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Effects of the Use of Leaderboards in Education

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ABSTRACT

Gamification has been used in education to increase student motivation and performance. In this research, we are interested to examine the effect of leaderboards on student motivation by assessing the interest of students to complete optional practice questions provided to them in a course. Based on goal setting theory and cognitive evaluation theory, we hypothesize that the use of leaderboards will lead to increased student motivation. We designed a within-subject experiment where leaderboards were not provided in the first half of the semester for the optional assignments comprising practice questions but were provided in the second half of the semester in order to assess any change in student motivation. The results will be analyzed and presented at the conference.

Keywords

Gamification, leaderboards, education, motivation, experiment

INTRODUCTION

Like gaming, education involves working within a set of rules to achieve an objective. Instructors embed gamification in their teaching units with the hope of increasing student motivation and engagement with the course content and assignments. Instructors also assume that student motivation and engagement in learning will be increased through gamification (Hanus and Fox 2015). Various gamification elements have been used in the education context, and they include leaderboards, points, levels and badges (Nah et al. 2013, 2014).

In this research, we are interested in examining the effect of leaderboards in education because of the contradictory findings in the literature. A "leader-board", as its name implies, is a gamified system where the leading players' scores on a given task or their earned badges are displayed for all other players to view. The use of leaderboards increased the amount of time students of an organizational psychology unit spent interacting with one another during their group assignment (Landers and Landers 2014). Banfield and Wilkerson (2014) assessed the usefulness of gamification as a teaching pedagogy and found that the use of a scorecard increased students' intrinsic motivation to perform in Information Assurance classes. Bellotti et al. (2013) reported higher student interest and engagement after gamifying an entrepreneurship course using leaderboards, competition, and serious games to teach concepts in a course. Dominguez et al. (2013) gamified an e-learning platform by applying competition, rewards, and leaderboards, and found that students who completed the gamified experience got better scores in practical assignments and in their overall scores, but the findings also suggest that students performed poorly on written assignments and participated less on class activities even though their initial motivation was higher. In a study that assessed the effectiveness of a gamified system by providing tasks to students to earn badges and a leaderboard to track progress and student engagement, the inclusion of a "gamified curriculum" which included leaderboards and badges resulted in reduced satisfaction, empowerment, and motivation when compared to the non-gamified class. In addition, intrinsic motivation was also shown to mediate the relationship between course type (gamified or not) and students' final exam scores, which, on average, were lower in the gamified class. The arguments provided by the authors suggest that student motivation depends on individual users' interest levels. Creating a gamified system alone may not have been sufficient to cause an increase in these behavioral measures (Hanus and Fox 2015). The authors suggest that the use of badges and reward systems could have a negative impact on student motivation and learning. Mixed findings on the effect of leaderboards were also reported by other researchers (Singer and Schneider 2012).

The mixed findings can be explained by cognitive evaluation theory (Deci and Ryan 1985). Cognitive evaluation theory 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. Intrinsic motivation occurs when a task is inherently interesting or enjoyable, whereas extrinsic motivation occurs when performing the task is a means to attain a desirable outcome (Ryan and Deci 2000). If a reward provided for a task is viewed as informational, then it will make one feel competent and in control, leading to higher intrinsic motivation. If a reward is seen as controlling, it can make

one feel powerless and incompetent, decreasing intrinsic motivation (Deci and Ryan 1985). While gamification design is aimed for self-purposeful and hedonistic use, gamification by design has utilitarian goals and is used to support extrinsic outcomes (Hamari and Koivisto 2015). Extrinsic motivators tend to be effective only until the desirable outcome has been achieved. On the other hand, an intrinsic motivator will continue to motivate one to work hard indefinitely (Perryer et al. 2016). In one study, employees who were not on the top-ten leaderboard frequently lessened their interaction with the system, while those who were on the leaderboard engaged with the system with their primary motivation being maximizing their accruement of points (Farzan et al. 2008).

Given the mixed findings and theoretical explanations in the literature, our research aims to assess the effect of the use of leaderboards on student motivation in education. We will draw on goal setting theory and cognitive evaluation theory to provide the theoretical foundation for the research.

THEORETICAL FOUNDATION AND HYPOTHESIS

Goal setting theory suggests that setting a high achievement goal causes one to strive for high performance (Locke and Latham, 1990, 2002). Drawing on goal setting theory, when leaderboards are used in education, we expect students to set higher achievement goals in learning, which increases their motivation in learning in order to achieve better performance. Cognitive evaluation theory suggests that events that promote perceived competence and autonomy will enhance intrinsic motivation (Deci and Ryan 1985). We believe that the use of leaderboards for optional assignments in the education context will lead to increased perceived competence and autonomy of students in learning. The use of leaderboards can help increase students' sense of competence, because the leaderboards provide the opportunities for students to be showcased as top scorers. In addition, participation in the assignments and hence, leaderboards, is optional, which offers a sense of autonomy to the students. The informational aspect of the leaderboards offers an internal perceived locus of causality to students and increases their perceived competence. Therefore, we hypothesize that the use of leaderboards will increase motivation of students because it increases their performance goal as well as their perceived competence.

Hypothesis: The use of leaderboards increases student motivation in learning.

RESEARCH METHODOLOGY

We designed a within-subject experiment to assess the effect of the use of leaderboards to increase student motivation in participating in optional weekly assignments given in a semester-long course. During the first half of the semester, these optional assignments were given to students as part of the course without any leaderboards provided or mentioned. Hence, students did not know how others performed. During the second half of the semester, we introduced the leaderboards to the students and let the students know that a leaderboard would be displayed for each of these optional weekly assignments in the learning management system, Blackboard. The system administered these assignments and tracked students' completion of these assignments and their scores for each assignment. At the end of each day (i.e., around midnight), the leaderboards for the optional assignments administered in the second half of the semester were updated. In other words, these leaderboards were updated once a day.

EXPECTED CONTRIBUTIONS AND FUTURE RESEARCH

In the context of this experimental study, we hypothesize that the use of leaderboards will increase user motivation through increased participation in completion of the optional weekly assignments. Based on goal setting theory and cognitive evaluation theory, we expect the use of leaderboards to motivate students to learn more about the subject or topics by completing the optional assignments. We have conducted a pilot study for this research and will be presenting the results at the conference. We are also in the process of designing a full-scale experimental study to assess the effect of leaderboards in education where the intervening variables in goal setting theory and cognitive evaluation theory will be captured as part of the study, in order to better understand the underlying theoretical underpinnings of the findings as well as to achieve explanatory power in the research. Because the relationship between extrinsic motivation (e.g., through the use of the leaderboards, points and/or badges in gamification) and intrinsic motivation is often unclear, we believe our research will provide significant implications for educators as well as offer theoretical and practical contributions to increase student motivation and engagement in learning and education.

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