An industry experiment of academic performance and drop-out in gamified distance education

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Abstract
In experimental study with 1780 adults who participated in distance education, it was shown that gamification did not have an effect on performance, drop-out rate and pass-rate compared to a control group. Although no effect was shown, descriptive survey data suggests that the students were positive towards having similar gamification in other courses and would likely recommend the course due to the design. While previous research on gamification in online education indicates that gamification can have a positive effect, gamification researchers highlight the importance of context and design for successful implementations. The present study supports the need for context considerations and psychological design in gamifying online education. Furthermore, the present study highlights the need for a more nuanced understanding of engagement measures in gamification research and for more practical frameworks regarding the successful application of gamification in online education.

1. Introduction

The production industry is currently going through a transformation in which digitalization, manufacturing and automation are in focus. Educational institutions are expected to provide accurate skills demanded by the industry. However, the size of the workforce and the rapid transformation renders traditional campus courses ineffective [1]. One problematic aspect with online education is low completion rates and as a consequence high drop-out rate. The completion rate for most MOOCs (Massive Open Online Courses) is below 13% [2] and at educational institutions, the drop-out is estimated to be up to seven times higher in online courses than campus courses [2]. Previous literature has suggested gamification as a means to increase student performance and engagement [3, 4, 5] Gamification has been defined as the use of game elements in a non-game context [6], and focuses on creating gameful experience to support the users' sense of value [7]. In education, the most common game elements used are points, badges and leaderboards (PBL) [3, 8]. However, the success of gamification is debated. While studies in academic settings show positive outcomes of gamification [9], many researchers also highlight the need for contextual considerations and good design practices [9, 10]. It has been suggested that simply applying game elements in education should not be expected to lead to desired results

[12]. Instead careful consideration should be made to each game element and its intended effects on students [10].

This study presents an experimental industry case in which students in several different online courses for adults were randomly divided into either a group with a gamified learning management system (LMS) or the same non-gamified LMS to measure the effect of gamification on drop-out rate, pass-rate and performance.

1.1. Previous research

Students have expressed interest for gamification in online learning environments. In a survey conducted with over 500 participants to measure students' expectations of MOOCs, approximately a third expressed a desire for more developed gamification elements within MOOCs [13]. Furthermore, in previous research it has been suggested that gamification can increase engagement and performance for students in online education as well as lower drop-out rates. Khalil et al. [14] found that of 10 previous studies that measured motivation and engagement effects of gamification in MOOCs, nine found a positive effect and one found a partially positive effect. In a more recent literature review, Rohan et al. [15] found that of the 26 studies reviewed, 11 reported positive findings, five partially positive findings and that no tests had been conducted in the remaining 10 studies. Similarly, to Khalil et al. [14] no studies were found that did not demonstrate a complete lack of effects. Aparicio et al. [16] suggests that using gamification in MOOCs can increase engagement and participation in learning contexts, and that the success of gamification can be measured through engagement. Aparicio et al. [16] further implies that the presence of game elements positively affects MOOC usage, and that gamification is a decisive factor in the success of MOOCs. De Freitas & da Silva [17] found a general increase in participation and retention on gamified MOOCs in a review of 22 papers. In another systematic review of 15 studies Looyestyn et al. [18] measured the effect of gamification in online programs. 12 of 15 studies showed that gamification could be useful to increase end-user engagement [18].

Despite the positive effects proposed in previous research, the effect of gamification

implementations in online education has been subjected to scientific scrutiny. The implication of study design, gamification design and contextual factors is a common theme discussed. Rohan et al. [15] note that some of sample sizes in the studies reviewed were small and that the studies focused on specific learner types or subjects, making the results less generalizable. Looyestyn et al. [18] state that although the majority of studies reviewed concluded that gamification is effective for increasing engagement in online programs, there is a need to determine how to better achieve sustained engagement. An et al. [19] addressed several barriers related to the gamification of MOOCs, specifically mentioning lack of time, limited knowledge, lack of funding, lack of fit between gamification and the course content, concerns about students' perceptions of gamification, and concerns regarding negative effects of gamification [19].

In another literature review of 61 articles concerning gamification in distance education, Antonaci et al. [20] showed that gamification in the different studies is not coherent regarding design, implementation, or outcome. A vital aspect of a gamification design seems to be that the context of the application is determined by the aim of the gamified intervention, which in distance education can differ from case to case [20]. Therefore, Antonaci et al. [20] suggests that each game element in a gamification design should be carefully chosen for its contextual purpose. However, the study concludes that the selection, as well as design of the most appropriate game elements are difficult to determine. In addition, the authors conclude that gamification, and its applications in distance education, is still an undeveloped field lacking rigorous empirical investigations [20].

Several studies imply the importance of an increased understanding of why users become motivated by the gamification design. Khalil et al. [14] highlight the need to empirically test the effectiveness of gamification elements in MOOCs based on theoretical and multidisciplinary approaches. Similarly, De Freitas & da Silva [17] highlight that an important premise for successful implementation is the need for a theoretical model that relates game elements to their specific learning outcomes. In addition, De Freitas & da Silva [17] argue that, based on self-determination theory, intrinsic motivation

should be a central to the design since elements that support extrinsic motivation are less effective, and can, in fact, reduces intrinsic motivation, leading to negative motivational effects [17]. Borrás-Gené et al. [21] found that students who had more fun were more likely to complete MOOC classes and that social aspects seemed to have a positive effect on engagement and completion rates. Romero-Rodríguez et al. [22] found that incorporating gamification in MOOCs by the means of competition increased social interaction through intrinsic motivation. Furthermore, Krause et al. [23] found that a social based gamification design in a MOOC was more successful than a less social design.

1.2. The present study

The present study responds to the discrepancy addressed in previous literature reviews between empirical findings and theoretical discussions on the importance of context and design considerations. By studying an industry experiment in which gamification was applied, this study aims to understand the potential effect of gamification in distance education. Compared to previous studies, in which sample sizes have been small and gamification has been course specific [15], the present case includes a large sample size (n=1780) with the same gamification design applied to several courses. The case involves a school that implemented gamification in several courses and in different subjects, with the aim to increase completion rates and decrease drop-out rates. The following research questions are explored:

- RQ1: Does gamification increase student performance in an online-learning environment?
- RQ2: Does gamification have an effect on student drop-out rate in an online-learning environment?
- RQ3: Does gamification have an effect on student pass rate in an online-learning environment?

2. Methods

In the present experimental case study, gamification was applied to an LMS that provided upper secondary courses and

programs for adults through distance education. The teaching method in the LMS differed from regular MOOCs by being teacher-driven with instructions taking place in the LMS, similar to an analog classroom. Lectures held by teachers ran several times a day and adult learners were expected to study in the LMS in which at least one teacher was present for student support during the workday. Course material (e.g., presentations, recorded video lectures, articles) was available in the LMS at all times.

Students who attended courses in the LMS during one semester (n=1780) were automatically and randomly assigned to the gamification condition (n=909) or a control group (n=871). The students in both conditions ranged in age from 17 to 69 (M=27.29, SD=7.619), 59.7% (n=1062) where women and 40.3% where men (n=718). The courses consisted of 19 different 5-week distance courses in English, History, and Mathematics. All courses had varying educational levels and used both physical and digital learning material. The gamified condition and control condition were identical apart from several game elements being included in the gamified condition. For ethical purposes the students had the option to turn off the game elements and continue the course without the elements present. The students who had switched off gamification were excluded from the analysis. In the following parts, the gamification condition is first presented, and the data analysis is later described.

2.1. The gamified condition

Gamification was implemented through a project done in collaboration between the LMS provider and a gamification studio. To identify the students' needs and the gamification design an initial workshop was conducted. In the workshop, two teachers, one educational leader, the LMS product owner, and three developers, partook from the LMS enterprise. A gamification designer from the gamification studio organized the workshop to collect information about the courses, the students and the intended outcome of the gamification implementation. The design workshop took approximately four hours and was outlined as a modified version of the UX-design workshop portrayed by the Nielsen and Norman Group. In the design workshop, the gamification designer

conducted several brainstorming exercises with the stakeholders regarding user demographics, background, and personas. Furthermore, the participating stakeholders' perceived notion of their users' attitudes and perceptions towards games in learning, study habits, and the digital experience was explored. The gamification designer asked questions concerning the enterprise existing impediments in their present value proposition and how they visualized gamification could aid their predicaments. The designer also explained why the enterprise desired to implement gamification and investigated how that intention corresponded with the stakeholder's intentions. Lastly, it was decided which performance indicator was relevant to evaluate. The design workshop's outcome was included in a gamification design document functioning as a blueprint of the upcoming gamification design and implementation.

The gamification designer who carried out the gamification design workshops and designed the gamification implementation, had experience from operating in several fields such as geosocial networking services, e-health e-commerce, education, retraining, and human resource management. The designer had a background in information systems and human-computer interaction, has executed over 40 gamification implementations to various extents - from smartphone applications to operator workflow in production plants. The designer had lectured on gamification in higher education, private institutions, presented at various gamification industry conferences, and had been ranked in the top 20 most influential thought leaders in gamification in several lists over the last decade. S/he defined gamification as a design practice within the user experience (UX) discipline concerning behavior science and motivational psychology as much as games.

The gamified platform included the following game elements: mission, accomplishments, experience points, level, a progression board and notifications about achieving experience points. Experience points were gained for completing specific behaviors included in missions and accomplishments (Table 1) as well as for in other ways interacting with the platform. The student's level was shown in the top left-hand corner and when pressing on the level icon the experience points needed for reaching the next level were shown.

The progression board contained a timeline for each week with stars for the activities to complete. If the activities for the week were completed, part of the timeline was marked as green and if the activities for the week were not fully completed, part of the timeline was marked as red. Apart from the game elements, the LMS, course design and learning environment was identical for the control group and the group with the gamified LMS.

Table 1
Gamification behaviors

Game element	Triggered behaviors
Missions	Visit site seven days in a week
	Hand in five voluntary assignments
	Hand in one mandatory assignment
	Book a national test
	Book a final test
Accomplishments	Start a course
	Do the first assignment in the course
	Pass all mandatory exercises in the course
	Visit a course site seven days in a row
	Finish half the course
	Complete all mandatory exercises
	Visit the site three days in a row
	Activate the course during the first or second day
	Visit the course five days in a row during the first week
	Pass the course with a final grade

2.2. Data collection and measures

Individual data for each student consisting of information on gender, age, final grade, study-pace, course, subject and if the student was in the gamification group or the control group was provided by the LMS provider. The final grade variable was divided into three

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variables; performance, measured by the grade achieved at the end of the course; pass-rate, measured by the students who had achieved a grade; and drop-out rate, measured by the number of students who had discontinued the course. In the performance variable, the students could get the grade A, B, C, D, E, F or II (insufficient information to set a grade), with A being the highest grade (coded as 7) and II being seen as the lowest grade (coded as 1). The students who discontinued the course were not included in the grade category. Drop-out rate was coded as a binary variable of either continuing the course (0) or discontinuing the course (1). The pass-rate variable was defined as the number of students from the start who received a passing grade (A, B, C, D, or E) and coded as either passing (1) or not passing (0) the course. SPSS version 26 was used for running all the tests.

To answer research question one (RQ1), the effect of gamification on student performance, a Mann Whitney test was run with performance as a dependent variable. Since the dependent variable was ordinal, the corresponding parametric test was not run. In answering research question two and three, the effect that gamification has on drop-out rate (RQ2) and pass-rate (RQ3) two Pearson's chi-square tests were run due to the dependent variables being categorical. The alpha level to determine significance was set to 0.05 in all of the tests run.

2.3. Descriptive measures

A voluntary user-survey was prepared and distributed throughout the 19 courses that had implemented gamification to complement the quantitative data and to investigate the students' impression and attitude towards the gamified LMS. Only the students assigned to the gamified LMS received the survey, of which 321 answered. The survey was sent to the students at the end of the courses. It included demographic questions and questions about how the gamification features in the LMS were perceived. Of the students who answered the survey, 63.6% were women, 34.9% were men, and 1.6% defined themselves as other, non-binary, or did not want to disclose gender. The respondents age ranged from 17 to 54 years ($M = 27.73$, $s = 7.83$).

The students' impression and attitude towards the gamification design were derived from the questions: "How likely is it that you would prefer further courses to have the same LMS design (using elements such as Levels and Accomplishments)" and "How likely is it that you would recommend the course to a friend due to the LMS design?". In assessing the students' responses, a 10-Point response scale was used, where one symbolized not at all likely and ten symbolized very likely. The survey was not the main focus for the study, but instead used as complementary descriptive data to understand the students' perception of the implementation.

3. Results

The research questions intended to determine the effect of the gamification implementation on student performance (RQ1), drop-out rate (RQ2) and pass-rate (RQ3). In the Mann Whitney test, run to determine if gamification had an effect on performance (RQ1), the student in the gamified condition had a higher mean rank (538.69) compared to the control group (525.9). However, the effect on performance was not significant, $U=144820$, $z=0.738$, $p=0.461$, $r=0.0175$. For research question two, the chi-square test for measuring drop-out rate showed that the gamification implementation did not have a significant effect on not dropping out of the course $\chi2\ (1) = 0.08$, $p=0.783$. Finally, the chi-square test for measuring pass rate showed that the effect of gamification on passing the course was not significant $\chi2\ (1) = 0.05$, $p=0.944$.

The gamified and control condition slightly varied in means regarding performance, drop-out-rate and pass-rate. However, none of the tests run produced a significant difference depending on the gamified or control condition (Table 2). Due to the large sample size in the gamified-condition (n=909) and in the control group (n=871) together with the high p-values in each test (Table 3), the results indicate that

Table 2

The effects of gamification

| Measure	p-value	Mean (SD)
Performance	0.461	3.56 (1.63)
Drop-out-rate	0.944	0.40(0.49)
Pass-rate	0.783	0.38(0.49)

Table 3
Mean (SD) for performance, drop-out and pass-rate in gamified and control condition

Measure	Gamified	Control
Performance	3.61 (1.69)	3.51(1.57)
Drop-out	0.41(0.49)	0.40(0.49)
Pass-rate	0.39(0.49)	0.38(0.49)

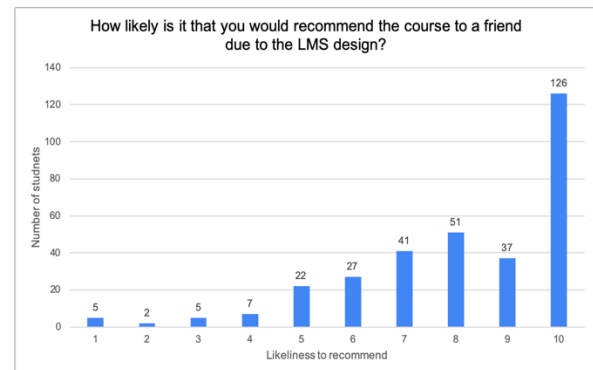**Figure 2**: Likeliness to recommend LMS

gamification in the present case did not have an effect on neither performance (RQ1), drop-out rate (RQ2) nor pass-rate (RQ3) for the students participating in the courses. Several follow-up tests were conducted to determine if there were any differences depending on gender, study pace or subject. However, no significant performance, pass-rate or drop-out-indicators could be identified.

Despite not seeing significant results for performance, drop-out-rate and pass-rate, the students reported positively toward wanting other courses to incorporate the game elements level and accomplishments (question 1) and to recommending the course to others due to the design (question 2). In both questions there was a clear positive skew. In question one (Figure 1) the average answer was 8.36 with a clear majority of the students (n=145, 45%) reporting the highest answer. Similar to question one, in question two (Figure 2), the average answer was 8.09 with most students reporting the highest answers (n=126, 36%).
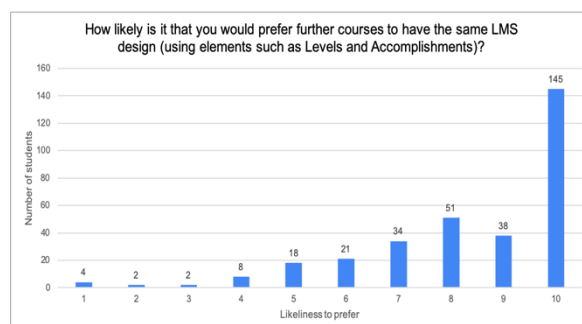
Figure 1: Preference for game-elements

4. Discussion

The results show that gamification did not have a significant effect on performance, drop-out rate or continuation of courses in an online learning environment for adult students partaking in distance education. One limitation in the research design is that the testing was not performed in a controlled setting and that

control variables, such as initial motivation or knowledge, were not accounted for, implying that other variables may have had a higher explanation to the variance in the dependent variables. However, due to the large number of students in both groups that were randomly assigned and the high p-values in each test, it is more probable that the gamification implementation did not in fact have an effect on the performance, drop-out rate, or pass-rate of the courses. Contradictory, the data provided in the survey reflects that students would like similar setups in further courses and would recommend the course to a friend due to the gamification design. Even though the performance, drop-out and pass-rate gave clear indications of no effect in the implementation, most students appreciated the game elements. From the results, two main aspects are important to highlight; 1) The reasons for gamification not being effective and its implications for researchers and practitioners and 2) The need for understanding engagement measures in gamification implementations and call for further research. The results should be considered from the context of the course, including the gamification design and course length. That is, the effect of gamification and its implications should be drawn with consideration to a five-week course design and specific gamification implementation.

4.1. The effect of gamification in distance education

The results of the study contradict previous findings of positive effects on drop-out rate and performance of gamification effects in online

education. Compared to the literature reviews mentioned above, which found positive effects of most gamification studies in MOOCs and online education [7, 8, 17, 18], the present study did not identify similar effects. This despite the implementation development being supervised by a designer with senior experience as well as precautionary measures being employed in the design process to understand the contextual factors of the implementation. Compared to other studies involving gamification in a more controlled setting and with more course specific design [15], this case involved a design that was not adapted to a specific setting but was instead expected to work due to the involvement of the game elements in the course per sei. However, the results showed that the gamification design was not sufficient to produce the desired outcomes, implicating the need for a greater consideration to what makes gamification work. In accordance with previous suggestions, gamification does not work in itself but needs to be designed in a mindful way from the user perspective and involve an iterative design process [26]. Instead of assuming that gamification works simply by the application of game elements, the inner workings of how the user interacts with the system needs to be central in the design process [27]. The results from the present study indicates that this is true for distance education as well.

The reasons for the gamification implementation not producing intended effects in light of the context and design could be due to several factors. To understand the study's results with regards to previous research and indications of positive effects in gamification implementations, further implications are derived from analyzing the structure of the platform, and the gamification design as well as how this differs from other studies. One of the most prevalent differences was that gamification was not only applied to several courses but also adapted to the behaviors that gamification could respond to on a general level instead of a course specific level. Instead of basing reward systems on the course progress and positive behaviors that could help a student in reaching his or her course goals, activity-related activities such as logging-in, visiting a site and booking exams were included. No clear connection could therefore be found between completing accomplishments and missions and progressing in level with the actual course progress and performance in the course. This

could have occurred due to a high technological focus compared to design focus in the development process. Instead of asking: how can the technology respond to design considerations, the design seems to have been derived from; how can the design respond to the technological barriers? This is in line with the time and funding barriers that have previously been identified related to the gamification of MOOCs [19]. Economic barriers, time constraints and technological limitations are often prevalent in an industry context with limited resources making it difficult to put the design efforts in center. Here, the gamification system was limited to what the students reported and did in the LMS, inhibiting linking the gamification progress to course specific progress. To realize and operationalize progress connected to behaviors that could enhance learning for students, the courses would need to comprise of progress related activities that could easily be tracked in the LMS. However, this would have gone beyond the feasible boundaries of the project.

Another important distinction from previous studies is that the teaching method in the LMS was more similar to analog classrooms than to regular MOOCs. I.e. the courses where teacher-centered with long lessons instead of including interactive digital material. Gamification was implemented without changing the teaching style and the course format. A potential reason for the change of course design not being considered is the belief that the game elements in themselves are motivating and drive behavior, without considering the learning and motivation theories behind them. As previous studies have suggested, other fields related to gamification should be considered in the design of gamification implementation [14]. Whereas research implementing gamification to study its effect is often embedded in an academic context with access to researchers from several fields, the same is not necessarily true for gamification practitioners. This was prevalent in the current design where important aspects from educational and motivational psychology were not included. No underlying theory had been used as a basis for the design. Neither could specific psychological mechanisms that are commonly used in gamification design be identified in the design. As other research suggests, the reason why game elements are successful in games is due to the motivational mechanism being triggered. For example,

Landers et al. [28] explains the success of gamification through the application of motivation theories such as self-determination theory, operant conditioning, expectancy theory and goal setting theory. Similarly, Deterding [29] proposes that the success in games is derived from achieving autonomy, competence and relatedness as proposed by self-determination theory, and that the success of gamification lies in the application of the same motivation mechanisms.

4.2. Understanding gamification measures

When looking at the engagement measures in the present study, without considering the performance, pass-rate and drop-out measures, one could falsely draw the conclusion that the gamification implementation had been successful and did not need to be optimized. However, as seen in the results, the engagement of students measured in their perception of the gamification design does not guarantee that the students were more likely to continue the course nor more likely to learn more. These results challenge the assumption made by Aparicio et al. [16] suggesting that the success of gamification can be measured through engagement. Instead of viewing gamification as a means to increase engagement towards the LMS, further research needs to consider engagement in terms of engagement towards the course material and the subject being learned. Even though students might appreciate game elements [13], this does not imply that gamification is successful in creating learning engagement that leads to lower drop-out-rate and higher performance and pass-rate. Therefore, it is important for both researchers and practitioners to clarify the main objective with gamification implementations; to make the course more appealing and make more students want to join, or to create a gameful design that engages and motivates students toward course completion and higher performance. The present case suggests that the latter requires more from the design and implementation in terms of course design, technological flexibility and knowledge in the underlying motivational mechanisms behind gamification.

In line with Rohan et al. [15], we recommend more studies to include large sample sizes in order to determine reliable results. There is also a need for more rigor in the research design connected to gamification in online education, where the effect of gamification can be isolated. In reviewing previous works several studies too hastily attribute effects to gamification, i.e. in a study conducted by Vaibhav and Gupta [30] it was concluded that gamification increased completion and pass-rate. However, the control condition consisted of students accessing a paper with the material whereas the gamified condition consisted of students accessing an online platform with game elements, making the comparison not only about gamification but also about analog compared to digital learning. Another reason for the high number of positive results presented previously, could be publication bias, increasing the number of studies showing positive effects of gamification. To gain a reliable understanding of gamification and its effects it is also important to study and understand gamification implementations that do not reach expected outcomes. For the field of gamification to move forward and become a successful learning tool in online education, more studies are needed to address and problematize why gamification does not always work on an empirical level as well. Finally, more practical frameworks for how to successfully apply gamification in an industry setting are needed, to broaden the field of gamification beyond academia and create successful implementations that lead to intended effects.

5. Conclusion

Contrary to previous studies in gamified MOOCs and distance education, the present study did not find an increased performance, pass-rate and decrease of drop-rate when gamification was implemented into an LMS for adults participating in distance education. The findings highlight that the design and context are crucial to consider when implementing gamification in industry settings. This calls for more practical frameworks on how to apply gamification and more empirical research that questions the effect of gamification. Moreover, this study found that students were positive to a gamification implementation despite it not leading to intended effects, which implies the need for a more nuanced understanding of engagement measures in gamification research.

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