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A multilevel analysis of the effects of external rewards on elementary students' motivation, engagement and learning in an educational game

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ABSTRACT

This study investigated the effects of external rewards on fifth graders' motivation, engagement and learning while playing an educational game. We were interested in exploring whether the feedback-rich environment of the game could mitigate the predicted negative effects of external rewards. Data of students' engagement and learning were collected and analyzed at multiple levels. A quasi-experimental design was used to examine the effect of external rewards in one group ($n = 50$) compared to a control group without such rewards ($n = 56$). According to the results, the external rewards did not undermine students' motivation (e.g., at proximal and distal levels), however they did not foster disciplinary engagement. On the other hand, students in the reward condition showed significantly larger gains in conceptual understanding (proximal) and non-significantly larger gains in achievement (distal). These results suggest that the predicted negative consequences of external rewards may be addressed in this new generation of learning environments. Future research and contributions of the study are provided.

1. Introduction

Despite the controversy concerning the use of external rewards in education (Cameron, Pierce, Banko, & Gear, 2005), they have remained a common practice for supporting achievement, motivation and appropriate behavior (Hoffmann, Huff, Patterson, & Nietfeld, 2009). Furthermore, today such rewards have rapidly expanded alongside increasingly popular educational innovations such as *educational games* and *digital badges* as well as other *gamification* strategies. However, apparently little research has explored both the potential negative and positive consequences of such reward systems on individuals' motivation, engagement and learning[1] in these newer technological contexts.

The past decade has seen an interest in the design of *educational* games at the national and international level (Federation of American Scientists, 2006; Honey & Hilton, 2011; Kirriemuir & McFarlane, 2004). Well-designed educational games offer continual opportunities for player improvement, massive amounts of feedback, tasks too complex for any one individual to solve alone, and environments that change in response to learners' actions (Barab, Gresalfi, & Ingram-Goble, 2010; Garris, Ahlers, & Driskell, 2002). However, research has consistently shown that learners often do not take advantage of the resources they could use to improve and learn (e.g., Hickey, Ingram-Goble, & Jameson, 2009; Nelson, 2007). All this translates into a poor engagement with the learning content, which may be at the core of the modest empirical evidence of games as learning tools (cf. Connolly, Boyle, MacArthur, Hainey, & Boyle, 2012; Hay, 2005; Randel, Morris, Wetzel, & Whitehill, 1992). In terms of educational game design, these resources usually take the form of facts and content embedded in the game narrative, which may be experienced as disruptive or disconnected (Filsecker and Kerres, in press, 2013) instead of a more "endogenous" sense in Malone (1981). Therefore, an extra motivational support might be needed. This situation was also the case in Taiga (Hickey et al., 2009) – the learning environment used in the present study and which is part of the larger project *Quest Atlantis* (Barab et al., 2010). As Taiga

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[1] Motivation and engagement are usually employed interchangeable. However, we follow the motivation–volition distinction proposed by Kuhl (1987) and consider engagement as describing an ongoing, volitional process (Filsecker & Kerres, in press). Therefore, in this paper we discuss motivation and engagement in separate sections.

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has usually been a two weeks implementation, other motivational features in Quest Atlantis, which require more time, have not been fully implemented. To overcome this problem we sought quicker motivational strategies. One of these strategies is the inclusion of reward systems. Emulating the reward systems built around videogames (Tobias & Fletcher, 2011) we included *externals rewards* in order to induce individuals' deeper engagement with the resources and learning content embedded in educational games. However, while commercial videogames offer players some form of external reward (such as points or "levels") to motivate their progress, rewards remain controversial in education due to their possible negative side effects on individuals' motivation.

More recently, these rewards have rapidly expanded in educational settings in the form of digital badges and other gamification practices (e.g., Deterding, Dixon, Khaled, & Nacke, 2011; Dominguez et al., 2013; Hickey & Rehak, 2013; Lee & Hammer, 2011; Landers & Callan, 2011; Muntean, 2011). These digital tokens appear as icons or logos on web pages or other online venues. Numerous schools, organizations, and programs have begun offering them to signify individual accomplishments, such as completion of a project, mastery of a skill, or gaining of an experience. Although they are implemented in order to provide credentials, they are also used to support individuals' motivation to learn and engagement. This last use has raised some concerns about the unintended negative effects of badges on scholars such as Mitchell Resnick[2] and Henry Jenkins,[3] supported also by preliminary empirical evidence (see Abramovich, Schunn, & Higashi, 2013). Their concerns echo earlier ones on rewards and motivation (see Section 1.1), namely that such incentives may undermine individuals' intrinsic motivation and interest in the activity, by focusing on the acquisition of incentives and losing interest in the material itself. As with educational games, proponents of such systems appear to be ignoring these concerns. In contrast, this study aims at empirically examining such concerns in the context of a specific educational game.

Previous research on rewards and gamification has presented the following limitations. First, research on rewards has been conducted mainly in laboratory conditions rather than in more ecologically valid settings (e.g., Pierce, Cameron, Banko, & So, 2003). Second, rewards are usually given by test performance and not during the performance in a learning activity (e.g., drafting a quest). Third, studies seldom examine whether intrinsic motivation for a task transfers to broader activities (e.g., from solving an ecological problem to general interest in scientific issues) (e.g., Cameron et al., 2005). Finally, although some studies have proposed mediator variables to understand the process by which rewards affect motivation (e.g., Harackiewicz & Manderlink, 1984), most studies do not provide evidence related to the differential quality of individuals' engagement during specific learning activities (e.g., quality of drafted quests). Concerning digital badges and gamification, research is still in its infancy and only a few empirical studies have addressed the effects of such motivational strategies (e.g., Abramovich et al., 2013; Domínguez et al., 2013; Landers & Callan, 2011). A central weakness of this research is that it usually acknowledges the role of gamification as fostering engagement, but without providing a definition and operationalization of the concept. Without an explicit definition of the desired outcome (i.e., engagement), it makes it difficult to empirically address the effectiveness of gamification and similar design strategies. Finally, these studies tend to replicate the tendency of awarding badges for test performance, instead of awarding them during an ongoing learning activity.

The aim of this paper is to examine the consequences of external rewards within an educational game on students' motivation, engagement and learning science. In the context of Quest Atlantis, a quasi-experimental study compared students ($n = 106$) playing in two conditions. In one condition, students were rewarded with a badge affixed to their in-game virtual avatar. They also were invited to move a paper version of their avatar up and across a physical "leader board" that was prominently placed in the room. Therefore, this reward condition was called Public Recognition (PR) condition. In the control or Non Public Recognition (NPR) condition, students were not offered badges nor given the opportunity to display their progress via the leader board. To gain a deeper understanding of the effects of this reward system on engagement and learning, we used a multilevel model of assessment (Hickey & Anderson, 2007) that captures at different levels increasingly removed from the curriculum (i.e., individuals' actions, discourse, understanding and achievement) motivational and learning variables. Thus, fine-grained analyses were conducted of individuals' actions, discourse and understanding within an ecologically valid setting.[4]

1.1. External rewards and motivation

Rewards represent a positive external influence. As Cameron and Pierce explain: "external rewards are those that come from outside the person and are usually arranged by other people" (Cameron & Pierce, 2002, p. 27). Cognitive theorists have suggested that rewards are detrimental for individuals' intrinsic motivation and subsequent engagement by undermining their perception of competence and autonomy and/or by deviating the perceived source of motivation to external causes. The first mechanism is accounted for by Cognitive Evaluation Theory or CET (Deci, Koestner, & Ryan, 1999), while the second mechanism is accounted for by attribution theory and the "overjustification" hypothesis (Lepper, Greene, & Nisbett, 1973; Tang & Hall, 1995). According to Deci et al., rewards have both controlling and informational qualities. If tied to performance standards, rewards are likely to be perceived as controlling, undermining the perception of autonomy and therefore reducing individuals' intrinsic motivation. On the other hand, the overjustification hypothesis suggests that when an external reward is introduced for an activity which was previously interesting, the individual subsequently attributes the basis for the activity to the external reward. Hundreds of studies have shown that "extrinsic" rewards direct attention away from intrinsically motivated learning, leading to diminished engagement once rewards are no longer offered (Tang & Hall, 1995).

Cameron and Pierce (2002), after reviewing 30 years of research on rewards, provided a summary of the conditions that could lead to the negative effects of rewards: (1) task is of high initial interest; (2) use of tangible/material rewards; (3) rewards is offered beforehand (expected); (4) rewards are delivered regardless of the person performance; (5) intrinsic motivation is indexed as free-choice behavior or self-reported task interest following the withdrawal of the reward; and, (6) intrinsic motivation measured with a single assessment. Therefore, from the initial controversy of whether or not external rewards were negative per se, the scientific discussion has focused on the

[2] See http://www.hastac.org/blogs/mres/2012/02/27/still-badge-skeptic.

[3] See http://henryjenkins.org/2012/03/how_to_earn_your_skeptic_badge.html.

[4] By "ecologically valid setting" we mean that the results of our study were produced (in contrast to more controlled studies typical in external reward research) in the context of real classrooms.