www.ijte.net

The Effects of Gamified Components on Learning Motivation, Engagement, and Teamwork in an Online University Course

Chien-Yuan Su
National University of Tainan, Taiwan

Yuqing Guo
Zhejiang University, China

Juncheng Shen
Zhejiang University, China

To cite this article:

Su, C.Y., Guo, Y., & Shen, J. (2025). The effects of gamified components on learning motivation, engagement, and teamwork in an online university course. *International Journal of Technology in Education (IJTE), 8*(2), 467-481. https://doi.org/10.46328/ijte.1072

International Journal of Technology in Education
2025, Vol. 8, No. 2, 467-481 https://doi.org/10.46328/ijte.1072

The Effects of Gamified Components on Learning Motivation, Engagement, and Teamwork in an Online University Course

Chien-Yuan Su, Yuqing Guo, Juncheng Shen

Article Info

Article History

Received:
11 October 2024
Accepted:
29 March 2025

Keywords

Gamification
Game mechanics
Reward
Role-play
Competition

Abstract

The incorporation of gamification into online courses has become an increasingly popular approach to enhance students' learning experience, as it has the potential to increase their engagement, motivation, and interest. In this study, we examined the impact of three gamified components—rewards, role-playing, and competition—on students' learning motivation, engagement, and teamwork in an eight-week online university course. The study surveyed 60 undergraduates from a public university in East China, who completed an eight-week online course and responded to a questionnaire survey, and the data were analyzed using partial least squares structural equation modeling (PLS-SEM). The results revealed that rewards had a positive effect on students' teamwork, while role-playing significantly impacted learner engagement and teamwork, but had a limited influence on learning motivation. Competition had a positive impact on learning motivation, but did not significantly affect engagement or teamwork. The implications of these findings for gamification design in teaching practice are discussed.

Introduction

Gamification, a concept that integrates game elements into non-game contexts, has been increasingly adopted in online curricula as an innovative and effective strategy to enhance students' learning experiences (Alsawaier, 2018). Gamification, which may be activated by using game components such as rewards, points, levels, role-play, badges, leaderboards, and virtual gifts, has been found to boost motivation, engagement, and interest in learning, thus resulting in increased learning performance (Alsawaier, 2018; Aguiar-Castillo et al., 2020; Bakhanova et al., 2020; Özhan & Kocadere, 2020; Moccozet et al., 2013).

Despite the growing interest in gamification in the context of education, previous research has primarily focused on the effects of individual game components in diverse learning settings, with limited investigation on the interplay of multiple game elements in online learning environments (Özhan & Kocadere, 2020). Therefore, the current study aims to fill this gap by developing a game-based online learning curriculum that integrates the three gamified elements of reward, role-play, and competition, as supported by Moodle, to explore their impact on university students' learning motivation, engagement, and teamwork.

The integration of these gamified elements is expected to create an interesting, joyful, and enjoyable learning experience for students, encouraging them to actively participate in the learning process (Alsawaier, 2018). Rewards such as virtual badges and certificates are anticipated to increase students' intrinsic motivation, while competition such as leaderboards is predicted to enhance their extrinsic motivation (Bakhanova et al., 2020). The role-play element is also expected to promote engagement and teamwork, as it allows students to take on different roles and collaborate with their peers to solve problems and complete tasks (Moccozet et al., 2013).

The study will employ a quantitative approach via questionnaire collection methods to gather insights into the impact of the gamified elements on students' learning experiences. Quantitative data will be collected through a survey that measures students' motivation, engagement, and teamwork to provide in-depth information on students' perceptions of the gamified elements. Overall, this study aims to contribute to an understanding of the interplay between multiple game components in online learning environments and further provide practical implications for educators to design effective and engaging online curricula.

Reward

As a well-known real-time incentive feedback approach, reward plays a critical role in gamification design (Garaialde et al., 2021; Rapp, 2017). Rewards are commonly granted in the form of points or virtual gold coins when specific actions are successfully completed within the gamified environment. These rewards are used to quantitatively measure a player's progress (Lewis et al., 2016; Werbach & Hunter, 2012, 2015). For instance, students who perform well in a virtual game learning environment may receive measurable stars, medals, or gold coins that can be exchanged for other products. Points are also a popular type of reward that enable students to accumulate or exchange them for privileges, such as using a calculator during an exam, which can enhance academic achievement and promote collaboration (Sánchez-Martín et al., 2017). Furthermore, social recognition of accomplishment motivates students to perform well to earn more rewards (Skinner, 2014), which in turn leads to improved learning performance and outcomes. Numerous prior studies have demonstrated that incorporating rewards into the online learning process significantly enhances learning motivation (Bicen & Kocakoyun, 2018; D. Song et al., 2017), attitude (Hasan et al., 2018; Yildirim, 2017), engagement (D. Song et al., 2017), and learning collaboration (Sánchez-Martín et al., 2017) by increasing optimism for achievement (Bicen & Kocakoyun, 2018). Thus, the following hypotheses are proposed:

H1: Reward has a positive impact on learning motivation.

H2: Reward has a positive impact on learning engagement.

H3: Reward has a positive impact on learning collaboration.

Role-Play

Role-playing is a genre of game that involves players taking on the role of a specific character, complete with unique talents, personality traits, and combat style, among other characteristics, and navigating the game world accordingly (Ntokos, 2019). In the educational context, integrating a role-playing mechanism into the learning environment can enhance the engagement of students, as they can choose a particular role to immerse themselves

in learning tasks such as overcoming challenges and gaining experience, levels, or achievements (P. W. Kim et al., 2013; Lim et al., 2011; Wishart et al., 2007). For instance, previous studies have demonstrated that incorporating role-playing into the classroom can enhance learner involvement, creativity, verbal divergent thinking, academic performance, and learning attitudes (Chen et al., 2020; Chiu & Hsieh, 2017; E. Sanchez et al., 2017; Kusuma et al., 2021). E. Sanchez et al. (2017) introduced role-play into class management and discovered that allowing students to manipulate virtual characters can enhance their engagement and promote creativity and verbal divergent thinking. Similarly, Chiu & Hsieh (2017) developed an RPG-based game assessment to teach second-graders mathematical concepts which led to improved academic performance and learning attitudes. Kusuma et al. (2021) implemented a role-playing game on a mobile platform to teach historical concepts, and the results suggested that incorporating role-play into the game may increase students' learning motivation and achievement.

Studies have shown that role-playing has a positive impact on students' learning outcomes, including increasing learning proficiency, motivation (Stansbury & Earnest, 2017), attitude (Mirliss, 2014), and engagement (P. W. Kim et al., 2013; Lim et al., 2011; Wishart et al., 2007). Additionally, role-playing can foster collaboration among students by integrating perspectives from various roles to achieve a common goal (Ferrero et al., 2018). Based on the above findings, we hypothesize that role-playing can also have a significant impact on students' online learning experiences. The following hypotheses are proposed:

H4: Role-play has a positive effect on learning motivation.

H5: Role-play has a positive effect on learning engagement.

H6: Role-play has a positive effect on learning collaboration.

Competition

Competition is a crucial component in game-based learning activities that can lead to several benefits for learners. Reeves and Read (2009) highlighted competition as one of the ten essential qualities of effective game designs. Competition can stimulate learners' interest and motivate them to outperform their peers, leading to increased engagement and improved learning outcomes (Cheng et al., 2009; Vorderer et al., 2004). Additionally, competition can enhance collaboration among learners (Battisti et al., 2010) and improve their academic performance (Van Eck & Dempsey, 2002). Moreover, competition can drive learners extrinsically, causing them to put more effort into present activities (Pareto et al., 2012). Atanasijević-Kunc et al. (2010) suggested that competition in games could also stimulate learners' attention and enhance the effectiveness of the learning process. Therefore, incorporating competition into online learning activities could be a promising approach to promote learners' motivation and engagement. Based on the associated research, we hypothesize that competition can positively influence students' online learning. By incorporating competition into online learning activities, students may be motivated to outperform their peers and put more effort into their learning, leading to improved learning outcomes and collaboration. Thus, this research aims to explore the effects of competition on students' online learning and test our hypotheses:

H7: Competition has a positive effect on learning motivation.

H8: Competition has a positive effect on learning engagement.

H9: Competition has a positive effect on learning collaboration.

Methods

Gamified Components within an Online Curriculum

This study aimed to incorporate three gamification components, namely reward, role-play, and competition, into a university course using the Moodle platform. To represent the reward component, we utilized currency and virtual goods as incentives. Students can earn rewards by engaging in various learning activities such as reading online learning materials, completing tasks, taking quizzes, participating in discussion forums, or exchanging virtual goods with other students. In the case of failing assessments, students have the option to exchange their privilege keys for retests with gold money. On the other hand, students might receive bonus points for frequently reading course materials. Moreover, students were permitted to send surprise gifts from their personal gold coin library to individuals who lacked sufficient gold, or donate resources to others in need. In addition, to enhance the effectiveness of the reward component, this study incorporated the use of privilege keys which can be exchanged for retests with gold money. This mechanism not only provides learners with additional motivation to engage in desired learning activities, but also enables them to mitigate the negative impact of assessment failure on their learning progress. This approach aligns with the principles of self-regulated learning, as it allows students to take responsibility for their learning and make informed decisions regarding their learning progress (Zimmerman, 2000). Overall, the reward component in this study was designed to foster extrinsic motivation, increase engagement, and enhance learning outcomes among learners. By providing students with tangible and intangible incentives such as gold coins and privilege keys (as shown in Figure 1), they were encouraged to engage in various learning activities and make progress towards their learning goals.

Figure 1. Gold Coins and Privilege Keys for Retests

To incorporate the role-play component, students were given the opportunity to choose one of three game identities (see the Figure 2)—Aesthetician, Technician, or Translator—upon logging in to engage in the online activity. Aestheticians were responsible for aesthetic concerns in interface design, technicians for technological capabilities, and translators for translation difficulties in the study of systems created in different languages. Three students joined an online learning group and engaged in a virtual city scenario to collect concerns about city environmental protection. They had to understand ecological challenges such as river pollution, stray animal protection, and recyclable waste management in virtual reality through interactions with game NPCs (non-player characters).

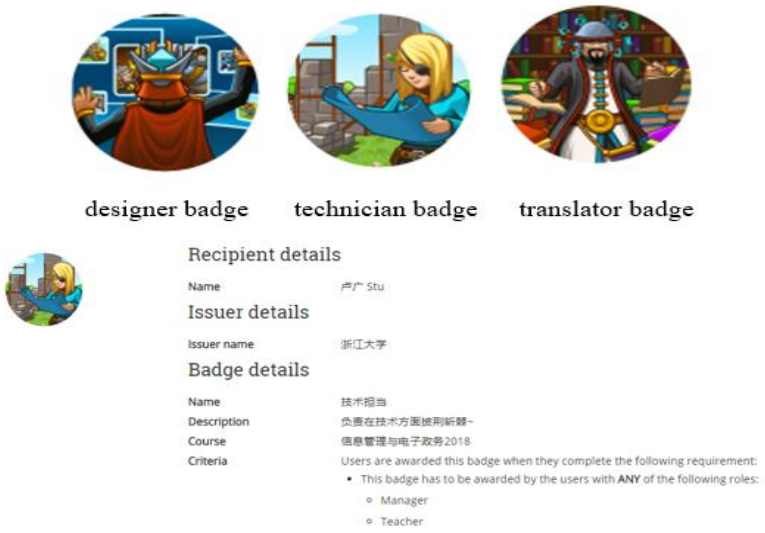

Figure 2. The three Game Identities

Finally, the competition component was introduced using leaderboards to foster friendly competition among students and motivate them to become more active participants in the learning process. A Moodle plug-in called "Ranking Block" was used as a leaderboard to display students' weekly or monthly learning performance (see Figure 3). Moodle was also used to create conditional activities in e-courses to restrict access to learning content. Instructors could establish pre-conditions for a combat quiz to ensure students completed assignments in a specific sequence. A student could acquire level status and reputation if they won the combat quiz, and they could access higher-level tasks or move to the next level after completing the fundamental challenge and conditional assignments.

Figure 3. Leaderboard used in the Study

Instruments

In order to assess the effectiveness of the gamified online learning experience, a self-created questionnaire was utilized with 13 items that addressed the three gamification components of reward, role-play, and competition. The questionnaire was designed to capture students' perceptions and opinions of the gamified learning process. For example, the item "I recognized the significance and purpose of the avatar role I picked during the gamified

learning process" was used to assess the construct of role-playing. Similarly, "I always keep track of my position on the leaderboard" was used to evaluate the construct of competition. Each question was scored on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). To ensure the validity and reliability of the questionnaire, a pilot test was conducted to identify any ambiguities in the phrasing of the questions and to modify the layout as required. The pilot data yielded a Cronbach's alpha of 0.911, indicating a high level of internal consistency among the questions.

In addition to the self-created questionnaire, this questionnaire based on earlier research was utilized to evaluate students' learning motivation (Lin et al., 2017), engagement (Liu & Huang, 2015), and collaboration (So & Brush, 2008). To ensure the validity and reliability of the questionnaire, the items were updated and evaluated by two university professors from China with extensive teaching experience. The Cronbach's Alpha coefficients of internal consistency were found to be greater than 0.8, indicating an acceptable degree of reliability.

Participants and Procedure

The study involved 60 undergraduate students (23 females (38.3%) and 37 males (61.7%)) between the ages of 18 and 24 who were enrolled in an online course at a prominent university in China. These students were selected based on their lack of prior experience with gamified learning activities online, and they were taught fundamental computer abilities and how to use a word processor and slide-based presentation software. The participants were introduced to Moodle, an LMS platform, at the beginning of the course, and the online learning activities took place throughout an 8-week period. The participants were able to access the course content at their convenience, and they were given half a day to complete the online activities. After the course was completed, the participants were asked to complete a questionnaire that took less than 20 minutes on average to complete. The questionnaire consisted of items that assessed the participants' perceptions of the online game-based learning experience, and they were promised anonymity and data confidentiality to ensure their privacy.

Results

A partial least squares structural equation modelling approach was employed to analyse the questionnaire data. The model analysis was composed of two parts, namely the measurement model and the structural model, and was evaluated using SmartPLS 3.0. In this analysis, the R^2 value of the target endogenous variable, inner model path coefficients, as well as the reliability and validity of the indicators were all thoroughly evaluated.

Reliability and Validity Analysis of the Constructs

The measurement model was utilized to assess the reliability and convergent validity of the research indicators (Gefen & Straub, 2005). As presented in Table 1, Cronbach's alpha values for all variables were found to be reliable (Byrne, 2001). Furthermore, all outer model loadings, ranging from .669 to .947, were above the minimum threshold of .6, indicating satisfactory levels of convergent validity (Hulland, 1999). The average variance extracted (AVE) values were all above .5, ranging from .576 to .724, and the composite reliability (CR) values

were all above .7, ranging from .843 to .929 (Hair et al., 1998). These results provide strong evidence for the validity and reliability of the research indicators.

Table 1. Convergent Validity and Reliability of the Measurements

Construct	Loadings	AVE	CR	Cronbach's α
Reward	.736~.843	.604	.859	.781
Role-play	.680~.871	.614	.888	.841
Competition	.669~.852	.576	.843	.751
Learning Motivation	.731~.947	.756	.925	.894
Learning Engagement	.802~.870	.707	.923	.897
Learning Collaboration	.768~.894	.724	.929	.903

Note. CR = composite reliability; AVE = average variance extracted.

To assess the discriminant validity of the constructs, two criteria were employed, namely the Fornell-Larcker criterion and the heterotrait-monotrait (HTMT) correlation ratio. According to the Fornell-Larcker criterion (Fornell & Larcker, 1981), the square root of the average variance extracted (AVE) of each construct should be greater than the correlations between that construct and the other constructs in the model and not less than 0.50. As shown in Table 2, the square roots of the AVEs for all six constructs ranged from .576 to .724, which exceeded the cutoff value of 0.50, thus indicating satisfactory discriminant validity.

In addition, the HTMT ratio was calculated to further examine the discriminant validity. The HTMT ratio measures the extent to which the correlations between different constructs are higher than the correlations within the same construct (Hair et al., 2017). The recommended threshold value for the HTMT ratio is .85. As indicated in Table 2, all HTMT ratios in the present study were below this threshold value, indicating satisfactory discriminant validity for all constructs.

Table 2. Discriminant Validity and HTMT

	Discriminant Validity (Latent Variable Correlation)						HTMT (Heterotrait-Monotrait Ratio of Correlations)					
Construct	1	2	3	4	5	6	1	2	3	4	5	6
1	**.777**						-					
2	.375	**.784**					.452	-				
3	.569	.391	**.759**				.744	.523	-			
4	.498	.430	.614	**.869**			.532	.458	.682	-		
5	.319	.575	.440	.707	**.841**		.358	.632	.518	.794	-	
6	.519	.575	.440	.567	.643	**.851**	.619	.776	.529	.598	.700	-

Note. Diagonals represent the square root of the average variance extracted, whereas the other matrix entries represent the correlations. 1: Reward; 2: Role-play; 3: Competition; 4: Learning Motivation; 5: Learning Engagement; 6: Teamwork.

The Structural Model and Hypothesis Testing

The results of the path analysis conducted to evaluate each hypothesis are presented in Table 3. The analysis showed that four out of the nine hypotheses were supported by significant path coefficient results. The explained variances (R^2) for learning motivation, learning engagement, and learning collaboration were .440, .385, and .561, respectively. Specifically, reward had a significant positive effect on learning collaboration (β = .280, p < .05), supporting H3. Role-play was found to have a positive effect on learning engagement (β = .477, p < .001) and learning collaboration (β = .574, p < .001), thus supporting H5 and H6, respectively. Furthermore, competition was found to have a positive effect on learning motivation (β = .439, p < .01), thus supporting H7. On the other hand, there was no significant association between reward and learning engagement or reward and learning collaboration, indicating that H1 and H2 were not supported. Similarly, H4 was rejected due to the absence of a significant relationship between role-play and learning motivation. Finally, there was no significant relationship between competition and learning engagement or learning collaboration, indicating that hypotheses H8 and H9 were also rejected.

Table 3. Summary of Hypothesis Tests

Hypotheses	Path	β	t-value	p	Support
H1	Reward → Learning Motivation	.176	1.268	.205	No
H2	Reward → Learning Engagement	-.006	0.048	.961	No
H3	Reward → Learning Collaboration	.280*	2.081	.038*	**Yes**
H4	Role play → Learning Motivation	.193	1.757	.079	No
H5	Role play → Learning Engagement	.477***	3.614	.000***	**Yes**
H6	Role play → Learning Collaboration	.574***	5.990	.000***	**Yes**
H7	Competition → Learning Motivation	.439**	2.806	.005**	**Yes**
H8	Competition → Learning Engagement	.257	1.579	.114	No
H9	Competition → Learning Collaboration	.041	0.355	.723	No

Note: *p < .05. **p < .01. *** p < .001.

Discussion

Based on the results of the structural equation model analysis, it was found that reward has a positive influence on students' learning collaboration. This finding is in line with previous research studies, such as those conducted by Hong and Masood (2014). It is possible that team members earn coins individually but consume them together, leading to more interaction and helping behavior among them. In-game gifting also allows members to collaborate closely within a game's community to overcome challenges. These behaviors foster social motivation components such as socializing, relationships, and teamwork, which can enhance peer-to-peer collaboration instead of solely relying on the teacher-student relationship (Yee, 2007). However, our data show that rewards have less of an impact on Chinese university students' motivation and engagement, which is contrary to previous studies (Dias, 2017; Hong & Masood, 2014; Villagrasa et al., 2014). Several factors might account for this slightly contradictory result. Firstly, it has been suggested that the fantasy game screen or visual content might be a critical component

influencing students' learning experiences (J. T. Kim & Lee, 2015). However, our participants reported that gamification elements like coins in the learning system were not as engaging as those in real video games. This may lead to a decline in the enjoyment and utility of coins, ultimately reducing the effective results of rewards (D. R. Sanchez et al., 2020). Secondly, acquiring gold coins was too simple for the students who participated in the study, which is a common occurrence in the online environment due to the zero-cost characteristic of virtual gold coins to distribute generously. Lastly, it is important to note that a decrease in motivation is a general shift in an educational context from the beginning to the end of a semester (Pan & Gauvain, 2012), which is true even in online gamified learning environments (Van Roy & Zaman, 2018). Therefore, while reward positively influenced learning collaboration, it may not be enough to sustain motivation and engagement over time. This suggests that educators should consider incorporating more engaging and challenging game elements into the learning environment to maintain students' interest and motivation. Future research could explore how to design effective game elements that can maintain students' motivation and engagement in the long run.

The use of role-playing has been shown to have a positive impact on learner engagement and collaboration, which is consistent with previous studies (Chan, 2012; Wishart et al., 2007; Ferrero et al., 2018). In this study, we aimed to investigate the impact of role-playing on learner engagement and collaboration in a gamified learning environment. Our results indicate that role-playing provided students with several opportunities to choose roles that aligned with their interests and strengths, leading to increased chatting, helping, and teamwork. Furthermore, role-playing in groups with well-defined learning tasks fostered collaboration and co-construction of knowledge. Aldemir et al. (2018) also found that team skills must be balanced in a gamified learning environment, highlighting the importance of considering the composition of teams when designing gamified learning activities. Our findings contrasted with previous studies that found role-playing to be ineffective for increasing learning motivation (Sailer et al., 2017; Stansbury & Earnest, 2017). One possible explanation for this lack of linkage is the absence of a 'host' to facilitate communication among team members. Although neither the instructor nor the student served as the "host" in this study, students' learning motivation may have been impaired due to inadequate handling of various opinions during collaboration. Additionally, we found that role-playing without a story framework had minimal influence on students' involvement in gamified activities, thus failing to enhance learning motivation. It is important to consider the impact of other contextual variables, such as platform usability, on motivation. Therefore, it is difficult to attribute the gains in motivation solely to gamification effects. Overall, our findings suggest that role-playing can have a positive impact on learner engagement and collaboration in a gamified learning environment, as long as there is adequate support for communication and a well-defined division of learning tasks. Furthermore, a story framework is crucial for enhancing student involvement and motivation in gamified learning activities. Further research is needed to explore the effects of other contextual variables on motivation in gamified learning environments.

The results showed that competition had a positive influence on learning motivation, which is consistent with previous research (Bicen & Kocakoyun, 2018; Fotaris et al., 2016). Competition was found to be a stimulus for learning more, giving students more control, curiosity, and intrinsic interest in the learning process (Aldemir et al., 2018; Burguillo, 2010; Cagiltay et al., 2015; Chen & Chang, 2020; Hwang & Chang, 2016; Landers & Landers, 2014; Wei et al., 2018). However, the present study also found that competition had no significant impact

on student engagement, which contradicts previous studies (Aldemir et al., 2018; Kuo & Chuang, 2016). This finding is consistent with the argument put forward by Collins et al. (1989) that the negative consequences of competition may be more indicative of impoverished learning environments and a lack of feedback and opportunities to improve, rather than any fundamental consequence of competition. Another possible explanation for the lack of impact of competition on student engagement is that though leaderboards can provide people with some fun, they also place them under a certain deal of stress (Lazzaro, 2004). As noted by Barata et al. (2013), too much challenge can be just as detrimental as too little. Therefore, the most critical task in developing a gamified e-learning environment might be adding the correct amount of challenge that is highly related to the students' skills and progression through the course. Furthermore, the results indicated that competition had no impact on collaboration. One possible reason is that the leaderboard showed personal ranking but not group ranking, thereby lacking a sense of group identity in the competition mechanics. Group members did not share and participate in similar experiences or understand each other, leading to a lack of collaboration. In conclusion, the present study suggests that competition can positively impact learning motivation, but may not necessarily lead to higher levels of student engagement or collaboration. Therefore, future research should explore how to balance the benefits and drawbacks of competition in gamified learning environments, such as by adding appropriate levels of challenge and feedback and by fostering a sense of group identity and collaboration among students.

Conclusion

In conclusion, this study sheds light on the impact of three gamification elements on students' learning motivation, engagement, and collaboration. Specifically, reward was found to have a positive impact on learning collaboration, while role-play positively affected learning engagement and collaboration, but not motivation. Competition, on the other hand, was shown to have a positive impact on learning motivation, but no significant influence on engagement or collaboration. These findings have both theoretical and practical implications for the use of gaming components in higher online education settings.

However, it is important to note that there are limitations to this study. The sample size was limited to students from a public university in China, which may limit the generalizability of the results to other student populations. Therefore, future research could expand the sample to include students from different university groups, locations, and countries to ensure a more diverse representation of the student population. Despite these limitations, the results of this study can inform educators and instructional designers about the effective integration of gamification elements into online learning environments, and highlight the importance of considering the specific context and target population when doing so.

Acknowledgements

The authors declare that they have no conflict of interest.
The dataset of this study is available from corresponding author on reasonable request.
The data was collected in Hangzhou, China.

References

Aguiar-Castillo, L., Hernández-López, L., De Saá-Pérez, P., & Pérez-Jiménez, R. (2020). Gamification as a motivation strategy for higher education students in tourism face-to-face learning. *Journal of Hospitality, Leisure, Sport and Tourism Education, 27*, Article e100267. https://doi.org/10.1016/j.jhlste.2020.100267

Aldemir, T., Celik, B., & Kaplan, G. (2018). A qualitative investigation of student perceptions of game elements in a gamified course. *Computers in Human Behavior*, *78*, 235–254.

Alsawaier, R. S. (2018). The effect of gamification on motivation and engagement. *The International Journal of Information and Learning Technology*, *35*(1), 56–79. https://doi.org/10.1108/IJILT-02-2017-0009

Atanasijević-Kunc, M., Logar, V., Karba, R., Papič, M., & Kos, A. (2010). Remote multivariable control design using a competition game. *IEEE Transactions on Education, 54*(1), 97–103.

Bakhanova, E., Garcia, J. A., Raffe, W. L., & Voinov, A. (2020). Targeting social learning and engagement: what serious games and gamification can offer to participatory modeling. *Environmental Modelling & Software, 134*, Article e104846. https://doi.org/10.1016/j.envsoft.2020.104846

Barata, G., Gama, S., Jorge, J., & Gonçalves, D. (2013). Improving participation and learning with gamification. In L. E. Nacke, K. Harrigan, & N. Randall (Eds.), *ACM International Conference Proceeding Series* (pp. 10–17). Association for Computing Machinery. https://doi.org/10.1145/2583008.2583010

Battisti, F., Boato, G., Carli, M., & Neri, A. (2010). Teaching multimedia data protection through an international online competition. *IEEE Transactions on Education*, *54*(3), 381–386.

Bicen, H., & Kocakoyun, S. (2018). Perceptions of students for gamification approach: Kahoot as a case study. *International Journal of Emerging Technologies in Learning*, *13*(2), 72–93.

Byrne, B. M. (2001). Structural equation modeling with AMOS, EQS, and LISREL: Comparative approaches to testing for the factorial validity of a measuring instrument. *International Journal of Testing*, *1*(1), 55–86. https://doi.org/10.1207/S153275741JT0101-4

Chan, Z. C. Y. (2012). Role-playing in the problem-based learning class. *Nurse Education in Practice*, *12*(1), 21–27. https://doi.org/10.1016/j.nepr.2011.04.008

Chen, P. Z., Chang, T. C., & Wu, C. L. (2020). Effects of gamified classroom management on the divergent thinking and creative tendency of elementary students. *Thinking Skills and Creativity*, *36*(2), Atricle e100664. https://doi.org/10.1016/j.tsc.2020.100664

Cheng, H. N. H., Wu, W. M. C., Liao, C. C. Y., & Chan, T.-W. (2009). Equal opportunity tactic: Redesigning and applying competition games in classrooms. *Computers & Education*, *53*(3), 866–876. https://doi.org/10.1016/j.compedu.2009.05.006

Chiu, F.-Y., & Hsieh, M.-L. (2017). Role-Playing Game Based Assessment to Fractional Concept in Second Grade Mathematics. *EURASIA Journal of Mathematics, Science and Technology Education*, *13*(4), 1075–1083. https://doi.org/10.12973/eurasia.2017.00659a

Davis, K., Sridharan, H., Koepke, L., Singh, S., & Boiko, R. (2018). Learning and engagement in a gamified course: Investigating the effects of student characteristics. *Journal of Computer Assisted Learning*, *34*(5), 492–503. https://doi.org/10.1111/jcal.12254

Dias, J. (2017). Teaching operations research to undergraduate management students: The role of gamification. *The International Journal of Management Education*, *15*(1), 98–111.

Ferrero, G., Bichai, F., & Rusca, M. (2018). Experiential learning through role-playing: Enhancing stakeholder collaboration in water safety plans. *Water*, *10*(2), 227–237. https://doi.org/10.3390/w10020227

Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research*, *18*(1), 39–50. https://doi.org/10.1177/002224378101800104

Fotaris, P., Mastoras, T., Leinfellner, R., & Rosunally, Y. (2016). Climbing up the leaderboard: An empirical study of applying gamification techniques to a computer programming class. *Electronic Journal of E-Learning*, *14*(2), 94–110.

Garaialde, D., Cox, A. L., & Cowan, B. R. (2021). Designing gamified rewards to encourage repeated app selection: Effect of reward placement. *International Journal of Human-Computer Studies*, *153*, Article e102661. https://doi.org/10.1016/J.IJHCS.2021.102661

Gefen, D., & Straub, D. (2005). A practical guide to factorial validity using PLS-Graph: Tutorial and annotated example. *Communications of the Association for Information Systems*, *16*(1), 91–109. https://doi.org/10.17705/1CAIS.01605

Hair, J. F., Anderson, R. E., Tatham, R. L., & Black, W. C. (1998). *Multivariate data analysis： with readings* (5th ed.). Prentice-Hall.

Hair, J. F., Hult, G. T., Ringle, C. M., & Sarstedt, M. (2017). *A primer on partial least squares structural equation modeling (PLS-SEM)* (2nd ed.). Sage Publications, Inc.

Hasan, Ã., Kanbul, S., & Ozdamli, F. (2018). Effects of the gamification supported flipped classroom model on the attitudes and opinions regarding game-coding education. *International Journal of Emerging Technologies in Learning*, *13*(1), 109–123. https://doi.org/10.3991/ijet.v13i01.7634

Hong, G. Y., & Masood, M. (2014). Effects of Gamification on Lower Secondary School Students' Motivation and Engagement. *International Journal of Social, Education, Economics and Management Engineering*, *8*(12), 3487–3494.

Hulland, J. (1999). Use of partial least squares (PLS) in strategic management research: A review of four recent studies. *Strategic Management Journal*, *20*(2), 195–204. https://doi.org/10.1002/(SICI)1097-0266(199902)20:2<195::AID-SMJ13>3.0.CO;2-7

Kim, J. T., & Lee, W. H. (2015). Dynamical model for gamification of learning (DMGL). *Multimedia Tools and Applications*, *74*(19), 8483–8493. https://doi.org/10.1007/s11042-013-1612-8

Kim, P. W., Kim, S. Y., Shim, M., Im, C.-H., & Shon, Y.-M. (2013). The influence of an educational course on language expression and treatment of gaming addiction for massive multiplayer online role-playing game (MMORPG) players. *Computers & Education*, *63*, 208–217. https://doi.org/10.1016/j.compedu.2012.12.008

Kuo, M.-S., & Chuang, T.-Y. (2016). How gamification motivates visits and engagement for online academic dissemination–An empirical study. *Computers in Human Behavior*, *55*, 16–27. https://doi.org/10.1016/j.chb.2015.08.025

Kusuma, G. P., Putera Suryapranata, L. K., Wigati, E. K., & Utomo, Y. (2021). Enhancing Historical Learning Using Role-Playing Game on Mobile Platform. *Procedia Computer Science*, *179*, 886–893. https://doi.org/10.1016/j.procs.2021.01.078

Lazzaro, N. (2004). Why We Play Games: Four Keys to More Emotion in Player Experiences. *Proceedings of*

Games Developers Conference, 1–8.

Lewis, Z. H., Swartz, M. C., & Lyons, E. J. (2016). What's the Point?: A Review of Reward Systems Implemented in Gamification Interventions. *Games for Health Journal*, *5*(2), 93–99. https://doi.org/10.1089/g4h.2015.0078

Lim, M. Y., Leichtenstern, K., Kriegel, M., Enz, S., Aylett, R., Vannini, N., Hall, L., & Rizzo, P. (2011). Technology-enhanced role-play for social and emotional learning context–Intercultural empathy. *Entertainment Computing*, *2*(4), 223–231. https://doi.org/10.1016/j.entcom.2011.02.004

Lin, X., Featherman, M., & Sarker, S. (2017). Understanding factors affecting users' social networking site continuance: A gender difference perspective. *Information and Management*, *54*(3), 383–395. https://doi.org/10.1016/j.im.2016.09.004

Liu, C.-H., & Huang, Y.-M. (2015). An empirical investigation of computer simulation technology acceptance to explore the factors that affect user intention. *Universal Access in the Information Society*, *14*(3), 449–457. https://doi.org/10.1007/s10209-015-0402-7

Mirliss, D. (2014). Preparing Future Teachers: Taking the Perspective of Diverse Learners through Virtual World Role-Play. *International Journal of Gaming and Computer-Mediated Simulations*, *6*(2), 15–29. https://doi.org/10.4018/ijgcms.2014040102

Moccozet, L., Tardy, C., Opprecht, W., & Leonard, M. (2013). Gamification-based assessment of group work. In K. Russia (Ed.), *2013 International Conference on Interactive Collaborative Learning* (pp. 171–179). IEEE. https://doi.org/10.1109/ICL.2013.6644565

Ntokos, K. (2019). Swords and sorcery: A structural gamification framework for higher education using role-playing game elements. *Research in Learning Technology*, *27*, 1–16. https://doi.org/10.25304/rlt.v27.2272

Özhan, Ş. Ç., & Kocadere, S. A. (2020). The effects of flow, emotional engagement, and motivation on success in a gamified online learning environment. *Journal of Educational Computing Research*, *57*(8), 2006–2031. https://doi.org/10.1177/0735633118823159

Pan, Y., & Gauvain, M. (2012). The continuity of college students' autonomous learning motivation and its predictors: A three-year longitudinal study. *Learning and Individual Differences*, *22*(1), 92–99. https://doi.org/10.1016/J.LINDIF.2011.11.010

Pareto, L., Haake, M., Lindström, P., Sjödén, B., & Gulz, A. (2012). A teachable-agent-based game affording collaboration and competition: Evaluating math comprehension and motivation. *Educational Technology Research and Development*, *60*(5), 723–751. https://doi.org/10.1007/s11423-012-9246-5

Rapp, A. (2017). From Games to Gamification: A Classification of Rewards in World of Warcraft for the Design of Gamified Systems. *Simulation and Gaming*, *48*(3), 381–401. https://doi.org/10.1177/1046878117697147

Reeves, B., & Read, L. (2009). *Total engagement: using games and virtual worlds to change the way people work and businesses compete*. Harvard Business Press.

Sailer, M., Hense, J. U., Mayr, S. K., & Mandl, H. (2017). How gamification motivates: An experimental study of the effects of specific game design elements on psychological need satisfaction. *Computers in Human Behavior*, *69*, 371–380. https://doi.org/doi.org/10.1016/j.chb.2016.12.033

Sanchez, D. R., Langer, M., & Kaur, R. (2020). Gamification in the classroom: Examining the impact of gamified

quizzes on student learning. *Computers and Education*, *144*, Article e103666. https://doi.org/10.1016/j.compedu.2019.103666

Sanchez, E., Young, S., & Jouneau-Sion, C. (2017). Classcraft: from gamification to ludicization of classroom management. *Education and Information Technologies*, *22*(2), 497–513. https://doi.org/10.1007/s10639-016-9489-6

Sánchez-Martín, J., Cañada-Cañada, F., & Dávila-Acedo, M. A. (2017). Just a game? Gamifying a general science class at university: Collaborative and competitive work implications. *Thinking Skills and Creativity*, *26*, 51–59. https://doi.org/10.1016/j.tsc.2017.05.003

Skinner, B. F. (2014). *Contingencies of reinforcement: A theoretical analysis*. BF Skinner Foundation.

So, H. J., & Brush, T. A. (2008). Student perceptions of collaborative learning, social presence and satisfaction in a blended learning environment: Relationships and critical factors. *Computers & Education*, *51*, 318–336. https://doi.org/10.1016/j.compedu.2007.05.009

Song, D., Ju, P., & Xu, H. (2017). Engaged cohorts: Can gamification engage all college students in class? *Eurasia Journal of Mathematics, Science and Technology Education*, *13*(7), 3723–3734. https://doi.org/10.12973/eurasia.2017.00755a

Song, H., Kim, J., Tenzek, K. E., & Lee, K. M. (2013). The effects of competition and competitiveness upon intrinsic motivation in exergames. *Computers in Human Behavior*, *29*(4), 1702–1708. https://doi.org/10.1016/j.chb.2013.01.042

Stansbury, J. A., & Earnest, D. R. (2017). Meaningful gamification in an industrial/organizational psychology course. *Teaching of Psychology*, *44*(1), 38–45. https://doi.org/10.1177/0098628316677645

Tasadduq, M., Khan, M. S., Nawab, R. M. A., Jamal, M. H., & Chaudhry, M. T. (2021). Exploring the effects of gamification on students with rote learning background while learning computer programming. *Computer Applications in Engineering Education*, Advance online publication. https://doi.org/10.1002/cae.22428

Van Eck, R., & Dempsey, J. (2002). The effect of competition and contextualized advisement on the transfer of mathematics skills in a computer-based instructional simulation game. *Educational Technology Research and Development*, *50*(3), 23–41. https://doi.org/10.1007/BF02505023

Van Roy, R., & Zaman, B. (2018). Need-supporting gamification in education: An assessment of motivational effects over time. *Computers & Education*, *127*, 283–297. https://doi.org/10.1016/j.compedu.2018.08.018

Villagrasa, S., Fonseca, D., Redondo, E., & Duran, J. (2014). Teaching case of gamification and visual technologies for education. *Journal of Cases on Information Technology*, *16*(4), 38–57. https://doi.org/10.4018/jcit.2014100104

Vorderer, P., Klimmt, C., & Ritterfeld, U. (2004). Enjoyment: At the heart of media entertainment. *Communication Theory*, *14*(4), 388–408. https://doi.org/10.1111/j.1468-2885.2004.tb00321.x

Werbach, K., & Hunter, D. (2015). *The gamification toolkit: dynamics, mechanics, and components for the win*.

Werbach, Kevin., & Hunter, D. (2012). *For the win: How game thinking can revolutionize your business*. Wharton Digital Press.

Wishart, J. M., Oades, C. E., & Morris, M. (2007). Using online role play to teach internet safety awareness. *Computers & Education*, *48*(3), 460–473. https://doi.org/10.1016/j.compedu.2005.03.003

Yang, J. C., Quadir, B., & Chen, N.-S. (2016). Effects of the badge mechanism on self-efficacy and learning performance in a game-based English learning environment. *Journal of Educational Computing Research*, *54*(3), 371–394. https://doi.org/10.1177/0735633115620433

Yee, N. (2006). Motivations for play in online games. *CyberPsychology & Behavior*, *9*(6), 772–775. https://doi.org/10.1089/cpb.2006.9.772

Yildirim, I. (2017). The effects of gamification-based teaching practices on student achievement and students' attitudes toward lessons. *The Internet and Higher Education*, *33*, 86–92. https://doi.org/10.1016/j.iheduc.2017.02.002

Yu, F., & Liu, Y. (2009). Creating a psychologically safe online space for a student-generated questions learning activity via different identity revelation modes. *British Journal of Educational Technology*, *40*(6), 1109–1123.

Author Information

Chien-Yuan Su

https://orcid.org/0000-0003-1639-3948

National University of Tainan

Taiwan

Contact e-mail: *bredysu@gmail.com*

Yuqing Guo

https://orcid.org/0000-0003-2683-5260

Zhejiang University

China

Juncheng Shen

https://orcid.org/0009-0000-0463-2900

Zhejiang University

China