Computers & Education 80 (2015) 152–161

Contents lists available at ScienceDirect

Computers & Education

journal homepage: www.elsevier.com/locate/compedu

Assessing the effects of gamification in the classroom: A longitudinal study on intrinsic motivation, social comparison, satisfaction, effort, and academic performance

Michael D. Hanus*, Jesse Fox

The Ohio State University, Derby Hall DB Building 025, 154 North Oval Mall, Columbus, OH 43210, USA

ARTICLE INFO

Article history:
Received 20 May 2014
Received in revised form
25 August 2014
Accepted 28 August 2014
Available online 15 September 2014

Keywords:
Virtual reality
Improving classroom teaching
Human–computer interface
Interactive learning environments
Teaching strategies

ABSTRACT

Gamification, the application of game elements to non-game settings, continues to grow in popularity as a method to increase student engagement in the classroom. We tested students across two courses, measuring their motivation, social comparison, effort, satisfaction, learner empowerment, and academic performance at four points during a 16-week semester. One course received a gamified curriculum, featuring a leaderboard and badges, whereas the other course received the same curriculum without the gamified elements. Our results found that students in the gamified course showed less motivation, satisfaction, and empowerment over time than those in the non-gamified class. The effect of course type on students' final exam scores was mediated by students' levels of intrinsic motivation, with students in the gamified course showing less motivation and lower final exam scores than the non-gamified class. This suggests that some care should be taken when applying certain gamification mechanics to educational settings.

1. Introduction

Gamification, the use of game elements in a non-game context (Deterding, Sicart, Nacke, O'Hara, & Dixon, 2011), has emerged as a popular trend over the few years, with at least 50% of companies predicted to gamify at least one aspect of their workplace by 2015 (Gartner, 2011). Gamification can take a variety of forms, including the use of narratives to change the context around a typical activity, the creation of social competition, and the incentivizing of behavior through badge and reward systems (an aspect of gamification known as *pointification*). Given the potential to increase engagement and enjoyment, writers and scholars have been touting gamification as a way to transform education as well (e.g., Landers & Callan, 2011; McGonigal, 2011; Muntean, 2011). By applying gamification to the classroom, students could be motivated to learn in new ways or enjoy otherwise tedious tasks.

Teachers commonly employ games in the classroom (Kapp, 2012), but only recently have teachers begun exploring the possibility of making the class itself a game. Modern students are growing up in an age of interactive media and video games, so classroom gamification may be appealing and motivating (Glover, 2013). Recent research, however, suggests that the effects of various gamification elements are mixed. Additionally, of the limited sample of empirical studies done on gamification, many suffer from methodological problems such as a lack of comparison groups, short treatments, singular assessments, and a lack of validated measures (Hamari, Koivisto, & Sarsa, 2014). Although gamification is popular, the effectiveness of various gamification elements have not been sufficiently tested.

Our objective is to create a longitudinal study that addresses the methodological concerns with some previous studies and tests the effectiveness of specific gamification elements. Because the concept of gamification encompasses so many different game mechanics and their application, it is difficult to study every possible facet of gamification. Our study focuses specifically on the effectiveness of a gamified system that gives students tasks to earn badges and features a leaderboard to track progress and increase student engagement. These game mechanics were chosen because they are elements that tend to be used frequently in classroom gamification (e.g., Acedo, 2014; Alvarez, 2014; Gonzalez, 2012; Young, n.d.). Many gamified systems use leaderboards and badge systems as a way to facilitate social engagement

* Corresponding author. Present address: 808 Riverview Drive, Columbus OH 43202, USA. Tel.: +1 859 312 9520.
E-mail addresses: hanus.3@osu.edu (M.D. Hanus), fox.775@osu.edu (J. Fox).

http://dx.doi.org/10.1016/j.compedu.2014.08.019
0360-1315/

and competition, and our goal was to examine how these mechanics affect motivation, satisfaction, effort, learner empowerment, and class grades. The following will examine previous research on gamification and examine the effectiveness of popular gamification mechanics, such as badges and leaderboards. Then it will examine how research on rewards, motivation, and competition might apply to these mechanics and how to best utilize them for classroom gamification.

2. Background

2.1. Game mechanics and related work on gamification

Using games in education has a variety of benefits, and several game design mechanics demonstrated success in educational environments (de-Marcos, Domínguez, Saenz-de-Navarrete, & Pagés, 2014; Stott & Neustaedter, 2013). Games typically allow the player to restart or play again, making mistakes recoverable. This freedom to fail allows students to experiment without fear and increases student engagement (Lee & Hammer, 2011). Although educational settings provide feedback to students, it is often constrained: In class, teachers can often only evaluate and provide feedback to one student at time, and feedback via grading takes time. Thus, incorporating the immediate and frequent feedback found in game design may be even more beneficial (Kapp, 2012). Additionally, teachers typically present information to their classes in categories that scale by difficulty, a process known as *scaffolded instruction*, but it can be difficult to accommodate each individual student's needs. Games tailor difficulty progression on an individual basis, keeping players at a particular level until they have demonstrated the requisite mastery to move on (Beed, Hawkins, & Roller, 1991). Creating a narrative context around a task has been shown to increase student motivation and engagement (Clark & Rossiter, 2008). In addition, other elements of game design commonly applied to gamification might be helpful: leaderboards encourage engagement through competition, and badges offer a visual display of progress (Camilleri, Busuttil, & Montebello, 2011; Kapp, 2012).

Despite considerable speculation about the benefits of gamification (Brunsell & Horejsi, 2011; Gonzalez & Area, 2013; Hellwege & Robertson, 2012; McGonigal, 2011; Muntean, 2011), empirical research on the effectiveness of gamification is limited. Results from the few empirical studies on various elements of gamification conducted in educational settings are mixed. One study found that students who were given feedback on their course progress in the form of a competitive game enjoyed the experience more, learned more, and had lower rates of failure than previous classes (Charles, Charles, McNeill, Bustard, & Black, 2011). Another reported higher student interest and engagement after gamifying an entrepreneurship course using leaderboards, competition, and serious games to teach course concepts (Bellotti et al., 2013). Dominguez et al. (2013) gamified an e-learning platform by applying competition, trophies, rewards, and leaderboards and found that students in the gamified class scored higher overall and were more motivated, but tended to participate less in class activities and performed worse on writing assignments. de-Marcos et al. (2014) used a gamification system that gave students rewards, encouraged earned trophies, and used a leaderboard to encourage competition. They compared this and a traditional platform with a social networking learning platform where students could comment, blog, and interact with each other. The authors found that students in both gamification and social networking groups outperformed the control group on the skill assignments, though the control group did better on the final written examination designed to assess course knowledge. Additionally, students tended to have very low participation rates with the gamified (24%) and social networking platforms (38%).

These findings are similar to those that study gamification in non-education contexts. One recent study of over 3000 users found that those that viewed their own badges more frequently positively predicted increased page views, comments, trades, and transactions on an e-commerce website. This increased engagement only occurred among users who were actually interested in the badge system, however. In other words, creating a gamified system alone was insufficient to cause an increase in these behavioral measures; rather, it depended on individual users' interest levels (Hamari, 2013). Hamari et al. (2014) conducted a comprehensive review of empirical studies of gamification across different contexts (e.g., education, consumer science), but were only able to identify 24 studies. Of those studies, only two reported entirely positive effects. The majority of studies found some positive aspects of gamification, such as increased engagement and enjoyment, but these outcomes are often dependent on the context of the gamified system (e.g., marketing, educational) and the characteristics of the player. Additional work has shown that the appeal of a gamified system might be due to a novelty effect, and that positive effects such as engagement and interest decrease over time (Koivisto & Hamari, 2014). The authors also noted methodological problems with the studies; of the 24 reviewed, the authors found that few actually compared gamified and nongamified experiences (Hamari et al., 2014). Thus, it is uncertain whether the effects found can be attributed to gamification or other factors. Further, it is possible that the mixed results from studies on gamification come from the different applications of game mechanics in each study. A more focused approach may be required to determine which elements of gamification are most effective to help practitioners make the most of its application.

In addition to these questions regarding the effectiveness of gamification, a long history of research on reward systems in education suggests that elements of gamification, particularly the use of badge and reward systems, might have a negative impact on student motivation and learning (Deci, Koestner, & Ryan, 1999; Deci, Ryan, & Koestner, 2001). Cognitive evaluation theory (Deci & Ryan, 1985) predicts that external events can shape one's intrinsic motivation (i.e., doing it because one wants to, and not due to outside pressures) based on whether individuals process those events as informational or controlling. If a reward provided for a task is seen as an informational, then it will make one feel competent and in control, leading to higher intrinsic motivation. If a reward is seen as controlling, it makes one feel powerless and incompetent, decreasing intrinsic motivation. Studies have shown that giving rewards for a task one already finds interesting ends up harming motivation to do that task (Deci et al., 1999, 2001; Lepper, Greene, & Nisbett, 1973). Thus, although there may be benefits to gamification, it is also important to examine potential drawbacks as it may hamper the motivation educators are trying to cultivate.

2.2. Badge systems, rewards, and intrinsic motivation

Getting students motivated to pay attention and engage with material is a central goal of education. More importantly, educators want students to be *intrinsically* motivated to learn, which occurs when the desire to learn comes from within the student (Deci & Ryan, 2000). Less desired is students being *extrinsically* motivated to perform, wherein their motivation for a behavior is due to some outside force (e.g., parental pressure). Intrinsically motivated students are more engaged, retain information better, and are generally happier (Deci & Ryan,