Using Video Games to Trigger Interest Emergence and Task Engagement in Science Classrooms

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Abstract: Interest is a powerful predictor of subsequent academic motivation and success, and behavioral psychologists and teachers alike have struggled to find the best method of getting students excited and engaged in classroom activities (Hidi & Harackiewicz, 2000). The current study proposes that video games are an excellent vehicle for producing an initial trigger to allow interest formation to take place. By using the educational video game *Virulent* in a 7th grade science classroom, it was demonstrated that in-class educational video game play led to higher task involvement for a science-based learning activity, as well as greater levels of interest, enjoyment, and free-time media use, when compared to a more traditional reading assignment. Methodological shortcomings of the present study and future direction of the research are discussed.

Introduction

Social psychologists have defined two types of interest: situational and individual (Hidi & Renninger, 2006). Situational interest describes initial curiosity and attention given to an *object or concept*, and individual interest describes beliefs about the object or subject being ascribed and attributed to *an individual's sense of self*. An individual's interest in a topic, subject or activity consists of two components – a situational component of interest that is *context-specific*, and an individual component that refers to *a person's preexisting beliefs, values, and affect for the content*.

Emergence of situational interest is sensitive to factors such as the medium through which information is presented and to the external support that an individual receives, e.g. through a teacher, friend, or online community. As an individual proceeds from novice to expert, factors of situational interest can be gradually replaced by factors of individual interest. For example, a student interested in physics may find a dense textbook too difficult to read, while a student well-versed in physics may actively seek out and read the same textbook to add to his or her knowledge. The first student did not read the textbook due to situational constraints, while the second student understood the value of adding to his or her physics knowledge and sought out the textbook independently.

Research has repeatedly shown that interest in a subject or topic is a strong predictor of later performance and motivation (Hulleman & Harackiewicz, 2009; Shen, Chen and Guan, 2007). For interest to emerge, however, an initial stimulus must capture an individual's attention and cause them to engage with the content. Current research hypothesizes that video games can be effective vehicles for triggering situational interest, especially when compared to standard classroom instruction techniques (e.g. articles and book readings or movies and video viewings).

Additionally, research has repeatedly observed high levels of student task engagement and interest when using video games to introduce students to new school-related topics such as history (Squire 2004) and science (Gaydos & Squire, 2010; Ketelhut, Dede, Clarke, Nelson, & Bowman 2004; Steinkuehler & Duncan, 2008; Squire, 2011). This enhanced engagement associated with video games is especially pronounced for students who do not perform well in traditional classroom environments (Steinkuehler, 2006). Outside of videogames, task engagement is also a good predictor of achievement, motivation, and affect towards a specific learning content (Lee & Anderson, 1993).

The current study hypothesizes that educational videogame play is a more powerful means of promoting situational interest emergence and task engagement generation than traditional forms of classroom instruction. It is hypothesized that students will report higher levels of interest and enjoyment for educational videogame play, and that they will report feeling more involved in the task when playing an educational video game than when they work with traditional classroom instruction methods.

Methods

To fully address these hypotheses, the current study was designed to examine differences in levels of task engagement that students displayed following a 15-minute session of either educational video game play or reading followed by video clips. Prior levels of student interest and knowledge of biology were measured, along with student task involvement for each activity. After both activities had been completed, students were asked to select which of the two activities they preferred based on how interesting, how enjoyable, and how informative they were.

Subject Pool

Participants in the study were 7th grade science students (*n* = 56, mean age = 12.48) drawn from a middle school in the midwest, with IRB approval and parental and minor consent. The students had no prior knowledge of virology topics in a formal school setting. Males and females were almost evenly split, there was one more male than female student. The subject pool was predominantly caucasian, with African Americans, Asian Americans, and Hispanics comprising 5% of the sample.

Activities

In order to measure participant interest in different presentation styles and engagement with different forms of learning media, while maintaining a robust learning atmosphere, experimental stimuli were presented as in-class introductory activities to a two-week virology and bacteriology curriculum unit. The two activities, educational video game play and a typed summary about viruses with embedded videos, comprised the majority of the students' class for that day.

The first activity consisted of a Word document introduction about viruses. Topics included: what a virus is, how it reproduces, what it is made of, how it infects a cell, and how the body defends against it. A brief section on vaccinations was also included. If participants completed the reading exercise early, they were also able to watch several video clips of viral life cycles.

The second activity consisted of the educational video game *Virulent*, developed as a collaboration between organization A and organization B. In *Virulent*, players assume the role of the Raven virus, which is based on the vesicular stomatis virus. During the game, players begin as a virion infecting a host cell, and explore viral life cycles and cellular defense as they attempt to make more virions and further the infection.

Both treatments (the traditional learning activity and the *Virulent* activity) were given to all students to ensure equality in dispersion of the educational resources, but in different orders, so that the impact of each activity could be measured individually.

Assessment Tools

Several assessment tools were developed to measure interest emergence and task engagement. These domains were measured through survey tools adapted from Linnenbrink-Garcia et al. (2010), Cole Gaeth and Singh (1986), and Schaufeli, Bakker and Salanova (2006).

The introductory questionnaire consisted of basic demographic information, initial measures of interest in biology, prior knowledge of biological topics, and prior engagement with the presentation media.

The interim questionnaires, administered after each of the two activities, consisted of questions designed to measure relative task engagement in the activity. Participants also completed two short free-response questions concerning specific things they liked or disliked about doing the activity. The interim questionnaires were nearly identical, except for the final bank of questions. The first interim questionnaire contained a four-item section on the perceived value of learning about viruses, as an indirect method of measuring interest and relevance. The second interim questionnaire asked students to compare the reading and video game activities based on which was more interesting, which was more fun, and which was more informational. These questions served as a measure of situational interest: which activity was more enjoyable, and which was more educational.

Procedure

The study began on the first day of a two-week unit on viruses and bacteria. Participants were introduced to the experimenter, and instructed to complete the introductory questionnaire before beginning the activities. Student assent and parental consent had already been obtained prior to the experimenter's visit. After all students had completed the introductory questionnaire, they were instructed to read the top of their first questionnaire. The first paragraph of this questionnaire contained instructions for which activity the students were to begin with. Half of the students in the study began by playing the video game *Virulent* for 15 minutes and half began by reading the virus summary and watching videos. The instructor had already posted both the game and the reading activity to her class website, therefore, the methods of presentation were not different than what the students were used to seeing. When 15 minutes had passed (as timed by the experimenter), students were instructed to stop the activity and complete the first questionnaire. After all students had completed the first questionnaire, the experimenter instructed students to do the activity that they had not yet done - students who began by playing the game would now do the reading, and vice versa. These directions were also printed in bold on the top of the second question-

naire, to ensure that all students interacted with both activities. After another 15 minutes had elapsed, students were again instructed to stop the activity and complete the second questionnaire.

If any time was left over after completion of the second questionnaire, students were free to return to either of the activities until class ended. The class instructor also led informal discussions about viruses to fill any additional time after the completion of the paradigm.

Results

Cronbach's alphas were used to validate the item inventories used in the experiment session. To analyze differences in task engagement between reading and gameplay, a one-sample *t*-test was used.

All response inventories were found to have a Cronbach's alpha of at least .8 (prior knowledge = .884, prior interest = .951, task engagement I/II = .944/.950, utility value = .885).

A main effect of presentation format on task engagement was found, $t = 3.249$, $p = .002$. Students were more engaged in educational gameplay than in readings and videos.

Students were also more interested in, and reported more enjoyment from, the video game as compared to the reading activity. 73% of students reported that the game was more interesting than the readings, and 75% reported that the game was more fun. However, only 15% of the students reported that the game contained more information. While this supports the hypothesis that educational video game play can be an effective method of generating situational interest, more data is necessary to understand any effect that its perceived lack of informational content may have on subsequent learning.

Outside of school, after the experiment, students also recorded more page views for *Virulent* (221) than the reading exercise (137) and instructor's curriculum introduction (124) on the class website. These data further reinforce that, for many students, *Virulent* was a more effective trigger for situational interest in viruses and virology than traditional forms of classroom instruction.

Conclusions and Future Goals

Students reported higher levels of task engagement, and displayed greater amounts of situational interest emergence after playing *Virulent* when compared to a more traditional classroom instruction method. These results confirm the hypotheses that well-designed educational video games can be an effective trigger for situational interest emergence, as well as an effective means of generating task engagement. Importantly, students displayed higher levels of interest in the video game even outside of the experimental setting, in their own free time.

Despite these results, there were numerous technical difficulties encountered when bringing *Virulent* into the classroom that hampered further engagement and interest in the activity. First, *Virulent* was originally designed for the iPad, with a touch and drag interface for controlling the virus. When *Virulent* was brought into the classroom, however, students played the game on school-issued laptops. In the personal experience of the experimenters, attempting to play *Virulent* on a laptop touchpad increases the (already considerable) difficulty of the game to a great degree. Future studies should make greater attempts to ensure that the game can be played on some touch-based device, preferably a compatible iPad. Second, although most of the instruction and guidance provided in *Virulent* is audio based, many students did not have headphones and did not turn up their volume during play. This led many students to comment that the game was frustrating, and that it didn't provide very good instructions. Finally, the second level of *Virulent* is especially challenging, and requires that players elude antibodies for an extended period of time (around 5 minutes). With the entire activity only lasting 15 minutes, and with the previously mentioned problems in game control, a very small percentage of students successfully completed this level within the available time. It is likely that the contrast in perceived information between game and reading assignment stemmed from the inability of most students to complete this level and progress further in the game. Considering the substantial methodological problems that were encountered in the research, it is a true testament to the ability of a videogame to excite and engage young students and an accomplishment that positive results were found at all.

Current interest research maintains that interest is a content-specific construct, despite stating that situational interest is influenced heavily by factors external to the content (Linnenbrink-Garcia et. al., 2010). Situational interest is a prerequisite for subsequent interest development; therefore, research on interest emergence should consider the factors external to content that play a role in its emergence, such as the medium through which the content is presented, or the types of external support an individual receives during situational interest formation. This gap in the discussion of factors of situational interest is neatly filled by using an engaging content platform such as an educational video game. Educational video game researchers have suggested that students display strong

interest in video games in educational settings, however, detailing the development of individual interests requires further investigation. By merging these two bodies of research, the intrinsic engaging qualities video games can subsequently be harnessed in more formal educational settings.

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