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Need-supporting gamification in education: An assessment of motivational effects over time

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ABSTRACT

Although many studies have focused on the potential of implementing gamification in education, the existing literature remains inconclusive about its effectiveness. In order to make sense of the contradictory findings regarding the effectiveness of implementing game design elements in an online learning environment, this paper complements the available body of research by addressing three holes. We have (1) analysed gamification's underlying motivational processes from a Self-Determination Theory-perspective, thereby accounting for the motivational effects of various game design implementations; (2) empirically assessed subtle motivational changes over time, and (3) accounted for the potential individual differences in motivational effects of gamification. Over a period of 15 weeks, we administered four surveys to measure the possible evolution in students' (N = 40) motivational levels in response to interacting with need-supporting game elements that were implemented in Google + Communities used in a university course. Participants' autonomous and controlled motivation was curve linear, showing an initial downward trend that surprisingly shifted to an upward tendency towards the end of the semester. Their controlled motivation stayed stable throughout. The results illustrated the significance of the individual nature of motivational processes, the importance of sensitive longitudinal motivation measurements, and the relevance of the implemented game elements' design characteristics. We end this article by opening the debate on using theoretical lenses when designing gamification, and by providing avenues for future research.

1. Introduction

In education, motivation is regarded as one of the most important factors leading to academic success (Abramovich, Schunn, & Higashi, 2013; Buckley & Doyle, 2014). However, research in educational environments revealed that students' motivation diminishes during academic semesters and years, and throughout learners' school careers (e.g., Darby, Longmire-Avital, Chenault, & Haglund, 2013; Pan & Gauvain, 2012). In order to reverse this trend, researchers and practitioners have been looking into techniques to motivate learners. One such technique is gamification. In gamification "design elements from games," such as badges and rankings, "are implemented in non-game contexts" (Deterding, Dixon, Khaled, & Nacke, 2011, p. 10), generally with the goal to motivate people. Famous examples include Duolingo®, a foreign language learning app; and Codecademy®, an online platform to learn how to code. As games are voluntarily played for hours by millions of people each day (e.g., Interactive Software Federation of Europe, 2016), the reasoning goes that those games are inherently motivating (Domínguez et al., 2013; Su & Cheng, 2015). By singling out these motivating game elements and introducing them in other contexts, like in education, proponents believe the motivational

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strength will be transferred too (Deterding, 2015a). The same holds true for serious games, where game mechanics are also used as a driver to motivate learners. The difference is that serious games are full-fledged games (Blumberg, Almonte, Anthony, & Hashimoto, 2013; Michael & Chen, 2005), whereas gamified systems only incorporate a limited range of game design elements (Walz & Deterding, 2015).

Since gamification gained traction around 2010, research scrutinising its educational effectiveness boomed. The available data show a scattered picture, though (for overviews, see Caporarello, Magni, & Pennarola, 2019; de Sousa Borges, Durelli, Reis, & Isotani, 2014; Dicheva, Dichev, Agre, & Angelova, 2015; Nah, Zeng, Telaprolu, Ayyappa, & Eschenbrenner, 2014, pp. 401–409). On the one hand, many studies demonstrated beneficial learning outcomes of gamification implementations (see e.g., Barna & Fodor, 2017; Yildirim, 2017), while, on the other hand, several studies also reported mixed results and undesirable effects (see e.g., Buckley & Doyle, 2017; Homer, Hew, & Tan, 2018).

To unravel these contradictory research findings and to strive for a detailed comprehension of how gamification can work, we argue that an elaborated understanding of the psychological mechanisms underlying the interaction with gamification in education is first needed. As such, we echo earlier stances of Hamari (2017) and Nacke and Deterding (2017). Therefore, we report on a study that incorporated three research perspectives. Firstly, rather than focussing on the learning outcomes after implementing gamification in education, we scrutinised the underlying *motivational effects*. To do so, we assessed the motivational processes following interaction with gamification in education that is designed to foster learners' basic psychological needs satisfaction. In line with the terminology used by other researchers (see e.g., Deci, Olafsen, & Ryan, 2017; and; Standage, Duda, & Ntoumanis, 2005), we will refer to this kind of gamification as *need-supporting gamification* in the remainder of this paper. Secondly, rather than adding yet another cross-sectional study to the existing body of research, we shed light on the motivational effects of interacting with a gamified learning environment *over time*. Finally, instead of evaluating the effects of gamification implementations on a group level, we researched the experiences of learners on a more fine-grained, *individual level*.

This study contributes to the research field (1) by illustrating the value of a precise assessment of gamification's motivational effects, taking different motivational types, individual differences and time factors into account; and (2) by exemplifying the added value of using a theoretical lens like Self-Determination Theory during the design (and evaluation) phase of a gamified system.

In the remainder of this article, we first highlight relevant gamification research, which will lead to the postulation of two hypotheses. Then, we discuss the method of our study and report the results. We will end this article overviewing implications of the findings, limitations of the study, avenues for future research and conclusions.

2. Related work

In this section, we position our study against the available body of research on gamification. We point to three holes in the literature that are likely to explain the apparently contradictory findings on the effects of interacting with gamified systems. Firstly, given that previous research has rarely addressed the motivational processes underlying gamification, we use Self-Determination Theory (SDT; Deci & Ryan, 2004) as a theoretical lens to enable a better understanding of how gamification works. This provides us with a background against which we can interpret motivation as an important intermediate variable in the relation between gamification and learning outcomes (see Fig. 2). It also helps us to substantiate our critiques of the typical design affordances in gamified systems that tend to foster controlled motivation at the expense of autonomous motivation. Secondly, we argue that the effects of gamification manifest over a longer period of time, which calls for a more longitudinal research focus in order to scrutinise gamification's potential. Finally, we look into personal characteristics that may potentially encroach upon gamification's impact on motivation.

2.1. Gamification, motivation and Self-Determination Theory

Most existing gamification research focuses exclusively on learners' performance like grades (e.g., Barna & Fodor, 2017), or on behavioural outcomes like time-on-task (e.g., Denny, McDonald, Empson, Kelly, & Petersen, 2018). In order to gain a deeper understanding of gamification, research should first address the underlying motivational processes that steer these behavioural and cognitive changes (Landers, Bauer, Callan, & Armstrong, 2015).

In this study, we use the theoretical lens of Self-Determination Theory (SDT; Deci & Ryan, 2004) to explain these motivational processes. Although we acknowledge that other theoretical perspectives, like flow theory (Csikszentmihalyi, 1990) or operant conditioning (Skinner, 1953), might be equally valuable, SDT is a popular, research-based psychological theory to scrutinise motivation in different settings, including education (Reeve, 2004). Furthermore, it is the most used theory in gamification research (Seaborn & Fels, 2015).

In SDT, Deci and Ryan (2004, 2015) posit that it is the type of motivation one has that drives behaviour and performance. Next to *amotivation*, a situation in which a person doesn't hold any intention to perform a particular behaviour (Deci & Ryan, 2004; Vansteenkiste, Sierens, Soenens, Luyckx, & Lens, 2009), Deci and Ryan (2004) define a continuum with four[1] types of motivation ranging from intrinsic to identified to introjected and finally to external regulations (see Fig. 1).

[1] Originally, Deci and Ryan (2004) defined a fifth type of motivation based on integrated regulations. In recent literature, however, academics have started to combine integrated and identified regulation-based types of motivation because of their resemblance (e.g., Vansteenkiste et al., 2009).