Computers & Education 92-93 (2016) 221–236

Contents lists available at ScienceDirect

Computers & Education

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

Engaging Asian students through game mechanics: Findings from two experiment studies

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ARTICLE INFO

Article history:
Received 26 June 2015
Received in revised form 8 October 2015
Accepted 9 October 2015
Available online 23 October 2015

Keywords:
Gamification
Behavioral engagement
Cognitive engagement
Blended learning

ABSTRACT

There is an increasing interest in using game mechanics to foster user engagement in many real-world contexts. Many previous studies, however, focused on investigating user perceptions, while some experiment studies lacked control groups. Additionally, many studies in the higher education context focused on the discipline of Computer Science and Information Technology, and involved participants mainly in Europe or North America. In this paper, we report the effects of game mechanics on student cognitive and behavioral engagements through two experiment studies conducted in an Asian university. In Study 1, we employed a randomized experiment-control group design. The experiment group ($n = 11$) attended an education-related course on *Designing Questionnaire* that incorporated the use of game mechanics (points, badges, and leader board), as well as course activities informed by the Self-Determination theory of motivation. The control group ($n = 11$) attended the same course and activities taught by the same instructor but without the game mechanics. In a subsequent semester, we repeated the research with a larger cohort of students (Study 2) through a quasi-experiment design ($n = 20$ experiment, and $n = 22$ control group). The deployment of game mechanics produced greater student contribution in the discussion forums, but no significant difference on students' recall of factual knowledge. However, we found that the use of game mechanics had a positive effect on motivating students to engage with more difficult tasks, and that the quality of artifacts produced by participants in the experimental groups were higher than those in the control groups.

1. Introduction

Student engagement is frequently considered a necessary prerequisite for student learning and participation (Appleton, Christenson, & Furlong, 2008). Most researchers view student engagement as a construct that encompasses multiple components (Appleton, Christenson, Kim, & Reschly, 2006; Fredricks, Blumenfeld, & Paris, 2004). In this paper, we have adopted a two-part typology and conceptualized student engagement as consisting of behavioral and cognitive engagement. Behavioral engagement refers to student participation in a course such as attending lessons and completing assignments (Fredricks et al., 2004). Cognitive engagement refers to students' thinking and understanding of the subject or topic (Fredricks et al., 2004).

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http://dx.doi.org/10.1016/j.compedu.2015.10.010
0360-1315/

These two engagement components are considered some of the most critical indicators of student involvement and achievement in school (Jimerson, Campos, & Greif, 2003).

Traditionally, teachers have used strategies such as positive reinforcements (e.g., praise, reward), active learning methods (e.g., hands–on activities, question-and-answer sessions), or problem-oriented learning (e.g., relating content to real-life use) to engage students in learning. Despite the use of these strategies, student engagement is still considered one of the major problems faced by today's schools and colleges (Lee & Hammer, 2011). Kuh (2007), for example, reported that first-year university students typically study less, write less, and read less than they thought they would. About 31% of faculty at a western US college reported that students often or very often come to class without completing reading assignments (Atnip, 2015).

To address these problems, educators have attempted other types of methods to engage students such as using digital games (Gee, 2003; Prensky, 2001). However, the design and development of digital games are usually very expensive in terms of money and time requirements (Ibanez, Di-Serio, & Delgado-Kloos, 2014). Therefore, instead of calling for the implementation of full-fledged digital games in the classrooms, some researchers advocate the use of game mechanics to support user engagement in real-world non-game contexts. Such a strategy has become known as gamification (Deterding, Dixon, Khaled, & Nacke, 2011).

In this paper, we examined the effects of game mechanics on Asian students' cognitive and behavioral engagements through two experiment studies. However, before describing the two studies in detail, we will first review the relevant extant literature on gamification. We will then describe the current research gap and purpose of our study. A general overview of the two experiment studies is included in the subsequent section. Next, we describe each study in greater detail, its participants and results. This is followed by an overall discussion of the results and their implications. Suggestions for follow-up research are discussed in the Section 8.

2. Related work

Current forms of gamification have been most commonly associated with the game mechanics of digital points, badges, or leader boards (Deterding et al., 2011; Dicheva, Dichev, Agre, & Angelova, 2015; Hamari, Koivisto, & Sarsa, 2014; Zichermann & Cunningham, 2011). Digital points or points (for short) refer to tokens that can be collected by users, which can be used as status indicators, to unlock access to certain content, or to spend on virtual goods or gifting (Bunchball, 2010; Educause, 2011). Badges refer to tokens that appear as icons to signify an individual's achievements. Leader boards refer to high-score tables that indicate an individual's performance compared with other users (Christy & Fox, 2014).

Collectively, points, badges, and leader boards may be considered as external reward mechanism, as all three are used to provide positive reinforcement (Skinner, 1953; Woolfolk, 1998) that can motivate a user's behavior. They can also stimulate student self-efficacy (Bandura, 1982) by measuring progression and providing feedback on performance (Gnauk, Dannecker, & Hahmann, 2012). Furthermore, they can drive comparison among individuals. According to social comparison theory, human beings tend to assess their abilities by comparing with those of others (Festinger, 1954). More specifically, individuals tend to compare themselves with better performers. Such upward comparison can make self-views of competence and motivation more positive (Collins, 2000; Lockwood & Kunda, 1997), and provide inspiration and hope for the weaker students (Suls, Martin, & Wheeler, 2002).

It is, of course, possible that teachers employ these game mechanics manually in a classroom. However, there is a certain advantage of digital over manual implementation of game mechanics. Probably the main advantage of the former is the convenience and time savings that it can offer. With a digital implementation of game mechanics, teachers do not have to constantly keep track of their students' activities in order to award them with the necessary points or badges, or adjust their positions in the leader board. The task of manually monitoring every individual activity even in a small class is very tedious; to do it consistently for a large class is near impossible. Digital implementation of game mechanics keeps track of these students' activities automatically. In fact, such features are now readily available in learning management systems such as Moodle.

Compared to full-fledged games-based learning research, studies on the use of gamification in education is still at its nascent stage. In a recent literature review, Hamari et al. (2014) identified nine articles in education or learning contexts. In writing this paper, we reviewed additional empirical studies not covered by Hamari et al. (2014) (i.e., Abramovich, Schunn, & Higashi, 2013; Attali & Arieli-Attali, 2015; Coetzee, Fox, Hearst, & Hartmann, 2014; Davis & Singh, 2015; Hanus & Fox, 2015; Ibanez et al., 2014; Mekler, Brühlmann, Opwis, & Tuch, 2013).

We found that a majority of studies were conducted in the context of in-class higher education setting particularly on the subject discipline of Computer Science and Information Technology (Dicheva et al., 2015). One study examined the use of digital badges in afterschool learning (Davis & Singh, 2015). A majority of previous studies used anecdotal data such as student self-reported surveys to investigate user perceptions (Denny, 2013). A small number of studies employed objective measures such as test scores, task completion rates, or participation logs as well as comparison-based design such as experimental-control method (e.g., Attali & Arieli-Attali, 2015; Coetzee et al., 2014; Dominguez et al., 2013; Hakulinen, Auvinen, & Korhonen, 2013; Hanus & Fox, 2015; Mekler et al., 2013).

Overall, a majority of prior research employing experiment and control designs and objective measures suggests that the impact of game mechanics on student test scores is non-significant. Several studies found that students who followed non-gamified exercises or courses tended to perform similarly with those who followed gamified activities (e.g., Attali & Arieli-Attali, 2015; Coetzee et al., 2014; Hakulinen et al., 2013; Hanus & Fox, 2015). One study, however, reported that the