Personality Based Gamification – Educational Gamification for Extroverts and Introverts

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Abstract

Gamification in education is being used as a way to increase the student's engagement and learning. While carrying a big promise, little is known about the influence of game elements and mechanics on different personalities, specifically extrovert and introverts, knowledge that is essential to ensure implementations that will not disengage part of the students. In a study performed in an academic course, students (n=102) were faced with several feedback related game mechanics. Immediate feedback mechanics such as points, rewards, badges and comparative feedback mechanics such leaderboards, and progress were used to examines the relations between these elements and the way they increase the perceived playfulness of a semester long project. A Partial Least Squares (PLS) analysis of the results based on personality trait of extroversion was performed to examine how extroverts and introverts perceive a specific implementation. Our results show there are significant differences in how these two types of personalities achieve the playfulness of the system and specifically the lack of playfulness of leaderboards. These results are significant for educators who plan to include game elements in their courses.

Keywords: Gamification, Personality, Game mechanics, Playfulness

Background

The inclusion of ludic elements into information systems and business processes is becoming commonplace as a means of engaging users and increasing system acceptance (Deterding, Sicart, Nacke, O'Hara, & Dixon, 2011; Huotari & Hamari, 2011; Zichermann & Cunningham, 2011). Traditionally, hedonic and utilitarian systems were treated and researched as separate entities (Van der Heijden, 2004) but in the past years they are converging into a field called gamification which is defined as the use of game design elements in non-game contexts such as, but not limited to, workplaces (Deterding, Dixon, Khaled, & Nacke, 2011). In the context of education, it can be viewed as the inclusion of game elements into the traditional classroom, existing training materials, and the Learning Management Systems (LMS).

Game elements are also referred to as game mechanics and dynamics. Game mechanics are defined as "constructs of rules and feedback loops intended to produce enjoyable gameplay. They are the building blocks that can be applied and combined to gamify any non-game context" (Gamification.org Wikipedia, 2012). Most common game mechanics are Points, Badges, and Leaderboards (PBL) (Antin & Churchill, 2011; Narasimhan, Chiricescu, & Vasudevan, 2011; Werbach & Hunter, 2012; Zichermann & Cunningham, 2011) but there are many additional mechanics (SCVNGR, 2010) that exist in games and can be designed into systems and processes. Dynamics are the run-time behavior of the mechanics acting on player inputs and each other's outputs over time (Hunicke, LeBlanc, & Zubek, 2004) and can be viewed as the pattern of play that is generated by the application of specific mechanics and in

response to other player interactions or expected interactions (Brathwaite & Schreiber, 2009). Dynamics cannot be programmed into a gamified solution but the use of the right mechanics can improve the chance of the dynamic occurring. Typical dynamics found in games are constraints, emotions, narrative, progression, and relationships (Werbach & Hunter, 2012).

Games as a means of learning have been studied extensively and while they have been found to mostly increase learning and understanding, there are still several cases where they did not (Hays, 2005; Ke, 2009; Vogel et al., 2006). The recommendations from these studies are that "games should be used as adjuncts and aids, not as stand-alone instructions" (Hays, 2005).

An important distinction exists between Game Based Learning (GBL) and gamification. GBL provides students with games that have an educational objective that are achieved through the game play (Kim, Park, & Baek, 2009). These games can supplement frontal teaching or replace it, but it is clearly a game. The essence of gamification is that it occurs in a non-game context therefore it would be applied in such a way that would not change the existing practice of learning and instead focus on making it more engaging and challenging for students.

There is an increasing number of case studies and research dealing with gamification in general (Hamari, Koivisto, & Sarsa, 2014) and in educational contexts (Barata, Gama, Jorge, & Gonçalves, 2013; Sheldon, 2011). The objectives of gamification in these educational context studies has been to increase student motivation to attend class, download course material, participate in on-line discussions, and complete extra assignments. While majority of studies report overall positive results as a result of adding game elements, not all have exhibited these results. Some of these differences can be explained by design and context, but even within the studies themselves there are differences in how individuals are impacted by the gamification which can be explained by personality differences (Hamari, 2013; Hamari et al., 2014).

Different personality theories exist focusing on personality types and needs, but for the sake of this paper we will focus on the Big five model (also called the Five Factor Model – FFM) which has been proposed as trait theory (McCrae & Costa, 1989) and is widely acceptable. FFM posits that individuals can be measured on the following five traits: neurotism, extroversion, openness, agreeableness, and consciousness (McCrae & John, 1992).

This study takes a specific view at the personality trait of extroversion and seeks to understand how people with high levels of extroversion and people with high levels of introversion perceive different game mechanics in a gamification setting and do they perceive the entire solution to be playful. Studies show that extroverts are more likely to be achievement oriented and seek hedonic values (Roccas, Sagiv, Schwartz, & Knafo, 2002) and have learning styles that promote group activities, talking out loud, and learning through interactions (Lawrence, 1993). Introverts prefer to reflect first and act later, work privately, present their work in a way that lets them keep their privacy (Lawrence, 1993), prefer asynchronous communication, and in online setting would typically have higher levels of usage (Amichai-Hamburger, Wainapel, & Fox, 2002; Yeung, Read, & Schmid, 2012).

LMSs provide educators with the ability to combine online experiences that supplement the classroom teaching and provide additional channels of communication with students. Gamifying a traditional academic classroom using a LMS has several of the characteristics that would promote learning styles that are more suitable for introverts providing ability to reflect and to communicate at their own pace. On the other hand, since there is no anonymity and classmates know each other in person, they can also promote extroversion learning styles such as group activities and achievement.

Several game mechanics exist and every given solution would be different, still, there are common feedback game mechanics such as points, rewards, and badges, and presentation mechanics such as leaderboards and progress bars that are typical in many of the systems. Our model (Figure 1) includes these feedback and presentation mechanics, leading to the playfulness of the system. Points are operationalized as the desire to receive feedback in the form of grade points, rewards are the desire to receive physical rewards and badges are the desire to receive virtual feedback/reward. Leaderboards are a form of comparative feedback and progress bars refers to individual feedback.

Our research questions are aimed at understanding personality differences in the perceived playfulness from a gamification implementation in an academic course setting. Specifically, is there a difference in how introverts and extroverts perceive the playfulness of a gamified solution and what are the relations between the feedback mechanics and the presentation mechanics and are they moderated by the extroversion trait?

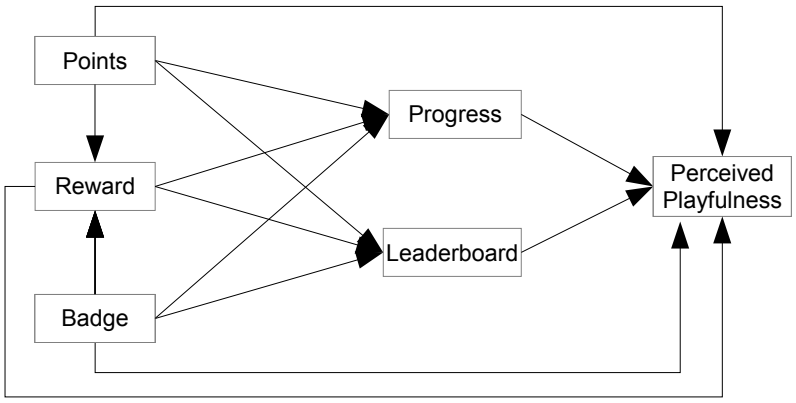

Figure 1. Research Model

Methodology

To test the model, a simple gamified version of a semester long project in a software analysis and design course taken mostly by undergraduate students in their third year of four in industrial management and engineering was developed. Throughout the course students completed their assignments and at specific points in time all projects were switched between the groups, mimicking real life situations of developers, system analysts, and business analysts. While not presented as a game, project teams received different forms of feedback and were asked about their preferences about presentation format of the feedback. Teams that did extremely well received badges in the form of frontal class appraisal and an appreciation email from the course staff. Rewards were granted based on specific criteria in the form of extra credit points for tasks the teams were willing to do.

At the beginning of the semester students completed a personality questionnaire using the revised FFM questionnaire (Goldberg, 1992) which includes 50 items. Throughout the semester additional questionnaires were administered which are not relevant for this study, and at the end of the semester, students were asked about their enjoyment from the different game mechanics using a newly designed questionnaire, and from their overall enjoyment from the work on the project using a nine item scale adapted from Moon and Kim (Moon & Kim, 2001).

Results

Descriptive statistics of the measured values are presented in Table 1. The course included 133 students; 102 completed all surveys and were included in final analysis (76.7%). Of the students responding, 58 were female and 44 were male. Students were all in the age range of 23-30 years.

Table 1. Descriptive statistics

	n. items measures	Minimum	Maximum	Mean	Std. Deviation
Points	2	2	10	4.75	2.10
Leaderboard	6	8	30	20.10	5.51
Progress	4	8	20	16.14	2.76
Badge	4	6	20	12.65	3.46
Playfulness	6	6	24	13.92	4.75
Reward	4	4	20	13.59	3.04
Extraversion	10	16	49	35.01	7.01

Internal and convergent validity indices have been examined for the full model. Cronbach alpha values are above the desired 0.7 index with the exception of the points construct that is 0.67 and is deemed acceptable by us due to the explorative nature of this study. Average Variance Extracted (AVE) and cross correlations are presented in Table 2.

Table 2. Cross Correlations and AVE

	AVE	Composite Reliability	Cronbachs Alpha	Badge	Leaderboard	Playfulness	Points	Progress	Reward
Badge	0.59	0.85	0.77	**0.77**					
Leaderboard	0.63	0.91	0.89	0.49	**0.80**				
Playfulness	0.66	0.88	0.83	0.15	0.04	**0.81**			
Points	0.72	0.84	0.67	0.19	0.07	0.23	**0.85**		
Progress	0.54	0.82	0.73	0.22	0.19	0.36	0.32	**0.74**	
Reward	0.57	0.84	0.75	0.52	0.31	0.13	0.17	0.29	**0.75**

[a] Squared root of the AVE are the bolded diagonal values

The extroversion scale doesn't have a value that is acceptable for determining when one is an Extrovert or an introvert and therefore this scale was standardized and students with $z \geq 0$ were considered as extroverts while students with $z < 0$ were considered as introverts. A t-test was performed comparing the two groups against the different game mechanics and playfulness (Table 3) showing that extroverts have a stronger enjoyment level from badges but no other significant difference existed.

Table 3. T-test comparing extroversion and intraversion

	Extroversion		Intraversion		
	Mean	Std. dev.	Mean	Std. dev.	Sig.
Leaderboard	19.92	5.80	20.29	5.23	0.74
Badge	13.49	3.58	11.73	3.11	0.01
Points	4.85	2.12	4.63	2.09	0.60
Rewards	13.89	3.23	13.27	2.81	0.30
Progress	16.42	2.86	15.84	2.66	0.29
Playfulness	14.47	4.81	13.33	4.66	0.23

To test the entire model we used Partial Least Squares (PLS) structural equation modeling. This selection is due to a) the exploratory nature of the research and the relatively small sample size (Henseler, Ringle, & Sinkovics, 2009), and b) the interaction nature of the model which is best tested with PLS methods (Endler & Parker, 1992). The software used was SmartPLS version 2.0M3 (Ringle, Wende, & Will, 2005).

The model was executed three times: for the entire sample, for introverts, and for extroverts. Validity indices are presented in Table 4. Cronbach's alpha level for extroversion is low but still within the 0.6 range which is acceptable for exploratory stages. AVE for progress in introverts is slightly lower than 0.5 but still significantly shares more variance with its indicators than with other constructs.

Total effects between constructs were extracted using a bootstrap approach with 500 re-sampling setting which is at the upper end of what researchers recommend (Lee & Chen, 2010). A comparative table showing the total effects between the mechanics and playfulness for each model are presented in Table 5. Missing values indicate that there was no direct or indirect significant relation between the constructs. Several difference between introverts and extroverts are visible in this table, specifically leaderboard-playfulness which is negative for extroverts and positive though not significant for introverts, and the higher relations of badges-leaderboard and badges-rewards in introverts.

Table 4. Validity indices for extroversion and introversion models

		AVE	Composite Reliability	Cronbachs Alpha	Badge	Leaderboard	Playfulness	Points	Progress	Reward
Extroverts	Badge	0.61	0.86	0.78	**0.78**					
	Leaderboard	0.62	0.91	0.88	0.43	**0.79**				
	Playfulness	0.69	0.90	0.85	0.06	-0.07	**0.83**			
	Points	0.69	0.82	0.62	0.24	-0.02	0.24	**0.83**		
	Progress	0.57	0.84	0.75	0.23	0.20	0.40	0.41	**0.76**	
	Reward	0.59	0.85	0.77	0.39	0.29	0.07	0.17	0.43	**0.77**
Introverts	Badge	0.53	0.82	0.71	**0.73**					
	Leaderboard	0.66	0.92	0.90	0.63	**0.81**				
	Playfulness	0.62	0.87	0.80	0.18	0.20	**0.79**			
	Points	0.68	0.80	0.72	0.10	0.19	0.24	**0.82**		
	Progress	0.48	0.78	0.71	0.05	0.14	0.37	0.34	**0.69**	
	Reward	0.54	0.83	0.72	0.67	0.37	0.16	0.09	0.06	**0.74**

To test the significance of the differences between low and high extroversion, a multi-group analysis t-test was performed (Andreev, Heart, Maoz, & Pliskin, 2009; Keil et al., 2000). The results of this test are presented in Table 6 and highlight some areas where group differences exist.

Table 5. Comparative Total Effect

		Entire Sample	Extroversion	
			L	H
Badge	Leaderboard	0.49 ***	0.63 ****	0.43 ****
	Progress	0.12 **		0.14 **
	Reward	0.52 ****	0.67 ****	0.39 ***
	Playfulness	0.03	0.02	0.00
Points	Leaderboard			
	Progress	0.30 **	0.34	0.34 ***
	Playfulness	0.11 ***	0.12	0.15 **
Reward	Leaderboard			
	Progress	0.24 **	0.03	0.37 ***
	Playfulness	0.09 *	0.01	0.16 **
Leaderboard	Playfulness	-0.03	0.15	-0.15 *
Progress	Playfulness	0.37 ***	0.34 **	0.44 ****

* P<0.1; ** p<0.05; *** p<0.01; **** p<0.001

Table 6. Significance of difference based on Multi-Group Analysis

		Extroversion	
Badge	Leaderboard	0.05	**
	Progress	0.21	
	Reward	0.02	**
	Playfulness	0.19	
Points	Leaderboard		
	Progress	0.37	
	Playfulness	0.32	
Reward	Leaderboard		
	Progress	0.05	**
	Playfulness	0.02	**
Leaderboard	Playfulness	0.06	*
Progress	Playfulness	0.30	

Last, the predictive relevance of the different models was tested using blindfolding method in SmartPLS. Q^2 values were calculated for each of the models and are presented along with their R^2 in Table 7.

Table 7. Q^2 predictive relevant indices and R^2

	Full model		Introvert		Extrovert	
Endogenous Latent Variable	R^2	Q^2	R^2	Q^2	R^2	Q^2
Playfulness	0.133	0.0757	0.155	0.0679	0.186	0.1109
Progress	0.167	0.085	0.117	0.0475	0.297	0.1624
Leaderboard	0.239	0.1216	0.403	0.2254	0.184	0.0809
Reward	0.27	0.1349	0.445	0.2494	0.154	0.0869

Discussion and Conclusion

The objective of this study was to highlight the potential moderating effects that personality has on the enjoyment from gamification in an educational setting, and specifically extroversion. Such moderation can explain the different results seen in similar gamification implementations. Realizing these differences can assist educators in designing solutions that address needs of both extroverts and introverts. Our research questions were to check if there are differences between how introverts and extroverts perceive playfulness in a gamified educational setting. While no significant difference in playfulness was found, the way this playfulness is achieved, differs.

We found that there is a significant difference in how leaderboards are related to playfulness. For extroverts, the enjoyment from leaderboards had a negative effect on the playfulness of the entire system. For introverts, this relation was opposite in direction (although insignificant). Building on previous research, this can be explained by the offline nature of leaderboards. Being top on a leaderboard was enjoyable for both types of personality (as seen in Table 3) but since extroverts would prefer to be able to brag about it in real-time and in a face-to-face situation, they perceive it to not be enjoyable.

The enjoyment from badges is significantly different between groups with extroverts enjoying them more than introverts. This can be explained by the fact that badges in our implementation were related to achievements and were given during the class time, unlike some situation where they are given automatically and discreetly by a system. The relations between badges to leaderboards and between badges to rewards was stronger for introverts which aligns with their higher enjoyment from leaderboards.

Rewards were perceived as more enjoyable by extroverts which aligned with our expectation that anything physical and tangible would be highly evaluated by extroverts. The enjoyment from these mechanics was positive and significant for extroverts and was neutral but insignificant for introverts.

We expected points to be related to leaderboards but this was not the case. Instead, points are related to progress and playfulness for extroverts. The overall lack of playfulness from the leaderboard can be explained by the nature of the course which students didn't perceive as competitive.

This study has several limitations that should be acknowledged and further researched. First, the measurement model for the game mechanics was developed from scratch and need further validation. In future research we plan to include additional personality traits which should enhance our understandings. We have divided the sample into introverts and extroverts but those with z values close to 0 could have been misclassified. With a larger sample it would be possible to exclude these measurements and focus on the real high and low subjects. Finally, as with every self-reported study, there are many biases in the responses and specifically with gamification where people are not always conscious about how they will behave when faced with a competitive or a collaborative environment. This research evaluated the theoretical behavior and not the actual behavior. Future research should measure the constructs in this research in a live environment based on usage logs, through a controlled experiment, or based on a longitudinal research.

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