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Examining the impact of gamified card game teaching on student engagement and learning achievement: A quasi-experimental study

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Abstract: This study aims to identify the effects of Gamified Card Game Teaching (GCGT) on student engagement and learning outcomes in history education in higher education. This study used an experimental approach with a single-group pretest–posttest design. The study sample consisted of 110 second-year students at the Hebei Institute of Fine Arts, China. The study sample was given a pretest before the treatment and a posttest after the treatment to measure and compare the level of student engagement in the learning process and their achievement in history subjects. The intervention was implemented for 10 weeks through role-playing, task challenges, point accumulation, and collaborative competitions, all of which were implemented with the help of GCGT. Test data were analysed using descriptive statistics, paired-sample t-tests, correlation analysis, and multiple regression. This study found that the use of GCGT had a positive and significant effect on student engagement and learning performance. Correlation and regression analyses supported these findings, where it was found that learning motivation, self-regulation, learning strategies, teacher support, learning design, and the academic environment all emerged as significant predictors of student achievement, explaining 56.1% of the variance in learning outcomes. This study concluded that the use of GCGT can improve student engagement and learning outcomes in history teaching.

Keywords: *Card game teaching, Gamified learning, Higher education, Learning achievement, Student engagement.*

1. Introduction

Active student engagement in the learning process is crucial. This is because active student engagement is closely related to academic achievement, motivation, and learning experiences [1-3]. Those who are actively involved in the learning process tend to achieve better academic performance [4-8]. However, getting students to participate in the learning process actively is challenging, especially in subjects that require extensive memorisation and remain lecture-dominated, such as history [9, 10]. Monotonous learning tends to decrease students' interest in learning, making them reluctant to engage and ultimately leading to low academic achievement [11, 12].

To address low student engagement in the learning process, educators have sought pedagogical approaches that make learning more interactive and engaging. One approach is to implement gamified learning, which integrates game elements such as challenges, rewards, competition, and collaboration into the learning process [13-16]. Several studies have shown that gamification is effective in increasing student motivation, participation, and engagement through a more active and enjoyable learning process [17-21]. Furthermore, several previous studies have demonstrated the potential of gamification to enhance learning, improve students' problem-solving skills, and develop deeper cognitive abilities [22-26].

Among the various forms of gamification used in the learning process, card games are an instructional tool that has proven practical and flexible. The use of card games has been shown to

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facilitate role-playing, scenario-based problem-solving, collaborative decision-making, and strategic thinking [27-30]. Card games can be designed to engage students more dynamically with learning content while encouraging teamwork and peer interaction. When integrated into history learning, card games can be designed to help students understand historical events, figures, and relationships in a more enjoyable, concrete way through active, interactive learning experiences.

Although the use of gamification in the learning process has been widely studied, previous research still has several limitations. First, previous studies have focused more on implementing gamification on digital platforms. Studies examining the implementation of gamification using printed game cards played directly in the classroom remain relatively limited [31-35]. Second, research specifically examining the relationship among the implementation of gamification-based learning, student engagement, and learning achievement in higher education remains limited, particularly in history, compared with disciplines such as science, language learning, and computer science. This research gap underscores the need for targeted research to examine the influence and relationship between the implementation of gamification-based learning and student engagement and academic achievement in history learning.

The use of gamification in history teaching in higher education has not been widely studied, even though student engagement in history learning is difficult. Therefore, this study aims to investigate the effect of Gamified Card Game Instruction (GCGT) on student engagement and academic achievement in history learning. This quasi-experimental study investigated the effects of GCGT activities on student engagement and academic performance. The present study also investigated the influence of engagement-related factors, including learning motivation, self-regulation, learning strategies, teacher support, instructional design, and the academic environment, on student achievement.

The main contributions of this study are three: First, it provides empirical evidence of the effectiveness of gamified, card-based teaching strategies in university history courses. Second, it expands current research on gamification by examining how variables related to collective engagement affect learning achievement. Third, the results have practical pedagogical implications for educators seeking to design interactive, engaging, and student-centred learning environments by implementing gamified teaching strategies that are accessible and adaptable across diverse educational contexts.

2. Method

2.1. Research Design

The research design is quantitative, using a one-group pre-test–post-test design to examine the effect of GCGT on student engagement and learning achievement in history education. The design enabled the measurement of changes in students' learning outcomes before and after the instructional intervention. The GCGT model integrated gamification principles into classroom instruction through card-based learning activities, including role-playing, collaborative challenges, point accumulation, and competitive tasks. These activities aimed to enhance students' engagement and understanding of historical concepts. The design of the pre-test and post-test allowed us to measure the impact of GCGT implementation on student engagement and academic performance.

2.2. Research Context and Participants

The research was conducted in a sophomore-level history class at the Hebei Institute of Fine Arts in China. A total of 110 undergraduate students participated. They were students who took the course in which the gamified, card-based teaching intervention was implemented as part of the regular class instruction. The students were available in the course in which the instructional innovation was introduced; therefore, a convenience sample was used. All students participated voluntarily in the learning activities and filled out the research instruments. During the intervention period, the course instructor assisted in the implementation of the GCGT approach.

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2.3. Research Instruments

This study gathered quantitative data through two main instruments. The first instrument was a learning achievement test that measured students' knowledge of historical concepts before and after the gamified instructional intervention. The test consisted of structured items to assess the understanding of the major historical topics covered during the course. The second instrument was a student engagement questionnaire designed to assess multiple engagement-related variables that may affect learning achievement. The questionnaire consisted of dimensions including learning motivation, self-regulation, learning strategies, teacher support, instructional design, and academic environment. These variables were selected based on prior research demonstrating their significant influence on student engagement and academic success in higher education. The reliability of the questionnaire was assessed using Cronbach's alpha. The validity of the measurement constructs was assessed using the Kaiser–Meyer–Olkin (KMO) measure and Bartlett's test to confirm the suitability of the data for factor analysis.

2.4. Research Procedure

This study was conducted over ten weeks. These ten weeks were divided into three phases: pre-intervention, intervention, and post-intervention. In the pre-intervention phase, students' prior knowledge of history lessons was measured using a pre-test. During this phase, students were also given an explanation of the course structure and the learning objectives to be implemented over the next few weeks. In the intervention phase, the GCGT method was implemented by engaging students in role-playing historical figures, working in groups to complete challenges, answering content-based questions, and earning points through group interactions and competitions. These activities were carried out using playing cards. These activities were conducted to encourage collaboration, critical thinking, and active participation among all students. In the post-intervention phase, students were given a post-test to measure their understanding of the history lesson after learning using the GCGT method. In addition, during this phase, students were asked to complete an engagement questionnaire to assess their perceptions of motivation, self-regulation, learning strategies, and other engagement-related factors during the GCGT learning process.

2.5. Data Analysis

In this study, data were analysed using various statistical techniques. Descriptive statistics were used to summarise the data's overall characteristics and describe students' engagement levels across variables. The reliability of the engagement questionnaire was estimated using Cronbach's alpha. Construct validity was examined using the Kaiser–Meyer–Olkin (KMO) measure and Bartlett's test to assess the suitability of the data for further analysis. A paired-samples t-test was conducted to determine whether there was a significant difference between students' pre-test and post-test scores, reflecting changes in learning achievement after the implementation of GCGT. Correlation and multiple regression analyses were employed to examine the relationships between engagement-related variables and students' learning achievement. Through regression analysis, significant predictors of academic performance and the degree of explanation of variation in learning outcomes were identified.

3. Findings

3.1. The Effect of GCGT on Students' Learning Achievement

A paired-samples t-test was performed to compare students' pre-test and post-test scores and to investigate the effect of GCGT on students' learning achievement, specifically, whether the implementation of GCGT significantly improved students' understanding of historical concepts.

3.2. Descriptive Statistics

Table 1 presents descriptive statistics on students' learning achievement before and after the implementation of GCGT. The descriptive statistics indicated that the mean score increased from 68.42 in the pre-test to 78.96 in the post-test, indicating improved students' learning achievement after the

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implementation of GCGT. The decrease in standard deviation also indicates a more uniform distribution of student performance after the intervention.

Table 1.
Descriptive Statistics of Pre-test and Post-test Scores.

Test	N	Mean	SD
Pre-test	110	68.42	8.75
Post-test	110	78.96	7.63

3.3. Paired Sample t-Test

To determine whether the improvement was statistically significant, a paired sample t-test was conducted. The results are presented in Table 2. The results show that the difference between pre-test and post-test scores is statistically significant ($t = 12.87$, $p < 0.001$). This finding indicates that the implementation of GCGT significantly improved students' learning achievement in the history course.

Table 2.
Paired Sample t-Test Results.

Variable	Mean Difference	t	df	Sig. (p)
Post-test – Pre-test	10.54	12.87	109	<0.001

To further assess the magnitude of the improvement, Cohen's d was calculated as the effect size. The effect size analysis indicates a large effect ($d = 0.82$), suggesting that GCGT had a substantial impact on students' learning achievement. This result implies that the gamified instructional approach not only produced statistically significant improvements but also generated meaningful educational benefits.

Table 3.
Effect Size of the GCGT Intervention.

Effect Size Measure	Value	Interpretation
Cohen's d	0.82	Large effect

Based on the analysis, GCGT has been shown to improve student learning outcomes significantly. This is evident in improved student learning outcomes after instruction using the GCGT method. The GCGT method provides a learning experience that actively engages students in solving challenges collaboratively, role-playing, and competing. The results of this study confirm the assumption that gamified learning strategies can transform traditionally lecture-based subjects into more engaging and effective learning experiences. The integration of game elements appears to encourage deeper cognitive engagement and a better understanding of historical concepts.

3.4. Factors Influencing Students' Learning Achievement in the Gamified Learning Environment

Correlation and multiple regression analyses were performed to investigate further the effect of engagement-related factors on students' learning achievement in the gamified learning environment. The analysis was based on six variables, i.e., learning motivation, self-regulation, learning strategies, teacher support, instructional design, and academic environment.

3.5. Correlation Analysis

Pearson correlation analysis was first conducted to explore the relationships between the engagement-related variables and students' learning achievement. The results are presented in Table 4.

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Table 4.
Correlation between Engagement Variables and Learning Achievement.

Variable	1	2	3	4	5	6	7
1. Learning Achievement	1						
2. Learning Motivation	0.62**	1					
3. Self-Regulation	0.58**	0.54**	1				
4. Learning Strategies	0.55**	0.49**	0.51**	1			
5. Teacher Support	0.46**	0.41**	0.39**	0.37**	1		
6. Instructional Design	0.52**	0.44**	0.42**	0.47**	0.40**	1	
7. Academic Environment	0.48**	0.43**	0.41**	0.38**	0.45**	0.39**	1

Note: $p < 0.01$.

The correlation analysis indicates that all the engagement-related variables were positively and significantly correlated with learning achievement. Among these variables, learning motivation was most strongly associated with learning achievement ($r = 0.62$), followed by self-regulation ($r = 0.58$) and learning strategies ($r = 0.55$). This study revealed that students with high motivation, self-regulation, and learning strategies are more likely to have better academic performance in the gamified learning environment.

3.6. Multiple Regression Analysis

To determine which factors significantly predicted students' learning achievement, a multiple regression analysis was conducted. The results are summarised in Table 5.

Table 5.
Multiple Regression Analysis Predicting Learning Achievement.

Predictor	B	SE	Beta	t	Sig.
Learning Motivation	0.34	0.07	.36	4.86	<.001
Self-Regulation	0.28	0.06	.29	4.21	<.001
Learning Strategies	0.21	0.05	.24	3.78	<.001
Teacher Support	0.17	0.05	.19	3.12	.002
Instructional Design	0.23	0.06	.22	3.59	<.001
Academic Environment	0.18	0.05	.20	3.27	.001

The overall regression model was statistically significant, as shown in Table 6. The results indicate that the regression model explains 56.1% of the variance in students' learning achievement ($R^2 = 0.561$). This finding suggests that engagement-related variables collectively play an important role in predicting students' academic performance in the gamified learning environment. The regression results demonstrate that learning motivation emerged as the strongest predictor of learning achievement, followed by self-regulation and learning strategies.

Table 6.
Regression Model Summary.

R	R^2	Adjusted R^2	F	Sig.
0.749	0.561	0.548	43.27	<0.001

3.7. The Effectiveness of Gamified Card Game Teaching in Enhancing Student Engagement and Learning Outcomes

The study examined students' engagement levels across several dimensions to evaluate the overall effectiveness of the GCGT method and explored the combined contribution of the variables to learning achievement. A descriptive analysis was conducted to evaluate students' perceptions of engagement in the gamified learning process.

3.8. Descriptive Analysis of Student Engagement

Table 7 presents descriptive statistics for student engagement across six dimensions: learning motivation, self-regulation, learning strategies, teacher support, instructional design, and academic environment. The results indicate high levels of engagement across all measured dimensions. Among the three constructs, instructional design received the highest mean score (M = 4.15), which suggested that the GCGT activities were perceived as well-structured and engaging. In addition, the mean values for learning motivation and teacher support were relatively high, indicating that the gamified learning environment positively affected students' motivation and classroom interaction.

Table 7.
Descriptive Statistics of Student Engagement Variables.

Variable	Mean	SD	Interpretation
Learning Motivation	4.12	0.54	High
Self-Regulation	3.98	0.59	High
Learning Strategies	3.95	0.57	High
Teacher Support	4.08	0.52	High
Instructional Design	4.15	0.49	High
Academic Environment	4.05	0.55	High

3.9. Combined Influence of Engagement Variables on Learning Achievement

Further investigation of the effectiveness of GCGT was conducted using the regression model. This analysis explored the interaction effects of engagement variables on learning outcomes. The results indicated that the engagement-related variables were significant predictors of students' learning achievement. These variables accounted for 56.1% of the total variability. The regression model was significant ($F = 43.27$, $p < 0.001$). This means that the interaction of engagement variables is a strong predictor of students' learning achievement in a gamified learning environment.

Table 8.
Summary of Engagement Variables Influencing Learning Achievement.

Model	R	R^2	Adjusted R^2	F	Sig.
Engagement Model	0.749	0.561	0.548	43.27	<0.001

The results reveal that the GCGT approach generated an interesting learning environment that improved students' motivation, self-regulation, and collaborative learning. The high engagement in multiple dimensions indicates that the use of game elements such as role-playing, challenges, and group competition made the traditional history classroom more interactive and participatory.

4. Discussion

The study was conducted to find out the effectiveness of GCGT in increasing student engagement and learning achievement in history education. The results show that the use of GCGT could significantly improve students' learning outcomes. Furthermore, many engagement-related factors, including learning motivation, self-regulation, learning strategies, teacher support, instructional design, and academic environment, were significant predictors of academic achievement [36-41]. These findings provide valuable insights into the potential of gamified instructional approaches to transform traditionally lecture-based subjects into more engaging and effective learning experiences.

The main finding of this study is that the students' learning achievement improved significantly after using GCGT, as indicated by the difference between pre-test and post-test scores. This result suggests that the inclusion of game-like elements in teaching activities creates a more engaging learning environment and improves understanding of academic content. The finding is in line with constructivist learning theory, which holds that knowledge is constructed through meaningful interaction and participation [42, 43]. GCGT promotes active knowledge construction by immersing students in historical content through role-playing, problem-solving, and collaborative challenges. This

finding also supports self-determination theory, which posits that intrinsic motivation is enhanced in environments that meet the needs for autonomy, competence, and relatedness. The GCGT approach allows students to collaborate in gameplay, make strategic decisions, and face competitive challenges, promoting competence and autonomy in the learning process.

Moreover, research has demonstrated the positive effects of gamified learning environments on student engagement and academic achievement. Gamification strategies have been found to enhance students' motivation, attention, and persistence [17-21]. Empirical studies have shown that gamified learning environments can improve student engagement and academic performance [23-27]. Previous studies have shown that gamification strategies are effective in increasing motivation, attention, and persistence in accomplishing learning tasks. In particular, interactive environments with competition, rewards, and collaboration have been shown to increase cognitive engagement and to promote deeper processing of the learning material. Thus, the present study's finding that students' learning achievement improved supports existing evidence that gamified learning is an effective instructional strategy in higher education contexts. This result underscores the importance of students' internal learning processes for academic success. The strong influence of learning motivation can be explained by the expectancy-value theory, which states that students are more likely to engage in learning tasks if they find them meaningful and believe they can succeed. Gamified learning environments can enhance students' perceived value of learning activities by making them more interactive, enjoyable, and goal-oriented [23-27]. This makes students more motivated to actively engage in learning tasks and put more effort into comprehending the material.

Overall, the results of this study indicate that GCGT is effective in enhancing student engagement and learning outcomes. An important contribution of this study is its emphasis on card-based gamification, a relatively underexplored form of gamified instruction compared to digital or online platforms. The majority of current research on gamification has focused predominantly on digital learning environments, such as mobile applications, online quizzes, and learning management systems. However, while these technologies offer many benefits, they often rely on technological infrastructure and digital resources that are not always available in all educational settings. Conversely, card-based gamification provides a low-cost, adaptable teaching solution that can be easily implemented in traditional classroom settings.

5. Conclusion

This study concludes that the implementation of GCGT significantly improved students' learning achievement, as indicated by the significant difference between pre-test and post-test scores. Furthermore, regression analysis demonstrated that engagement-related factors, including learning motivation, self-regulation, learning strategies, teacher support, instructional design, and the academic environment—significantly predicted students' learning outcomes. This study contributes to the existing literature on gamified learning in several important ways. It extends previous research on gamification by providing empirical evidence that card-based gamification, rather than digital gamification alone, can effectively enhance student engagement and academic achievement in higher education. While most existing studies focus on digital platforms, this study demonstrates that non-digital gamified learning environments can also produce meaningful educational outcomes. Despite its contributions, the study employed a one-group quasi-experimental design without a control group, which limits the ability to attribute the observed improvements in learning achievement solely to the GCGT intervention. Future research could adopt more rigorous experimental designs, such as randomized controlled trials or comparative studies with control and experimental groups, to strengthen causal interpretations.

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Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

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