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Gamification in Academia: Does Psychological Engagement Boost Performance?

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ABSTRACT

Gamification is increasingly applied in contexts where personal performance is of importance. However, the psychological nature of their relation has not been thoroughly examined. The authors investigated how achievement-based gamification impacts attitudinal engagement and performance across 6 university courses. The authors created challenges and badges connected to coursework and measured students' engagement and performance while gamifying the course in 1 year of the 2-year quasi-experiment. In the other year, the authors examined engagement, performance, and would-be-attained achievements were the course gamified. Results show students performed moderately better in gamified condition. Moreover, badges had a guiding effect on students as badge-awarding actions were carried out more in gamified courses. Importantly, the authors found a small mediation effect of engagement in gamification-performance relation. The authors thus conclude badges may be a useful method when gamifying academic performance and that work attitudes are a useful framework to further examine the relation.

KEYWORDS

academia, achievements, engagement, gamification, gamified course design, goal-setting theory, performance, self-determination theory

INTRODUCTION

Gamification refers to a development in which reality becomes either intentionally or emergently more gameful (Hamari, 2019). Intentional gamification is usually pursued by implementing different

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kinds of essential elements of games outside games (Huotari & Hamari, 2017; Deterding et al., 2011; Landers et al., 2018). Lately, gamification has been increasingly used in schools, e-shopping, health-improvement, and other mobile applications, and work environment (Koivisto & Hamari, 2019).

There are several ways to taxonomize and typify game design elements such as into dynamics, mechanics, and elements (Werbach & Hunter, 2012). Another way is designing the elements in accordance with the HEXAD typology of players (Marczewski, 2015). It can also be based on feedback type (personal, performance, social, fictional, and ecological) (Toda et al., 2019). However, one of the canonical ways has been to perceive three primary types of game design and gamification for that matter; achievement, immersion, and socialization -based (e.g., Yee 2006; Koivisto & Hamari 2019; Xi & Hamari, 2012).

In work environments, gamification is often used to increase engagement and motivation and to improve performance (Huotari & Hamari, 2017), during training (Kampker, 2014), onboarding (Depura & Garg, 2012), and routine tasks (Anable, 2013). Based on previous research, one of the possible pathways from gamification to performance is via users' engagement. If a gamified design of an activity or a task suits the users, their needs and the environment, users should behaviorally engage more with the gamification (actively logging in, more time-on-task, etc.), thus becoming more psychologically engaged in the underlying task itself, which leads to higher performance in that task (Kuo & Chuang, 2016). However, this proposed relation has not yet been thoroughly examined and described (Sarangi & Shah, 2015) as not much research has been done in gamification on engagement as an attitude. In the current study, the authors decided to use a gamification design (challenges and achievements) which is suitable for academic environment (Çakıroğlu et al., 2017; Kuo & Chuang, 2016), and assess its relation to performance with regards to behavioral and attitudinal engagement. Specifically, the authors observed the supposed mediating effect of engagement on performance.

THEORY

Conceptual Framework

Gamification is only functional if its components are suitable for the target environment, the activities (Suh, 2017). the users and their characteristics in order to create reciprocal interaction of the users and the gamified design (Hassan et al., 2020; Landers & Marin, 2021). Reaching this suitability is also far easier if participation is voluntary and if failure or partial success is framed as an occasion for improvement (Furdu, Tomozei & Köse, 2017). Some critics even warn that making a gamification mandatory may support the feeling of working in yet another utilitarian system of rules instead of a hedonically utilitarian experience of playfulness (Woodcock & Johnson, 2018).

If these conditions are met, a gamification design has the potential to increase performance and engagement both in the gamification itself and in the work it is designed for (Harms et al., 2015). Ideally, game elements should positively affect attitude or behavior (engagement and motivation), which affects performance (Landers, 2015). From this stance, gamification is also often designed with respect to self-determination theory (SDT) and goal-setting theory (GST) (Kuo & Chuang, 2016; Landers et al., 2017).

According to SDT (Ryan & Deci, 2000a), to motivate people, gamification should promote their competence (e.g., by giving feedback), relatedness (by sharing the gamification with others or by putting the gamification in context with their work), and autonomy (by letting them decide which gamification tasks are relevant to them) (Gagné & Deci, 2005; Sailer et al., 2016). Specifically, suitable gamification designs have the potential to affect autonomous motivation as defined by Ryan and Deci (2000b). With a personally valuable goal (identification) or a goal in line with one's own beliefs (integration), over time, gamification may lead to intrinsic motivation (Çakıroğlu et al., 2017) and, thus, to higher work engagement (van Beek et al., 2011).

At the same time, if this goal is specific and difficult, it becomes an effective motivator in many situations and tasks (Locke & Latham, 2002) due to the mediation via self-regulation (Latham & Locke, 1991). Therefore, when designing gamification in accordance with GST, it needs to set specific, difficult goals in order to enhance performance, since setting specific goals leads to better performance than a "do-your-best" goal (Landers et al., 2017). Moreover, goals in such gamification design should be "specific, measurable, attainable, realistic, and time-bound" (SMART; Landers & Landers, 2014). If a goal (e.g., challenge) is not SMART, a reward (e.g., badge) cannot be tied to the goal. Also, if a goal is not realistic, users will not choose it voluntarily, and, if it is not attainable, the game mechanics (e.g., feedback) cannot be employed to reinforce participation, or "playing." However, if SMART goals are used in the design, the gamification should be able to enhance both engagement and performance (Landers et al., 2017). In sum, using challenges and badges may be a good way to improve performance through engagement. Thus, the strength and form of their relations require further examination.

Performance

Performance is defined by behavior and actions related to fulfilling organizational goals (Bartram, 2005). It may be divided into task performance and contextual performance (Woods, 2008). Task performance consists of fulfilling duties defined by the work and its content and is determined by the skills and knowledge of the worker. Contextual performance consists of things done beyond the scope of duties, and it is determined by personality and motivation (Jenkins & Griffith, 2004). While task performance may be easier to measure objectively (such as by KPI or production), subjective measures (such as evaluation by oneself or superiors) are better for contextual performance (Judge & Bono, 2001). Although gamification may influence both types of performance (Silva, 2010), its design usually centers around objectively measurable outcomes (Kuo & Chuang, 2016).

The relation of gamification and performance has been studied throughout the last decade in various ways in diverse applications. When educating employees, cooperative gamification led to a 13% improvement in comparison to a competitive one (Kampker, 2014). In a short-term uncomplex task, participants with goals set through a leaderboard performed similarly to those with a difficult and impossible goal and better than those with an easy or "do-your-best" goal (Landers et al., 2017). And in a gamified school subject, a correlation study with a small sample (40 students) found a moderate positive relationship (Çakıroğlu et al., 2017) between the use of several elements (leaderboards, points, and reputation) and student performance. However, when comparing gamification designs, it seems that in academia achievement-based gamification is more suitable if the goal is to enhance performance in the long-term (Kuo & Chuang, 2016).

A gamification for the long-term in academia was designed and observed by Legaki et al. (2020) in an experimental study with 365 students from several fields while finding better results for some of the fields. Similarly, Domínguez et al. (2013) found out that while using gamified, non-gamified with challenges, and non-gamified group, the gamified group performed better in practical tasks and the non-gamified group performed slightly better in theoretical tasks. However, studies altogether show learning performance improves more with gamification than without it (Ortiz-Rojas et al., 2019).

Therefore, the authors may assume that various gamification designs have the potential to increase performance. Achievement-based designs may be suitable to enhance performance in academic education as they focus on desired self-development and cooperation instead of rivalry (Kuo & Chuang, 2016; Ladd & Fiske, 2003). On the other hand, competition does not necessarily mean hindering performance in a group as the authors should also take team, individual, and task characteristics into account along with the interaction with the design of the intervention (Landers & Marin, 2021; Otoiu et al., 2019). Thus, depending on the academic environment and the users, a competitive design may also be suitable to enhance performance, especially if balance between competition and cooperation is achieved (Cantador & Donde, 2010). Nonetheless, the specifics of this relationship between gamification designs and performance are not clear. As most of the research

so far has focused on functional gamification design and on finding the relationship in general, the discovered associations have not been described in detail (Calderón et al., 2018). Previous research therefore urges to focus on possible mediators, moderators and user or environmental characteristics playing a role in this relation (Hamari & Koivisto, 2019; Hassan et al., 2020; Landers et al., 2017). One such explanatory variable that may be of importance is the psychological (work) engagement (Sarangi & Shah, 2015).

Engagement

Work Engagement refers to a positive, highly motivated, work-related state of mind, determined by vigor, dedication, and absorption (Schaufeli et al., 2002). It is characterized by the effort to perform well and to work for the organization's benefit (Albert, 2010). However, it can also be applied with students or athletes, as their actions in these roles may be considered "work" in the psychological sense (Schaufeli, 2017). Such attitudinal engagement is positively related to qualities such as a person's health and performance (Schaufeli, 2017), job satisfaction, and organizational commitment (Saks, 2006). As an attitude engagement is relatively stable similarly to a trait, but it can change over time (Schaufeli et al., 2002). In this sense, attitudinal engagement supports the argumentation that attitudes are a combination of a dispositional tendency towards an object and a product of social context. For instance, despite its trait-like stability, engaged leaders may foster it (Rahmadani et al., 2020) and engaged workers may spread it on less engaged coworkers (Bakker et al., 2004). Thus, work engagement does not change easily, but systematic effort – such as gamification – may lead to a change.

However, even though engagement has been observed in gamification studies, it usually concerns users' behavioral engagement in the gamification (Çakıroğlu et al., 2017), not engagement as a persistent attitude. Thus, engagement has mainly been examined as the amount of activity in a gamification system, even when engagement has been proposed as a mediator in the gamification-performance relationship (Ortiz-Rojas et al., 2019). However, based on cognitive dissonance theory (Metzger et al., 2015) the authors may assume that if behavioral engagement in gamified tasks increases, attitudinal engagement for the whole activity also increases. Simultaneously, gamification should enhance a persons' willingness to put effort into – and their positive attitude toward – their work (Deterding et al., 2011). Its use should also lead to higher flow and absorption in work (Suh et al., 2017). These impacts point to the relationship between behavioral engagement in gamification and engagement as an attitude.

Subsequently, engaged workers feel better at their jobs; they are more satisfied with it and more immersed in it, which leads to higher performance (Harter et al., 2002). Engaged people also set high goals (Albrecht, 2010); they are intrinsically motivated and see their work as fun. Thus, higher engagement leads to positive emotions and improved performance of people both in their own work and their work in teams (van Beek at al., 2011).

Therefore, the authors assume that with a suitable gamification design, behavioral engagement in the gamification (i.e., logging in, time spent) may increase performance via attitudinal engagement. This presumption is supported by previous research. Ilayyan (2015) demonstrated a strong positive relationship between gamification engagement and attitudinal engagement. Furthermore, engagement may increase with a gamified design of a school subject (Barata et al., 2013). At the same time, a positive (typically moderate) relation between engagement and performance has been found in numerous studies of various measurements of both constructs (Bakker & Bal, 2010; Kim et al., 2018, Xanthopoulou et al., 2008). Based on these previous findings, the authors tested the following hypotheses:

H1: Students attain higher performance with an achievement-based gamification of several course activities compared to control conditions.

H2: Students' behavioral gamification engagement is related to their attitudinal engagement to the course.

H3: Attitudinal engagement mediates the relationship between gamification engagement and performance.

METHOD

Participants and Study Plan

The quasi-experimental study included 562 Czech university students from six university courses in the fields of psychology and political science. The authors recorded the number of students in each course, the type of degree they were pursuing, and their major field of study. The authors chose this sample based on their knowledge of the environment and its system. This allowed us to create sensible gamification and to collect data more effectively. On the other hand, such sample consists of various courses with multiple seminar groups and different instructors and students across two years. Such treatment conditions and intervening variables (e.g., instructor or group effects) may weaken the comparability and interpretability of the results. The authors mitigated this limit through several methods. From the study plan point of view, the authors gamified the design of each course in academic year 1 or 2 based on a randomization so that one half of courses was gamified in the first year and the other one in the second (Table 1). The authors also used courses with similar course evaluation statistics across previous years.

Design

As the authors needed to create a suitable gamification design, they investigated what was needed in the courses according to their own experience, according to instructors, and according to students while keeping the theory behind gamification the whole time in mind.

There were several criteria to the design. Due to course sizes, the authors needed to use several courses across two years instead of one split-halved course. To achieve comparability in such conditions, they strived for a design that would be as similar as possible across courses. Simultaneously, the authors targeted voluntary course activities with room for student improvement (Furdu et al., 2017). Regarding the gamification itself, they focused on self-development and cooperation, not competition for several reasons. Ethically, they could not risk harming performance in compulsory courses with an unsuitable competitive gamification (Azmi et al., 2017). Second, coursework is done in groups which may vary from task to task, i.e., team competition on task A could harm group cohesiveness and performance in task B (Beal et al., 2003). This could also lead to unwanted complications for the students declining participation in the research.

Based on these criteria, the authors investigated course syllabuses and used their own experience to identify gamifiable tasks and activities. In a discussion with the instructors and previous students, the authors explored what needs and hindrances were related to these tasks and activities from the point of view of the students, the instructors, and the course environment. This led to a draft of their design with challenges and achievements. After getting feedback from the instructors, the

Table 1. Quasi-experimental condition manipulation across years

	PERPSY	METHOD	PSYDIA	ORGPSY	POLHIS	POLINT
2018	0	1	0	1	1	0
2019	1	0	1	0	0	1

Note. 1 = Gamified; 0 = Control. Course codes: PERPSY = Personnel Psychology; METHOD = Methodology of psychological research; PSYDIA = Psychodiagnostics; ORGPSY = Organizational psychology; POLHIS = History of political ideas; POLINT = Introduction to political science.

authors created the gamification system and asked a graphic designer to create the first version of their badges. These were again discussed with the instructors, but also with an art history student and several to-be course students. This allowed us to finalize their design, test their system, create a course-transferable schedule, and to implement the design into the administrative system of the course. The full list of their design component, their operationalization, and the logic behind them may be found in Appendix 1. The authors also present the aesthetics and the wording of the challenges, and the overall front-end in Appendix 2.

PROCEDURE

The authors introduced their research at the beginning of each course after obtaining the approval of the course instructors. They presented an "introductory lecture" to explain what the gamification looked and worked like, and what would be required of them if they agreed to participate. The authors also guaranteed their data would be kept confidential and anonymized. Then they explained that the purpose of this study was to observe students' attitudes towards course activities and the usefulness of such activities. Afterwards, they asked for their written consent and emphasized they could withdraw from the study at any moment. Gamification was delivered through the university system throughout the semester. At the end of each semester, they measured students' attitudinal engagement and collected their performance data.

Materials

Gamification and Gamification Engagement

The authors manipulated gamification dichotomously as the courses were either gamified or control across the two years.

They also measured behavioral gamification engagement through the number of accesses to the gamification system, i.e., as discrete values from zero to infinity (how many times participants browsed the gamification system).

Achievement Attainment

The authors measured how many badges students gained in gamified courses. In the second year, they also observed how many badges would be obtained in the courses which were not gamified that year. Thus, they have a comparison of actual and would-be achievement attainment for three courses. Although the number of badges and what they were awarded for was similar for all courses, due to the minor differences, the authors still transformed them into percentages of attained achievements and converted them to z-scores for accurate comparison of the data between courses. They also checked whether it was easier or more difficult to obtain some types of badges in one course than the others and found no major differences, thus ensuring the comparability of achievement attainment difficulty.

Performance

Performance was measured through grade points gained in the course for mid-term tests, written and spoken assignments, and the final exam. As the point scale varied across courses, the authors balanced the scores by subtracting the average course grade points of the pre-research year (2017) from the individual grade points in the two research years (2018, 2019). This way the authors ensured that any performance increases seen in the gamified year (in comparison to the non-gamified year) were likely to be the effect of gamification. Although the differences might have also been caused by students or course differences, they deem this necessary to ensure at least limited comparability.

Attitudinal Engagement

Based on the research of Schaufeli (2017), the authors may consider taking part in a university course as "work," in the psychological sense of the word, and measure the engagement of students via UWES. Thus, they adapted the Czech shortened Utrecht Work Engagement Scale (UWES, Schaufeli, et al., 2002) for university courses. In UWES-9, respondents rate how they feel about their work experience on a 7-point Likert scale (1 = *never*, 2 = *hardly ever*, 3 = *occasionally*, 4 = *sometimes*, 5 = *often*, 6 = *very often*, 7 = *always*). The reliability and validity of UWES-9 have been supported various times (e.g., Schaufeli et al., 2006). Czech version of UWES-9 has satisfactory reliability both for research and praxis ($\alpha = .92$; Kašpárková et al., 2018). After adopting the scale, the authors conducted cognitive interviews and a pilot study to evaluate its functionality. They found strong reliability (a = .92) with a 1-factor solution based on ML estimation (F = .98, $\chi^2(27) = 153.28$, $p < .0001$, RMSEA = .17, 90% CI = [.15; .20]). As students of various courses do not presumably perceive the work engagement scale differently, they did not transform this scale.

RESULTS

Descriptive Statistics

Of the 562 Czech university students who originally enrolled in the study, 34 dropped out of the study, 62 were excluded because they did not complete the exit questionnaire or did not engage in the gamification system. Thus, the sample available for data analysis consisted of 466 students who were, on average, 21.61 years old (SD = 1.82). The majority were women (290, 62%).

The details of the participants' field of study, degree, and the number of students in each course are presented in Table 2. The table also indicates the percentage of the entire sample size for each course category and the percentage of the participants who attended the introductory lecture. It should be noted, the differences in treatment and control conditions may have affected which students volunteered to participate, thus constraining the results. However, since a similar percentage of attending students participated in the study in most courses across the two years, they deem the sample similarly representative across courses.

Table 2. Distribution of student participants

	Absolute frequency (N)	Relative frequency (%)	% course students	% attending students
Course				
PERPSY	85	18,24	86.28	91.88
METHOD	108	23,18	88.02	91.73
PSYDIA	54	11,59	65.60	87.40
ORGPSY	74	15,88	91.52	94.49
POLHIS	51	10,94	51.35	75.22
POLINT	94	20,17	61.04	72.09
Type of study				
BS – Psychology	193	41.42	87.18	91.80
BS – Political Science	145	31.12	56.85	73.28
BS – both fields	338	72.53	71.98	83.46
MS – Psychology	128	27.47	78.09	91.27

All variables except for behavioral gamification engagement were approximately normally distributed on the general level. The authors present the general descriptive statistics and correlations (Spearman for gamification engagement, Pearson otherwise) in Table 3, thus finding support for the hypothesis of the relation between behavioral gamification and attitudinal course engagement (H2).

Performance Differences

Descriptive statistics of the dependent variable (i.e., performance differences) for each combination of manipulation and cluster are displayed in Table 4. As the trends among most courses show better performance for the gamified condition, the authors may proceed with hypothesis testing.

To test if gamified condition differs in academic performance (H1), the authors performed a linear regression with centered performance as the dependent variable. As there may be a course effect and an effect of measuring some students twice, they decided to perform multilevel regression instead of ordinary regression, thus accounting for observation dependency. Ideally, the authors would control for field, year, course, seminar group, and student effect. However, based on the effects in previous research and a subsequent singularity error, the data are not large enough to perform such complex analysis. As a less-fitting multilevel model is still more sensible than an ordinary regression with dummy variables (Matuschek et al., 2017), the authors decided to use a simpler multilevel model which would be as maximal as possible (Barr et al., 2013). As this meant leaving out higher-order terms, the assumption of linearity could not be followed, and their residuals were somewhat related to the predicted values. However, as other assumptions were met, the authors tested a multilevel model with student and course levels. The baseline model (Model 1) includes the fixed intercept and the random intercepts across students in the courses. In Model 2, they added the effect of experimental

Table 3. Unstandardized descriptive statistics and correlation matrices

	Student level				**Course level**			
	M(SD)	**P**	**Ach**	**E**	**M(SD)**	**P**	**Ach**	**E**
Performance	-1.14(6.62)				-.93(3.39)			
Achievements	.43(.18)	.39***			.46(.09)	.64		
Engagement	3.87(1.00)	.25***	.20***		3.87(.28)	.47	.33	
GE	4.99(3.09)	.39***	.25**	.16*	4.85(1.28)	.71	.49	.89*

Note. GE = gamification engagement (number of logins into gamification). * p = .05, ** p < 0.01, *** p < 0.001

Table 4. Descriptive statistics for relative performance*

	Non-Gamified			**Gamified**		
	M (SD)	**Me**	**Min; Max**	**M (SD)**	**Me**	**Min; Max**
ORGPSY	-0.2 (3.79)	-0.07	-10.07; 5.93	5.66 (4.88)	5.43	-4.07; 14.93
PSYDIA	-5.63 (5.91)	-4.89	-21.89; 7.11	-2.57 (6.43)	-2.89	-10.89; 14.11
METHOD	-1.91 (7.78)	-3.4	-15.65; 16.35	-4.23 (7.13)	-4.15	-23.65; 8.35
PERPSY	-1.64 (6.33)	-0.77	-15.77; 12.23	-4.6 (7.95)	-6.77	-13.77; 11.23
POLHIS	0.8 (3.98)	-0.2	-7.2; 7.3	3.73 (4.54)	4.55	-6.2; 9.8
POLINT	-2.09 (5.44)	-2	-12; 10	1.53 (6.09)	2	-12.25; 10
Total	-1.71 (6.15)	-1.74	-21.9; 16.4	-.131 (7.29)	-.375	-23.6; 14.9

Note. *Performance subtracted by the year-before-research performance.

condition. Finally, since the authors know attitudinal engagement predicts performance, they included attitudinal engagement and its interaction in Model 3. Table 5 shows both the fixed and random effect coefficients and model fit. Finding significant positive effects for the experimental condition, attitudinal engagement, and their interaction, they can see the gamification effect on performance was stronger with higher attitudinal engagement. Thus, the authors found support for H1.

Achievement Attainment Differences

For the courses gamified in 2018, the authors also observed the percentage of achievements that students in 2019 would attain, were those courses gamified again. Thus, they have a sample of three courses and N = 232 with attained (i.e., in gamified condition) and would-be attained (i.e., in non-gamified condition) achievements (Table 6). Comparing the trends, there was better performance in attaining achievements in the gamified courses.

The authors performed a multilevel linear regression with (would-be) attained achievements as the outcome. As this time there were no students measured twice, the baseline model (Model 1) includes the fixed intercept and only the random intercept across courses. In Model 2, the authors added the effect of experimental condition. They present the coefficients and the model fit in Table 7, finding support for a positive effect of gamified design on students' effort in the given tasks.

Mediation Effect of Attitudinal Engagement in the Relation Between Gamification Engagement and Performance

To test the hypothesis (H3) that the mediating effect of attitudinal engagement in the relationship between gamification engagement (i.e., predictor) and performance (i.e., dependent variable), the authors would ideally perform a multilevel mediation SEM. Since the sample was not large enough

Table 5. Multilevel linear regression with course performance as the dependent variable

Fixed effects	**Model 1**			**Model 2**			**Model 3**		
	Coef	**95% CI**	*SE*	*Coef*	**95% CI**	*SE*	*Coef*	**95% CI**	*SE*
Intercept	0.24	[-1.55, 2.05]	.94	-.39	[-2.32, 1.79]	.97	-.58	[-2.37, 1.10]	.97
Condition				1.60*	[.35, 2.82]	.63	2.01**	[.66, 3.31]	.67
Engagement							1.14**	[.46, 1.94]	.39
Eng × Cond							1.34*	[.15, 2.55]	.63
Random effects	*SD*	95% CI	*Var*	*SD*	95% CI	*Var*	*SD*	95% CI	*Var*
Inter (Student)	4.21***	[2.86, 5.03]	17.71	4.18***	[3.14, 4.99]	17.49	4.01***	[2.88, 4.89]	16.08
Inter (Course)	2.17**	[.61, 3.30]	4.72	2.16*	[.41, 3.25]	4.64	2.12*	[.20, 3.11]	4.50
Residual	4.70***	[3.94, 5.49]	22.07	4.66***	[3.90, 5.33]	21.76	4.59***	[3.79, 5.34]	21.02
Model fit									
Deviance		2535.7			2527.8			2497.2	
N parameters		4			5			7	
AIC / BIC	2543.7 / 2559.6			2537.8 / 2557.6			2511.2 / 2538.9		
Δ χ^2 (df)		-			[a]7.93 (1)*		[b]30.63 (2)***		

Note. Estimator: Maximum Likelihood. [a] Comparison with Model 1, [b] Comparison with Model 2. Conditions were coded [-1 = control, 1 = experimental].
* < .05, ** p < .01, *** < p < .001

Table 6. Descriptive statistics for 2018-attained and 2019-potentially-attained achievements

	Non-Gamified				Gamified		
	M (SD)	**Me**	**Min; Max**		**M (SD)**	**Me**	**Min; Max**
POLHIS	.46 (.19)	.53	.05; .84		.53 (.17)	.57	.19; .86
METHOD	.36 (.15)	.35	.06; .71		.44 (.11)	.41	.24; .65
ORGPSY	.33 (.17)	.36	.07; .71		.64 (.18)	.61	.29; 1.00
Total	.37 (.17)	.36	.05; .84		.52 (.17)	.53	.19; 1.00

Table 7. Multilevel linear regression with achievement attainment as the dependent variable

Fixed effects	**Model 1**			**Model 2**		
	Coef	**95% CI**	*SE*	*Coef*	**95% CI**	*SE*
Intercept	0.01	[-.04, .05]	.02	-.05	[-.09, .00]	.02
Condition				.15***	[.10, .19]	.02
Random effects	*SD*	95% CI	*Var*	*SD*	95% CI	*Var*
Inter (Course)	.04	[.00, .06]	.001	.03	[.00, .05]	.001
Residual	.18***	[.17, .20]	.03	.17***	[.15, .18]	.03
Model fit						
Deviance		-128.86			-166.6	
N of parameters		3			4	
AIC / BIC	-122.86 / -112.51			-158.6 / -144.8		
$\Delta\ \chi^2$ (df)		-			[a]37.79 (1)***	

Note. Estimator: Maximum Likelihood. [a] Comparison with Model 1. Conditions [-1 = control, 1 = experimental].
* < .05, ** p < .01, *** < p < .001

for such analysis due to working only with the gamified conditions (N = 178), the authors decided to perform a quasi-Bayesian approximation of the mediation effect for the multilevel regression models. Beforehand, they checked for outliers, homoscedasticity, and the assumption of normality. As gamification engagement is a heavily positively skewed variable, which cannot be sensibly transformed to a normal distribution, they did not meet all assumptions. Despite that a mediation analysis of the data may still be informative for future research which is why they continued with the analysis. However, it should be noted the results should be taken rather exploratively than as causally implicative.

As can be seen from Table 8, the effect of gamification engagement may be partially mediated by attitudinal engagement. Figure 1 illustrates the regression coefficients between gamification

Table 8. Attitudinal engagement mediation in the relation between gamification engagement and performance

	B	**p**	**95% BCa CI**
Total effect	.42	.004	[.14, .72]
Direct effect	.31	.02	[.04, .60]
Indirect effect	.10	.03	[.02, .21]

engagement and performance and between attitudinal engagement and performance were significant. The indirect effect was (.06) *(1.59) = .10. Computing for 1000 bootstrapped samples with a 95% confidence interval, the bootstrapped indirect effect was .10, and the 95% confidence interval ranged from .02 to .21. Thus, even if the analyses were not affected by the violated assumption, the effect would be rather small, though statistically significant ($p < .05$). Nonetheless, the authors found weak support for the third hypothesis.

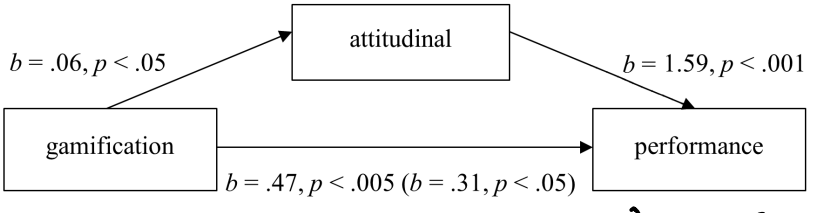
DISCUSSION

In this study, the authors observed how an achievement-based gamification design relates to performance in academic courses. Specifically, they hypothesized that the relation between behavioral gamification engagement and performance is mediated via attitudinal engagement. The authors have come to several primary findings. Firstly, they found support for the functionality of their gamification design. When they gamified a fraction of academic activities through challenging goals, students spent more time on these activities, gaining more badges, and performing better in the activities than those in non-gamified conditions. The authors may thus assume participants in the gamified condition worked harder on the tasks the authors gamified. Secondly, they found support for H1 that their gamification design positively affects students' performance in university courses. When students were presented with gamified challenges connected to their coursework, they attained better course evaluation compared to non-gamified condition. Further, they also found support for H2 as students who were more actively engaged in the gamification reported they were also more psychologically engaged in the coursework itself. Meaning, students may have justified their engaged behavior and slightly changed their attitude to achieve higher consistency between them. Finally, they found some support for their third hypothesis. The relation between behavioral gamification engagement and performance may be partially mediated via attitudinal engagement. Students who were more active in the gamification were also more psychologically engaged in the coursework and, therefore, showed higher course performance.

Theoretical Implications and Future Research

This study provides further evidence for the relation between gamification and performance. Moreover, the authors found support for a partial explanation of this relation by attitudinal engagement. Such findings extend the work of Landers (2015), who explains gamification has the potential to affect their behavior and performance. When designing a gamification, they do not aim to address participants' performance directly (i.e., to build a completely new system to create a performance; a serious game). The authors intend to change their behavior or attitude (e.g., commitment or engagement) in some pre-existing situation so that they perform better than before (Landers, 2015; Landers et al., 2017). Thus, people who partake in a suitable gamification tend to have more positive attitudes towards their work. The results also support recent findings that gamification design has the potential to affect performance (Domínguez et al., 2013; Landers et al., 2017; Ortiz-Rojas et al., 2019). Simultaneously, the authors build on the research of the

Figure 1. Mediation analysis model for indirect effect of gamification engagement on performance via attitudinal engagement



performance is effected by both gamification and engagement

relationship between work engagement and job performance (Bakker & Bal, 2010; Bakker & Xanthopoulou, 2009), finding a similar relation in academic environment. Such findings are in line with the work of Schaufeli (2017) who writes that psychologically, engagement should not be treated as exclusive to work since energy and determination are also important for education, hobbies, and other activities. Similar results may thus be found in work environment and future research should focus on that.

It should also be noted, the authors found a moderate effect of gamification on course performance (Coef = .30, $p < .01$) when taking attitudinal engagement (Coef = .17, $p < .01$) and its interaction with experimental conditions (Coef = .20, $p < .05$) into account. Not only gives this support for the effect of an achievement-based self-developing and cooperative gamification on academic performance as the authors would expect from previous literature (Azmi et al., 2017; Kuo & Chung, 2016; Ortiz-Rojas et al., 2019), it also means a suitable gamification design may moderate the relation between attitudinal engagement and performance. This is in line with previous research as a suitable well-designed gamification has the potential to moderate the relation between attitudes and (behavioral) outcomes (Treiblmaier & Putz, 2020). Thus, future research should further explore such possible moderating effect.

Regarding the mediating effect of attitudinal engagement, the observed effect is small and may be affected by the violation of normality. A possible explanation could be in the research design. Students must familiarize with the course requirements and learn from multiple sources. Adding another layer to that may be overwhelming. Especially if the gamification is too complex (Rapp et al., 2019). Further, even though the author's gamification system was a part of course materials, it was not intertwined with them. Meaning, a stronger intention to interact with the system might have been required, thus narrowing the variance of behavioral gamification engagement and decreasing the value of their mediation results. Therefore, the authors recommend controlling for gamification complexity or user experience and to facilitate orientation in the system so that it is even more easily accessible to users (Morschheuser et al., 2018).

The weak mediation effect may also be explained by user characteristics. If the users are already highly internally motivated and engaged, they may not benefit as much from the gamification design. Simultaneously, not much research has been conducted on the relation between personality traits and gamification elements (Hassan et al., 2020). If the design did not suit the users' personality traits, the effect of their gamification design would be weaker. For example, people who score higher in agreeableness or extraversion may have preferred social game elements (e.g., teamplay, sharing and commenting results). Therefore, future research should focus on the relation between gamification design, environmental conditions, and personality.

Finally, as the authors found a partial weak mediation effect, other mediators should be considered for the effect on performance. For example, the gamification effect could be mediated by the users' satisfaction with their work as gamification should make the tasks more enjoyable and fun (Suh et al., 2017). Another mediator may be the perceived task meaningfulness since gamification should provide highly frequent feedback and contextualize the tasks (Furdu et al., 2017). Thus, further research should not only focus on the replication of this mediation effect, but also on other mediators as well.

In conclusion, when a task is redesigned through gamification, performance may weakly to moderately increase. In academia, a partial explanation for this effect may lie in attitudinal engagement. However, the increase may be influenced by the centrality of the task, by the traits and state of the users, by their other attitudes and their interaction with the gamified system. Hence, one needs to choose wisely which tasks to gamify and what will or will not work for certain users. Future research should, therefore, focus on these topics as well as on their relevance outside of academia.

Limitations

The first limitations of this study are the sample size and characteristics as well as the quasi-experimental nature (non-random with self-selection) of their data. To mitigate the intervening effects, the authors prepared a varied gamification schedule, subtracted the average evaluation from 2017 from the course evaluation during research years and performed a multilevel analysis. Yet, their model did not account for all possible random effects, thus weakening the support for a causal effect. The authors should also note subtracting previous year's performance to rescale the variable may have added some noise to the data. The differences the authors found may have thus been caused by other effects than their design (e.g., student differences) even though it is less probable with the number of courses they used. These limitations could be prevented by using a larger sample, which would be split into halves on the gamified and non-gamified group.

Second, the current study focuses on students' performance and engagement as the authors carried out their research in academia. Although they could argue that performance and attitudinal engagement are considered similar under various circumstances (Roth et al., 1996; Schaufeli, 2017), there may be some differences. For example, undergraduate students may be more used to a gameful environment because they play out different scenarios while learning at school and their grades are often based on points. Thus, students may react more positively and orientate themselves more easily in the system in comparison to e.g. workers. The mediation effect of attitudinal engagement should thus be replicated and further examined not only with one larger academic sample, but also under non-educational circumstances.

Third, even though the authors strived for a transferable gamification design, used similarly difficult courses with similar tasks, and verified it through badge type attainment comparisons, it is possible gamification and the users' interaction with it did not function the same way in all courses. This may be supported by the performance trend differences in two courses centered around ongoing work on a project with regular feedback. This is yet another reason to use a larger one-course split-halved sample.

Lastly, the effect of their design may be caused by a novelty effect (i.e. introducing something new to the environment), not by the design itself (Kuo & Chuang, 2016). However, it has been proposed that such novelty effect is a part of the gamification and thus long-term gamification should change and adapt to maintain this effect (Raftopoulos, 2020). The authors will address this topic through further research where they implement something new even for those in non-gamified condition, nonetheless.

CONCLUSIONS

Despite its limits, this study shows gamification may be a useful tool to enhance performance and engagement while learning and working on a set of course tasks. There has been a call for strong data-driven evidence to support gamification effect (Hamari & Koivisto, 2019). The contribution of their research is that the authors have addressed this call, tested the effect of a gamification design on performance in a quasi-experimental study and found significant moderate results. Furthermore, they have found weak support for a mediation effect of attitudinal engagement and proposed several pathways from gamification to performance. By better understanding gamification effects, the authors may be able to create designs more suitable to various users and settings. The usefulness of their research lies in the usability of its gamification design across various courses with minimal customization. Not only may such design be useful in other courses, but also in future research of peripheral vs. central task gamification. Last but not least, they pose numerous suggestions for future empirical research. This study, thus, contributes to the understanding of gamification, its usefulness and hindrances, and its presumed effects.

CONFLICT OF INTEREST STATEMENT

We have no conflicts of interest to disclose. Thus, all authors declare that they have no conflicts of interest.

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- pre-existing course engagement will effect the improvements of course gamification.

- participation rates are high in in-course gamification studies.