Detecting playfulness in educational gamification through behavior patterns

D. Codish
G. Ravid

Games are not a new concept in learning. Game-based learning, simulations, and serious games are known pedagogical methods used to build on the inherent playfulness of learners. Technological advances and the popularity of learning management systems are making it easier to implement gamification, analyze the resulting engagement and playfulness, and modify the implementation if needed. However, knowledge is often missing about how different combinations of game mechanics and dynamics create playfulness. We discuss the concept of gamification behavior patterns, which are sequences of actions performed by a user that can be attributed to the application of a gamification design pattern. A preliminary experiment was conducted in an academic course where perceived playfulness was analyzed with respect to three different sets of independent variables: personality, perceived enjoyment from game mechanics, and gamification behavior patterns. Results show that it is practical to measure gamification behavior patterns and that they have a significant predictive power. We propose the development of an open-source, cloud-based gamification behaviors database that will collect specific gamification engagement events from systems worldwide, along with metadata about each implementation. With such a database, Big Data, machine-learning, and recommender-system algorithms can be applied to increase knowledge regarding steering user behaviors through gamification.

Introduction

The inclusion of game elements into non-game environments, referred to as gamification [1, 2], is gaining momentum as a method for creating gameful user experiences that add value [3] and increase engagement, motivation, and user involvement in the gamified activities. The underlying logic at the basis of gamification is that adding elements, such as those found in games to utilitarian activities, will create immersion in a similar way to what happens in games [4, 5]. While this makes sense, empirical studies show this is not always the case [6, 7].

One possible explanation to these mixed results is that different people perceive enjoyment differently [8–11], and thus a gamified experience may create enjoyment in some people but not in others [12–14]. Depending on the design of the gamified experience, and the people involved, results may vary from an overall successful implementation to a complete failure. Designers should understand which mechanics and dynamics create enjoyment, taking into account different personalities, needs, and motivations. Doing so is not a trivial task [15] since user personalities, needs, and motivations are not known to designers, and even if they were known, it is not clear how to use this knowledge to achieve better results. Scholars seeking to define gamification, in such a way that will address different users, use a more user-centric definition and define it as "the integration of user-centered game design elements into non-game contexts" [16], emphasizing the fact that not all users will be equally engaged. Other definitions to gamification exist but are beyond the scope of this paper [2, 17, 18].

Digital Object Identifier: 10.1147/JRD.2015.2459651

To overcome the lack of knowledge about user motivations and needs, designers use analytics to measure user reactions to the gamification through various metrics such as duration of sessions, recency—defined as the amount of time between user sessions, and the number of daily active users [2, 4, 19]. This analytical data, viewed at the system or individual user level, is used by designers to modify the implementation and to seek better overall results in an iterative trial-and-error process similar to that performed in game design [20]. However, when gamifying a utilitarian system such as an educational environment, the risk of error may be significantly high, as learners may disengage. Thus, while a trial-and-error approach may be plausible for game designers who deal with hedonic systems and relatively known audiences, educators should seek a more data-driven approach.

The aforementioned measures indicate engagement with the system, which could indicate that users find the gamification playful or enjoyable; however, this is not always the case, as shown in nonvoluntary gamification [12, 21]. *Playfulness* in this study refers to the situational characteristic of the interaction between an individual and the situation [22] and is measured through perceived playfulness. Perceived playfulness is a controllable system characteristic and has been shown through the expectation-confirmation theory to positively influence intention to use [9] and intention to continue using [22]. Perceived playfulness is conceptualized as: 1) the focus on the interaction, 2) curiosity during the interaction, and 3) finding the interaction intrinsically enjoyable or interesting. Enjoyment is often used as a similar construct to perceived playfulness and is defined as "the extent to which the activity of using a specific system is perceived to be enjoyable in its own right, aside from any performance consequences resulting from system use" [23, 24]. Researchers looking for causality between gamification and playfulness are starting to assess the effects that different constructs and structures [25], as well as specific game mechanics and dynamics [12, 26], have on playfulness and on gamification success. However, since implementations differ in many ways, it is not simple to compare data from different implementations. For instance, a leaderboard, which may increase playfulness in one case, may decrease it in another. Yet, it has been assumed that the underlying theoretical foundation for the creation of playfulness through motivation and emotions remains identical and is grounded in psychological theories such as Self Determination Theory (SDT) [27], flow [28, 29], and the Theory of Planned Behavior (TPB) [30]. Being able to isolate playfulness and engagement from their specific implementations would help us understand how and when to use game elements, and would allow future systems to increase their success rates.

In this paper, we take a specific view of a gamification implementation conducted in a learning environment using a Learning Management System (LMS). In addition to the gamified activities the LMS offered, subjects (students ranging in age from 23 to 30 years) were requested to complete personality, enjoyment from game mechanics, and playfulness questionnaires—and their activities were tracked through system logs. Different models were then compared to assess the predictability of users' perceived playfulness and to assess the hypotheses that females and subjects with learning disabilities would find gamification more playful. Results show that behavior is a good predictor of playfulness and that females' playfulness levels were higher than those of male students, but we did not find any differences related to learning disabilities. The paper is structured as follows: After a brief background that covers measures of success in gamification, and design patterns and their relevance to gamification design, we present four hypotheses and their rational. Next, we present the experiment along with its results. A discussion, including limitations of the present research and suggestions for future directions, is followed by conclusions.

Background

The inclusion of hedonic elements into utilitarian information systems is becoming commonplace as a means of engaging users and increasing system acceptance [1, 2, 31]. Traditionally, hedonic and utilitarian information systems have been considered separate research entities [32–34], but in recent years they are converging into a field called gamification, which is frequently defined as the use of game design elements in non-game contexts such as, but not limited to, workplaces [35]. Utilitarian systems focus on ease of use and usefulness [23], whereas hedonic systems focus on enjoyment, curiosity, and immersion [34]. The combination of both, as done in gamification, raises questions about the ability to increase system usage through hedonic motivation while maintaining the utilitarian nature of the system.

Gamification is a rapidly growing field from both business and research perspectives. Initial expectations for gamification growth were very high [36, 37], but in the past couple of years it has become evident that these expectations have not been met. Yet, market predictions remain high with expectations for a cumulative average growth rate of 68.4 percent in the years 2014–2018 [38]. For the gamification market to grow, we must understand what makes a gamification implementation successful. However, measuring success is not a straightforward task and can be approached using different points of view.

From the users' point of view, which some scholars adopt as the means to measure success [16], the gamified system should be fun and rewarding [2, 39], and thus the users' sense of playfulness [40], or gamefulness [35] from it, is expected to grow. According to this point of view, increased user playfulness may indicate success, and theory shows that this is a positive indication for system acceptance [8, 14, 23, 41, 42]. Playfulness, however, is difficult to define and thus to measure. Some treat it as a situationally invariant trait, which can be more salient in some individuals than in others [8], and with regards to a system usage context, defined it as the degree of cognitive spontaneity in microcomputer interactions [10, 43]. Playfulness has been shown to positively influence a systems' perceived ease of use, perceived usefulness, and continued usage intentions [8, 44]. A second approach, used in this study, treats perceived playfulness as a state which is a situational characteristic of the interaction between an individual and the situation [22]. Perceived playfulness is a controllable system characteristic, and thus more suitable as a measure for gamification. As mentioned above, perceived playfulness and perceived enjoyment have many commonalities in their conceptual definitions, and both are also closely related to the conceptual definition of flow, defined as "an experience so gratifying that people are willing to do it for its own sake, with little concern for what they will get out of it, even when it is difficult or dangerous" [29]. Flow is measured among other variables by perceived playfulness [45] and has been found to influence the extent of use [46, 47]. Hedonic motivation has also been used by researchers and is operationalized as perceived enjoyment [14, 32]. These circular definitions mean that perceived playfulness, perceived enjoyment, flow, and hedonic motivations share many similarities in their conceptual definitions.

The users' point of view looks at the actual behavioral changes that occur as a result of gamification and can be broken down into two categories, increasing engagement and meeting objectives. Increasing user engagement may be the sole objective of gamification and is measured by recency, frequency and duration of visits, virality, and rating [2]. An increase in any of these measures indicates a positive influence on the user. When looking at gamification objectives, designers ask themselves what the objectives of gamifying the system are, and seek to meet them. In a sports application, this could be an increase in the amount of steps a person takes daily [40], and in a recommendation system, this could be an increase in the amount of content contributed [48].

Measuring success is a reactive approach to designing successful gamification, meaning that it is only after all resources have been applied, that designers can know if has worked. In game design, this is resolved by an iterative playtesting approach [49] in which system designers test out ideas and measure their success during development until a final version is deployed. In gamification of utilitarian systems, this is not always possible. Designing fun games is not easy [39]; thus, researchers and practitioners have been seeking ways to structure this process by breaking down elements from games into game design patterns [25] or interactions [50]. By breaking systems into subsystems, and analyzing their effects, it is hoped that we can learn how to reconstruct a new system from scratch, in a successful and playful way. However, research on how to do this is scarce [51].

Game patterns research is starting to emerge in different domains such as marketing patterns of status restriction in items [52], stratified content, and avatar types [52]; engagement patterns such as task status display and progress bar [53]; game behavior patterns such as paper-rock-scissors that prevent the user from making trivial decisions or privileged moves [54]; behavior based on the amount of points provided [55]; and different interaction patterns studied in massive multiuser online games [56]. The common theme to all these studies is the notion that understanding the relations between these patterns and the user will help in the design and development of better games. Gamification design is different from game design since the key objective in gamification is utilitarian; however, game design principles and the notion of patterns are finding their way into gamification as well [25].

Pattern identification is mostly accomplished using heuristics and by examining games or gamification implementations and deriving common artifacts from them. Only a relatively few studies [25] propose going beyond the obvious and seek emerging patterns that are less obvious, through log analysis. These studies focus on the identification of patterns and provide some guidance as to when and where to use them based on motivational theories or simple heuristics. They do not, however, propose any monitoring or measurement system to analyze their actual fit for a specific implementation.

Study objectives and hypotheses

The key objective of this preliminary study was to test the effectiveness of measuring actual behavior and specifically Gamification Behavior Patterns (GBPs), as a means of measuring user playfulness, which can be considered a proxy to successful gamification. A GBP is a sequence of actions performed by a user that can be attributed to the application of a gamification design pattern. It represents an objective measure, as opposed to subjective self-reported perceptions. An example of such a GBP in an exercise application could be a user checking his activity statistics within the application, noticing that a friend has a higher daily score on some measure, and immediately starting to exercise until the friend's score is surpassed. Such a behavior may be attributed to the gamification of the system.

Gamification includes the use of different game mechanics. One can usually assume that if designers are successful in identifying and combining those game mechanics that users enjoy, overall playfulness will increase [12, 26]. Although this approach has shown positive results, it is not practical to use, since designers do not have access to such data. A hypothesis, denoted *H1*, may be stated as: objective system usage measures and gamification behavior patterns will predict perceived playfulness better than or at least equal to subjective reported measures of enjoyment from specific game mechanics.

Different people are motivated differently based on their personalities, needs, values, defense mechanisms, coping styles, learning styles, and developmental issues [57]. For gamification to be successful, it must address these differences, posing two challenges to designers. First, these user characteristics are unknown to designers. A second challenge is designing a single gamification solution that will positively influence a wide variety of personalities. A common personality theory is the big five model (also called Five Factor Model, or FFM) [58], which posits that individuals can be measured on a scale of five traits: emotional stability, extraversion, openness, agreeableness, and conscientiousness [59]. People with a low score on emotional stability tend to be anxious and insecure, whereas emotionally stable personalities will often be calm. Extraverted personalities tend to be more social and active, whereas introverts will be shy, reserved, and cautious. High openness personalities are strongly related to imagination and curiosity, while the opposite personalities are more "down to earth" and conventional. Agreeableness is related to sympathy, kindness, and compliance, whereas the opposite are unfriendly and "hard-headed." Last, conscientiousness is related to organization and efficiency [59–61].

There is a plethora of literature on the moderating effects of personalities on work-oriented task performance [62, 63], on learning styles [64–67], and on gaming preferences [68–70]. These studies highlight the importance of personality traits in daily tasks such as working, learning, leisure activities, and computer game playing. The majority of these studies examine personality within a single context, with the exception of Furnham et al. [66] who look at training combined with work activities. As gamification combines the worlds of work and play, there is a missing body of research on the interaction of a ludic and utilitarian environment with personality. A hypothesis, denoted *H2*, may be stated as: objective system usage measures and gamification behavior patterns will predict perceived playfulness better than or at least equal to personality traits.

Existing research consistently shows that there are gender differences regarding motivations for game playing and game genre preferences, as well as play styles and emotions experienced during a game [70–76]. Gender differences also exist in technology acceptance models—male users focus mostly on technology usefulness, while female users pay higher attention to ease of use, playfulness, and subjective norms [77–81]. Despite these differences, gender implications are often missing from most information systems research and are worthy of further research [78, 80–82]. Gamification combines the two worlds of hedonic motivations and utilitarian systems, and thus poses a great challenge, since a wrong implementation of gamification can result not only in lower acceptance but in disengagement and lower performance. Initial indications of such differences already exist, with female users reporting a specific solution to be more playful and to have higher social benefits than male users' assessments, and thus reported higher continued use intentions [83]. A hypothesis, denoted *H3*, may be stated as: female users will find gamification significantly more playful than male users.

In recent years, there has been an increase in the number of students diagnosed with learning disabilities, which requires educators to adapt to different learning styles and preferences [84]. One way to address these needs is through games [85], which can provide an additional learning environment for such students. The potential benefits of games and gamification for students with learning disabilities, and the call from the National Academy of Sciences to further explore how simulations and games can support diverse learners [86], has led us to include these topics in our study, despite them not being the main focus. A hypothesis, denoted *H4*, may be stated as: students with learning disabilities will find gamification significantly more playful than students without learning disabilities.

The study

In this preliminary study, we examined the case of gamification in an educational environment. Learning through games is a common practice [87–89], and digital games and game-based learning have been studied for several years [90]; therefore, it is no surprise that gamified education is a common research domain [13, 91–94]. In this quasi-experiment, we included game elements in the instruction of an undergraduate software analysis and design course. The experiment took place during the fall semester, 2015 (Oct. 2014–Jan. 2015). More

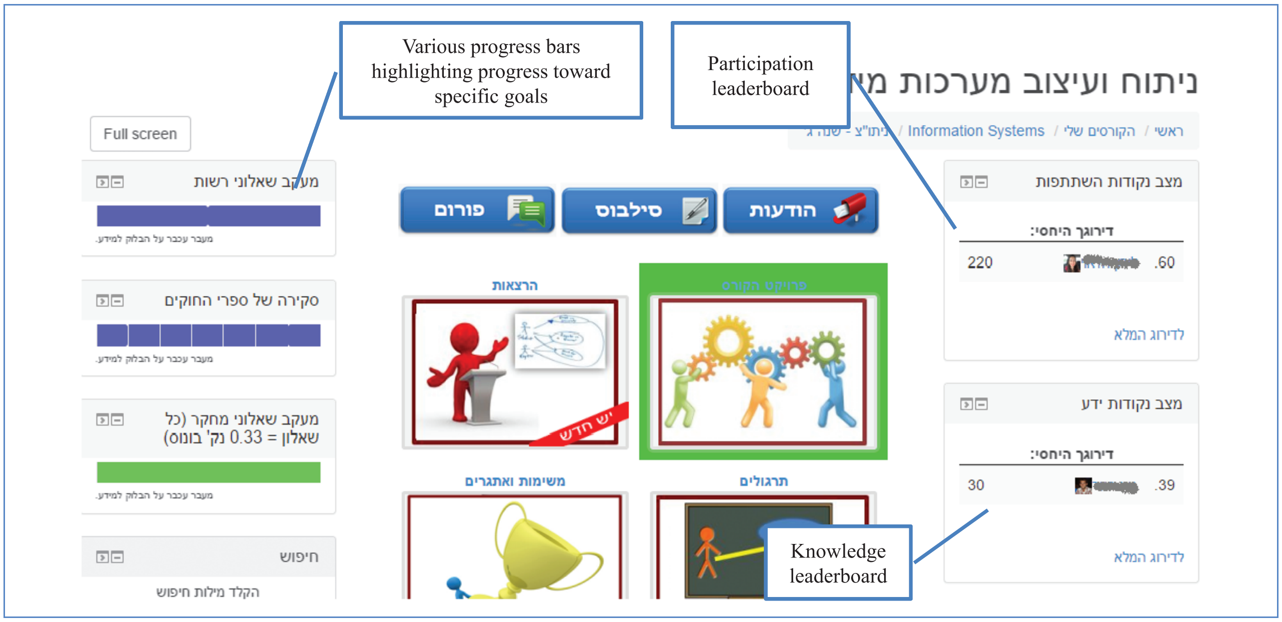

Figure 1

Course home page showing a few of the game mechanics available.

than 95% of the participants were juniors (third year of a four-year program) who majored in industrial engineering and management.

The main objective of the gamification was to increase students' engagement and involvement by motivating frequent interactions between students and material. Unlike traditional courses, where students access the LMS mostly to download class material, specific mechanics were used to promote engagement. First, we included a discussion board where students and course staff could raise topics and discuss them. Discussion boards address many good design principles for the incorporation of games in education. They provide interaction opportunities between students and course staff—and allow students to create content, build an online identity, explore ideas, and take risks [95, 96]. For each contribution to the discussion board, students received a default value of ten credit points, but for more meaningful contributions, participants received up to fifty points. Relatively meaningless contributions, such as "I agree with the comment above," did not grant any points. The number of points each participant had was visible to all students through a leaderboard. Contribution to the discussion board was partially mandatory, as students were required to reach 600 points during the semester. However, there were other mechanisms of earning points available to those who did not feel comfortable with posting their thoughts online. At the end of the course, the average number of points was 647.46 with a standard deviation of 285.14 indicating that some of participants were extremely engaged while others were not (points ranged from 140 to 1,565).

Additional mechanisms used to increase engagement were weekly quizzes available to students, relating to the course content covered during that week. These quizzes were not mandatory and were not related to the final grade in any way. The summation of the weekly test scores for each participant was presented in a dedicated leaderboard comparing students with one another. Badges were granted to users for completing certain activities in the discussion board such as contributing a number of posts, responding to questions, and participating in various activities on the LMS. Logic riddles or small game-theory experiments, in which students could voluntarily participate, were made available at certain points throughout the course.

Figure 1 presents the home page of the site, showing the two leaderboards on the right side, and progress bars providing action queues to users on the left. Gamification scholars and practitioners often criticize the use of points, badges, and leaderboards in gamification, claiming it is a trivial implementation that harms long-term intrinsic motivation. While this may be true in many cases, in short-term tasks where intrinsic motivation is weak to begin with, these mechanics have been found to be successful [94, 97–100] and are thus used in this study.

Table 1 Validity indices: average variance extracted (AVE), Cronbach's alpha, and cross-correlations. square roots of the AVE values are the bold diagonal values. (CR: composite reliability.)

	AVE	*CR*	*Cronbach's Alpha*	*Badges*	*Leaderboard*	*Playfulness*	*Points*	*Progress bar*	*Rewards*
Badges	0.87	0.95	0.93	**0.93**					
Leaderboard	0.60	0.86	0.78	0.58	**0.77**				
Playfulness	0.63	0.93	0.91	0.66	0.56	**0.79**			
Points	0.72	0.89	0.81	0.27	0.54	0.35	**0.85**		
Progress bar	0.82	0.90	0.80	0.30	0.39	0.21	0.11	**0.91**	
Rewards	0.79	0.89	0.75	0.40	0.38	0.36	0.28	0.08	**0.89**

Measures

Participants completed a 50-item personality questionnaire, using the revised FFM questionnaire [101], and in addition provided demographic data such as age, gender, and whether or not they have been formally diagnosed as having any form of learning disability. Perceived playfulness from specific course activities was measured at the beginning (week 2) and towards the end (week 10) of the experiment, using a nine-item scale adapted from Moon and Kim [9]. At the beginning of the experiment (week 2), subjects were also asked about their preferences and perceived enjoyment of different game mechanics, using the game mechanics preference questionnaire [12].

Three gamification behavior patterns were defined. Behavior Pattern 1 (BP1) covered cases where subjects logged in and immediately viewed a leaderboard, indicating that the key purpose of logging in was to view the leaderboard. Behavior Pattern 2 (BP2) included cases where subjects performed a task that granted them points, checked their position on the leaderboard, and immediately repeated the task that granted points. This would indicate that their position on the leaderboard was a motivator to repeat the action. Last, Behavior Pattern 3 (BP3) included cases where subjects first viewed a leaderboard and then decided to perform an action that granted them points, indicating the cognitive relation between the leaderboard and the action that granted the points and excluded cases covered by BP2. Towards the end of the experiment, system log files and the different questionnaires submitted throughout the course were analyzed, and the target behaviors were extracted. These BPs were selected since they represent a common theme in gamified applications where points are granted based on an activity performed by the user and presented on a leaderboard, with the hope of creating a competitive dynamic that would encourage the behavior performed [102].

Behavior patterns were extracted from the LMS systems log, which included an entry for each access of the user to one of the elements of the web site such as reading and writing a post, viewing the leaderboard, or downloading class material. The time between each log-in activity and the last activity before the next log-in was defined as a session. Each session was then analyzed to extract specific actions of interest for our analysis such as session duration, number of activities in the session, and the existence of any one of the behavior patterns.

Results

Of the 60 students in the course, 38 completed all surveys and were included in the data analysis (63.3%). Students ranged in age from 23 to 30 years, 21 were female and 17 were male. 5 students reported having learning disabilities. Internal and convergent validity indices of the game mechanics questionnaire are presented in **Table 1**. Cronbach's *alpha* for all constructs was above the desired 0.7 index. Exploratory Factor Analysis confirmed the correctness of the measured constructs with average variance extracted (AVE) above 0.5, and cross correlations at acceptable values. Playfulness and enjoyment from mechanics constructs were calculated using partial least squares (PLS) using Smart PLS version 2.0M3 [103]. Personality constructs were calculated using a sum of all items. Playfulness had been measured at the beginning of the experiment ($T1$) and towards the end of it ($T2$). A set of paired samples t-tests was performed to test if the perceived playfulness of different groups had changed by the gamification and results, and an effect size analysis has been done using Cohen's d [104]. Results of this analysis can be found in **Table 2**. A Cohen's d value between 0.5 and 0.8 represents a medium effect size. In general, the playfulness in $T2$ was lower than the playfulness measured in $T1$. The changes in playfulness for constructs that do not appear in the table were insignificant.

Regression analysis was performed using three sets of variables: subjective invariant personality variables,

Table 2 T test for changes in playfulness showing differences in playfulness between the beginning ($T1$) and end of experiment ($T2$) based on differnet groups. Higher values mean higher levels of playfulness. (n.s.: not significant.)

		T*1 playfulness*	T*2 playfulness*	*df*	t *value*	*Cohen's* d	*Significance*
Gender	Male	20.71	15.76	16.00	0.52	0.69	0.003
	Female	22.10	21.33	20.00	3.46	0.11	n.s.
Extraversion	Low	20.05	15.30	19.00	3.91	0.71	0.001
	High	23.06	22.78	17.00	0.17	0.04	n.s.
Agreeableness	Low	19.85	16.55	19.00	2.91	0.50	0.009
	High	23.28	21.39	17.00	1.00	0.24	n.s.
Emotional stability	Low	21.89	20.42	18.00	1.16	0.23	n.s.
	High	21.05	17.26	18.00	2.20	0.46	0.041
Openness	Low	20.79	19.68	18.00	0.98	0.17	n.s.
	High	22.16	18.00	18.00	2.33	0.52	0.032
Badges	Low	17.57	16.48	20.00	0.67	0.16	n.s.
	High	26.29	21.76	16.00	3.79	0.77	0.002
Leaderboard	Low	18.95	17.21	18.00	0.94	0.24	n.s.
	High	24.00	20.47	18.00	3.25	0.50	0.004
Points	Low	18.81	17.24	20.00	0.99	0.23	n.s.
	High	24.76	20.82	16.00	2.93	0.54	0.01
Learning disabilities	No	21.06	19.00	32.00	1.82	0.30	0.078
	Yes	24.20	17.80	4.00	2.15	0.56	0.098
Total sample		21.47	18.84	37.00	2.46	0.36	0.019

subjective enjoyment from the different mechanics variables, and objective usage data. For each set of variables, an explorative Generalized Linear Model (GLM) was executed to test all possible interactions. The significant interactions were then coded as variables and executed in a linear regression. To allow comparison and selection of the best model, a Bayesian Information Criterion (BIC) [105] was calculated for each model. Results of the regression models are presented in **Table 3**. Gender ($gender = 1$ represents females) and learning disabilities ($learning\ disabilities = 1$ represents a subject with a learning disability) are coded as binary variables. **Table 4** shows the significant correlations between variables selected for the model. Not surprisingly, there are high correlations between the different GBPs since they represent some form of behavior that is triggered by the gamification. Similar high correlations exist among the enjoyment from game mechanics.

Discussion

In this experiment, we started with an academic course web site, which students used regularly to access course material and submit assignments, and gamified it. We defined a task of contributing to an online discussion board and included different game mechanics to the LMS with the objective of increasing subjects' playfulness. We then tested our hypotheses that actual behavior on the site, and specifically the existence of specific gamification behavior patterns, would predict playfulness better than personality traits and subjective measures of enjoyment. We also tested the hypotheses that female students and students with learning disabilities would find gamification more playful.

Both $H1$ and $H2$ were supported in our study. Table 3 shows that $H1$ is supported, as the model based on enjoyment from game mechanics produced lower BIC values than the model based on actual behavior. Lower BIC values represent a better model, and the difference between models is greater than 10, representing a very strong difference [106]. $H2$, which compared personality traits to actual behavior, is supported as well through the BIC indicator with a strong difference of 8.08. However, it is worth noting that the adjusted R square for the model based on personality was higher due to a larger number of predictors in the model. $H3$ was strongly supported by this study, indicating that while at $T1$, when there was a very low level of exposure to the gamification, there was no difference in playfulness between female and male students ($p = 0.532$), at $T2$, there was a significant difference ($p = 0.03$) with females reporting higher levels of playfulness. $H4$ was not supported, as there was no significant difference between students with and without learning disabilities; however,

Table 3 Comparing regression analysis of three models. Lower BIC values are better.

Variable set	*Predictors*	*β*	*P value*	*Adjusted R square*	*BIC*
Enjoyment from specific game mechanics	Badge	1.76	.003	0.43	271.86
	Gender	13.07	.032		
	LD	−139.40	.006		
	LD × Badge	3.88	.010		
	LD × Leaderboard	9.25	.017		
	Gender × Badge	−1.27	.079		
	Gender × LD	−33.95	.042		
Personality	Emotional Stability	−0.45	.002	0.58	266.38
	LD	−102.49	.002		
	Gender × Openness	−0.91	.000		
	LD × Conscientiousness	2.77	.003		
	Gender × Extraversion	1.06	.000		
	Gender × LD	14.43	.011		
Actual behavior	Behavior Pattern 2	−0.99	.000	0.50	258.30
	Behavior Pattern 3	0.44	.000		
	Average session duration	0.05	.000		
	Average number of events in session	−1.85	.002		
	Gender	4.20	.035		

Table 4 Cross-correlation table. (** indicates significant at the 0.01 level [2-tailed]; * indicates correlation is significant at the 0.05 level [2-tailed]. Agreeable: Agreeableness; Consc.: Conscientiousness; #: number.)

		A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*	*K*	*L*	*M*	*N*	*O*	*P*	*Q*
A	*Gender*	1																
B	*Learning Disabilities*	0.037	1															
C	*Enjoyment from Badges*	0.216	0.236	1														
D	*Enjoyment from Leaderboard*	0.057	0.355*	0.479**	1													
E	*Enjoyment from Points*	−0.154	0.102	0.350*	0.548**	1												
F	*Extraversion*	0.203	−0.050	0.343*	0.155	0.146	1											
G	*Openness*	−0.222	0.346*	0.075	0.201	0.044	0.152	1										
H	*Agreeable*	0.432**	0.011	0.130	0.083	−0.026	0.102	−0.044	1									
I	*Consc.*	0.229	0.045	0.226	0.403*	0.325*	0.342*	−0.061	0.233	1								
J	*Emotional Stability*	−0.325*	0.111	−0.203	−0.034	0.326*	0.207	0.254	−0.276	0.292	1							
K	*Average of session duration*	0.163	0.053	0.308	0.151	0.013	0.195	0.017	0.182	−0.164	−0.273	1						
L	*Avg. of # of events in session*	0.198	−0.064	0.101	−0.049	−0.061	0.200	0.061	0.105	−0.143	−0.176	0.785**	1					
M	*Behavior Pattern 1*	0.329*	0.392*	0.232	0.314	0.015	0.221	0.075	0.174	0.077	−0.251	0.257	0.197	1				
N	*Behavior Pattern 2*	0.128	0.488**	0.318	0.325*	0.033	0.120	0.132	0.070	−0.203	−0.373*	0.397*	0.165	0.742**	1			
O	*Behavior Pattern 3*	0.218	0.495**	0.362*	0.358*	0.124	0.294	−0.022	0.148	−0.060	−0.263	0.423**	0.288	0.772**	0.834**	1		
P	*Playfulness*	0.352*	−0.052	0.508**	0.185	0.214	0.378*	−0.255	0.267	0.125	−0.253	0.410*	0.184	0.096	0.079	0.345*	1	
Q	*Forum Contributions*	−0.095	0.323*	0.105	0.296	0.336*	−0.092	−0.092	0.126	−0.058	−0.132	0.257	0.127	0.290	0.534**	0.512**	0.163	1

with the low limited sample size, we could not really address this hypothesis, and it remains an area for future research. Students with a learning disability reported a higher level of playfulness at $T1$ than students without a learning disability, but at $T2$ changed and students with a learning disability reported lower playfulness, indicating a possible moderation of time, which would require further analysis as well.

Creating a playful environment, where subjects would voluntarily participate, is difficult to do in an academic environment since students seek to optimize their time investments across different courses, and are not easily engaged in tasks that are not directly related to course grades [107]. Studies performed in academic environments show that towards the fifth or sixth week of the semester, students lose interest in voluntary tasks, as the mandatory assignments from other courses become time consuming [108]. This can partially explain the decline in playfulness between $T1$ and $T2$ as shown in Table 2. We assume that if the gamification was not successful, all groups would be impacted by it equally, but the fact that some groups declined while others did not requires searching for additional explanations. To further understand this decline, a mid-experiment measurement should be made.

Of the three models tested, the model using actual behavior, and specifically gamification behavior patterns, was the best model based on the Bayesian Information Criterion (BIC) for model selection. This may not be a surprise, since measuring actual behavior is what designers do regularly; however, the notion of including GBP is new and is shown to add value and simplicity to the model. Our findings suggest that defining the desired GBP during the design phase, and measuring those behaviors, would give designers an additional indication of success. When looking at explained variance of the models through the adjusted R-square, the model with invariant variables of personality and demographics yielded the best results with an adjusted R-square of 0.578, which highlights the important role of personality, gender, and other demographic variables in the formation of playfulness. Personality traits are not available to system designers and therefore are of no practical value, other than understanding that different personalities will be affected differently by gamification, which is a factor to consider when designing gamification [13]. The explained variance in the model using perceived enjoyment from mechanics was the lowest. Enjoyment from badges involved the only mechanic found to be related to playfulness, despite the fact that perceived enjoyment from badges was the lowest compared to other mechanics. This finding is in line with other studies [99, 100] showing the importance of badges. The main caveat of using perceived enjoyment or personality is that it requires that this data is available, which means that in most situations this would be a problematic approach. Separating enjoyment from mechanics and personality is done here to allow simple model comparisons, but in reality we would expect personality to mediate this enjoyment. This mediation effect was not tested in this study and should be further explored.

When using actual usage data, designers typically use descriptive statistics such as number of sessions, duration of sessions, and number of accesses to a specific feature [2]. We proposed the use of behavior patterns, which are similar to the concept of design patterns where designers identify a common problem and propose a common solution to it. An example of such a problem in our experimental gamification design involved how to encourage subjects to contribute to the discussion board, when there is no intrinsic motivation to do so. A design pattern approach in gamification [52] would be to solve this by including a competitive dynamic based on a leaderboard and points. We could then measure success by how many points each subject has. There is, however, a pitfall in measuring success this way, as can be seen in Table 4 where there is no correlation between number of contributions and playfulness. Instead, our approach is to associate a behavior pattern to such a design pattern and measure our success as the ability to both invoke those patterns and increase playfulness by them.

Therefore, the last model used actual behavior data and gender, which is assumed to be available to many gamification designers, especially in education, as independent variables. The models' BIC was significantly lower than the previous models tested and its adjusted R-square was 0.499, which is considered high for systems that measure a psychological measure such as playfulness. Longer sessions with fewer activities in each had a positive effect on playfulness, meaning that subjects who really spent time reading and writing, and not just wandering around, had higher playfulness levels. BP2—where we measured users who performed an action, checked the leaderboard, and immediately preformed the action again—had a negative effect on playfulness. At the same time, BP3, where users viewed the leaderboard first and only then performed an action, had a positive effect on playfulness. This is an interesting finding that requires further analysis. It is possible that users in BP2 logged into the site with the purpose of promoting themselves on the leaderboard, which indicates extrinsic motivation. Users with BP3 contributed knowledge only after noticing the leaderboard indicating intrinsic motivation which would be considered as a playful activity. BP1, where users logged in and immediately checked their position on the leaderboard, was not statistically significant, and, therefore, we cannot reach conclusions about it.

Playfulness by females and males was identical at the beginning of the experiment. However, while females retained this level of playfulness throughout the experiment, males' playfulness had significantly dropped. While this supports our hypothesis that females would find gamification more playful than males as shown in previous research [83], there is also research showing that in a competitive environment presenting leaderboards, females' playfulness will not be higher [13]. Female playfulness in this case can be explained by the fact that although leaderboards existed, the position on the leaderboard, i.e., the competition, did not carry any tangible value. Additional explanations could be the high correlation found in this case between females and agreeable personality, which tend to be more compliant. Agreeable personalities were also found to retain their level of playfulness compared to low agreeable personalities. In interviews with females who were high on playfulness, it became clear that they were all very competitive in nature. Individuals reporting high enjoyment from game mechanics applied in the course reported higher levels of playfulness at the beginning of the experiment compared to those who reported lower enjoyment; however, at $T2$, only those who enjoyed badges were still significantly higher on playfulness. Our limited sample does not include sufficient subjects with learning disabilities to reach clear conclusions about them, yet an interesting observation is that those subjects' behavior patterns were significantly higher than other students as seen in Table 4. This, however, was not reflected in their playfulness level.

Limitations and future directions

The key limitation of this study is its limited sample size and context. With a small sample size, any inference would be questionable; thus, this study should be considered as preliminary findings and are the basis for future studies. Yet, even with the small sample size, significant effects were demonstrated, indicating that this is indeed an interesting research direction. As a result of the small sample size, it is difficult to assess correctly several interactions and specifically those relating to subjects with learning disabilities where results should be treated with caution. Running multiple regressions with a small sample size may result in lower-than-desired statistical power; however, with strong effect sizes this would be less problematic. The context of this study is education and the ability to promote offline discussions through an LMS, and while the results can be generalized to other educational environments, it is important to note the specific demographic context of this study. Our dependent variable was perceived playfulness towards the end of the experiment. This self-reported value is prone to many biases, as students do not always separate their feelings about the course and semester in general from their response to the playfulness from the LMS. Further research with higher sample sizes should be done to increase validity of this measure.

The study should be considered as a case study, since it includes a specific course targeted at a specific population with distinct characteristics. Additional populations and gamification implementations should be added to allow external validity and better understanding of how gamification patterns can steer user behaviors. A proposed future direction for this exploratory study is the creation of an open-source, cloud-based "Gamification Behaviors Database," which will track gamification behavior patterns with relation to the design patterns used. If possible, additional personality and demographic data could be collected, but to respect privacy concerns this may not be mandatory. Such a database would allow the execution of big data and machine learning algorithms, providing recommendations to designers about what design patterns would best serve their specific implementations. It would also allow the development of adaptive gamification allowing designers to automatically react by changing design rules when behavior patterns are not achieved.

Conclusion

A gamification behavior pattern is a sequence of actions performed by a user that can be attributed to the application of a gamification design pattern. Gamification design patterns are similar to design patterns with the key difference being that the artifacts used as building blocks are game mechanics. We have shown the ability of GBP to successfully predict playfulness, and that unlike personality or user perceptions of games, which are unknown to designers, GBP can be measured and can be controlled by designers.

We posit that just as design patterns are commonly used in software development and design, GBP should complement them when it comes to gamification which aims to steer the users' behavior towards a given objective. We further propose that for GBP to become a useful tool, implementers should openly share their usage data related to these behavior patterns and related metadata through an online collaborative database. This would advance the research and understanding of gamification and help design playful environments that promote desired user behaviors, which is the ultimate goal of gamification.

References

1. S. Deterding, M. Sicart, L. Nacke, K. O'Hara, and D. Dixon, "Gamification. Using game-design elements in non-gaming contexts," in *Proc. CHI Conf.*, Vancouver, ON, Canada, 2011, pp. 2425–2428.
2. G. Zichermann and C. Cunningham, *Gamification by Design: Implementing Game Mechanics in Web and Mobile Apps*. Sebastopol, CA, USA: O'Reilly Media, 2011.
3. K. Huotari and J. Hamari, "Defining gamification: A service marketing perspective," in *Proc. 16th Int. Acad. MindTrek Conf.*, 2012, pp. 17–22.

4. K. Werbach and D. Hunter, *For the Win: How Game Thinking Can Revolutionize Your Business*. Philadelphia, PA, USA: Wharton Digit. Press, 2012.
5. M. Herger. *Enterprise Gamification*. (2011, 28/4/14). [Online]. Available: https://www.udemy.com/enterprise-gamification
6. E. MacIvor, “Assessing the impact of game dynamics in the classroom: Eye candy or learning gains?” Senior thesis, Ohio Univ., Athens, OH, USA, 2013. ~~AQ1~~
7. J. Hamari, J. Koivisto, and H. Sarsa, “Does Gamification Work?—A literature review of empirical studies on gamification,” in *Proc. 47th Hawaii Int. Conf. Syst. Sci.*, Waikoloa, HI, USA, 2014, pp. 3025–3034.
8. R. Agarwal and E. Karahanna, “Time flies when you’re having fun: Cognitive absorption and beliefs about information technology usage,” *MIS Quart.*, vol. 24, no. 4, pp. 665–694, 2000.
9. J.-W. Moon and Y.-G. Kim, “Extending the TAM for a world-wide-web context,” *Inf. Manag.*, vol. 38, no. 4, pp. 217–230, Feb. 2001.
10. J. Webster and J. J. Martocchio, “Microcomputer playfulness: Development of a measure with workplace implications,” *MIS Quart.*, vol. 16, no. 2, pp. 201–226, 1992.
11. J. Vassileva, “Motivating participation in social computing applications: A user modeling perspective,” *User Model. Use-Adapt. Interact.*, vol. 22, no. 1/2, pp. 177–201, Apr. 2012.
12. D. Codish and G. Ravid, “Academic course gamification: The art of perceived playfulness,” *Interdiscip. J. E-Learn. Learn. Obj.*, vol. 10, pp. 131–151, 2014.
13. D. Codish and G. Ravid, “Personality based gamification: How different personalities perceive gamification,” presented at the European Conf. Information Systems, Tel-Aviv, Israel, Jun. 5–13, 2014.
14. V. Venkatesh, J. Thong, and X. Xu, “Consumer acceptance and use of information technology: Extending the unified theory of acceptance and use of technology,” *MIS Quart.*, vol. 36, no. 1, pp. 157–178, 2012.
15. J. Schell, *The Art of Game Design: A Book of Lenses*. Burlington, MA, USA: CRC Press, 2008.
16. S. Nicholson, “A user-centered theoretical framework for meaningful gamification,” in *Proc. Games Learn. Soc.*, 2012, vol. 8, pp. 1–7.
17. K. Werbach, “(Re) defining gamification: A process approach,” in *Persuasive Technology*. Cham, Switzerland: Springer-Verlag, 2014, pp. 266–272.
18. B. Burke, *Gamify: How Gamification Motivates People to do Extraordinary Things*. Brookline, MA, USA: Bibliomotion, Inc., 2014.
19. Y. Xu, “Literature review on web application gamification and analytics,” University of Hawaii, Honolulu, HI, USA, Tech. Rep. 11-05, Apr. 2012.
20. P. Stacey and J. Nandhakumar, “Opening up to agile games development,” *Commun. ACM*, vol. 51, no. 12, pp. 143–146, Dec. 2008.
21. E. Mollick and N. Rothbard, “Mandatory fun: Consent, gamification and the impact of games at work,” *Soc. Sci. Res. Netw. Electron. J.*, 2014. ~~AQ2~~
22. C. S. Lin, S. Wu, and R. J. Tsai, “Integrating perceived playfulness into expectation-confirmation model for web portal context,” *Inf. Manag.*, vol. 42, no. 5, pp. 683–693, Jul. 2005.
23. F. D. Davis, R. P. Bagozzi, and P. R. Warshaw, “Extrinsic and intrinsic motivation to use computers in the workplace,” *J. Appl. Soc. Psychol.*, vol. 22, no. 14, pp. 1111–1132, Jul. 1992.
24. V. Venkatesh, “Determinants of perceived ease of use: Integrating control, intrinsic motivation, and emotion into the technology acceptance model,” *Inf. Syst. Res.*, vol. 11, no. 4, pp. 342–365, 2000.
25. D. Ašeriškis and R. Damaševičius, “Gamification patterns for gamification applications,” *Procedia Comput. Sci.*, vol. 39, pp. 83–90, 2014.
26. R. Hunicke, M. LeBlanc, and R. Zubek, “MDA: A formal approach to game design and game research,” in *Proc. AAAI Workshop Challenges Game AI*, San Jose, CA, USA, 2004, pp. 1–5.
27. E. L. Deci and M. Vansteenkiste, “Self-determination theory and basic need satisfaction: Understanding human development in positive psychology,” *Ricerche di Psicologia*, vol. 37, pp. 23–40, 2004.
28. J. Nakamura and M. Csikszentmihalyi, “The concept of flow,” in *Handbook of Positive Psychology*. Oxford, UK: Oxford Univ. Press, 2002, pp. 89–105.
29. M. Csikszentmihalyi and I. S. Csikszentmihalyi, *Optimal Experience: Psychological Studies of Flow in Consciousness*. Cambridge, U.K.: Cambridge Univ. Press, 1992.
30. I. Ajzen, “From intentions to actions: A theory of planned behavior,” in *Action-Control: From Cognition to Behavior*. Berlin, Germany: Springer-Verlag, 1985, pp. 11–39.
31. K. Huotari and J. Hamari, “Gamification from the perspective of service marketing,” in *Proc. CHI Workshop Gamification*, Vancouver, BC, Canada, 2011, pp. 1–5.
32. H. Van der Heijden, “User acceptance of hedonic information systems,” *MIS Quart.*, vol. 28, no. 4, pp. 695–704, Dec. 2004.
33. S. A. Brown and V. Venkatesh, “Model of adoption of technology in households: A baseline model test and extension incorporating household life cycle,” *MIS Quart.*, vol. 29, no. 3, pp. 399–426, Sep. 2005.
34. P. B. Lowry, J. E. Gaskin, N. W. Twyman, B. Hammer, and T. L. Roberts, “Taking “fun and games” seriously: Proposing the Hedonic-Motivation System Adoption Model (HMSAM),” *J. Assoc. Inf. Syst.*, vol. 14, no. 11, pp. 617–671, Nov. 2013.
35. S. Deterding, D. Dixon, R. Khaled, and L. Nacke, “From game design elements to gamefulness: Defining gamification,” in *Proc. 15th Int. Acad. MindTrek Conf., Envisioning Future Media Environ.*, Tampere, Finland, 2011, pp. 9–15.
36. “Gartner says by 2015, more than 50 percent of organizations that manage innovation processes will gamify those processes,” Gartner, Stamford, CT, USA, Apr. 2011. [Online]. Available: http://www.gartner.com/newsroom/id/1629214
37. “Gartner says by 2014, 80 percent of current gamified applications will fail to meet business objectives primarily due to poor design,” Gartner, Stamford, CT, USA, Nov. 2012. [Online]. Available: http://www.gartner.com/newsroom/id/2251015
38. “Global gamification market 2014–2018,” Technavio, Elmhurst, IL, USA, Oct. 2014. [Online]. Available: http://www.technavio.com/report/global-gamification-market-2014-2018
39. M. A. Blythe, K. Overbeeke, A. F. Monk, and P. C. Wright, *Funology: From Usability to Enjoyment*, vol. 3. Houten, The Netherlands: Springer-Verlag, 2004.
40. J. Hamari and J. Koivisto, “Social motivations to use gamification: An empirical study of gamifying exercise,” in *Proc. 21st Eur. Conf. Inf. Syst.*, Utrecht, The Netherlands, Jun. 5–8, 2013, pp. 1–12.
41. S. Kulviwat, G. C. Bruner, II, A. Kumar, S. A. Nasco, and T. Clark, “Toward a unified theory of consumer acceptance technology,” *Psychol. Market.*, vol. 24, no. 12, pp. 1059–1084, Dec. 2007.
42. H. Montgomery, P. Sharafi, and L. R. Hedman, “Engaging in activities involving information technology: Dimensions, modes, and flow,” *Hum. Factors, J. Hum. Factors Ergonom. Soc.*, vol. 46, no. 2, pp. 334–348, Summer 2004.
43. S. E. Yager, L. A. Kappelman, G. A. Maples, and V. R. Prybutok, “Microcomputer playfulness: Stable or dynamic trait?” *ACM SIGMIS Database*, vol. 28, no. 2, pp. 43–52, Spring 1997.
44. G. Hackbarth, V. Grover, and M. Y. Yi, “Computer playfulness and anxiety: Positive and negative mediators of the system experience effect on perceived ease of use,” *Inf. Manag.*, vol. 40, no. 3, pp. 221–232, Jan. 2003.
45. T. P. Novak, D. L. Hoffman, and Y.-F. Yung, “Measuring the customer experience in online environments: A structural modeling approach,” *Market. Sci.*, vol. 19, no. 1, pp. 22–42, 2000.
46. J. A. Ghani, R. Supnick, and P. Rooney, “The experience of flow in computer-mediated and in face-to-face groups,” in *Proc. ICIS*, New York, NY, USA, 1991, pp. 229–237.

47. J. A. Ghani and S. P. Deshpande, "Task characteristics and the experience of optimal flow in human-computer interaction," *J. Psychol.*, vol. 128, no. 4, pp. 381–391, 1994.
48. R. Farzan and P. Brusilovsky, "Encouraging user participation in a course recommender system: An impact on user behavior," *Comput. Hum. Behav.*, vol. 27, no. 1, pp. 276–284, Jan. 2011.
49. A. Cugun and K. Alfrink, "New games for extant contexts," in *Proc. CHI*, Apr. 27–May 2, Paris, France, 2013, pp. 1–4.
50. S. Lundgren and S. Bjork, "Game mechanics: Describing computer-augmented games in terms of interaction," in *Proc. TIDSE*, 2003, pp. 1–12.
51. P. Sweetser and P. Wyeth, "GameFlow: A model for evaluating player enjoyment in games," *Comput. Entertainment*, vol. 3, no. 3, p. 3, Jul. 2005.
52. J. Hamari and V. Lehdonvirta, "Game design as marketing: How game mechanics create demand for virtual goods," *Int. J. Business Sci. Appl. Manag.*, vol. 5, no. 1, pp. 14–29, 2010.
53. S. Niebuhr, K. Kohler, and C. Graf, "Engaging patterns: Challenges and means shown by an example," *Eng. Interact. Syst., Lect. Notes Comput. Sci.*, vol. 4940, 2008, pp. 586–600.
54. B. Kreimeier. (2002, 1/1/2015). *The Case For Game Design Patterns*. [Online]. Available: http://www.gamasutra.com/view/feature/132649/the_case_for_game_design_patterns.php
55. D. Raban, G. Richter, and Y. Corem, "Harnessing the power of games to enhance organizational knowledge sharing systems," in *Proc. ILAIS Conf.*, 2011, p. 73.
56. N. Ducheneaut and R. J. Moore, "The social side of gaming: A study of interaction patterns in a massively multiplayer online game," in *Proc. ACM Conf. Comput. Supported Cooperative Work*, Chicago, IL, USA, Nov. 6–10, 2004, pp. 360–369.
57. D. P. McAdams, "What do we know when we know a person?" *J. Pers.*, vol. 63, no. 3, pp. 365–396, Sep. 1995.
58. R. R. McCrae and P. T. Costa Jr., "Reinterpreting the Myers-Briggs type indicator from the perspective of the five-factor model of personality," *J. Pers.*, vol. 57, no. 1, pp. 17–40, Mar. 1989.
59. R. R. McCrae and O. P. John, "An introduction to the five-factor model and its applications," *J. Pers.*, vol. 60, no. 2, pp. 175–215, Jun. 1992.
60. O. P. John and S. Srivastava, "The big five trait taxonomy: History, measurement, and theoretical perspectives," in *Handbook of Personality: Theory and Research*, vol. 2. New York, NY, USA: Guilford Press, 1999, pp. 102–138.
61. S. Roccas, L. Sagiv, S. H. Schwartz, and A. Knafo, "The big five personality factors and personal values," *Pers. Soc. Psychol. Bull.*, vol. 28, no. 6, pp. 789–801, 2002.
62. M. R. Barrick, M. K. Mount, and J. P. Strauss, "Conscientiousness and performance of sales representatives: Test of the mediating effects of goal setting," *J. Appl. Psychol.*, vol. 78, no. 5, pp. 715–722, Oct. 1993.
63. A. E. Colbert, M. K. Mount, J. K. Harter, L. A. Witt, and M. R. Barrick, "Interactive effects of personality and perceptions of the work situation on workplace deviance," *J. Appl. Psychol.*, vol. 89, no. 4, p. 599, 2004.
64. A. Y. Kolb and D. A. Kolb, "Learning styles and learning spaces: Enhancing experiential learning in higher education," Academy of Management Learning and Education, vol. 4, no. 2, pp. 193–212, Jun. 2005.
65. A. Furnham, "Personality and learning style: A study of three instruments," *Pers. Individual Diff.*, vol. 13, no. 4, pp. 429–438, Apr. 1992.
66. A. Furnham, C. J. Jackson, and T. Miller, "Personality, learning style and work performance," *Pers. Individual Diff.*, vol. 27, no. 6, pp. 1113–1122, Dec. 1999.
67. A. Yeung, J. Read, and S. Schmid, "Students learning styles and academic performance in first year chemistry," in *Aust. Conf. Sci. Math. Educ.*, Sydney, Australia, 2012, pp. 137–142.
68. M. B. Holbrook, "Play as a consumption experience: The roles of emotions, performance, and personality in the enjoyment of games," *J. Consum. Res.*, vol. 11, no. 2, pp. 728–739, Sep. 1984.
69. C.-I. Teng, "Personality differences between online game players and nonplayers in a student sample," *CyberPsychol. Behav.*, vol. 11, no. 2, pp. 232–234, Apr. 2008.
70. N. Yee, "The demographics, motivations, and derived experiences of users of massively multi-user online graphical environments," *Presence, Teleoperators Virtual Environ.*, vol. 15, no. 3, pp. 309–329, Jun. 2006.
71. P. T. Costa, Jr. and R. R. McCrae, "From catalog to classification: Murray's needs and the five-factor model," *J. Pers. Soc. Psychol.*, vol. 55, no. 2, pp. 258–265, Aug. 1988.
72. T. Hartmann and C. Klimmt, "Gender and computer games: Exploring females' dislikes," *J. Comput. Mediated Commun.*, vol. 11, no. 4, pp. 910–931, Jul. 2006.
73. K. Lucas and J. L. Sherry, "Sex differences in video game play: A communication-based explanation," *Commun. Res.*, vol. 31, no. 5, pp. 499–523, 2004.
74. H. Y. Wang and Y. S. Wang, "Gender differences in the perception and acceptance of online games," *Brit. J. Educ. Technol.*, vol. 39, no. 5, pp. 787–806, Sep. 2008.
75. D. Williams, M. Consalvo, S. Caplan, and N. Yee, "Looking for gender: Gender roles and behaviors among online gamers," *J. Commun.*, vol. 59, no. 4, pp. 700–725, Dec. 2009.
76. E. A. Van Reijmersdal, J. Jansz, O. Peters, and G. Van Noort, "Why girls go pink: Game character identification and game-players' motivations," *Comput. Hum. Behav.*, vol. 29, no. 6, pp. 2640–2649, Nov. 2013.
77. H. Nysveen, P. E. Pedersen, and H. Thorbjørnsen, "Explaining intention to use mobile chat services: Moderating effects of gender," *J. Consum. Market.*, vol. 22, no. 5, pp. 247–256, 2005.
78. D. Gefen and D. W. Straub, "Gender differences in the perception and use of e-Mail: An extension to the technology acceptance model," *MIS Quart.*, vol. 21, no. 4, pp. 389–400, Dec. 1997.
79. C. Van Slyke, C. L. Comunale, and F. Belanger, "Gender differences in perceptions of web-based shopping," *Commun. ACM*, vol. 45, no. 8, pp. 82–86, Aug. 2002.
80. V. Venkatesh and M. G. Morris, "Why don't men ever stop to ask for directions? Gender, social influence, and their role in technology acceptance and usage behavior," *MIS Quart.*, vol. 24, no. 1, pp. 115–139, Mar. 2000.
81. V. Venkatesh, M. G. Morris, T. A. Sykes, and P. L. Ackerman, "Individual reactions to new technologies in the workplace: The role of gender as a psychological construct," *J. Appl. Soc. Psychol.*, vol. 34, no. 3, pp. 445–467, Mar. 2004.
82. D. Liu, X. Li, and R. Santhanam, "Digital games and beyond: What happens when players compete?" *MIS Quart.*, vol. 37, no. 1, pp. 111–124, Mar. 2013.
83. J. Koivisto and J. Hamari, "Demographic differences in perceived benefits from gamification," *Comput. Hum. Behav.*, vol. 35, pp. 179–188, Jun. 2014.
84. T. Heiman and K. Precel, "Students with learning disabilities in higher education: Academic strategies profile," *J. Learn. Disabil.*, vol. 36, no. 3, pp. 248–258, May 2003.
85. J. Cromby, P. J. Standen, and D. J. Brown, "The potentials of virtual environments in the education and training of people with learning disabilities," *J. Intell. Disab. Res.*, vol. 40, no. 6, pp. 489–501, Dec. 1996.
86. M. A. Honey and M. L. Hilton, *Learning Science Through Computer Games and Simulations*. Washington, DC, USA: Nat. Acad. Press, 2011.
87. J. J. Vogel, D. S. Vogel, J. Cannon-Bowers, C. A. Bowers, K. Muse, and M. Wright, "Computer gaming and interactive simulations for learning: A meta-analysis," *J. Educ. Comput. Res.*, vol. 34, no. 3, pp. 229–243, 2006.
88. R. Blunt, "Does game-based learning work? Results from three recent studies," in *Proc. I/ITSEC*, 2007. ~~AQ3~~
89. H. Leemkuil, T. Jong, and S. Ootes, "Review of educational use of games and simulations," Univ. Twente, Enschede, The Nederlands, 2000.
90. K. Squire and H. Jenkins, "Harnessing the power of games in education," *Insight*, vol. 3, pp. 5–33, 2003.

91. S. O'Donovan, J. Gain, and P. Marais, "A case study in the gamification of a university-level ggames development course," in *Proc. South African Inst. Comput. Scientists Inf. Technol. Conf.*, 2013, pp. 242–251.
92. L. Sheldon, *The Multiplayer Classroom: Designing Coursework as a Game*. Boston, MA, USA: Course Technol. Press, 2011.
93. R. N. Landers and R. C. Callan, "Casual social games as serious games: The psychology of gamification in undergraduate education and employee training," in *Serious Games and Edutainment Applications*. London, U.K.: Springer-Verlag, 2011, pp. 399–423.
94. R. N. Landers and A. K. Landers, "An empirical test of the theory of gamified learning the effect of leaderboards on time-on-task and academic performance," *Simul. Gaming*, vol. 45, no. 6, pp. 769–785, Dec. 2014.
95. J. P. Gee, "Good video games and good learning," in *Phi Kappa Phi Forum*, vol. 85, no. 2, pp. 33–37, 2005.
96. J. P. Gee, "Learning by design: Good video games as learning machines," *E-Learn. Digit. Media*, vol. 2, pp. 5–16, 2005.
97. E. D. Mekler, F. Brühlmann, K. Opwis, and A. N. Tuch, "Do points, levels and leaderboards harm intrinsic motivation?: An empirical analysis of common gamification elements," in *Proc. Gamification*, Stratford, ON, Canada, 2013, pp. 66–73.
98. C. Butler, "The effect of leaderboard ranking on players' perception of gaming fun," in *Online Communities and Social Computing*. Berlin, Germany: Springer-Verlag, 2013, pp. 129–136.
99. L. Hakulinen, T. Auvinen, and A. Korhonen, "Empirical study on the effect of achievement badges in TRAKLA2 online learning environment conference," in *Proc. LaTiCE*, Macau, China, 2013, pp. 47–54.
100. A. Anderson, D. Huttenlocher, J. Kleinberg, and J. Leskovec, "Steering user behavior with badges," in *Proc. 22nd Int. Conf. World Wide Web*, Rio de Janeiro, Brazil, 2013, pp. 95–106.
101. L. R. Goldberg, "The development of markers for the big-five factor structure," *Psychol. Assess.*, vol. 4, no. 1, pp. 26–42, Mar. 1992.
102. I. Guy, A. Perer, T. Daniel, O. Greenshpan, and I. Turbahn, "Guess who?: Enriching the social graph through a crowdsourcing game," in *Proc. SIGCHI Conf. Hum. Factors Comput. Syst.*, 2011, pp. 1373–1382.
103. C. M. Ringle, S. Wende, and S. Will, *SmartPLS 2.0 (M3) Beta*. Hamburg, Germany: Univ. Hamburg, 2005.
104. J. Cohen, "A power primer," *Psychol. Bull.*, vol. 112, no. 1, pp. 155–159, 1992.
105. G. Schwarz, "Estimating the dimension of a model," *Ann. Statist.*, vol. 6, no. 2, pp. 461–464, 1978.
106. R. E. Kass and A. E. Raftery, "Bayes factors," *J. Amer. Statist. Assoc.*, vol. 90, pp. 773–795, 1995.
107. M. Scherer, "Do students care about learning," *Educ. Leadership*, vol. 60, no. 1, pp. 12–17, 2002.
108. G. Barata, S. Gama, J. Jorge, and D. Goncalves, "Engaging engeneering students with gamification," in *Proc. 5th Int. Conf. VS-GAMES*, Bournemouth, U.K., 2013, pp. 1–8.

Received January 26, 2015; accepted for publication February 19, 2015

David Codish *Ben-Gurion University of the Negev, Beer-Sheba, Israel (codishd@post.bgu.ac.il)*. Mr. Codish is a Ph.D. student at the Industrial Engineering and Management department at Ben-Gurion University, Israel. His M.Sc. and B.Sc. degrees are from Ben-Gurion University. For the past 20 years, he managed several information systems organizations for a variety of high-tech organizations and is now focusing most of his time on research. His key research area is gamification and its inclusion in various information systems as a means of making tedious tasks more fun, increasing user acceptance and achieving higher performance.

Gilad Ravid *Ben-Gurion University of the Negev, Beer-Sheba, Israel (rgilad@bgu.ac.il)*. Dr. Ravid is a senior faculty member in Information Systems at the Department of Industrial Engineering and Management, Ben-Gurion University of the Negev, Israel. His Ph.D. work, with a thesis on "Information Sharing with CMC in Small Groups: Communication Groups and Tasks," is from Haifa University; his M.B.A. degree is from the Hebrew University; and his B.Sc. degree is in agricultural engineering is from the Technion. He was a postdoctoral fellow at the Annenberg Center for Communication, University of Southern California, Los Angeles. Dr. Ravid's main interests are focused on the relationship between social structure and human behavior, games and gamification, and computer-mediated communication systems. His work includes such research as information overload phenomena, social structure in web-based educational forums, wiki-based education and Wikipedia* as a social space, celebrity formation, the "social structure" of lightning synchronization, civil information needs and information sharing in groups, learning with games, and gamification solutions. He has published in top peer-reviewed journals including *Information Systems Research, First Monday, and Information Systems Journal*.

AUTHOR QUERIES

AUTHOR PLEASE ANSWER ALL QUERIES

AQ1 – Please provide department of organization in Ref. [6].

AQ2 – Please provide publication update in Ref. [21].

AQ3 – Please provide page range in Ref. [88].

END OF ALL QUERIES