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Let's Play: Using Gameplay Mechanics in Case Study Discussions

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Abstract

We used gameplay mechanics to encourage contributions during case discussions in undergraduate and graduate computer information systems classes. Based on the results of a student survey, we find that in game-based learning exercises, competitiveness and playfulness are both positively related to contribution behavior – although playfulness more so than competitiveness. Contribution and enjoyment are both positively related with learning outcomes. This suggests that instructors should design gameplay mechanics focusing more on playfulness than on competitiveness in order to increase contribution. Moreover, it is crucial that the overall experience of the gameplay is enjoyable. Given the nascent literature investigating game-based learning and the use of gameplay mechanics in higher education, this study presents several theoretical propositions that may form the basis for future research.

Keywords: gameplay mechanics, game-based learning, gamification

1. INTRODUCTION

Recent technological advances have fundamentally changed the classroom environment in higher education (Azarnush et al., 2013). It is now common for students to have access to a smartphone and/or a laptop during lectures. As a result, distraction is always only a click away.

Game-based learning and gamification have been proposed as possible solutions to dwindling student attention (Redfield, 2013). Gamification refers to the use of gameplay mechanics in non-game contexts – the higher education classroom being an example of a non-game context. By applying game aspects, such as points, public high score lists, and competition, in a lecture setting, instructors hope to capture students' attention and ultimately improve student learning outcomes.

But how does this theory play out in practice? We have applied gameplay mechanics to enhance case discussions in undergraduate and graduate-level computer information systems classes. Specifically, we have used a case study game to encourage and reward students for quality contributions to the case discussions. Using an exploratory survey, we aim to understand how aspects of competitiveness and playfulness influence students' contributions to the case study discussions, and how their contributions paired with enjoyment ultimately impact learning outcomes. Specifically, we

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answer the following research questions with regard to the case study game:

- To what extent does competitiveness and playfulness influence student contribution during a game-based learning exercise?
- How does contribution activity and enjoyment impact learning outcomes in game-based learning?

2. LITERATURE REVIEW

Gaming, in terms of entertainment, has grown in popularity across the world (Liu, et al., 2014). Coupled with this growth in the entertainment industry, interest to use gamification in the classroom setting has also increased. In fact, 2.37 million documents were found on Google Scholar referencing game-based learning (Ariffin et al., 2013). Studies have shown that computer games help to improve perception and decision making skills (Holz, 2012). Due to these types of results, this method of instruction has been introduced at different levels of education from kindergarten to higher education (Verenikina and Herrington, 2009).

Effectiveness of game-based learning is a central issue of concern among most studies in the area. Erhel and Jamet (2013) conducted two experiments to study effectiveness using digital game-based learning. They found that a game environment can promote learning and motivation as long as it includes ways for the students to actively process the material presented. Liu, et al. (2014) studied game-based learning in the six grade science class setting. They found by designing game-based approach that was engaging and interactive helped students to learn while incorporating fun. They found that this type of environment impacted the students' motivation to learn. Ariffin, et al. (2014) studied game-based learning effectiveness in the higher education setting. They found that incorporating a learner's background (i.e., culture, ethnicity, and native language) into the game-based learning design increased the students' motivation and ultimately the learners' performance.

Giannakos (2013) hypothesized that enjoyment with an educational game was positively related to performance. He conducted a two-step experiment involving 13 year old middle school math students. The first step compared game-based instruction to traditional instruction and found that the game-based instruction yielded no significant difference in their overall performance on the test. Therefore, the next step in the experiment was to determine which factors played a role in the students' performance. He found that enjoyment had a significant relationship with performance.

With the continued increase in technological distractions in the classroom, instructors are forced to find ways to (1) keep the students engaged and (2) motivate them to learn the material presented. Based on previous research studies, game-based learning appears to be the answer to this issue. This paper presents the results of utilizing game-based learning in two different levels of higher education. The following sections provide the methods used, results and conclusions.

3. METHODS

During the fall 2013 semester, both authors taught classes in computer information systems (CIS) at a private, mid-sized university in the Northeastern US. The first author taught CIS 600 – Information Systems Strategy (N = 51), which is a required course in the MBA program. The second author taught CIS 301 – Enterprise Systems (N = 37), which is a required course in the undergraduate CIS program. As part of both classes, students were required to analyze cases and participate in weekly case discussions. Each case discussion was scheduled to last about one hour. We used a case study game to encourage and reward contributions from students.

McGonigal (2011) stated that games have four defining traits: goals, rules, feedback, and voluntary participation. Each of these traits were present in the case study game. Students were given the goal of making "quality" contributions to the discussion. This provided the students with a "sense of purpose" (McGonigal, 2011). Specifically, students received a point every time they made a quality contribution to the case discussion. At the beginning of each case discussion, two students were randomly selected to serve as scorekeepers. The class and scorekeepers were provided with the rules of the game. They were instructed to judge students' contributions to the discussion and assign one point for each contribution they deemed of quality. Quality contributions are more than simple yes/no answers and must include substantial analysis or background information from the case. By having two randomly selected

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scorekeepers, we reduced the potential of favoritism among students, while also freeing up the instructor to focus on the actual case discussion. It was not mandatory for students to contribute to the discussion. They were given the goals and rules of the game, but their active participation was voluntary.

McGonigal (2011) states that feedback can take the form of points or a score. At the end of the class, everyone's raw contribution score was divided by the highest contribution score, thus creating relative contribution scores for all students (out of 100 points). The resulting scores showed considerable variation (*M* = 60.00, *SD* = 28.35), suggesting that the gameplay mechanics did not just encourage contributions from a part of the class. The scores were added each week and were posted publicly on the learning management system (i.e. Blackboard). The points accounted for 50% of the participation grade in the class.

At the end of the semester, students completed an online survey, which assessed their competitiveness, playfulness, contribution, enjoyment, and learning outcomes as a result of the case study game. All scales for the survey were self-developed and can be found in Appendix A.

4. RESULTS

A total of 83 students (50 graduate students and 33 undergraduate students) responded to the survey, indicating a response rate of 94%. After removing cases due to missing data, we retained 69 usable responses. We did not find any statistically significant differences between graduate and undergraduate students and will thus focus the analysis on the group of students as a whole.

Given the exploratory nature of the survey, we used partial least squares (PLS) path modeling to develop and estimate a path model that best reflects the underlying data (Vinzi et al., 2010). We constructed a path model in which learning outcome is the dependent variable and enjoyment and contribution are both regressed on learning outcome. In turn, competitiveness and playfulness are both regressed on contribution.

First, we assess the results of the measurement model in order to establish convergent and discriminant validity of our constructs. An analysis of the factor loadings indicates that all items load highly (> .7) and significantly ($p < .001$) on their respective constructs, indicating convergent validity. Moreover, all constructs exhibit favorable measures of convergent validity, such as Cronbach alpha > .7, Dillon Goldstein rho > .7, and average variance extracted (AVE) > .5. The exact values of these measures can be found in Table 1 (Appendix B). Next, we evaluated the discriminant validity of the constructs by comparing the square root of average variance extracted with the inter-construct correlations. We found the former to exceed the latter, thus indicating discriminant validity of our constructs. The exact values of these measures can be found in Table 2 (Appendix B). Thus, we conclude that the measurement model exhibits adequate quality to proceed with the analysis of the structural model.

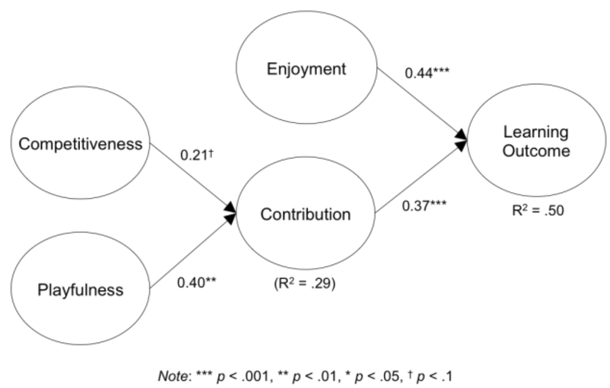

Figure 1: Results of the path analysis

Next, we evaluate the structural model to understand the relationships between the constructs. The path coefficient between competitiveness and contribution is positive and approaches significance (β = .21, p = .079). This suggests that higher competitiveness tends to be weakly associated with higher contribution behavior. The path coefficient between playfulness and contribution is positive and significant (β = .40, p = .001), indicating that higher playfulness is related to higher contribution behavior among our respondents. Both enjoyment and contribution have positive and significant path coefficients with learning outcome (β_{EN} = .44, p_{EN} < .001, β_{CON} = .37, p_{CON} < .001). This suggests that higher enjoyment and higher contribution behavior are both associated with higher learning outcomes. The relatively high R^2 of both contribution (R^2 = .29) and learning outcome (R^2 = .50) indicate that the model explains a good amount of variation in student responses. The results of the path analysis are shown in Figure 1.

Since we did not begin the analysis with a-priori hypotheses, it is possible that the identified relationships are unique to the data set at hand. Hence we suggest that the identified relationships be investigated further in future research. To aid in the development of future research, we restate our findings in the form of four propositions:

- P1: In game-based learning exercises, competitiveness is positively related with contribution.
- P2: In game-based learning exercises, playfulness is positively related with contribution.
- P3: In game-based learning exercises, contribution is positively related with learning outcome.
- P4: In game-based learning exercises, enjoyment is positively related with learning outcome.

5. CONCLUSION

We used gameplay mechanics to encourage contributions during case discussions in both undergraduate and MBA-level CIS classes. Based on the results of a student survey, we find that in game-based learning exercises, competitiveness and playfulness are both positively related with contribution – although playfulness more so than competitiveness. Contribution and enjoyment are both positively related with learning outcome. This suggests that instructors should design and employ gameplay mechanics that focus more on playfulness than on competitiveness in order to increase contribution. Moreover, it is crucial for the learning outcome that the overall experience is enjoyable.

In light of the nascent literature investigating game-based learning and the use of gameplay mechanics in higher education, this study makes several important theoretical and practical contributions. It is among the first to study the antecedents to learning outcomes in a game-based learning context. Moreover, it extends previous work on the relationship between enjoyment and learning to the context of higher education. It also lends additional empirical support to the hypothesis that enjoyment and performance are positively related. The resulting propositions of this study can and should be used in future research to investigate if and how learning outcome can be further increased.

At the same time, the study is not without limitations. Although the study was conducted among both undergraduate and graduate students, the relatively small sample size and potential lack of representativeness of the sample must be kept in mind when evaluating the findings. Also, lacking established constructs, the survey made use of self-developed scales, which the results of the statistical analysis not withstanding may or may not exhibit adequate retest reliability. Lastly it is possible and likely that there are other factors playing a role in influencing contribution and learning outcome in different game-based learning exercises.

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Appendix A: Survey measures

All measures use a five-point scale, with 1 – strongly disagree, 2 – disagree, 3 – undecided, 4 – agree, 5 – strongly agree.

Contribution
CON1: The game aspect of the case study discussions increased my quality of contributions.
CON2: The game aspect of the case study discussions increased my quantity of contributions.
CON3: I felt that the game aspect enhanced the case study discussions.

Competitiveness
COM1: I am a competitive individual.
COM2: I enjoy competing against other people.
COM3: Competing against other people makes me happy.

Enjoyment
EN1: I like the game aspect of the case study discussions.
EN2: I enjoy the game aspect of the case study discussions.
EN3: The game aspect of the case study discussions is fun.

Learning Outcome
LO1: I learned a lot as a result of the case study discussions.
LO2: My knowledge about managing information systems increased as a result of the case study discussions.
LO3: The case study discussions greatly enhanced my learning.

Playfulness
PL1: During the case study game I am flexible.
PL2: During the case study game I am creative.
PL3: During the case study game I am playful.
PL4: During the case study game I am inventive.

Appendix B: Results of measurement model

Table 1: Item loadings and construct reliability

Construct	Item	Loading	SE	α	ρ	AVE
Contribution	CON1	.88***	.04	.80	.88	.72
	CON2	.85***	.04			
	CON3	.80***	.05			
Competitiveness	COM1	.95***	.03	.93	.96	.88
	COM2	.96***	.03			
	COM3	.90***	.04			
Enjoyment	EN1	.93***	.02	.92	.95	.86
	EN2	.97***	.01			
	EN3	.86***	.04			
Learning outcome	LO1	.94***	.02	.92	.95	.86
	LO2	.92***	.02			
	LO3	.93***	.02			
Playfulness	PL1	.84***	.04	.83	.89	.67
	PL2	.81***	.05			
	PL3	.77***	.07			
	PL4	.84***	.07			

Note: SE = standard error, α = Cronbach's alpha, ρ = Dillon Goldstein's rho, AVE = average variance extracted. *** $p < .001$

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Table 2: Inter-construct correlations

Construct	CON	COM	EN	LO	PL
Contribution (CON)	**.85**				
Competitiveness (COM)	.42	**.94**			
Enjoyment (EN)	.53	.21	**.93**		
Learning outcome (LO)	.60	.33	.64	**.93**	
Playfulness (PL)	.51	.50	.37	.46	**.82**
Mean	3.87	3.92	4.24	4.94	3.81
SD	.91	.96	.69	.74	.69

Note: Numbers in bold denote the square root of average variance extracted.