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Assessing the Impacts of Gamification on Students' Motivation, Learning and Participation

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Abstract: Gamification is an approach for motivating and engaging participants using game-like design elements. Integrating game-like design elements into educational context has the potential to increase students' motivation and improve students' academic outcome. Empirical studies on gamification have tested how one or several game design elements could influence student learning, motivation, and participation. There is a lack of empirical research on evaluating the effectiveness of a complete gamification design model. We propose to extend their research by developing a gamification design model based on motivation theories and empirical findings. We will then field test this design model in three university-level courses. The purpose of this research is twofold: first, to examine the effectiveness of this gamification design model, and second, to develop a deeper understanding on the impact of gamification on students' motivation, academic outcome, and participation.

Keywords: gamification, design, motivation, learning, participation

1. Introduction

Gamification is the use of game-like elements in non-game context (Deterding, Dixon, Khaled, & Nacke, 2011). The main goal of gamification is to motivate participants and encourage expected behaviors in a meaningful way (Deterding, et al.2011; Nicholson, 2012).

Motivation is regarded as a crucial drive that stimulates and sustains learning behavior (Gage & Berliner, 1998). In tertiary education, it is a challenge to make technically and conceptually challenging courses engaging and motivating (Iosup & Epema, 2014). How to stimulate and sustain learners' motivation, and help support various skill-level students to optimize learning outcome in technically and conceptually challenging courses? Gamification has the potential to empower learners with a more engaging learning experience when coupled with effective pedagogy (Ibanez, Di Serio, & Delgado Kloos, 2014).

Current research on gamification, in education context, covers different topics, such as how badges affect learners of different skill levels (Abramovich, Schunn, & Higashi, 2013), how badges influence forum participation (Anderson, Huttenlocher, Kleinberg, & Leskovec, 2014), and how leaderboard can impact students' learning and motivation in math course (Christy & Fox, 2014). These studies extended our knowledge on how one or several game elements could influence student learning, motivation, and participation. But, unfortunately, there seems a lack of empirical study on evaluating the effectiveness of a complete gamification design model.

As gamification is a quite new approach (Deterding, et al.2011), and not all educators are experts in gamifying a course, there is a demand for an effective gamification design model which could be used to scaffold wise usage of gamification strategies. This study propose to extend previous research by developing a gamification design model based on motivation theories and empirical findings. We will field test this design model in three university-level courses (i.e. one undergraduate course and two postgraduate course), and assess its impacts on students' motivation, learning and participation.

Our research questions are: 1. Is this proposed gamification design model effective in scaffolding gamification design? 2. What are the impacts of gamification on students' motivation, learning and participation?

2. Literature Review

2.1 Definition of Gamification

Gamification is not a game. Game is a system that engages players with artificial conflict, complex narrative, defined rules, and exquisite visual settings (Salen & Zimmerman, 2004). Gamification employs elements and dynamics of game to motivate learners and help solve problems, which addresses not the deployment of complex narrative or exquisite visual settings (Ibanez et al., 2014).

Game design element or game mechanics are building blocks of games (Deterding et al., 2011). In our reviewed empirical studies, the most frequently applied game design elements are badges, points, leaderboard (e.g. Anderson et al., 2014). Badges are icons that indicate the completion of certain activities, points are tokens that commonly used to signify the achieved outcome, and leaderboards are high-score tables that enables players to track their status, as well as comparing with peers' performance (Bunchball, 2010; Educause, 2011). From empirical gamification studies, there are many lessons we may borrow. For example, Nicholson (2013) reported that points could be used to help students adopt expected behavior at the beginning stage, but relying too much on it may decrease students' interest and engagement. See Table 1 for reported merits and drawbacks of game mechanics.

2.2 Motivation theories

As the purpose of implementing gamification is to motivate learners and change their behavior in a meaningful way, it is important to understand the motivation mechanism functions behind human. In this section, relevant motivation theories will be described.

Goal-setting theory: A goal is an outcome that one makes conscious effort to achieve or attain. According to goal setting theory, students' motivation and learning can be promoted when the goals are specific and moderately challenging (Locke & Latham, 1990). Moreover, when immediate feedback is provided to learners during learning process, learners are more likely to achieve the expected outcome (Schunk, 1990). In gamified practices, points and badges could be used to guide learners in setting up reasonable goals and direct their attention to important activities.

Self-determination theory: Deci & Ryan (2000) posits that autonomy, relatedness, and competence are three innate psychological needs that can facilitate motivation. Gamified practices that provide learners the freedom to choose which activity to complete, the channel for them to interact or collaborate with their peers, or the access for strengthening their competences would address the three innate needs and motivate learners.

Social comparison theory: Festinger (1954) states that human beings evaluate their abilities and performance by comparing with others'. It helps them judge the appropriateness of their own behaviors (Schunk, 1990). Integrating mechanics like leaderboards and badges into learning setting could facilitate self-evaluation and sometimes behavior changes.

2.3 Design of Gamification Model

Based on the motivation theories and findings from empirical studies, it is suggested that meaningful gamification design should have five basic properties: First, it makes the learning tasks meaningful to the user (Deci & Ryan, 2000; Nicholson, 2012). Second, it helps learners feel the difficulty level of tasks match their abilities, and helps them feel their competences are growing when participating in learning activities (Csikszentmihalyi, 1978; Locke & Latham, 1990). Third, it gives them concrete feedback so that they can check their performance and thus do self-plan or self-correction (Csikszentmihalyi, 1978; Locke et al., 1981). Fourth, it helps users experience optimal challenge and experience mastery (Deci & Ryan, 2000). Fifth, it makes learners feel they are connected to their peers and they can compare their performance with their peers (Deci & Ryan, 2000; Festinger, 1954).

Table1 Reported merits and drawbacks of game mechanics

Game Mechanics:	Merits	Drawbacks
Participation badge/ cumulative badge	● It can help low-achievers increase interest and help reduce their concern about poor performance.[1] ● It can increase participation rate [2] [3] [8]. ● It can increase enjoyment.[8]	● It cannot increase high-achievers' motivation[1] ● It cannot increase students intrinsic motivation [2] ● It cannot increase students' participation quality(e. g. correctness rate).[8]
Skill badge	● It can increase high-achievers' expectancy on doing well, when they earn more skill badges.[1][16]	● It cannot increase low-achievers' motivation. [1]
Points/rewards	● It has the potential to help students adopt expected behavior at the beginning stage.[16]	● Students stopped working for it after a period of time.[16] ● If the point system is unclear and not easy to apply, it might bring confusions. [16]
Leaderboard	● Students ranked it as the best incentive element.[17]	● It could be demotivating when the gap between leader and other student grows.[16]
Levels/Progress bar	● It can increase forum participation rate, by showing students' progresses.[2]	

Notes: The merits and drawbacks are extracted from Abramovich et al. (2013), Anderson et al. (2014), Barata et al. (2013), Denny (2013), Nicholson (2013), and O'Donovan et al. (2013).

3. Methods

3.1 Participants

Participants will be recruited from 1 undergraduate course (i.e. Information Management) and 2 postgraduate courses (i.e. E-learning Strategies and Management, Research Methods and Inquiry). Take Information Management course as an example, there will be two rounds of implementations. In the first round, 1 class from BSc IM (2016) will be assigned into the control group, while another class from BSc IM (2016) will be assigned into the treatment group. It is estimated that around 80 students will participate in the first round study. In the second round, the quasi-experiment will be replicated in new BSc IM (2017) students. In total, 160 students of Information Management courses will participate in this study.

3.2 Experiment Design

Control group will take the traditional Information Management course. Treatment group will take the gamified Information Management course. Both the control group and the treatment group will use similar learning material (i.e. the learning content will be the same). Topics will be introduced in the same sequential order and assignments will be scheduled almost at the same time.

3.3 Data Collection Method

Multiple data collection tools will be adopted in this study, i.e. pre-test, post-test, survey questionnaire, students' logs, and interview. To evaluate the impact gamification has on students' academic outcome, a pre-test and a post-test will be conducted. To assess the impact gamification has on learners' motivation, a revised Intrinsic Motivation Inventory survey questionnaire (Deci & Ryan, 2000) will be used. To evaluate the impact gamification has on learners' participation, student logs online (e.g. votes, forum posts) will also be computed and gathered. To gain deeper understanding on students' perception on gamification and facilitate data triangulation, a semi-structured interview will be administered.

4. Pilot Study

A pilot study has been conducted in a master-level course Research Methods and Inquiry. In the pilot study, one cohort (i.e. quantitative data analysis cohort) of this course has been gamified. Results showed following the proposed gamification design model, gamified group (M=6.43, SD=4.64) were motivated to post more than the non-gamified group (M=0.42, SD=0.84); t (38) = -5.55, p< .05. Gamified group were also motivated to participate more pre and post course activities. Though students in both groups were informed that they have freedom in opt to or not to do the post course activities, 95% students from the gamified group (N=21) opted to complete 3-5 post course activities, while no students from the non-gamified group (N=19) choose to do these activities. It proved that this gamification design was effective in motivating learners to make more efforts and take more challenging tasks. Interview result corroborated with the quantitative result, among the 11 interview participants from gamified group, 91% showed their willingness to experience gamification in future courses.

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