The Effects of Entertainment on Knowledge Retention

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1 INTRODUCTION

Technology is constantly evolving and changing, particularly in the essential field of education. Traditional classrooms involved a teacher or professor lecturing at the front of a lecture room with chalk and a chalkboard while students used pen and paper to take notes. However, classrooms are constantly evolving as technology improves, becomes more available, and decreases in cost. This can be seen when the radio first entered classrooms in the 1920s, the overhead projector was introduced in the 1930s, and in 1972 the handheld calculator and the Scantron system were introduced. Everyday-use computers made it to the market and were used for education starting in the 1980s with the Apple Macintosh and the Toshiba T1100. Technology made its way into the education field so rapidly that by 2009, ninety-seven percent of classrooms had one or more computers, causing there to be one computer for every five students [12]. This increasing presence of technology has allowed for faster and more available communication, improved accommodations for different learning styles and paces, increased the speed of grading and feedback, and allowed for broader concepts to be included in the curriculum. Technology will continue to improve and increase its footprint in education with emerging technologies such as augmented reality (AR), virtual reality (VR), biometrics, and more [12]. The rising amount of technology in education can be attributed to many causes, such as increasing student-to-teacher ratios, technology becoming more accessible, and the benefits of technology in the classroom.

The constantly changing landscape of technology in schools has various effects. The platform of learning is one of the aspects that is affected. The learning platform is the medium through which students are taught. Different learning platforms include in-person lectures, online videos, traditional or interactive textbooks, educational video games, etc. Another important aspect being affected is knowledge retention, which is a term referring to the process in which memory is moved from short-term memory to long-term memory [15]. The main contributor to knowledge retention is putting what one has learned into practice [9]. This paper will explore entertainment of the learning platform and its

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effects on knowledge retention. This information is vital in making decisions on how students are taught as technology changes and in understanding how engagement of the learning platform affects knowledge retention. The results from this study can be used to make decisions in education to better prepare the next generation and increase knowledge retention.

2 RELATED WORKS

2.1 Learning with Entertainment

Studies looking at the effect entertainment has on knowledge retention have found a positive correlation between the two. These studies have only been conducted on games that focus on one specific application, however, the correlation has been found in multiple subject matters and age ranges. For example: safety equipment training, ages (18-38) [5]; evolution class material, ages (12-13) [4]; mathematics, ages (12-13) [10]. Since these previous studies have shown correlations in different subject fields, there is a possible positive effect between knowledge retention and entertainment in a broader sense. There is no previous work looking at the effect a general study game has on knowledge retention. The game created for this study aims to be universal, allowing the users to input their own study questions while still being engaging and educational.

A study on teaching Physics through the video game "Portal" [1], found that there was no correlation between using the video game and improving the physics reasoning of the students. The reason for the lack of improvement in the children could be due to a couple factors. It is possible that the game was not related to the content, so the game did not assist the participants in learning the laws of physics. Another possibility is that "Portal" is too much of a game, the participants got too invested in playing the game and not in learning material. The game created for this study uses the content in the game as a way of allowing the user to progress, so it cannot be ignored.

Another study looking into improving knowledge on tick bites and Lyme disease [2] found no improvement in the knowledge of ticks in the participants. This could be because of a lack of interest in the material or a lack of entertainment of the game. The participants of this study were young kids, which could lose interest in the subject matter quickly. The goal of our game is to remain engaging and incentivizes the users to select correct responses.

2.2 Knowledge Retention

Many studies on knowledge retention implement only a pretest (an assessment before the experiment) and a posttest (an assessment following the experiment). Very rarely do they implement dual posttests, directly following the experiment as well as a delayed assessment afterwards.

For the former, one such study, Calvo-Ferrer et al. [3] Spanish students were being taught English with the use of the game "Among Us". They were assigned a pretest which gauged their current knowledge of English words. Group 1 was taught common phrases that could be used and encouraged to learn them, and Group 2 was not taught anything. The following week they were invited to play the game using only English phrases. Two days later, they were assessed on learning gains. The results were significant at ($M = 5.19$, $SD = 1.145$) for Group 1 and ($M = 2.44$, $SD = 1.340$) for Group 2, ($t(52) = 8.081$, $p <= 0.001$). The issue with this study is that it only tests the viability of using an entertaining instructional method. It does not compare knowledge known immediately after the experiment and knowledge retained after a period of time. Thus, it cannot be used to judge whether any knowledge is better retained following an entertaining versus traditional education method.

For the latter, a more effective approach was taken. For example, Hitosugi et al. [8] involved the use of an educational video game, "Food Force" (FF), which was used as a learning system in both experimental groups. Group 1 used FF without traditional educational methods and Group 2 used FF with traditional educational methods. Following the experiment there was a significant effect of FF in both studies (Wilkis Lambda = .20, $F(2,7) = 14.41$, $p < 0.01$) and (Wilkis Lambda = .10, $F(2,9) = 39.42$, $p < 0.001$) respectively. For both studies, there were significant differences between the pretest and immediate posttest, and the pretest and delayed test, but not between the posttest and delayed test. Unfortunately, this experiment only tested the effectiveness of the learning system rather than the educational method. This means the conclusion that the efficacy of the entertaining educational method improves upon the traditional method for knowledge retention is impossible to make. Thus, the methodology in this paper tests the use of an entertaining educational method and a traditional educational method separately.

2.3 Motivation and Engagement

A major issue brought up about traditional teaching methods is that student "experiences have taught them to focus on the grade and the degree rather than on learning and individual development." [7]. By employing a range of approaches and strategies to involve students, the emphasis can be shifted from solely achieving a good grade to a more comprehensive learning experience.

Student engagement is defined in [6] as "how involved or interested students appear to be in their learning and how connected they are to their classes, their institutions, and each other." As shown in [5], the learning outcome of an engaging, immersive game proved superior to traditional methods in knowledge retention between posttest and delayed test scores with no significant difference in the engaging group and a significant difference in the traditional group ($p = 0.008$). This emphasizes the importance of the relationship between play time and course study. Firstly, the game must cover relevant curricula and also must promote engagement. Tobias et al. [14] reports that students who play games designed to teach course material were more engaged in the course and evaluate it more positively, and learning increases when games are integrated into the curriculum. Evidence indicates that students spend more time on computer games than on instructional methods, and engagement with instructional material is directly proportional to learning.

Kahoot! is among one of the most popular alternative teaching platforms. It is an educational platform that provides a free student response system similar to trivia. Teachers utilize Kahoot! to produce game-based quizzes, surveys, and discussions. In [13], a Likert-scale questionnaire was used to survey student enjoyment with this teaching method. The findings reported that 98.2% enjoyed playing, 92.9% thought it was easy to use, 100% thought it made the class more interactive, and 86.5% stated that it helped with conceptual understanding. In [11], a similar questionnaire was used. The findings reported that Kahoot! significantly impacted student attention and focus ($r = 0.60$, $p < 0.05$) as well as interaction and engagement ($r = 0.60$, $p < 0.05$). Fun and enjoyment positively correlated with levels of interaction and engagement as well ($r = 0.61$, $p < 0.05$). However, no evidence in either study was given on overall course preparation. These studies indicate that using entertaining educational methods do promote motivation and engagement within students but lack empirical evidence on learning and retaining the material. Thus our experiment aims to identify whether entertaining learning methods are attributable to increased engagement and knowledge retention.

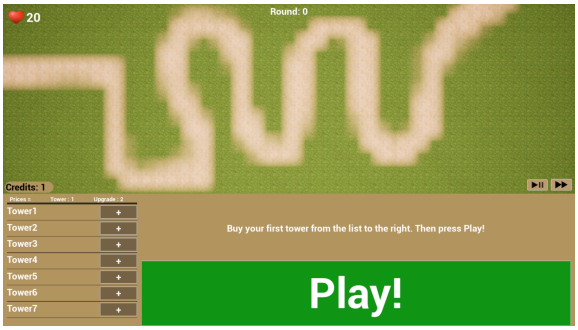

Fig. 1. Startup screen

3 METHODOLOGY

3.1 Product

The application that we created to test if entertainment while studying improves knowledge retention is a tower defense game. It was created using Unreal Engine 5 using custom assets along with free scanned assets from the Quixel Bridge. We added the quizzing functionality into the game and we reward correct answers with credits that can be used to create new towers or to upgrade. This means that users will have to answer correctly or else they will run out of lives and have to restart. The design of this is to improve they users engagement in the game and require learning. We increase the number and the spawn rate of the enemy's as the rounds progress so the game will get harder as the users gets more towers keeping the challenge engaging.

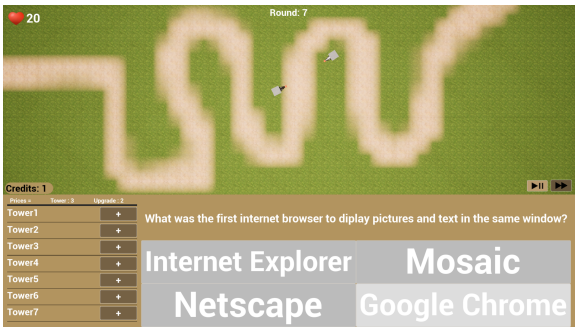

Fig. 2. Quizzing portion of the game

3.2 Experiment

To determine the effectiveness of our program in relation to knowledge retention we designed the following experiment to collect data relevant to our hypothesis. The treatment participants of this experiment involves the random assignment of two test groups, an experimental group and a control group. The groups were similar in any relevant factors that may affect memory retention, for example age, gender, and education level. We used students at Colorado State University to provide a common background of being university-level students that have to study regularly for classes. Between these two groups, our independent variable was the type of stimuli used to study the material. Our dependent variable

was the short term and long term memory retention of the study material. For the stimuli, we used our custom game as an engaging study tool, and Quizlet for the more traditional study tool. The material for the quizzes were taken from a 5 minute YouTube history video about the dot com crash. Before presenting the participants with the video, they were given a test for the content to determine if there was any previous knowledge on the subject matter. After watching the video, the participants were asked to use the study tool for 15 minutes. After the stimuli was presented, we administered the content test to measure memory retention and engagement immediately following the use of the stimuli as well as a week following the use of the stimuli. We then averaged the scores and used statistical methods to determine if there is a significant difference in memory retention between the groups.

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