The Effect of Textbook Format on Mental Effort and Time on Task

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Abstract

Using Astin's theory of student engagement as a framework, the purpose of this study was to determine whether a significant difference in engagement, as indicated by mental effort and time on task, existed for college students who used a digital game-based textbook versus students who used a traditional print-based textbook. The results showed a statistically significant difference in engagement, Hotelling's T^2 (2, 52) = 25.11, $p < .001$, D^2=1.86.

Problem

College faculty greatly value textbook reading and many professors assign textbook reading on a weekly basis (Ryan, 2006). One threat to students' academic success is the relatively little amount of time students typically spend reading their textbooks outside of lecture (Arum & Roska, 2011; Culver & Morse, 2012; Yonker & Cummins-Sebree, 2009). The problem is that many college students do not exert enough mental effort or time on task with the textbook outside of lecture, and there is a lack of knowledge on the efficacy of using digital games as an alternative to textbooks related to mental effort and time on task.

Purpose

The purpose of this study was to test the efficacy of a digital game-based textbook designed specifically to increase student engagement outside of the classroom above the engagement level found with a traditional textbook.

- The independent variable was defined as the type of textbook (digital game-based or traditional print-based textbook).
- The first dependent variable was mental effort, which was measured using the Mental Effort Scale. Mental effort, also known as psychological intensity, is defined as the amount of cognitive energy that a student invests while involved with an object (Astin, 1985, 1999).
- The second dependent variable was time on task. Time on task, also known as physiological intensity, is defined as the amount time a student invests when involved with an object (Astin, 1985, 1999).

Relevant Literature

The Use of Textbooks in College Courses

- Faculty rely heavily on the course textbook(s) when providing instruction (McFall, 2005; Phillips & Phillips, 2007).
- College faculty assign students reading assignments from the textbook and expect the weekly or daily reading assignments to be accomplished before students attend the course lecture (Hoeft, 2012; Ryan, 2006).

Astin's Student Involvement Theory

- According to Astin's student involvement theory, when students engage in continuous time on task with an object (physiological intensity) and increased mental effort (psychological intensity) involvement with an object, a student's performance, as it relates to the object, will improve.

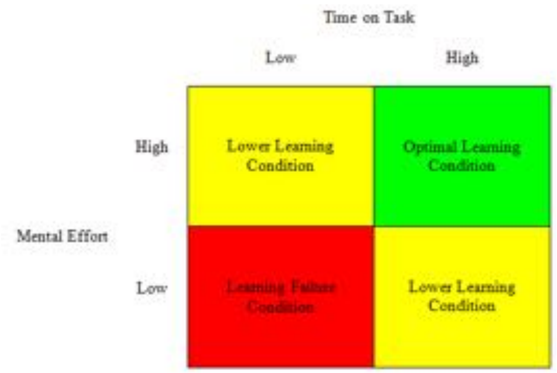

Figure 1. A pictorial depiction of Astin's student involvement theory.

Digital Game-Based Learning Theory

- Digital-game based learning theory ensures the internal structure of the learning tool utilizes major elements found in a variety of popular digital games.

Research Question

- For a sample of undergraduate college students, are there significant differences in engagement as indicated by mental effort and time on task, based on the format of a textbook (traditional or digital)?

Procedures

- The research study was conducted over a 4-week period in a controlled setting that consisted of an on-campus computer lab with individual workstations.
- Participants were randomly assigned to the digital game-based or print-based textbook group.
- Participants completed a textbook activity session
- The computer screen of each activity session was recorded, which allowed each participant's time on task to be retrospectively assessed by viewing the recording after all data was collected.
- When a participant finished the activity session, the participant was given the Mental Effort Scale and demographic survey.
- Participants were limited to a maximum of 2 hours.

Data Analysis

- The inferential statistical test used to conduct data analyses for this study was the Hotelling's T^2 test.

Findings

- The results of the Hotelling's T^2 indicated that there was an overall significant difference in the mental effort and time on task of participants in the digital game-based textbook group and participants in the traditional print-based textbook group, $T^2(2, 52)= 25.11$, $p < .001$.
- The multivariate measure of effect size (D^2 =1.86) obtained is considered a large effect size.

Time on Task

- The results of the post hoc analyses show that a significant difference between the digital game-based textbook group and print-based textbook group exists for time on task ($t = 4.61$, $p < .001$).
- Time on task was significantly higher for the digital game-group.

Mental Effort

- The results of the post hoc analyses showed no statistically significant difference, based on the conservative criterion, exists between the digital game-based textbook group and print-based textbook group for mental effort ($t = 2.30$, $p= .021$).
- The trend was toward a positive impact, however, and a larger sample might have demonstrated the expected outcome.

Limitations

- The scope of this study was limited to the conceptual frameworks of mental effort and time on task, the key concepts discussed in the first three premises of Astin's (1994) student involvement theory.
- A convenience sample was used in this study. Because a convenience sample is a non-probability sampling design, scientific inferences about what exists in the population of interest cannot be made.

Conclusions

- The results of this study provide compelling evidence that the digital game-based textbook is a viable alternative textbook format to the traditional print based-textbook format.
- These results are important, because involvement with college course material outside of the classroom is a requirement for success in many face-to-face college courses (Kuh et al., 2006).
- It is hoped that the results of this research will be used to contribute to the improvement of the academic experience of college students in higher education and thus improve society.
- This research lays the ground work for future research on digital game-based textbooks and learning.

Social Change Implications

- This study provides college educators with compelling evidence that the digital game-based textbook is a viable alternative textbook format to the traditional print based-textbook format
- The results of this study provide evidence that a digital game-based textbook can increase student involvement with the course material.
- These results suggest that a digital game-based textbook could help students to learn college course material and improve the academic performance of students in college courses.

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