Association for Information Systems
AIS Electronic Library (AISeL)

2017 Proceedings | SIGED: IAIM Conference

2017

Gamifying the First Programming Class: Outcomes and Antecedents of Continued Engagement Intention

Mathupayas Thongmak
Dept. of MIS, TBS, Thammasat University, mathupayas@tbs.tu.ac.th

GAMIFYING THE FIRST PROGRAMMING CLASS: OUTCOMES AND ANTECEDENTS OF CONTINUED ENGAGEMENT INTENTION

Mathupayas Thongmak
MIS Department
Thammasat Business School
Thammasat University
mathupayas@tbs.tu.ac.th

Abstract:

Gamification is applying games in non-game contexts. This study uses card game plays to gamify assessment activity in the first programming class. An experimental study with one-group and post-test are conducted to test the perceived usefulness of the gamifying evaluation method and verify the proposed research model, based on Expectation Confirmation Theory; IT Continuance Model. Students perceive the usefulness of gamifying take-home exams in terms of increasing understanding, problem solving, creativity, and confidence more than the traditional ones. This study provides empirical supports for the relationship between performance and satisfaction and the influence of satisfaction on continued engagement intention of the game plays in classroom settings. The results could be applied to relax students' anxiety in the programming course's testing.

Keywords: gamification, engagement intention, programming, education, Expectation Confirmation Theory; IT continuance model

I. INTRODUCTION

MIS and computer science enrollment has been declined [Azmi, Iahad, & Ahmad, 2015; Marshall, Cardon, & Godin, 2014]. Changing recruiting methods, redesigning curricula, and implementing novel approaches in teaching such as a project-based approach could attract more majors and non-majors [Marshall et al., 2014]. Four foundation areas of MIS are web design, databases, programming, and networking. Programming is a core course for computer science and engineering professionals [Azmi et al., 2015; Qu, Zhao, Wang, & Liu, 2014]. Moreover, it is now reaching the public at large [Combefis, Bersnevicius, & Dagiene, 2016]. Object-oriented programming is widely applied in universities and industries [Azmi et al., 2015; Combefis et al., 2016]. Although programming is important and programmers are shortage, programming received least expectations about enjoyment and career importance, but most expectations about difficulty before and after class [Liyanagunawardena, Lundqvist, Micallef, & Williams, 2014; Marshall et al., 2014]. The difficulties in coping with the programming of novice students could decrease their passion, participation, and learning interests and increase dropout rates [Azmi et al., 2015; Combefis et al., 2016; Qu et al., 2014].

Holding students' attention and providing engaging experiences can significantly improve their learning [Chen, Kuo, Chang, & Heh, 2009; Tomaselli, Sanchez, & Brown, 2015]. Gamification is the use of game elements in non-game contexts such as education [Azmi et al., 2015; Combefis et al., 2016; Thiebes, Lins, & Basten, 2014; Tomaselli et al., 2015]. It has potential to boost participants' engagement and has been applied across various areas such as MIS and computer sciences [Yang, Asaad, & Dwivedi, 2017]. The use of gamifications could effectively motivate young learners, promote interaction among students, and make classrooms more fun and exciting [Azmi et al., 2015; Barata, Gama, Jorge, & Gonçalves, 2013; Combefis et al., 2016; Liyanagunawardena et al., 2014; Thiebes et al., 2014]. Gamification approaches for programming are gamifying learning activity, gamifying social activity, and gamifying assessment activity [Azmi et al., 2015]. In terms of assessment, a take-home exam can prolong students' retention of materials than an in-class test [Rich Jr, Colon, Mines, & Jivers, 2014]. It also saves classroom times and brings convenience both to students and instructors [J. Tao & Li, 2012]. Gamifying assessment activity using game-based take-home tests are interesting scope to study in practical research.

Some studies explore the gamification in education. Barata et al. conducted an experiment to assess the impact of gamifications on a Master's level College course, by comparing the gamified course to non-gamified course in the previous semester. Results showed the significant increase of lecture attendance, online participation, proactive behaviors, motivation, interesting, and easier to learn compared to other courses [Barata et al., 2013]. Thiebes et al. studied applying gamification to information systems to boost end-user motivation, by synthesizing system design, challenges, rewards, social influences, and user specify. The results revealed the potential of motivating information system end-users with gamifications [Thiebes et al., 2014]. Qu et al. explored the combination of online games and course teaching for software engineering to propose the practice guideline to achieve the training objectives for universities in China [Qu et al., 2014]. Hamari and Koivisto explored the relationship between utilitarian, hedonic and social motivations and continued use intention together with attitude toward gamification, gathering data from gamified service users. Findings pointed that attitude toward gamification mediates the relationship between utilitarian benefits and use. Hedonic motivation positively drives usage, while social factor weakly associates with the intention to continued usage of a gamified service [Hamari & Koivisto, 2015]. Tomaselli et al. conducted a survey to explore gamers' preferences. Eight engaging factors representing different aspects about playing, mastering, and competing were extracted. Competing were a least influential factor to engage users [Tomaselli et al., 2015]. Landers and Armstrong applied the Technology-Enhanced Training Effectiveness Model [TETEM] in gamifying the organizational context. Results suggested that learner attitudes towards game-based-learning and video game experience were important to produce better instructional outcomes [Landers & Armstrong, 2015]. Azmi et al. guided how to embed gamification in online collaborative learning to maximize the participation of novice programming students, using a list of game elements [Azmi et al., 2015]. Hamari et al. investigated the effect of flow, engagement, and immersion on learning in the game-based settings, using a survey from players. Game challenges positively affected directly and indirectly [via engagement] on learning outcomes, whereas being skilled in the game increased game engagement. Both factors had a positive influence on engagement and immersive [Hamari et al., 2016]. Combefis et al. reviewed online platforms to learn coding and presented the review with concrete game-based platforms [Combefis et al., 2016]. Yang et al. adopted the technology acceptance model [TAM] to examine the use of gamification in the marketing context. Findings supported that perceived usefulness and perceived enjoyment predicted engagement intention and attitudes toward the brand, while perceived ease of use and social influence did not significantly impact the intention [Yang et al., 2017].

Despite these studies, gamification is relatively new area, in the exploration stage. There is limited knowledge how gamification can be effectively applied. Also, academic evidences regarding adoption factors and benefits of gamification are still lacking [Barata et al., 2013; Hamari & Koivisto, 2015; Hamari, Koivisto, & Sarsa, 2014; Qu et al., 2014; Thiebes et al., 2014; Yang et al., 2017]. The objective of this study is therefore to examine these research questions: 1) Do different types of individual/ team strategy affect the individual's/ team's performance? 2) Does the performance in game plays increase students' satisfaction in gamification? 3) Does students' satisfaction predict the continued engagement intention? 4) Are there any differences in the students' perceived usefulness of gamifying assessment activity with a take home exam and students' perceived usefulness of traditional classrooms with a lab exam?

II. RESEARCH HYPOTHESES

Strategy and Performance

Students' intrinsic motivations (competence, effort, and interest) are related to the strategic use [Vos, Van Der Meijden, & Denessen, 2011]. Strategies such as deep strategy highly impact outcomes such as deep learning outcomes and student learning outcomes [Biggs, Kember, & Leung, 2001; Vos et al., 2011]. Gamification can lead to the learning outcome improvement

[Landers & Armstrong, 2015]. Game play also motivates the use of strategy more than during regular school lessons [Vos et al., 2011]. Contests of programming games can engage and raise programming skills [Combefis et al., 2016]. According to the Expectation Confirmation Theory, perceived performance positively relates to satisfaction. In the context of business simulation games, student's learning performance strongly impacts the satisfaction level too [Y.-H. Tao, Cheng, & Sun, 2009]. Challenge in game plays significantly affect the engagement [Hamari et al., 2016]. Companies adopt gamification because of the hope in improving business performance [Yang et al., 2017]. Performance gamefulness as an interpersonal goal is proposed to positively drive users' engagement [Tomaselli et al., 2015]. Therefore, this study proposes the following hypotheses:

H1: Individual or team strategy is related to the performance of individuals or team.

H2: Performance in game plays positively affects students' satisfaction in gamification.

Satisfaction and Continued Engagement

Gamification has been a strategy to raise engagement such as engaging users and engaging trainees [Tomaselli et al., 2015; Yang et al., 2017]. In an educational context, engagement and motivation are expected in the game features [Combefis et al., 2016]. Gamification methods are reported as a tool for enhancing students' participation both in traditional classroom and online learning environments [Azmi et al., 2015; Combefis et al., 2016]. Participation elements consist of teamwork, instructor support and personal encouragement [Azmi et al., 2015]. Engagement is significantly related to perceived learning [Hamari et al., 2016]. Engagement in terms of class attendance has a strong relationship with academic performance, such as scores or grades [Credé, Roch, & Kieszczynka, 2010]. Generally, students want to participate in-class activities rather than to listen classroom lecture for the same amount of time [Gilboy, Heinerichs, & Pazzaglia, 2015]. Gamifying classroom positively affect lecture attendance [Barata et al., 2013]. A study from the literature shows that students were more engaged with gamified experiences in the form of the number of downloads, posts, and attendance more than the non-gamified settings [Barata et al., 2013].

Student satisfaction is an aspect of understanding new learning experiences [Stephens, McGowan, & Pape, 2015]. User satisfaction significantly increases the intention to use e-learning [Hassanzadeh, Kanaani, & Elahi, 2012]. According to IT continuance model, satisfaction has a positive influence on continuance intention [Bhattacherjee, Perols, & Sanford, 2008; Lee, 2010]. Empirical study supports that users had more valence for gamified instruction than traditional training [Landers & Armstrong, 2015]. Users' satisfaction level is strongly associated with continuance intention in various contexts [Bhattacherjee, 2001; Chiu, Hsu, Sun, Lin, & Sun, 2005; Lee, 2010; Liaw, 2008; Lin & Wang, 2012]. In addition, satisfaction of students in business simulation games has a noticeable influence on their continued use intention [Y.-H. Tao et al., 2009]. Students think that gamified course is satisfied and is much more motivating and interesting than other courses, although the course is required more time working [Barata et al., 2013]. Most students enjoy collaborating on group assignments [Elliott, 2014]. Therefore, this study proposes the following hypothesis:

H3: Students' satisfaction positively affects their continued engagement intention.

Perceived Usefulness

Believes that the use of the system is valuable could drive the tendency to use [Hassanzadeh et al., 2012; J. Tao & Li, 2012]. Perceived value significantly affects user satisfaction [Chiu et al., 2005]. Perceived usefulness has a noticeable impact on the satisfaction of e-learning [Arbaugh, 2000; Liaw, 2008; Lin & Wang, 2012; Sun, Tsai, Finger, Chen, & Yeh, 2008; J. Tao & Li, 2012]. It significantly affects the learning performance in business simulation games and customers' intention to engage gamification [Y.-H. Tao et al., 2009; Yang et al., 2017]. Perceived usefulness or perceived benefits are also associated with behavioral intention such as in the context of MOOC study [Mah & Er, 2009; Roca & Gagné, 2008; Tanakinjal, Andrias, Sondoh, & Ibrahim, 2012; Wojciechowski & Cellary, 2013; Xu, 2015]. In addition, perceived usefulness positively influence both satisfaction and continuance intention, particularly in the IT continuance model [Bhattacherjee et al., 2008; Lee, 2010; Lin & Wang, 2012]. Usefulness positively relates to continued use [Hamari & Koivisto, 2015].

Understanding: Most students believe that they learn more effectively when using online recorded lecture [Gilboy et al., 2015]. Take-home tests help improve students' knowledge by combining lectures and class activities, based on pre-existing knowledge [Rich Jr et al., 2014]. Students gain more knowledge after reviewing textbooks and notes to answer a take-home exam [Rich Jr et al., 2014]. Comprehensive content is an indicator of e-learning success [Hassanzadeh et al., 2012]. ***Problem Solving:*** Student-centered learning and the increase of student-teacher interaction enhance student performance and learning significantly [Schultz, Duffield, Rasmussen, & Wageman, 2014]. Applying student-centered activities such as a flipped classroom also noticeably increase solving problem skills of students [Aşıksoy & Özdamlı, 2016]. Contest as a part of game-based learning develops problem solving skills and computational thinking for students, making students focusing on algorithmic problem solving [Combefis et al., 2016]. ***Creativity:*** Innovative or creative course is important to MIS enrollment [Marshall et al., 2014]. Aesthetic is a very important part in a game, to make the game fun for learners [Combefis et al., 2016; Tomaselli et al., 2015]. Take-home work can incentivize students to collaborate and create innovative ideas with others [Rich Jr et al., 2014]. ***Challenges:*** Competition is a tool to create interpersonal motivation, which is vital for learning [Chen et al., 2009]. It also a tool to improve employee skills [Thiebes et al., 2014]. The challenge is one of dimensions pertaining to engagement in the literature [Tomaselli et al., 2015]. Implementing challenges are another aspect important for developing gamified IS course [Thiebes et al., 2014]. Normally, students like challenging works. Lack of challenges could lead to their disengagement [Hamari et al., 2016]. Higher challenges, as the major behavior drivers in the experience, enable greater engagement or the sense of immersive [Barata et al., 2013; Hamari et al., 2016]. Challenges to overcome the game obstacles and to master in game plays are matters the most, to prevent players from boredom or frustration [Barata et al., 2013; Chen et al., 2009; Hamari et al., 2016; Tomaselli et al., 2015]. Achievable goals with an optimal challenge should be set to increase perceived competence [Roca & Gagné, 2008]. ***Confidence:*** Take-home exam could decrease students' anxiety [Rich Jr et al., 2014]. Higher motivation could be received via greater self-efficacy, when players perceived themselves to be competent [Hamari et al., 2016]. Learners with high self-efficacy are more confident in finishing e-learning tasks and gain higher satisfaction and enjoyment [Sun et al., 2008]. Self-efficacy, presenting confidence in a user's ability, relates to continuance intention [Bhattacherjee et al., 2008]. Many game-based learning utilizes the concept of ARCS [attention, relevance, confidence, and satisfaction] to evaluate stimuli for learners' performance [Kim & Lee, 2012]. Thus, this study proposes the following hypothesis:

H4: There is a difference in students' perceived usefulness (understanding, problem solving, creativity, challenge, and confidence) of a take home exam with gamifications and students' perceived usefulness of a lab exam.

III. RESEARCH DESIGN AND METHOD

Participants and Procedure

Participants were students from three sections of three semesters of the course 'programming concepts', taught by the same lecturer at a public university in Thailand. The programming course is the fundamental course for students both in MIS major and in MIS minor. It applied JAVA, an object-oriented programming language, as a tool for representing the results of programming logics. Eighteen students [not including dropout students] enrolled in those three classes.

An experimental study with one-group and post-test was applied. The study was conducted in three closely similar settings. Students in each section played card games, both as individuals (competing with other students) and the team plays (competing with a group of students). Three card games had simple rules, but slightly different from each other. Every card game was later modified a bit and was turned to be the rules for take-home exams. All students were informed about the gamification with a take-home exam after first or second round game plays. Take-home exams with gamifications were applied to increase students' confidence in programming and to decrease students' anxiety from traditional exams. However, since cheating could be a problem of a take-home exam [J. Tao & Li, 2012], the assigned take-home exams contained both descriptive part and contest part, with two submitted milestones. So, students cannot copy the results from others, but had to work on and explain the programming logics on their own. To be successful, students had to derive embedded strategies that they applied to win others in the classes and express the strategies algorithmically.

The card games, playing in the programming courses, fulfilled the participatory elements of collaborative learning environment: instructor support, teamwork, and personal encouragement [Azmi et al., 2015]. It contained multiple modalities, which are visual, auditory, and haptic combination [Combefis et al., 2016]. Since multiplayer collaborative games were more motivating and engaging, the team plays were set, extra of the individual plays [Combefis et al., 2016]. Game elements should also contain mechanics, dynamics, and aesthetics [Azmi et al., 2015; Chen et al., 2009; Combefis et al., 2016; Landers, 2014; Thiebes et al., 2014]. In the aspect of mechanics, the card games had points [win/ lose/ draw points] for each round. The instructor provided clear rules, goals, and guidance, but students could participate and discuss about unclear rules since the first play. The feedback about the game results were announced to other players in every round. Teams were also the mechanic in each round, after finishing individual plays. In terms of dynamics, individual and team playing enabled social dynamics, competition, and peer collaboration. Students had to interact with other players in both space and time. The competitors were assigned to each student randomly. Players in each team were shuffled after each round too. In terms of aesthetics, the games were challenging, but not too easy and too difficult. Students felt fun and looked happy when it was time to play.

Instrument and Data Analysis

Two self-reported online questionnaires were collected. The first questionnaire was gathered immediately after card game plays in class each round, totally five rounds. Its first section was about students' information (id) and individual play details consisting of winning times, the satisfaction level of individual play (ranging from 0 to 5 marks), and strategy of individual play (1 = using old strategies from last play, 2 = improving old strategy, and 3 = applying new strategy). The second section were about the details of team play in terms of winning times, the satisfaction level of team play (ranging from 0 to 5 marks), team strategy (1 = no strategy, 2 = applying old strategy, 3 = applying strategy from a leader, and 4 = applying strategy from brainstorming), and leader role (1 = leading least and 5 = leading most). The last section was related to the feelings after game plays in terms of continued intention to lead team plays and continued intention to engage game plays, both were rated from 1 to 5 (lowest to highest). The second questionnaire was surveyed once after all game plays were finished, opening for students freely to fill until after take-home exam ends. Its first section collected students' information (id, GPA). The second section were the section to assess each assessment activity such as a lab exam and a take-home exam, ranging from 1 to 5 (strongly disagree to strongly agree). Four evaluation aspects regarding perceived usefulness consisted of understanding, problem solving, creativity, challenge, and confidence.

Data from the first questionnaire were applied to test H1 – H3, whereas data from the second questionnaire were used to test H4. After 5 repeated game plays in each section, 92 questionnaires were collected from the first questionnaire. Eighteen questionnaires were gathered from the second questionnaire. As the general rule of thumb, Heckler suggested that the number of observations should be greater than 5 times of variables in factor analysis [Heckler, 1996]. It should be 15 to 20 observations for each variable in a regression analysis [Siddiqui, 2013]. Therefore, all data were satisfied and ready for analysis phase. The H1 – H3 were analyzed using simple linear regression. The H4 were analyzed with the non-parametric test (equivalent to the dependent t-test), the Wilcoxon signed-rank test, because of non-normality of the data. Descriptive statistics were also reported.

IV. FINDINGS

Factor Analysis and Reliability Assessment

The instrument was tested the construct validity using factor analysis and reliability using Cronbach's alpha, applying the data from the first questionnaire. The minimum amount of data for factor analysis was passed with a sample size of 92, providing a ratio of over 5 cases per variable. For factor analysis, the Kaiser-Meyer-Olkin measure of sampling adequacy was above the rule of thumb of 0.5 [Andy, 2000; Mallery, 1999; Russell, 2002; Sharma, 1996]. Bartlett's test of sphericity was significant, determining that the correlation matrix is not an identity matrix [Andy, 2000; Mallery, 1999]. Principal components analysis and varimax rotation were applied, with eigenvalue more than one and factor loadings of each factor over .5. Five items were extracted as satisfaction and continued engagement intention factors, explaining 65.865 and 77.216 percent of the variance respectively. The internal consistency of each factor was assessed using Cronbach's alpha. The alpha values were moderate (α of satisfaction = .740, α of continued engagement intention = .698), as shown in Table 1.

Table 1. Factor analysis results

Variables/ Subscales	**Factor Loadings**		**%Cumulative Variance**	**Cronbach's alpha**
	SF[1]	**EI[2]**		
Satisfaction [individuals' plays]	.840		65.865	.740
Satisfaction [team plays]	.800			
Leader role	.794			
Continued intention to lead team plays		.879	77.216	.698
Continued intention to engage game plays		.879		

[1]Kaiser-Meyer-Olkin [KMO] = .680 Bartlett's Test of Sphericity: Chi-Square = 54.318 df = 3 p = .000

[2]Kaiser-Meyer-Olkin [KMO] = .500 Bartlett's Test of Sphericity: Chi-Square = 30.746 df = 1 p = .000

Descriptive Statistics and Hypotheses Testing

Of 18 students, all of them participated in gamifying programming class. Five of them (27.78%) are females. Thirteen of them (72.22%) are males. Twelve of them (66.67%) were sophomore. Six of them (33.33%) were junior and senior, half. The average GPA of students in each section were 3.19, 3.07, and 2.83 respectively. Female students had slightly higher average GPA comparing to male students (3.18 vs. 2.98).

Regression analyses were calculated to predict performance based on individual's/ team strategy (treated as dummy variables). Individual's strategy insignificantly drove game performance (game victory), β = -.004, $t(79)$ = -.034, p = .973, β = 0.78,$t(79)$ = .641, p = .524. Individual's strategy insignificantly explained a proportion of variance in performance of individual playing, R^2 = .006, $F(2, 79)$ = .250, p = .780. Team strategy (the game strategy from brainstorming) significantly predicted game performance (game victory), β = .222, $t(84)$ = 1.570, p = .120, β =.147, $t(84)$ = 1.043, p = .300, β =.415, $t(84)$ = 2.746, p = .007. Team strategy significantly explained a proportion of variance in the performance of team playing, R^2 = .091, $F(3, 84)$ = 2.814, $p < .05$. So, H1 was partially supported. Performance of both individual plays and team plays were calculated from winning times and were standardized to be 100 percent since the total sub-rounds played in each round of each section were not equal. Conducting regression analysis, game performance of individual playing significantly predicted satisfaction in individual playing, β =.239, $t(81)$ = 2.255, $p < .05$. Game performance of team playing significantly predicted satisfaction in team playing, β = .216, $t(81)$ = 2.036, $p < .05$. Performance of individual playing and team playing also explained a significant proportion of variance in satisfaction in game playing, R^2 = .126, $F(2, 81)$ = 5.813, $p < .01$. Therefore, H2 were confirmed. Simple linear regression analysis was used to test if the game satisfaction significantly predicted continued engagement intention. The results of the regression indicated the game satisfaction explained 19.9% of the variance (R^2 =.199, $F(1,82)$=20.419, p = .000). It was found that game satisfaction significantly predicted continued engagement intention (β = .447, p =.000). So, H3 was confirmed.

Data from the second questionnaire was applied to test the perceived usefulness of gamifying assessment activity (the take-home exam with gamifications). A Wilcoxon Signed-Ranks test indicated that a take home exam with gamifications (Mdn = 4.0) was rated more understanding than a lab exam (Mdn = 3.5), Z = -2.364, $p < 0.05$. It also indicated that the problem solving would be increased in a take home exam with gamifications (Mdn = 5.0) more than in a lab exam (Mdn = 4.0), Z = -2.801, p = .005. A sign test indicated that the creativity was perceived more in a take home exam with gamifications (Mdn = 5.0) than in a lab exam (Mdn = 4.0), Z = -2.752, p = .006. A Wilcoxon Signed-Ranks test pointed that gamifying a take home exam with gamifications (Mdn = 5.0) was insignificantly rated more challenging than a lab exam (Mdn = 4.5), Z = -1.096, p = .273. In addition, a sign test showed that a take home exam with gamifications could create more confidence (Mdn = 4.0) among students than a lab exam (Mdn = 3.0), Z = -2.811, p = .005. Thus, H4 was partially confirmed.

V. DISCUSSION

The present study quantitatively explores gamifying the programming classroom. Only a few studies apply Expectation Confirmation Theory and IT Continuance Model with the gamifying programming course. Researchers could extend the proposed model in the future with other factors. Findings suggest that the gamifying the assessment method with gamification yields good outcomes. Students perceive that the take-home exam that in line with card game plays in the programming class could increase their understanding, problem solving, creativity, and confidence more than traditional evaluation such as a lab exam. Considering the game plays, if play as a team, the game strategy from brainstorming can bring the better team performance. Both performances of individual and team plays drive higher satisfaction in gamification. Satisfaction could be the satisfaction of individual play, team play, and satisfied as team leader. Satisfying game plays both competing as individuals or teams could enhance students' intention to later lead the team or join the card game plays. These findings suggest that lecturers should apply gamifications to the assessment activity such as take-home exams or take-home assignments and keep the game elements to be simple but fun. Both individual and team plays should be combined to enhance the dynamic in the gamifying programming classroom.

VI. CONCLUSION, LIMITATIONS, AND FUTURE WORKS

The purposes of this study is to explore students' playing performance, satisfaction, and continued engagement intention in game plays during the programming course. This study contributes to the gamification literature by showing that simple games together with the related assessment method may be effective of programming course in terms of understanding, problem solving, creativity, and confidence of students. In addition, take-home exam with gamification could bring convenience to students and instructor, create a more relaxed environment of testing, and decrease exam time for students to freely review the contents [J. Tao & Li, 2012].

There is some limitation of this work in terms of the small sample size. Since the programming class in MIS major is quite small. Thus, future work should replicate this study in different environments such as in computer science or computer engineering majors. The research model should add other drivers such as specific game elements. More game styles rather than card games such as puzzle games or online games should be applied, to explore more choices for gamifying assessment activities.

LIST OF REFERENCES

Andy, P. [2000]. Field, Discovering Statistics Using SPSS for Windows: Advanced Techniques for Beginners: Sage Publications, Inc., Thousand Oaks, CA.

Arbaugh, J. B. [2000]. Virtual classroom characteristics and student satisfaction with internet-based MBA courses. *Journal of management education, 24*[1], 32-54.

Aşıksoy, G., & Özdamlı, F. [2016]. Flipped Classroom adapted to the ARCS Model of Motivation and applied to a Physics Course. *Eurasia Journal of Mathematics, Science & Technology Education, 12*[6], 1589-1603.

Azmi, S., Iahad, N. A., & Ahmad, N. [2015]. Gamification in online collaborative learning for programming courses: a literature review. *ARPN Journal of Engineering and Applied Sciences, 10*[23], 1-3.

Barata, G., Gama, S., Jorge, J., & Gonçalves, D. [2013]. *Engaging engeneering students with gamification.* Paper presented at the the 5th International Conference on Games and Virtual Worlds for Serious Applications [VS-GAMES].

Bhattacherjee, A. [2001]. Understanding information systems continuance: an expectation-confirmation model. *Mis Quarterly*, 351-370.

Bhattacherjee, A., Perols, J., & Sanford, C. [2008]. Information technology continuance: A theoretic extension and empirical test. *Journal of Computer Information Systems, 49*[1], 17-26.

Biggs, J., Kember, D., & Leung, D. Y. [2001]. The revised two-factor study process questionnaire: R-SPQ-2F. *British journal of educational psychology, 71*[1], 133-149.

Chen, P., Kuo, R., Chang, M., & Heh, J.-S. [2009]. Designing a trading card game as educational reward system to improve students' learning motivations *Transactions on Edutainment III* [pp. 116-128]: Springer.

Chiu, C.-M., Hsu, M.-H., Sun, S.-Y., Lin, T.-C., & Sun, P.-C. [2005]. Usability, quality, value and e-learning continuance decisions. *Computers & Education, 45*[4], 399-416.

Combefis, S., Bersnevicius, G., & Dagiene, V. [2016]. Learning Programming through Games and Contests: Overview, Characterisation and Discussion. *INTERNATIONAL OLYMPIAD IN INFORMATICS Vol. 10: 39–60. Vilnius: Vilniaus universiteto leidykla. ISSN 1822, 7732*.

Credé, M., Roch, S. G., & Kieszczynka, U. M. [2010]. Class Attendance in College A Meta-Analytic Review of the Relationship of Class Attendance With Grades and Student Characteristics. *Review of Educational Research, 80*[2], 272-295.

Elliott, R. [2014]. *Do students like the flipped classroom? An investigation of student reaction to a flipped undergraduate IT course.* Paper presented at the 2014 IEEE Frontiers in Education Conference [FIE] Proceedings.

Gilboy, M. B., Heinerichs, S., & Pazzaglia, G. [2015]. Enhancing student engagement using the flipped classroom. *Journal of nutrition education and behavior, 47*[1], 109-114.

Hamari, J., & Koivisto, J. [2015]. Why do people use gamification services? *International Journal of Information Management, 35*[4], 419-431.

Hamari, J., Koivisto, J., & Sarsa, H. [2014]. *Does Gamification Work?--A Literature Review of Empirical Studies on Gamification.* Paper presented at the the 47th Hawaii International Conference on System Sciences [HICSS].

Hamari, J., Shernoff, D. J., Rowe, E., Coller, B., Asbell-Clarke, J., & Edwards, T. [2016]. Challenging games help students learn: An empirical study on engagement, flow and immersion in game-based learning. *Computers in human behavior, 54*, 170-179.

Hassanzadeh, A., Kanaani, F., & Elahi, S. [2012]. A model for measuring e-learning systems success in universities. *Expert Systems with Applications, 39*[12], 10959-10966.

Heckler, C. E. [1996]. A Step-by-Step Approach to Using the SAS™ System for Factor Analysis and Structural Equation Modeling. *Technometrics, 38*[3], 296-297.

Kim, J. T., & Lee, W.-H. [2012]. Dynamical model for gamification: Optimization of four primary factors of learning games for educational effectiveness *Computer Applications for Graphics, Grid Computing, and Industrial Environment* [pp. 24-32]: Springer.

Landers, R. N. [2014]. Developing a theory of gamified learning: Linking serious games and gamification of learning. *Simulation & Gaming, 45*[6], 752-768.

Landers, R. N., & Armstrong, M. B. [2015]. Enhancing instructional outcomes with gamification: An empirical test of the Technology-Enhanced Training Effectiveness Model. *Computers in human behavior*.

Lee, M.-C. [2010]. Explaining and predicting users' continuance intention toward e-learning: An extension of the expectation–confirmation model. *Computers & Education, 54*[2], 506-516.

Liaw, S.-S. [2008]. Investigating students' perceived satisfaction, behavioral intention, and effectiveness of e-learning: A case study of the Blackboard system. *Computers & Education, 51*[2], 864-873.

Lin, W.-S., & Wang, C.-H. [2012]. Antecedences to continued intentions of adopting e-learning system in blended learning instruction: A contingency framework based on models of information system success and task-technology fit. *Computers & Education, 58*[1], 88-99.

Liyanagunawardena, T. R., Lundqvist, K. O., Micallef, L., & Williams, S. A. [2014]. Teaching programming to beginners in a massive open online course.

Mah, B. Y., & Er, A. N. [2009]. Measuring students' perception of writing web logs in ESL classroom employing the Technology Acceptance Model. *Proceedings of CSSR 08'09: quality research creates quality publications*.

Mallery, P. [1999]. SPSS for Windows Step by Step: A simple guide and reference: Needham Heights, MA: Allyn & Bacon.

Marshall, B., Cardon, P., & Godin, J. [2014]. A STUDY OF PROJECT-BASED LEARNING IN AN INTRODUCTORY MIS COURSE. *Issues in Information Systems, 15*[2].

Qu, W.-Q., Zhao, Y.-F., Wang, M., & Liu, B.-Q. [2014]. *Research on teaching gamification of software engineering.* Paper presented at the Computer Science & Education [ICCSE], 2014 9th International Conference on.

Rich Jr, J. D., Colon, A. N., Mines, D., & Jivers, K. L. [2014]. Creating learner-centered assessment strategies for promoting greater student retention and class participation.

Roca, J. C., & Gagné, M. [2008]. Understanding e-learning continuance intention in the workplace: A self-determination theory perspective. *Computers in human behavior, 24*[4], 1585-1604.

Russell, D. W. [2002]. In search of underlying dimensions: The use [and abuse] of factor analysis in Personality and Social Psychology Bulletin. *Personality and social psychology bulletin, 28*[12], 1629-1646.

Schultz, D., Duffield, S., Rasmussen, S. C., & Wageman, J. [2014]. Effects of the flipped classroom model on student performance for advanced placement high school chemistry students. *Journal of Chemical Education, 91*[9], 1334-1339.

Sharma, S. S. [1996]. *Applied multivariate techiques*: John Wiley & Sons.

Siddiqui, K. A. [2013]. Heuristics for sample size determination in multivariate statistical techniques. *World Applied Sciences Journal, 27*[2], 285-287.

Stephens, P. R., McGowan, M. K., & Pape, V. V. [2015]. BLENDED LEARNING IN THE INTRODUCTORY COMPUTER SKILLS COURSE. *Issues in Information Systems, 16*[3].

Sun, P.-C., Tsai, R. J., Finger, G., Chen, Y.-Y., & Yeh, D. [2008]. What drives a successful e-Learning? An empirical investigation of the critical factors influencing learner satisfaction. *Computers & Education, 50*[4], 1183-1202.

Tanakinjal, G. H., Andrias, R., Sondoh, S., & Ibrahim, A. [2012]. Relationship between perceived benefits and social influence towards self-disclosure and behavioral intention in web 2.0. *European Journal of Business and Social Sciences, 1*[4], 63-75.

Tao, J., & Li, Z. [2012]. A Case Study on Computerized Take-Home Testing: Benefits and Pitfalls. *International Journal of Technology in Teaching & Learning, 8*[1].

Tao, Y.-H., Cheng, C.-J., & Sun, S.-Y. [2009]. What influences college students to continue using business simulation games? The Taiwan experience. *Computers & Education, 53*[3], 929-939.

Thiebes, S., Lins, S., & Basten, D. [2014]. Gamifying information systems-a synthesis of gamification mechanics and dynamics.

Tomaselli, F., Sanchez, O., & Brown, S. [2015]. How to Engage Users through Gamification: The Prevalent Effects of Playing and Mastering over Competing.

Vos, N., Van Der Meijden, H., & Denessen, E. [2011]. Effects of constructing versus playing an educational game on student motivation and deep learning strategy use. *Computers & Education, 56*[1], 127-137.

Wojciechowski, R., & Cellary, W. [2013]. Evaluation of learners' attitude toward learning in ARIES augmented reality environments. *Computers & Education, 68*, 570-585.

Xu, F. [2015]. *Research of the MOOC study behavior influencing factors.* Paper presented at the Proceedings of international conference on advanced information and communication technology for education, Atlantis Press, Amsterdam, Netherlands.

Yang, Y., Asaad, Y., & Dwivedi, Y. [2017]. Examining the impact of gamification on intention of engagement and brand attitude in the marketing context. *Computers in human behavior*.