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Improving Learning Motivation and Engagement Through Gamification

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Abstract

Gamification is an increasingly popular strategy in education. This study presents a gamified course with a bingo-like game that enhances learning engagement, motivation, and outcomes. Specifically, the bingo-like game features cards with must-learn concepts presented in 16 elements, and the game was designed to help students review the material collaboratively. In experiments (42 and 57 undergraduates in intervention and control groups, respectively), the game improved undergraduates' engagement and learning performance. Specifically, the intervention and control groups exhibited improvements of 21% and 9% on posttest scores, respectively, relative to pretest scores. This study contributes to efforts at introducing gamification to education.

Keywords: Gamification strategy, game-based learning, motivation, engagement

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透過遊戲化教學改善學習策略中動機與投入

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摘 要

遊戲化應用於教育領域中已逐漸成為受歡迎的策略，本研究設計遊戲化課程整合修正的賓果遊戲，來提升學習涉入、動機以及學習績效。賓果遊戲能促使同學協同合作來複習學習的內容，本研究所提之遊戲化策略可協助教師採用現有賓果遊戲規則，以及整合同學必須學習的 16 個概念，對應到 16 個號碼的賓果卡中。本研究採用兩組學生進行實驗，A 組為 42 位研究生，B 組為 57 位大學生。實驗結果顯示，所使用之賓果遊戲，能改善研究生學習動機，並進一步提升學習績效，大學生的學習投入與學習績效亦會透過賓果遊戲改善。本研究亦進行單組實驗前後測與檢定，結果顯示學習的成效與結果有所提升，平均提升的百分比為 A 組 21% 以及 B 組 9%，本研究期望透過成果呈現賓果遊戲之有效性，並貢獻於遊戲化策略與遊戲化學習領域。

關鍵詞：遊戲化策略、遊戲學習、動機、投入

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I. Introduction

Games are increasingly commonly used in education to motivate active learning (Sobrino-Duque et al., 2022). Interesting games designed to supplement certain courses are used to provoke learner engagement to enhance performance as an innovative means of stimulating the effective learning process (Sharma & Sharma, 2021). Most learners today are members of Generation Z (Gen Z), which exhibits loyalty, thoughtfulness, compassion, open-mindedness, and responsibility (Seemiller & Megan, 2017). This cohort is also tech-savvy, although computer applications are not the only route teachers must consider when designing supplements to their courses. Gen Z students tend to enjoy games, small groups, and active learning (Miranda, 2020). Thus, effective game-based design can be used to provide learner engagement. It has been shown that games can produce an emotionally engaging experience (Plass et al., 2015) and can be used to improve learning (Boyle et al., 2016). Game-based learning is used in a range of contexts, including economics/investment finance (Lew & Saville, 2021), pharmacy studies (Khalafalla & Alqaysi, 2021), and accounting (Sugahara & Cilloni, 2021).

Game-based learning has led to improved learning performance relative to non-game instructional methods (Clark et al., 2016). It has also produced increased learner engagement and motivation. Engagement can be measured using behavioral, emotional, and cognitive dimensions (Fredricks et al., 2004). Behavioral engagement refers to participation, effort, attention, and persistence (Fredricks et al., 2004). Cognitive engagement refers to the learner's level of mental investment in learning activities (Fredricks et al., 2016). Emotional engagement refers to learners' emotional reactions to learning experiences, interest in the learning content, and their social connection with others (Henrie et al., 2015). The literature on game-based learning and gamification suggests that learning and gamified curricula will become commonplace and invoke engagement and flow in students (Crisp, 2014). Gamification can influence engagement and motivation in learning activities (Lavoué et al., 2021). Games and gaming strategies can enhance experiential learning (Murad, 2017; Strickland & Kaylor, 2016) and increase learning motivation (Fernandes et al., 2016; Graham & Richardson, 2008).

It is well recognized that students' attention tends to drift when they are presented with purely lecture-based content, which produces poor learning performance.

Gamification is a strategy whereby a gaming approach is used in real-life problem solving (Zichermann & Cunningham, 2011) to improve learning motivation, engagement, and attitude toward learning. Gamification strategy and game-based learning design can improve students' learning motivation, performance, and engagement (Dahalan et al., 2023). Exiting literature focuses on the improvement of all aspects of students' learning, but the incorporation of student collaboration with gamification strategy in course design still needs further investigation (Lester et al., 2023). In this study, we developed an adapted bingo game for use in the review of materials and case that can help students develop their domain knowledge. We expected that the motivation and engagement in the learning process would be enhanced through a collaborative gamification strategy. The research questions for this study were as follows: (a) will the bingo game influence motivation and engagement? and (b) will the motivation and engagement enhance learning performance?

II. Literature Review

A. Gamification and Game-Based Learning

Kapp (2012) found that "gamification is using game-based mechanics, aesthetics and game thinking to engage people, motivate action, promote learning, and solve problem." Gamification allows students to engage in tasks and achieve learning goals. It also motivates user behavior (Deterding et al., 2011) and improves student learning (Dichev & Dicheva, 2017; Koivisto & Hamari, 2019). The literature shows that gamification is associated with motivation (e.g., Albertazzi et al., 2019), engagement (Putz et al., 2020), and cognitive learning (Vlachopoulos & Makri, 2017). Game-based learning environments foster learning in culturally diverse contexts, such as that of the university (Jossan et al., 2021). Gamification strategies allow users to pursue individual goals and provide immediate feedback and reinforcement to improve performance (Krath et al., 2021).

Game-based learning environments are increasingly commonly in school settings, because it can improve academic and motivational outcomes. Game-based learning

provides an engaging learning experience that is suited to individual needs (Mayer, 2011). The games used in the learning process have been explored in the study of pharmacy subjects (Lew & Saville, 2021) and economics (Khalafalla & Alqaysi, 2021). Game-based learning can promote social interaction and cohesion among students and develop links among a range of materials in the learning environment (Crocco et al., 2016; Perrotta et al., 2013). The integration of games in learning can keep students motivated and engaged (Annetta et al., 2009) and can result in deep learning in an immersive environment. Researchers indicated that gamification and game-based learning can enhance motivation, performance, and engagement in vocational education learners (Dahalan et al., 2023). The use of gamification and game-based learning can encourage interaction and collaborative learning and improve engagement (Lester et al., 2023). In this study, we developed an adapted bingo game for use in the classroom to support student review of teaching content and improve motivation, engagement, and learning performance in students.

B. Motivation and Engagement in Game-Based Learning

Game-based learning is an effective learning strategy that can improve student learning motivation, engagement, involvement, and performance (Alsawaier, 2018). Game-based learning environments can support learning and promote positive affect and engagement (Sabourin & Lester, 2013). In a study of the employment of a virtual business retailing program, learning motivation was a crucial moderator of learning methods and learning performance (Lin et al., 2018). The motivation to learn refers to the desire to become involved in and learn from an activity (Garavan et al., 2010). Student motivation includes intrinsic and extrinsic motivation. Intrinsic motivation is driven by a unique interest or the gratification obtained by reaching personal objectives. It affects learning strategy (Lin et al., 2017) and influences the relationship between team interactions and learning (Gomez et al., 2010). Engagement influences perceived learning in the gaming environment (Hamari et al., 2016). The mixed condition of gamification (face-to-face and digital) may enhance cognitive engagement (Qiao et al., 2023). Adopting a gaming approach affects learning motivation and perception (Tapingkae et al., 2020). The literature also showed that gamification with tangible rewards influenced

motivation, engagement, and learning performance (Xiao & Hew, 2023). Using right level of gamification will help improve students' motivation, engagement, and performance (Imran, 2023).

In addition, game-based learning can increase emotional engagement in the learning environment (Ninaus et al., 2019) and enhance motivation and engagement in the medical context (Pesare et al., 2016). Game-based learning has a positive impact on motivation and involvement in mathematics (Ramli et al., 2020). Students who participate in game activities show improved knowledge (Perini et al., 2018). Rewards offered in game-based learning enhance motivation, engagement, and learning outcomes (Park et al., 2019). In addition, game-based learning has positive effects on student motivation, comprehension, and retention (Yousef et al., 2014). Game-based learning is an integrated and continuous process that produces advances in learning via affective engagement (Ke et al., 2016) and may have positive impact on teaching-learning process (Pando Cerra et al., 2022). Yu and Tsuei (2022) discovered that digital game-based learning is the effective method to enhance Chinese language learning. Moreover, intrinsic motivation predicts engagement (Dunn & Kennedy, 2019), and gamification may influence engagement and motivation in the learning context (Bai et al., 2021; Donnermann et al., 2021; Li et al., 2021). There may also be an interaction effect of between engagement and motivation. In this study, we designed an adapted bingo game to help students review subject matter; we expected that the game would facilitate learning motivation, engagement, and learning outcomes in the learning process.

C. The proposed model and hypothesis development

The theory of gamified learning (Landers, 2014) holds that games may influence behaviors and attitudes, which in turn may influence learning outcomes. Figure 1 shows the proposed research model for empirical examination, presenting the adapted bingo game. Behavioral engagement includes participation, collaboration, and independent learning (Zainuddin et al., 2020). The gamification strategy incorporates various approaches, such as competition, challenge, compensation, relationship, and usability (Kim, 2020); the bingo game developed in this study incorporates the competition strategy. Hence, we propose the following four hypotheses:

H1: A learning bingo game positively influences student motivation.

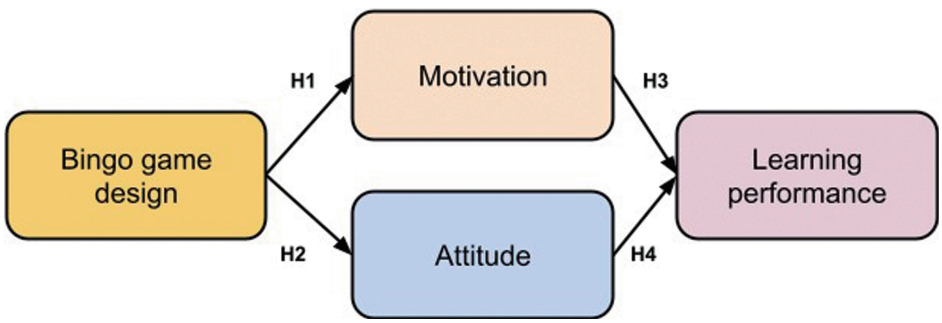
H2: A learning bingo game positively influences student engagement.

H3: Improved motivation positively influences learning performance.

H4: Improved engagement positively influences learning performance.

Figure 1

Proposed Model



III. Method

A. Gamification Design

We developed an adapted bingo game with modified rules for use in a selected course. The pattern is adaptable to any course, as follows. First, a four by four bingo card for all groups is generated using a number range from one to 40, with only 16 randomly selected numbers on each card. Next, the teacher develops ten questions regarding the teaching material each week. The group of students selected to present a case for the given week also develops six questions that refer to the most important aspects of the case. The idea is to incorporate group's engagement with the design of adapted bingo game. Thus, 16 questions are produced every week to help review course material and case by collaboration between students and teacher. The presenting group does not participate in the bingo game and plays the role of a teaching assistant, checking the correctness of the answers that other students provide. Third, the teacher randomly selects

a group of participating students and randomly selects a number to identify a question. If the group whose turn it is chooses to pass on a question, any group can answer it. The teacher goes through all groups in the round and returns to the groups that chose to pass. If the group still cannot answer, they are removed from the game. With this rule, each group has the chance to answer a passed question, but it is not allowed to pass twice (Figure 2). Finally, if the group correctly responds to their question, they can choose a number from their card, and all groups can cross out that number. A group that completes a line from one side of their card to the other (whether vertical, horizontal, or diagonal) has bingo and wins. The teacher controls the pace and timing of the game. When the time is up, then the game is over. The prizes are given to the groups who win most often. As incentive, a NT$100 gift card can be given to the top three best-performing groups.

Figure 2

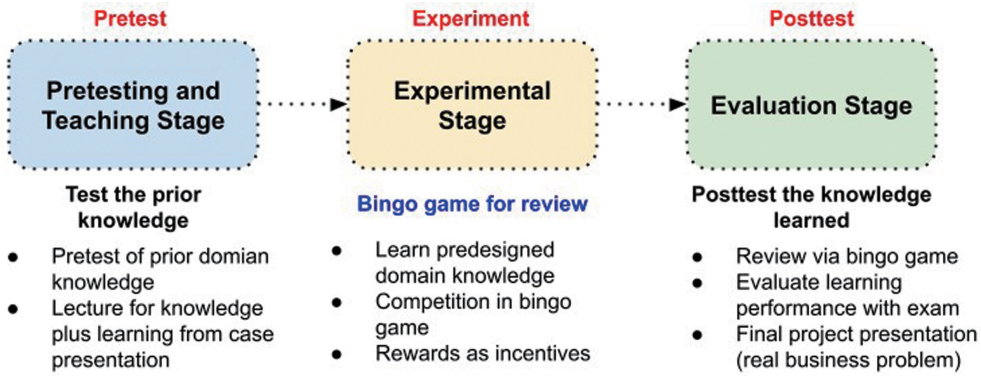
Bingo Game Being Played

B. Experimental Procedure

Figure 3 shows our experimental procedure, including the pretest and teaching, experimental, and evaluation stages. In the pretest and teaching stages, questions were developed to pretest assess knowledge. The three-hour class model involved a case presentation, mini-lecture, and review using the bingo game. The experimental stage examined the effectiveness of the game as a review element to allow students to recall and review the case and teaching material again. The evaluation stage provided a post-test of the knowledge and examined students' perceptions.

Figure 3

Experimental Procedure



We used a quasi-experimental research design that contained a single group of participants. In the educational context, quasi-experiments are commonly used to examine course designs due to the size of classes. A one-group pretest/post-test design is widely used (Sharma et al., 2019; Sharour et al., 2018; Yazici & Bulut, 2018; Wang et al., 2020). This includes a pretest, treatment/manipulation, and a post-test (Gliner et al., 2003). We use "one group pretest and posttest design" (T1 → X → T2) to examine learning outcomes. The first week of orientation will have a pretest before starting official lecture and post-test for eighth week to examine the learning performance. The use of a pretest and post-test may reveal the effectiveness of gamification strategy on learning outcomes. This post-test design entails a within-subjects experimental design, which means each student is tested in under a control condition and a treatment condition. If the average post-test score is greater than the average pretest score, the intervention is considered effective.

C. Course and Materials

This research designated a required course of "information management" to examine the effectiveness of adapted bingo game. The target audiences of selected course are non-technical background students who can learn knowledge and cases of information and communications technology (ICT) in various topics. We selected a three-credit course from an Master of Business Administration (MBA) program (first year

students) and an undergraduate program (third year students) respectively in which to implement the bingo game with lecture and case presentation. The goal and organization of both courses are similar. The goal of the information management course was to teach students without a technical background important concepts in ICT as well as applications in different functional areas. Specifically, the first half of semester is to teach students understand emerging technologies in business and the concept of digital transformation, the importance of ICT for business, how to enhance competition, why business process reengineering, and information systems of Enterprise Resource Planning (ERP)/ Customer Relationship Management (CRM)/ Supply Chain Management (SCM). The second half of semester is to show applications in functional area such as Human Resource Management (HRM, HR bots for employees), marketing (big data analytics), finance (FinTech), operations management (OM, intelligent factory), and ICT decisions of managers in the company. In addition, a designated group of students every week presented a case linked to a specific subject (e.g., Disney+ for digital transformation). The ultimate goal was to help students understand certain topics in information systems/ ICT and have sufficient ability to bridge ICT and management. The materials were sourced from the Harvard Business School Database, selected journal articles, and reports from consulting companies (e.g., Gertner, BCG, KPMG, etc.). By incorporating the adapted bingo game with course design, we expect to help students engage and enhance learning outcome with fun and joyful.

D. Instruments

The measurement instruments included a pretest/post-test and a questionnaire. The content of the pretest/post-test included 14 questions developed by teacher with many years of teaching experience to examine student knowledge in the first seven weeks. The purpose was to examine the knowledge of information management (lecture plus case) for pretest and posttest. The average accuracy will be calculated and compared accordingly to evaluate the improvement of students. The designed 14 questions are as follows:

a. What is digital transformation?
b. What is the top level of business transformation?
c. Data is important to companies, but data only can tell us?

d. Which one is not true for thick data?
e. Which one is not essential for information technology?
f. Information technology is the competitive weapon not on which level?
g. Which one is correct for the concept of business process re-engineering?
h. Business process re-engineering is?
i. Enterprise resource planning is to (multiple answers)?
j. What might not be the hidden cost of ERP?
k. Customer relationship management system is to support (multiple answers)?
l. The future of artificial intelligence CRM may?
m. Information technology can help the supply chain?
n. Which one is not true for information technology in SCM?

We also adapted items from existing literature to measure four constructs, including five items for gamification were modified from the measurement developed by Kim (2020), six items for learning motivation were adapted from Isen and Reeve (2005), eight items for learning attitude were adapted from De-Marcos et al. (2014), and four items for learning performance were adapted from Gatti et al. (2019). Specifically, five items of gamification strategy will be adapted from Kim (2020) as follows:

a. I like to compete while learning
b. I feel learning better than others is important
c. I think winning generally matters
d. I feel annoyed when defeated by others
e. I try harder when competing with others

Six items of motivation will be adapted from Isen and Reeve (2005) as follows:

a. Playing bingo game was enjoyable
b. Playing bingo game stimulated my curiosity.
c. It was fun to play bingo game.
d. While Playing bingo game, I felt curious about what would happen next.
e. Playing bingo game was interesting.
f. It was fun to explore the bingo game further.

Eight items of engagement will be adapted from the research of De-Marcos et al. (2014) as follows:

a. Content was efficiently presented by bingo game
b. I learned about the course topic with the bingo game
c. I enjoyed the experience of bingo game
d. The bingo game was easy to us
e. The functions and practical activities of bingo game were useful
f. Time to complete the activities was enough
g. I was involved in bingo game
h. Learning experience by bingo game was worthwhile

Finally, four items of learning performance will be adapted from Gatti et al. (2019) as follows:

a. Do you agree you understand the topics of information management after bingo game?
b. Do you agree it's important to learn about sustainability is towards your curriculum development after the game?
c. Do you agree it's useful to learn about information management is towards your future career after bingo game?
d. As a result of your participation, did your overall expertise in the topics covered in bingo game increase?

All questionnaires used a five-point Likert scale ranging from one to five, with one indicating a high degree of agreement and five indicating a high degree of disagreement.

E. Participants

The participants were students from two universities in Taiwan. Group A consisted of 42 graduate students in the fall semester of 2021 who had no experience learning information management. Group B consisted of 57 third-year undergraduate students in the spring semester of 2022 who also had no experience. To avoid the influence of different teachers on the results, all students were taught by the same teacher, using the same learning materials and the same adapted bingo game. Moreover, a paired-sample t-test was used to examine whether the pretest and posttest of groups A and B showed a different learning outcome. In group A, the average Delta value is 14.744 (standard deviation = 16.97). In group B, the average Delta value is 6.045 (standard deviation =

15.039). The results also showed significant differences between pretest and posttest for group A (p = 0.000) and group B (p = 0.002) on learning outcomes.

IV. Results

A. Pretest and Post-Test

Table 1 presents the summary of pretest and post-test. In the pretest and post-test, we examined the score of correct answer via 14 pre-designed questions to measure the learning outcomes (five points per question). In group A, the average score on the pretest was 31 (standard deviation is 11), and the average on the post-test was 45 (standard deviation is 15), which indicates a 21% improvement on average. In group B, the average score on the pretest was 33 (standard deviation is 12), and the average on the post-test was 39 (standard deviation is 15), which indicates a 9% improvement on average. The results showed that collaborative gamification design can help students review learning content and cases and enhance learning outcomes.

Table 1
The Summary of Pretest and Post-Test

	Group A			
	Maximum	Minimum	Mean	Standard Deviation
Pretest	60	10	31	11
Post-test	70	20	45	15
	Group B			
	Maximum	Minimum	Mean	Standard Deviation
Pretest	50	0	33	12
Post-test	70	0	39	15

B. Reliability and Validity

The reliability test of Cronbach's alpha values for Group A and Group B were 0.933 and 0.926, respectively. In group A, the mean value of motivation and engagement are 4.44 and 4.25. The C.R. (Composite Reliability) values of bingo game, motivation, engagement, learning performance are 0.767, 0.756, 0.756, and 0.902 which are all higher than 0.7. The AVE (Average Variance Extracted) values of bingo game, motivation, engagement, learning performance are 0.526, 0.511, 0.516, and 0.698 which are all higher than 0.5. In group B, the mean value of motivation and engagement are 3.37 and 3.54. The C.R. values of bingo game, motivation, engagement, learning performance are 0.843, 0.927, 0.746, and 0.767 which are all higher than 0.7. The AVE values of bingo game, motivation, engagement, learning performance are 0.575, 0.681, 0.507, and 0.623 which are all higher than 0.5. Table 2 presents the summary of validity of all variables.

Table 2

The Summary of Validity of Variables

Variable	Group	Mean	Standard Deviation	C.R.	AVE
Bingo game	A	3.71	0.7	0.767	0.526
	B	3.51	0.8	0.843	0.575
Motivation	A	4.44	0.71	0.756	0.511
	B	3.37	0.96	0.927	0.681
Engagement	A	4.25	0.61	0.756	0.516
	B	3.54	0.61	0.746	0.507
Learning performance	A	4.27	0.75	0.902	0.698
	B	3.89	0.63	0.767	0.623

C. Regression Analysis

Table 3 presents the variance and regression weights for each equation in the model. The design of the bingo game significantly influenced student motivation and engagement. Thus, H1 for group A (β = 0.347) and group B (β = 0.376) was supported. H2 was also supported for both group A (β = 0.402) and group B (β = 0.446). Motivation significantly influenced learning performance in group B (β = 0.361) but not in group A (β = 0.672). Conversely, engagement significantly influenced learning performance in group A (β = 0.137) but not in group B (β = 0.314). Moreover, 9.8% of the variance in motivation in group A (adjusted R2 = 0.098) and 12.6% (adjusted R2 = 0.126) in group B was explained by the game design. The game design explained engagement in group A with 14.1% of the variance (adjusted R2 = 0.141) and group B with 18.4% of the variance (adjusted R2 = 0.184). Learning performance was explained by motivation and engagement in group A with 60% of the variance (adjusted R2 = 0.6) and group B with 38.2% of the variance (adjusted R2 = 0.382).

Table 3

Summary of regression analysis

Hypothesis	Group	Adj. R2	F-value	β	Results
H1: Bingo game design > Motivation	A	.098	5.479	.347*	Supported
	B	.126	9.047	.376**	Supported
H2: Bingo game design > Engagement	A	.141	7.703	.402**	Supported
	B	.184	13.655	.446**	Supported
H3: Motivation > Learning performance	A	.600	31.76	.672	Not Supported
	B	.382	18.287	.361*	Supported
H4: Engagement > Learning performance	A	.600	31.76	.137**	Supported
	B	.382	18.287	.314	Not Supported

*$p < 0.05$; **$p < 0.01$

D. Discussion

This study developed an adapted bingo game for review of course materials and explored the effect on learning motivation, engagement, and performance. The results of the pretest and post-test for both groups showed an improvement in scores in both groups. We infer that the bingo game significantly and effectively increased students' knowledge in an information management course (group A). Teachers can use this bingo game to stimulate engagement and improve learning performance. We also collected qualitative feedback which showed that students considered the bingo game to be an interactive, fun, and entertaining means of promoting learning. Some students liked the idea of playing the game after the lecture as a way to summarize the material. The adapted bingo game is a novel way of consolidating knowledge. The findings are consistent with earlier studies that found a positive influence of game-based learning on learning outcomes (Chen et al., 2019; Clark et al., 2011; Erhel & Jamet, 2013). The more effort students put into playing the game, the better their game performance, which contributed to enhanced conceptual understanding and problem-solving in the curriculum area. Literature has also shown that motivation to learn positively affected learning outcome (Zhao & Huang, 2020). Motivation in education assists students in focusing their attention on a specific goal or outcome. Students who are motivated behave in a goal-oriented manner. We discovered that no matter the learning environment——online learning or game-based learning——students learn better when they are enthusiastic and motivated. Hence, our adapted bingo game allows students to become teaching assistants with more participation and engagement. Motivation to learn, engagement, and performance can be improved accordingly.

V. Conclusion

This study presents a gamified course involving an adapted game of bingo to enhance learner engagement, motivation, and learning performance. The proposed gamification strategy allowed students to contribute by developing bingo game questions. Bingo games can encourage students to review material collaboratively. We conducted

experiments in two groups, one with 42 graduate students (group A) and another with 57 undergraduate students (group B). Both courses are offered on the same subject (information management). The experiments showed that the adapted bingo game could improve graduate students' motivation and motivation may enhance learning performance. Using the bingo game, undergraduate students' engagement was improved. Further, learning performance may be enhanced by students' engagement. We also found that our gamification strategy was effective by comparing scores between the pretest and post-test. A comparison of the pretest and the post-test showed improved learning outcomes and the effectiveness of the game. The average improvement in accuracy between the pretest and post-test was 21% (group A) and 9% (group B). Students improved learning outcomes by in-class reviewing course materials and cases which may be facilitated by the adapted bingo game. Students also proactively immersed themselves in the game and looked forward to the next bingo game. In summary, our gamification strategy can help teachers adapt bingo rules and integrate must-learn concepts into 16 elements. Teachers and students can collaborate to achieve better learning goals and outcomes in the adapted bingo game. This research expects to contribute to gamification and game-based learning areas, indicating the effectiveness of an adapted bingo game for academic study.

VI. Limitations

There are several limitations in this research. First, more experiments can be conducted in different classes to improve the effectiveness of the gamification strategy. Second, the mediating effect of motivation and engagement can be examined by different methods (e.g., PLS-SEM) to reveal the importance of mediating variables.

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