Computers & Education 78 (2014) 66–77

Contents lists available at ScienceDirect

Computers & Education

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

Leaderboards in a virtual classroom: A test of stereotype threat and social comparison explanations for women's math performance

Katheryn R. Christy*, Jesse Fox [1]

School of Communication, The Ohio State University, 3016 Derby Hall, 154 N Oval Mall, Columbus, OH 43210, USA

ARTICLE INFO

Article history:
Received 31 December 2013
Received in revised form
12 May 2014
Accepted 15 May 2014
Available online 24 May 2014

Keywords:
Distance education and telelearning
Gender studies
Human–computer interface
Interactive learning environments
Teaching/learning strategies

ABSTRACT

Gamification includes the use of gaming features, such as points or leaderboards, in non-gaming contexts, and is a frequently-discussed trend in education. One way of gamifying the classroom is to introduce leaderboards. Leaderboards allow students to see how they are performing relative to others in the same class. Little empirical research has investigated the impact of leaderboards on academic performance. In this study, 80 female undergraduates took a math test in a virtual representation of a classroom after being exposed to one of three leaderboard conditions: a leaderboard where men held the majority of the top positions, a leaderboard where women held the majority of top positions, and a no leaderboard condition. Participants in the female majority leaderboard condition performed more poorly on the math test than those in the male leaderboard condition, yet demonstrated a higher level of academic identification than those in the male and control conditions. The authors conclude with a discussion of the implications that this study's findings may have for the use of leaderboards within educational environments.

1. Introduction

Gamification is the "use of game design elements in non-game contexts" (Deterding, Dixon, Khaled, & Nacke, 2011, n. p.), and many have discussed the benefits of gamifying the classroom (Connolly, Boyle, MacArthur, Haines, & Boyle, 2012; Deterding et al., 2011; Kapp, 2012; Landers & Callan, 2011; Lee & Hammer, 2011; Muntean, 2011). Supporters of gamification claim that the use of game elements in the classroom enhances learning by increasing engagement and motivation and facilitating social learning (Muntean, 2011), and encourage teachers to integrate these methods into their classrooms (Jones, 2010; Kaya, 2010; Salter, 2011a, 2011b, 2011c). Emerging studies, however, suggest that gamifying learning may not always be beneficial (e.g., de-Marcos, Domínguez, Saenz-de-Navarrete, Pagés, 2014; Domínguez et al., 2013; for a review, see Hamari, Koivisto, & Sarsa, 2014).

One way of gamifying the classroom is to introduce leaderboards to the learning environment (Hamari et al., 2014). Leaderboards allow students to see how they are performing relative to others in the same class; some argue that the competitive environment this creates is beneficial to learning (Camilleri, Busuttil, & Montebello, 2011; Charsky, 2010; Kapp, 2012; Muntean, 2011). However, little empirical research has investigated the impact of leaderboards on academic performance or the consequences arising from leaderboard-prompted comparisons. Indeed, it is possible that the use of leaderboards within educational settings may create high levels of stereotype threat or detrimental upward social comparisons. Research has demonstrated that both stereotype threat (Nguyen & Ryan, 2008; Sekaquaptewa & Thompson, 2003; Spencer, Steele, & Quinn, 1999; Thompson & Sekaquaptewa, 2002) and upward social comparisons (Dijkstra, Kuyper, van der Werf, Buunk, & van der Zee, 2008; Lyubomirsky, Kasri, & Zehm, 2003; Muller & Fayant, 2010) can have a detrimental influence on students' academic performance. This study aims to examine whether or not interaction with a leaderboard produces effects consistent with stereotype threat or social comparison experiences.

* Corresponding author. Tel.: +1 724 889 5101.
E-mail addresses: christy.89@osu.edu, katheryn.christy@gmail.com (K.R. Christy), fox.775@osu.edu (J. Fox).
[1] Tel.: +1 614 292 2055.

http://dx.doi.org/10.1016/j.compedu.2014.05.005
0360-1315/

2. Gamification, education, and leaderboards

Gamification has become a commonly recommended pedagogical tool (Anderson & Rainie, 2012; Boulet, 2012; Chou, 2013; Kapp, 2012), and advice on how to implement it in the classroom regularly appears in *The Chronicle of Higher Education*, a publication geared toward post-secondary school instructors (e.g., Jones, 2010; Kaya, 2010; Salter, 2011a, 2011b, 2011c). At its heart, gamification focuses on the idea of taking some of the elements that make games engaging (e.g., direct competition, visible rewards) and applying them to non-game contexts (Deterding et al., 2011). Gamification is theorized to increase student motivation by providing students with clear, achievable goals (Landers & Callan, 2011), by making learning environments more fun and engaging (Bajdor & Dragolea, 2011; Cohen, 2011; Landers & Callan, 2011; Muntean, 2011), and by encouraging competition (Hamari, 2013; Reeves & Read, 2009).

However, recent research has suggested that gamification may not always be an effective tool. Several studies have suggested that the positive results found in gamification studies may have been the result of novelty effects, as the impact of gamification seems to taper off as time goes on (Farzan et al., 2008; Hamari, 2013; Koivisto & Hamari, 2014). Other studies have found that gamification actually decreases class participation, and results in poorer performance on exams (Domínguez et al., 2013; de-Marcos et al., 2014). In this light, further research on the impact of gamification on learning outcomes is warranted.

One of the most popular gamification techniques is including a leaderboard in the learning environment (Hamari et al., 2014). A leaderboard is a game design element consisting of a visual display that ranks players according to their accomplishments; when used in an educational setting it serves as a way for students to directly compare their own performance with that of others (for an example, see Fig. 1). Indeed, past research has shown that leaderboards increase competition (Butler, 2013) and stimulate social comparisons (Costa, Wehbe, Robb, & Nacke, 2013) when used in a business context. Although these comparisons may be beneficial in business contexts, they may result in unintended consequences in academic environments. More specifically, the use of leaderboards within educational settings may act to create high levels of stereotype threat or present opportunities for upwards social comparison, either of which could have a negative

TOP TEN LEADERBOARD

	Username	Score
1.	JessicaP	20
2.	KateRC	20
3.	RachelE	19.5
4.	TonyC	19.5
5.	AlexisN	19.5
6.	MeganAB	19
7.	LauraMC	19
8.	KateAM	19
9.	MikeRH	18
10.	TedB	18

Fig. 1. An example leaderboard (here, female-dominated).