlx file that shows the data analysis and the raw data can be found online at (<https://github.com/sbechara/RMSASEE2019>).

RESULTS AND DISCUSSION

Contrasted with other studies which found high reading rates with e-Texts [4], the first result to note is that the student averages for time spent reading throughout the semester were disappointing, especially when considering limitations in the data. As can be seen in Figure 1, the median time spent reading was only 343 minutes throughout the whole semester. Since each student was assigned to read 15 chapters, this equates to an average of 23 minutes of reading per chapter. Given the difficulty undergraduate students have with numerical methods, it seems clear that the students could have spent more time reading to improve their comprehension. Unsurprisingly, it can also be seen in Figure 1 that there is a wide range in time students spent reading. It should be noted that the author can not be certain that the time spent reading metric reported in this paper represents engaged reading from the students. It is possible that the students left the e-Text open on their computer and were engaged in other activities. However, the interactive nature of the e-Text, specifically prompting the students to answer questions, does increase the probability that they were active for most of the time the e-Text was open.

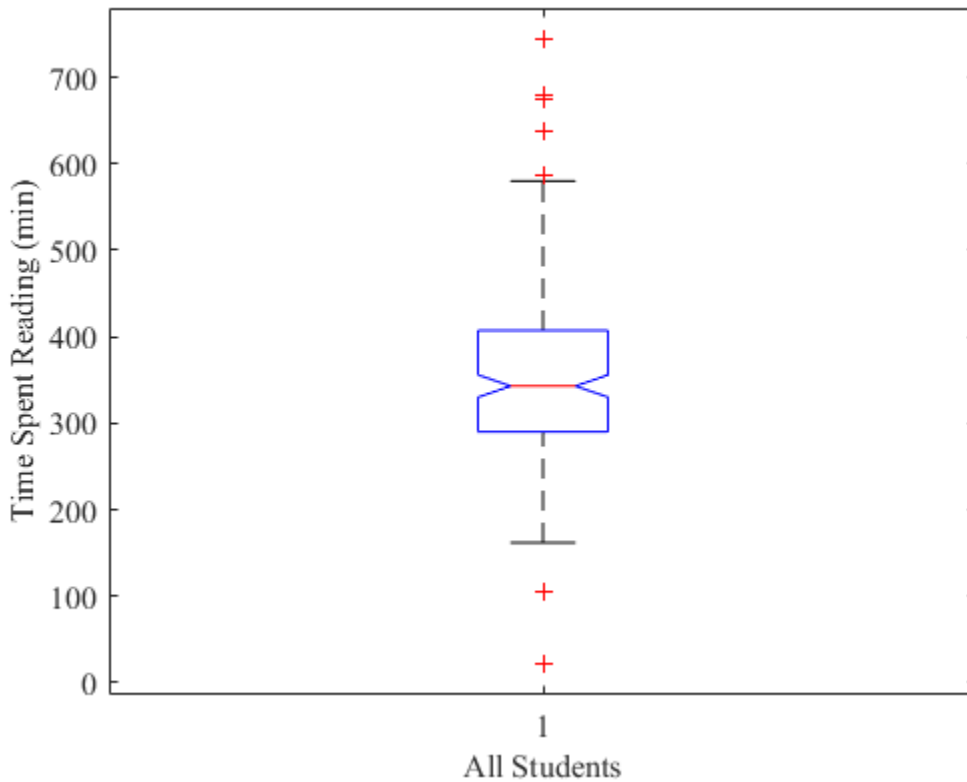


Figure 1: Boxplot showing distribution of the Time Spent Reading by students in MECH 105. The central mark indicates the median, and the bottom and top edges of the box indicate the 25th and 75th percentiles, respectively. The whiskers extend to the most extreme data points not considered outliers, and the outliers are plotted individually using the '+' symbol.

It was hypothesized that there would be a minor but positive correlation between the time spent reading and the final score the students received in the class. However, as seen in Figure 2, the R^2 value 0.04 of means that the variance of time spent reading is unlikely to explain the variance of the final score in the course.

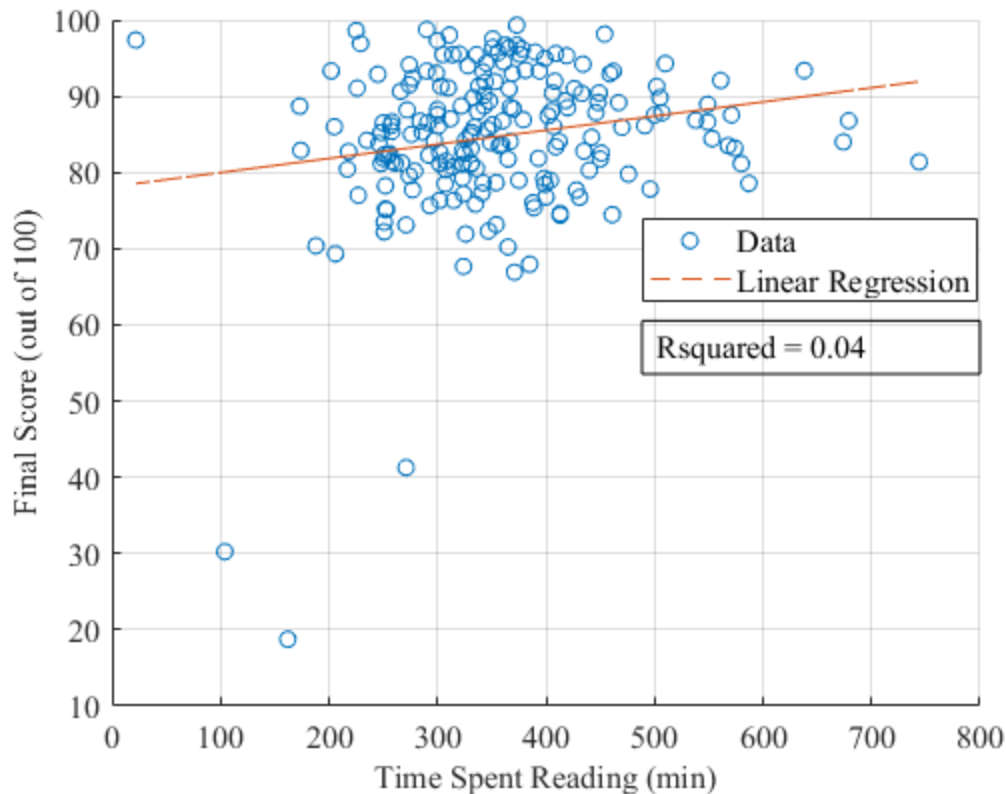


Figure 2: Linear Regression Analysis between the Time Spent Reading as reported by e-Text and the Final Score students received in the course. The R^2 value of 0.04 indicates that the variation in the data is unlikely to be explained by the trend.

The final hypothesis was that the HTC group would have a higher final score than the LTC group. The mean reading time for the HTC group was 444 minutes while the mean reading time for the LTC group was 287 minutes which was found to be statistically significant. The increased reading times appeared to lead to higher performance in the course overall. As figure 3 shows, the mean final score of 86.34 for the HTC was statistically significantly higher than the 83.45 that the LTC group scored.

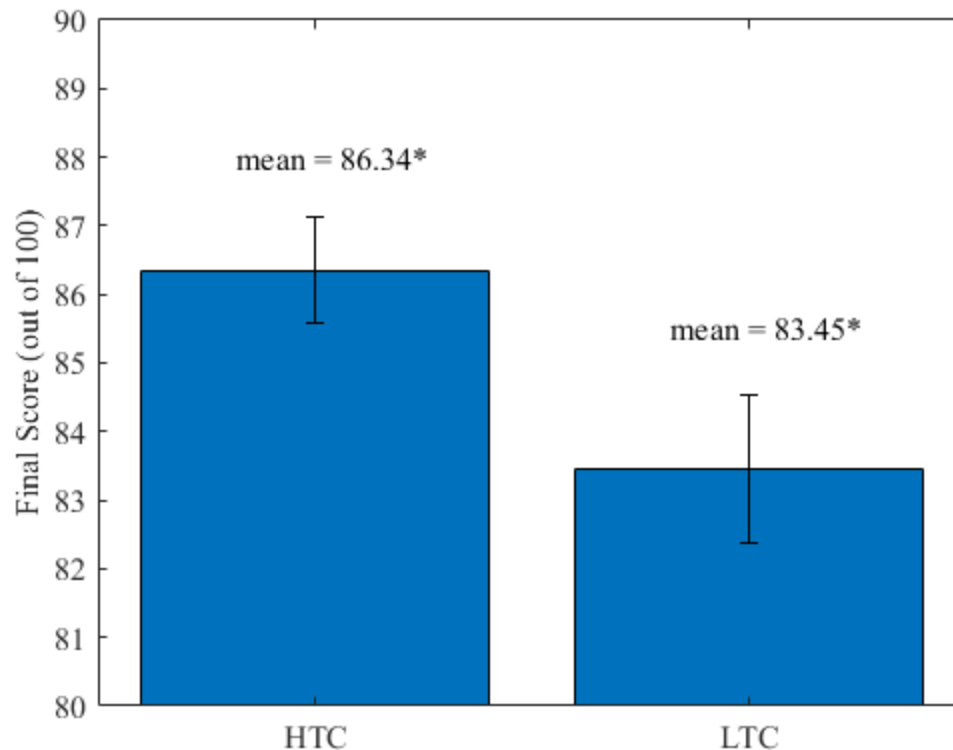


Figure 3: Bar chart showing the mean final course score for both the HTC and LTC groups. The error bars indicate the standard error of each group. The * indicates that there was a statistically significant difference between the two sample means at a significance level of 0.05. A two sample unpaired t-test was performed to investigate the sample means.

LIMITATIONS

Although the results seem to indicate that increased reading times lead to higher scores, it is difficult to attribute the fact that the HTC group outperformed the LTC group in final score to the e-Text alone. Isolating the e-Text factor against other human factors that are difficult to impossible to control makes definitive conclusions about e-Text efficacy elusive.

First, it is likely that the students who spent more time reading received higher overall scores because they are more diligent students overall and would have performed well on the course with or without the e-Text. A conclusion that may be drawn is that average reading time may be a good metric to determine the above average students. Further limitations that the author acknowledges is that the mean reading time as a threshold to split the groups is arbitrary and not based established pedagogical or scientific standards. Finally, the data were collected only among freshman students in one course using a particular textbook. It is difficult to make conclusions about e-Texts in general while limiting the e-Text to one book and one course.

CONCLUSION

The lack of published literature on the subject of e-Texts is troubling, especially as they are being adopted by more of the traditional textbook publishers. Despite the limitations, this paper presents evidence that increased utilization of e-Texts may lead to higher grade performance for students. Future research should be directed to address the limitations of this study.

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