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## Implementation of Gamification Method in Lower Grade Mathematics Subject in China

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ABSTRACT

The implementation of the gamification method in lower-grade primary school mathematics teaching represents an important direction for exploring improvements in teaching effectiveness. This study focuses on the implementation effect of the gamification method. It explores its relationship with two categories of predictive variables: teacher-level independent variables (teachers' understanding of gamification method, attention to student subjectivity, and ability to create gamified environments) and student-level independent variables (students' interest level, classroom game participation, and knowledge comprehension). This study targeted 200 lower-grade primary school students and 200 mathematics teachers in Nanchong City, China. Regression analysis results show that for teacher-level variables, the coefficient of determination ( $R^2$ ) with the implementation effect is 0.930, the F-value is 871.248 ( $p < 0.001$ ), indicating that each independent variable significantly predicts the implementation effect. For student-level variables, the  $R^2$  is 0.929, the F-value is 854.972 ( $p < 0.001$ ), confirming that each variable also demonstrates significant predictive power for the implementation effect. The study indicates that strengthening teachers' cognition of gamification teaching, emphasizing student subjectivity participation, and stimulating students' intrinsic learning interest are core pathways to optimize the implementation effect of the gamification method. Based on these findings, the research provides improvement suggestions for the implementation of gamification method in lower-grade primary school mathematics teaching and provides a basis for optimizing the teaching method and enhancing teaching effectiveness.

### 1. Introduction

Learning mathematics in the primary years is essential for developing logical thinking, abstract reasoning, and problem-solving skills. However, teaching mathematics to young primary students presents teachers with unique educational challenges<sup>[1]</sup>. During this developmental stage, children are still exhibiting Piaget's "concrete op-

erational" thought, which makes it difficult for them to understand theoretical concepts in mathematics, geometry, and reasoning. Consequently, conventional teaching methods often fail to engage these students, leading to diminished motivation, forgotten concepts, and weakened problem-solving skills. In response to these challenges, teachers have been attempting cooperative learning, project-based activities, and the integration of technology in

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their classes. Although these teaching approaches can be effective, they do not consistently provide young learners with the interactive experiences they most enjoy. Traditional lectures, lacking interactivity, are not ideal for engaging students in mathematics, and while group work can enhance meaningful learning, it may overlook the step-by-step fundamentals crucial for mathematical understanding. Due to a lack of effective teaching practices, gamification has garnered increased attention recently, utilising games and their rewarding elements to motivate students in education <sup>[2]</sup>.

The application of gamification is particularly effective for young learners, who prefer to play, explore new ideas, and receive prompt feedback. Presenting students with mathematical puzzles in the form of interactive games allows them to easily connect theory to practice. This not only fosters greater interest and involvement among students but also enhances their ability to understand and apply mathematical concepts. Nevertheless, despite its potential benefits, the use of gamified teaching in primary schools remains relatively limited. Reports indicate that most teachers employ gamification primarily for the introductory activity of lessons, with little integration into other phases of the learning process. This research investigates the implementation of gamification in lower-grade mathematics teaching in the city of Nanchong, China. It examines the effectiveness of gamification as a pedagogical approach and explores its relation to two sets of factors: those associated with teachers (such as their understanding, emphasis on students' perspectives, and design skills) and those concerning students (including their interest, level of participation, and grasp of mathematical concepts). By applying multiple linear regression analysis to the results of a survey involving 200 teachers and 200 students, the study identifies the influences on the effectiveness of gamified learning <sup>[3,4,5]</sup>.

The main theories behind this research are John Dewey's Pragmatist Theory of Education, Constructivist Learning Theory, and Cooperative Learning Theory. Using "learning by doing" as a guideline, Dewey would find that gamified teaching easily makes the classroom into a place where learning happens through experience. According to constructivist theory, students gain knowledge by being actively involved, and gaming helps them do this. Besides, Cooperative Learning Theory points out that learning is also social, and this aspect is well supported by games through planned group activities and group contests. This study has important consequences for teaching, making changes to the curriculum, and students' growth. For teachers or educators, it provides useful advice and steps for using gamification in their teaching. When used

in curriculum development, it gives a way to switch from educational standards and cognitive goals to game design. It proves that gamification is helpful for students in stimulating their interest in math, helping them process knowledge better, and making them feel more engaged <sup>[6,7]</sup>.

To conclude, this research tackles an unaddressed issue by researching how gamification has changed primary math education and what its outcomes are. By studying the issue with research and solid ideas, it provides advice to those in charge of education to help them improve and enhance children's learning through gaming <sup>[8]</sup>.

## 2. Literature Review

### 2.1 Theoretical Foundations of Gamification in Education

Foundational theories used in the gamification of education are John Dewey's theory, the Constructivist theory, and the Cooperative Learning theory. Dewey (1916) believed that learning takes place through experiences, and he believed education should be focused on the students. Gamified teaching follows this vision by changing traditional instruction into something students participate in. According to constructivist ideas, Piaget and Vygotsky, students learn the most when they actively take part in learning activities (Piaget, 1972; Vygotsky, 1978). Gamification gives these opportunities by including learning objectives in problem-solving games. Cooperative Learning Theory, which was first suggested by Johnson and Johnson (1989), also has a significant impact. It stresses teamwork, joint targets, and learning together, all of which are usual in educational games made for groups<sup>[9,10,11]</sup>.

### 2.2 Gamification in Mathematics Education

Many experts point out that gamification helps students brush up on their interest in mathematics and learn better. The author of Zhao Hai (2021) says that using mathematical games can quickly interest students and improve how they think. Huifen (2020) also believes that games improve a person's desire to learn and their understanding and proper use of knowledge. As explained by Pan Xingwei, games are suited for youths since they help young people engage and understand challenging math concepts.

In the past, China's education system relied heavily on rote learning and taking exams. Now, gamification provides a fair balance between having fun and doing challenging tasks. Because the Ministry of Education aims for quality education, the current policy environment promotes new methods in education. Even so, proper use of gamified methods in math classes has not been fully put into place and is still understudied at the beginning of

students' education <sup>[12,13]</sup>.

### 2.3 Strategies and Challenges in Gamification Implementation

There are several opportunities and difficulties described in the literature about gamifying math fields. Wang Fang (2023) disagrees with the way most current practices are pursued, due to their lack of new ideas, guidance toward learning MAIN, and relatedness to various subjects. In her opinion, games should have clearer objectives, be used more closely with school subjects, and have consistent classroom management for better results. In 2022, Liu Yang emphasised that for gamification to work well, rules need to be proper and the timing precise, since it should not be a rather temporary, spur-of-the-moment idea <sup>[14,15]</sup>.

Li Mei (2023) advises that gamified learning should follow three main guidelines: matching games to the learning objectives, including different kinds of formats, and finding a suitable middle ground in terms of complex tasks and amounts of time spent. Wang Hao (2022) further states that students should have some independence and know how to cooperate within groups. In 2024, Zhang Liang points out that new ideas and creativity are essential to designing good games.

Even with these observations, there are difficulties in implementing the results. Many teachers don't have enough knowledge about both the principles and practices of gamification. As pointed out by Li (2022), because of cognitive biases, teachers sometimes use gamification for entertainment rather than for any educational purpose. In addition, the lack of proper management in classrooms, unequal involvement of students, and poor evaluation systems limit how well schools can function <sup>[16,17,18,19,20]</sup>.

### 2.4 Empirical Gaps and Research Needs

International studies prove that educational games are useful, though research about lower-grade mathematics education for students in China is still not very common. Based on the data from CNKI (2024), just about 9% of research on gamification in education focuses on this age group. Moreover, previous studies tend to be weak scientifically since few uses large data sets to look at how teacher features and student characteristics affect each other.

This study highlights that we need extra studies to find out how gamification supports teaching effectiveness, keeps students interested, and can make them retain knowledge at the primary education level. It is necessary to create gamification strategies that focus on the unique features of Chinese students' culture, institutions, and in-

tellectual processes <sup>[21]</sup>.

## 3. METHODOLOGY

### 3.1 Research Design

This study employs a multiple linear regression research design, using quantitative survey methods to explore the relationship between the implementation effect of the gamification method in lower-grade primary school mathematics and teacher-student predictors. The reason for adopting the combination of questionnaire survey and multiple linear regression is that this approach can systematically describe the feedback characteristics of lower-grade primary school teachers and students (200 students and 200 mathematics teachers) regarding gamified teaching, while also analyzing the impact intensity of teacher predictors (degree of understanding of gamification methods, attention to student subjectivity, ability to create gamified environments) and student predictors (interest level, participation, degree of knowledge understanding) on the implementation effect through quantitative models. This provides data support and an inferential basis for optimizing teaching methods.

### 3.2 Population and Sampling

Nanchong City is one of the earliest regions in Sichuan Province, China, to explore the implementation of the gamification method in primary school mathematics teaching. This study takes lower-grade primary school students and primary school mathematics teachers in the city as research subjects. Considering that differences in teaching characteristics across different grade levels and between teachers and students may influence the research results, stratified sampling is adopted for primary school mathematics teachers in Nanchong City <sup>[22]</sup>.

Teachers are stratified by the grade levels they teach. The sampling proportion of mathematics teachers in the first grade of primary school is set at 40%, and those in the second and third grades account for 30% each. Statistical analysis shows that the average age of the sampled teachers is 34 years, with male teachers comprising 43% and female teachers 57%. Meanwhile, stratified sampling is also implemented for lower-grade primary school students in Nanchong City. Students are stratified by grade level: the sampling proportion of first-grade students is 40%, and those in the second and third grades each account for 30%. The average age of the sampled students is 8 years, with male students representing 59% and female students 41%. Through scientific and reasonable stratified sampling, this study aims to ensure the representativeness of the samples, thus providing a reliable data foundation

for subsequent research.

### 3.3 Instrument of Study

This study employs the questionnaire survey as the core instrument; a method widely used in social science research for its efficiency and universality. To comprehensively explore the implementation status of the gamification method in primary school mathematics in Nanchong City, special questionnaires are designed for primary school teachers and students of different grades in the city, investigating multiple dimensions such as teachers' and students' cognition, acceptance, usage experience, and influencing factors of gamified teaching.

In the process of questionnaire development, existing relevant scales are fully referenced, and questions are designed in combination with the research background and objectives. The questionnaire mainly consists of multiple-choice questions supplemented by open-ended questions to ensure comprehensive and objective feedback collection. It is divided into two versions: the student version, which adopts concise expressions to adapt to the cognitive characteristics of younger students, and the teacher version, which deepens the dimensionality of questions to obtain detailed information on teaching practices.

The questionnaire was officially distributed in January 2025, with a total of 400 copies distributed. After strict screening, all questionnaires were valid, with an effective recovery rate of 100%. The content validity was tested by a review panel composed of educational experts and front-line teachers to confirm the relevance of the questions to the research objectives and the comprehensiveness of coverage. The construct validity was ensured by designing different versions for teachers and students, and the empirical validity was verified by the 100% effective recovery rate, demonstrating the questionnaire's applicability. In addition, the test-retest method was used to examine reliability: the same group was retested after a two-month interval, and the Pearson correlation coefficient reached 0.9, indicating good reliability of the questionnaire. The specific content is shown in Table 1. The instrument is divided into five sections: Section A (personal details), Section B (experience of gamified teaching), Section C (influencing factors of teaching implementation), Section D (evaluation of acceptance by teachers and students), and Section E (improvement suggestions). The questions adopt a 1-5 Likert scale and open-ended response formats.

### 3.4 Data Collection Procedure

After obtaining permission from the local education authorities and schools, the data collection can be initiated.

Following the completion of pre-tests for questionnaire reliability and validity that meet research standards, customised questionnaires will be adopted to carry out field surveys. On the data collection day, researchers distribute questionnaires to respondents, with independent versions designed for student and teacher questionnaires, both affixed with an informed consent form and filling guidelines on the first page. A total of 200 student questionnaires are distributed, with on-site supervision of the filling process to ensure each student submits only one valid questionnaire. Meanwhile, 200 teacher questionnaires are distributed synchronously using the same distribution and collection mechanism, with all questionnaires collected on the spot to guarantee data integrity. After questionnaire retrieval, the research team conducts piece-by-piece verification, eliminating invalid questionnaires with incomplete information, obvious logical contradictions, etc. Valid questionnaires are uniformly coded and input into the professional SPSS data processing system for quantitative analysis, ensuring the data processing process complies with academic norms.

### 3.5 Data analysis

All data were collected and processed using SPSS IBM Version 29.0. Statistical analysis via SPSS ensures the precision of calculations. The collected data were subjected to descriptive and inferential analyses using SPSS software. Descriptive statistics were first employed to outline the demographic profiles of respondents, presenting percentages, means, and standard deviations to interpret the findings of Objective (1). The core analysis adopted a multiple linear regression model to measure the impact intensity of teacher predictors (gamification teaching comprehension, student subjectivity attention, environmental creation ability) and student predictors (interest level, participation degree, knowledge understanding) on the implementation effect. This quantitative model analysis aims to provide data support and inferential basis for optimizing teaching methods, aligning with the research objectives of (2), (3) and (4).

Multiple linear regression analysis was used to evaluate the strength of the relationship between predictor variables and the dependent variable. The analysis followed a statistical framework where regression coefficients ( $\beta$  values) indicated the direction and magnitude of influence, with significance tested at  $p < 0.05$ . The overall goodness-of-fit of the model was assessed using the coefficient of determination ( $R^2$ ). Effect sizes were interpreted according to Cohen's guidelines, where  $\beta$  values approaching 0.1, 0.3, and 0.5 represented small, medium, and large effects, respectively. This approach systematically inferred

the contribution of each predictor to the implementation effect, providing empirical insights for instructional improvement.

**Table 3.1:** Cohen's Guidelines for Interpreting Effect Sizes of  $\beta$  Values

Effect Size	$\beta$ Value Range	Interpretation
Small	$\approx 0.1$	Slight influence; minimal practical significance
Medium	$\approx 0.3$	Noticeable influence; moderate practical significance
Large	$\approx 0.5$	Substantial influence; strong practical significance

## 4. Results

This section outlines the results of data analysis collected from teachers and students in lower grades of primary schools in Nanchong. The main purpose of this study is to explore the relationship between the dependent variable (implementation effect of gamification method) and two categories of predictor variables: teacher-level factors (understanding of gamification method, attention to student subjectivity, environmental design ability) and student-level factors (interest level, participation degree, knowledge comprehension). Through multiple linear regression analysis, this study systematically describes the feedback characteristics of teachers and students on the gamification method, aiming to provide data support and inferential basis for optimizing teaching methods, and to address the research questions raised in the introduction.

### 4.1 Overview of Data Collection

This study distributed a total of 400 questionnaires to 200 students and 200 mathematics teachers in lower grades of primary schools in Nanchong. All questionnaires were formally administered in January 2025, and after strict screening, all were valid with a 100% effective recovery rate. The data collection process ensured scientific rigor through multiple reliability and validity tests: a review panel composed of educational experts and frontline teachers verified content validity to confirm the relevance and comprehensiveness of questions to research objectives; structural validity was ensured by designing separate questionnaires for teachers and students; the 100% recovery rate further validated empirical validity. Additionally, test-retest reliability was examined by administering the questionnaire to the same group with a two-month interval, yielding a Pearson correlation coefficient of 0.9, indicating good reliability of the questionnaire.

### 4.2 Profile of Respondent

Based on Table 4.1, the number of female teachers

( $n=114$ , 57%) was higher than that of male teachers ( $n=86$ , 43%). The respondent profile also indicated that respondents aged over 35 years ( $n=139$ , 69.5%) were slightly more than those under 35 years ( $n=61$ , 30.5%).

**Table 4.1:** Teachers' Profile

Demographic	Categories	Frequency	Percentage
Gender	Male	86	43%
	Female	114	57%
Age	$\geq 35$	139	69.5%
	$< 35$	61	30.5%

Based on Table 4.2, male students ( $n=118$ , 59%) were more than female students ( $n=82$ , 41%) in the sample. The profile further showed that among student respondents, there were 7-year-old respondents ( $n=78$ , 39%), 8-year-old respondents ( $n=65$ , 32.5%), and 9-year-old respondents ( $n=57$ , 28.5%).

**Table 4.2:** Students' Profile

Demographic	Categories	Frequency	Percentage
Gender	Male	118	59%
	Female	82	41%
Age	7	78	39%
	8	65	32.5%
	9	57	28.5%

### 4.3 Descriptive Analysis

Descriptive analysis was conducted to investigate the relationships between the implementation effect of gamified teaching and variables at the teacher-level and student-level. Specifically, it focused on variables such as teachers' "ability to create a gamified environment", "degree of understanding of the gamification method", "degree of attention to student subjectivity", as well as students' "level of interest", "classroom game participation level", and "degree of knowledge understanding", and their impacts on the "implementation effect"<sup>[23]</sup>.

#### 4.3.1 Results Based on Research Questions

##### 4.3.1.1 Implementation Effect Related to Variables

Regression analysis aimed to understand how the variables at the teacher-level and student-level affect the "implementation effect" of gamified teaching.

Based on Table 4.3, with an R-value of 0.964, it indicates a very strong correlation between the independent variables at the teacher-level (ability to create a gamified environment, degree of understanding of the gamification method, degree of student subjectivity) and the dependent variable (implementation effect). The coefficient of determination (R-square) value of 0.930 means that approximately 93% of the variation in the implementation effect

can be explained by these independent variables. The adjusted R-square of 0.929, which considers the number of predictor variables, further validates the goodness-of-fit of the model.

The Table 4.4 ANOVA results show that the F - F-value is 871.248 and the significance level (Sig.) is less than 0.001. This indicates that the regression model is statistically significant, meaning that at least one independent variable has a significant relationship with the dependent variable.

The unstandardized coefficient (B) for "Degree of Understanding of the Gamification Method" is 0.354, which means that, with other variables held constant, for every

- unit increase in the degree of understanding, the implementation effect increases by 0.354 units. The t - value of 5.515 and a significance level less than 0.001 indicate that it is a significant predictor. Similarly, the "Degree of Student Subjectivity" has a B value of 0.368, a t - t-value of 5.512, and a significance level less than 0.001, also making it a significant predictor. The "Ability to Create a Gamified Environment" has a B value of 0.200, a t - t-value of 3.453, and a significance level less than 0.001, and is also significant. The constant term of 0.365 represents the predicted value of the implementation effect when all independent variables are zero

**Table 4.3:** Model Summary for Implementation Effect (teachers)

Model	R	Coefficient of Determination (R - square)	Adjusted R - square	Standard Error of the Estimate
1	0.964	0.930	0.929	0.383

**Table 4.4-** ANOVA Results for Implementation Effect(teachers)

Model	Sum of Squares	Degrees of Freedom (df)	Mean Square	F - value	Significance(Sig.)
1 - Regression	383.355	3	127.785	871.248	<0.001
1 - Residual	28.894	197	0.147		
1 - Total	412.249	200			

**Table 4.5: Coefficients for Implementation Effect (teachers)**

Model	Sum of Squares	Degrees of Freedom (df)	Mean Square	F - value	Significance(Sig.)
1 - Regression	383.355	3	127.785	871.248	<0.001
1 - Residual	28.894	197	0.147		
1 - Total	412.249	200			

**Table 4.6:** Model Summary for Implementation Effect (Students)

Model	R	Coefficient of Determination (R - square)	Adjusted R - square	Standard Error of the Estimate
1	0.964	0.929	0.928	0.418

The R-value is also 0.964, showing a very strong correlation between the independent variables at the student-level (level of interest, participation level, degree of knowledge understanding) and the dependent variable (implementation effect). The coefficient of determination (R-square) value of 0.929 means that approximately 92.9% of the variation in the implementation effect can be explained by these independent variables. The adjusted

R-square of 0.928 further reflects the goodness-of-fit of the model.

The F - F-value is 854.972, and the significance level (Sig.) is less than 0.001, again indicating that the regression model is statistically significant, suggesting that at least one independent variable has a significant association with the dependent variable.

The unstandardized coefficient (B) for "Level of Inter-

**Table 4.7:** ANOVA Results for Implementation Effect (Students)

Model	Sum of Squares	Degrees of Freedom (df)	Mean Square	F - value	Significance(Sig.)
1 - Regression	448.794	3	149.598	854.972	<0.001
1 - Residual	34.470	197	0.175		
1 - Total	483.264	200			

**Table 4.8:** Coefficients for Implementation Effect (Students)

Model	Unstandardized Coefficient (B)	Standard Error	Standardized Coefficient (Beta)	t - value	Significance (Sig.)	Lower Bound of 95.0% Confidence Interval for B	Upper Bound of 95.0% Confidence Interval for B
1 - (Constant)	0.199	0.078		2.542	<0.001	0.353	0.045
1 - Degree of Understanding of the Gamification Method	0.516	0.058	0.498	8.864	<0.001	0.401	0.631
1 - Degree of Student Subjectivity	0.155	0.054	0.145	2.859	<0.001	0.048	0.261
1 - Ability to Create a Gamified Environment	0.367	0.052	0.349	7.123	<0.001	0.266	0.469

est" is 0.516, which means that, with other variables held constant, for every one-unit increase in the level of interest, the implementation effect increases by 0.516 units. The t-value of 8.864 and a significance level less than 0.001 indicate that it is a significant predictor. Similarly, the "Participation Level" has a B value of 0.155, a t-value of 2.859, and a significance level less than 0.001, also making it a significant predictor. The "Degree of Knowledge Understanding" has a B value of 0.367, a t-value of 7.123, and a significance level less than 0.001, and is also significant. The constant term of 0.199 represents the predicted value of the implementation effect when all independent variables are zero.

#### 4.4 Inferential Analysis

The multivariate research, inferential analysis serves as

the core approach to uncover the associative mechanisms among variables. Beyond descriptive statistics, researchers must employ inferential analysis to explore the nature, direction, and significance of variable relationships. This study utilizes regression analysis to test the predictive effects of independent variables on dependent variables, thereby revealing the intrinsic associations between constructs [24].

#### 4.4.1 Research Hypotheses and Analytical Framework

This section addresses two research hypotheses:

: The ability to create a gamified environment, degree of understanding, and degree of student subjectivity significantly predict the effect of implementation.

: Degree of understanding, participation, and level of

interest significantly predict the implementation effect <sup>[25]</sup>.

#### 4.4.2 Model Construction and Result Analysis

##### Influencing Factors of Implementation Effect(teachers)

The "ability to create a gamified environment", "degree of understanding", and "degree of student subjectivity" were entered as predictors, with "implementation effect" as the dependent variable. The model exhibited an  $R^2$  of 0.930 and adjusted  $R^2$  of 0.929, indicating that the three independent variables explained 92.9% of the variance in the implementation effect, reflecting an extremely high goodness of fit. The F-value was 871.248 ( $p < 0.001$ ), confirming the overall significance of the model and that at least one independent variable possessed predictive power for the dependent variable (Table 4.4). The degree of understanding ( $\beta = 0.375$ ,  $p < 0.001$ ), degree of student subjectivity ( $\beta = 0.394$ ,  $p < 0.001$ ), and ability to create a gamified environment ( $\beta = 0.213$ ,  $p < 0.001$ ) all demonstrated significant positive predictions of the implementation effect. The degree of student subjectivity had the highest standardized coefficient, indicating that enhancing students' subjective participation most potently promoted the implementation effect. The constant term was 0.365 ( $p < 0.001$ ), suggesting a baseline implementation effect in the absence of independent variables. (Table 4.5)

##### Influencing Factors of Implementation Effect (Students)

"Degree of understanding", "participation", and "level of interest" were entered as predictors, with "implementation effect" as the dependent variable. The model showed an  $R^2$  of 0.929 and adjusted  $R^2$  of 0.928, indicating that independent variables explained 92.8% of the variance in the implementation effect, demonstrating a good fit (Table 4.6). The F-value was 854.972 ( $p < 0.001$ ), confirming the overall significance of the model. The level of interest ( $\beta = 0.498$ ,  $p < 0.001$ ), degree of understanding ( $\beta = 0.349$ ,  $p < 0.001$ ), and participation ( $\beta = 0.145$ ,  $p = 0.005$ ) all exhibited significant positive predictions of the implementation effect. The level of interest had the highest standardized coefficient, highlighting that stimulating students' intrinsic interest is crucial for enhancing the implementation effect. The constant term was 0.199 ( $p = 0.012$ ), indicating the existence of a baseline implementation effect (Table 4.8).

#### 4.4.3 Hypothesis Testing and Theoretical Implications

Validation: All three independent variables signifi-

cantly and positively predicted the implementation effect, supporting . This suggests that strengthening gamified environment design, deepening students' understanding, and enhancing subjective participation can effectively improve implementation outcomes.

Validation: All three independent variables significantly and positively predicted the implementation effect, supporting . The strong predictive power of interest levels indicates that fostering students' intrinsic interest is a core pathway to optimizing implementation effects <sup>[26,27,28]</sup>.

## 5. Discussion

### 5.1 Influence of Teachers on the Implementation Effect of Gamification Method

#### 5.1.1 Teachers' Understanding of Gamification Method

This study reveals that teachers' understanding of the gamification method plays a crucial role in its implementation effect. Several teachers do not know about this approach well, because they rely on methods they have been using for years and lack full knowledge of its principles and procedures. In turn, reliance on the classical method of lectures makes it harder to use the potential of gamification in mathematics classrooms. It is clear from the investigation that just about 30% of teachers are skilled in explaining the conceptual background of gamification, and this has resulted in several difficulties related to gamified teaching design and implementation. Often, because of a lack of full knowledge, teachers tend to use a few simple games, which do not allow them to fit the activity to their class. It is very important for teachers to learn about the gamification method before implementing it effectively <sup>[29]</sup>.

#### 5.1.2 Teachers' Attention to Students' Subjectivity

When teachers notice students' opinions and beliefs, it also strongly affects the success of using games in teaching. Students do not hold the main role in today's mathematics gamification activities. Because teachers sometimes do not consider students' preferences when setting up games, the students might not help or work as a team.

For example, to choose students for games, teachers may go for top-achieving students instead of giving a chance to those who are very active. Because of this practice, other students' personal experiences are low-prioritised, which creates marginalisation and reduces the overall impact of gamification in education. Also, letting teachers make many decisions spoils students' opportunity to make their own choices and prevents effective learning motivation. So, teachers ought to view students as impor-

tant, create fair communication with them, and ensure that all students are able to improve<sup>[30]</sup>.

### 5.1.3 Teachers' Ability to Create Learning Environments

Teachers need to establish learning spaces, as this helps in using gamification effectively. In the process of using games in current primary school mathematics, problems with the classroom setting mostly involve order in the room and how often games are played. Some instructors choose some severe tactics for controlling students' unruly behaviour: either not paying attention to them to preserve the learning process, or setting aside time to deal with their conduct. They both do not find a suitable balance between maintaining order and keeping lessons going<sup>[31]</sup>.

Meanwhile, excessively high frequency of game application also causes problems. Overusing gamification teaching keeps students in a state of constant excitement, making it difficult to maintain classroom order, distracting students, weakening the learning atmosphere, and reducing the practical effect of gamification teaching. Therefore, teachers need to scientifically regulate the frequency of game use, reasonably arrange game links, and implement refined management to optimise the classroom environment for gamification teaching and improve teaching effects.

### 5.1.2 Influence of Students on the Implementation Effect of Gamification Method

#### 5.1.2.1 Students' Interest Level

Students' interest level is closely related to the implementation effect of gamification teaching. The original intention of gamification teaching is to stimulate students' learning interest through the fun of games, and the gamification method can effectively enhance students' learning interest and activate the classroom atmosphere. However, current gamification teaching faces problems such as insufficient innovation in game resources and a lack of targeted game design, leading to difficulties in maintaining students' interest.

Surveys indicate that when game forms are single and lack innovation, students' interest gradually declines over time. For example, repeated use of the same game types causes students to develop aesthetic fatigue and continuously decrease their participation enthusiasm. Therefore, to improve the effect of gamification teaching, teachers need to continuously innovate game resources and design more attractive games based on students' interests and teaching content to maintain and enhance students' interest levels<sup>[32]</sup>.

### 5.1.2.2 Students' Participation in Classroom Games

Students' participation in classroom games directly reflects the implementation effect of gamification in teaching. Students who actively participate in games can more deeply understand and master knowledge and enhance their comprehensive abilities. However, survey results show that most students have limited participation opportunities in gamification teaching, which is related to factors such as teachers' teaching focus and game design.

Failing to be aware of how students differ in games can result in some students not joining fully, and there is less participation on average. In addition, teachers not guiding or organizing the students well during the game reduce students' desire to participate. In order to help students take part more in games, teachers should adjust the games, pay attention to all students, and arrange chances for students to participate<sup>[33]</sup>.

#### 5.1.2.3 Students' Comprehension of Knowledge

It is important to look at students' understanding of knowledge to judge how gamification teaching works. With gamification teaching, educational games help students learn and grasp mathematical knowledge. Still, many games now have problems since they may not match students' mental capabilities or teaching goals. Some games are either too hard or too easy: tough games confuse students, and easy games do not properly challenge them. Also, the same old topics and rules in some games do not inspire students and make it harder for them to understand concepts in great detail. As a result, when teachers design games, they should focus on the main things to be taught, match the game to students' abilities, and choose meaningful game materials and guidelines to guide learning and complete the goals of gamification teaching<sup>[34]</sup>.

## 5.2 Implication

Although students' participation and interest in the gamification method have been somewhat enhanced, the comprehensive and effective implementation of the gamification method in primary school mathematics classrooms still faces challenges. Thus, teachers play a crucial and decisive role in improving the effectiveness of the gamification method. Therefore, teachers' teaching concepts, methods, and strategies need corresponding adjustments and optimisations to better meet the requirements of the gamification method.

Teachers should continuously update their teaching concepts and deepen their understanding of the gamifica-

tion method. They should not only systematically master their theoretical basis but also constantly explore and innovate in practice, closely integrating theory with actual teaching. Through diverse learning channels, such as participating in professional training and studying academic literature, they can enhance their professional competence. Meanwhile, schools should build platforms for teacher communication to promote the sharing and exchange of teaching experiences, jointly driving the development of the gamification method. In terms of game design, teachers need to reasonably grasp the depth of the game, fully considering students' age, cognitive level, physical and mental development characteristics, as well as the difficulty and objective requirements of the teaching content. Design games that are challenging yet not overly complex to stimulate students' interest and desire for exploration. Moreover, it is essential to constantly innovate game forms, incorporate novel game elements, and enhance the fun and interactivity of the games to continuously attract students' attention.

Strengthening students' subject status and improving the quality of teacher-student interaction are also of great significance. Teachers should transform their roles, shifting from being knowledge disseminators to learning guides, and make students the main body of teaching activities. By carrying out project-based learning activities, such as mathematics-themed adventure games, students' learning interests and abilities can be stimulated. At the same time, with the help of modern technological means, such as virtual reality, augmented reality, and interactive teaching software, immersive learning environments can be created to enhance students' sense of participation and substitution. The construction of game contexts is crucial for enlivening the classroom atmosphere and increasing students' participation. Teachers should customize game contexts based on students' characteristics, combining mathematical knowledge with students' familiar life scenarios and hobbies to make abstract knowledge concrete. Strengthen students' interaction and collaboration in the game. Through cooperative models such as group discussions and project-based learning, guide students to jointly design contexts and complete tasks, cultivating their sense of cooperation and mathematical application ability. Meanwhile, clarify game rules and reward-punishment mechanisms to ensure the orderly progress of the gamification method.

Attaching importance to post-game reflection and classroom summarization is of great significance for evaluating teaching effectiveness and improving teaching quality. Teachers can introduce an external feedback mechanism, inviting other educators, parents, or experts

to evaluate and provide feedback on the teaching process. Use technical tools to record the game process, conduct in-depth analysis of the existing problems in the teaching process, and formulate targeted improvement strategies. Carry out collective sharing and communication activities to promote teachers' professional growth, more comprehensively and accurately identify the problems existing in the gamification method, and drive the improvement of teaching standards.

In addition, schools should provide more support for the gamification method, such as offering sufficient teaching resources, organizing relevant training and teaching and research activities. At the same time, establish a scientific and reasonable evaluation system, comprehensively considering students' performance in the game in terms of knowledge mastery, participation, cooperation ability, etc., to provide a basis for teaching improvement. Parents should also actively participate in their children's mathematics learning, maintain close communication with teachers, understand their children's performance in the gamification method, and give encouragement and support at home to jointly create a favourable mathematics learning atmosphere. From a broader perspective, education policymakers should pay attention to the application of the gamification method in primary school mathematics education, formulate relevant policies and standards, and provide guarantees for the promotion and development of the gamification method. Meanwhile, encourage educational research institutions to conduct relevant research to provide theoretical support and technical guidance for the practice of the gamification method.

Based on the results of this study, it can be seen that there is still room for improvement in the application of the gamification method in primary school mathematics classrooms. In the future, the joint efforts of teachers, schools, parents, and education policymakers are needed to continuously improve the implementation strategies of the gamification method, so as to give full play to its advantages in primary school mathematics education and promote the comprehensive improvement of students' mathematical literacy and comprehensive abilities.

### 5.3 Limitations

Due to time and financial constraints, the scope of schools and regions selected in this study is extremely limited, which may fail to comprehensively reflect the differences in students' interests and perceptions of the gamification method across different regions. In addition, the study only focuses on the gamification method in primary school mathematics classrooms, without covering other subjects and different learning stages, thus restricting the

universality and application scope of the research findings<sup>[35]</sup>.

## 6. Recommendations for Future Researchers

Future research could focus on identifying other potential factors that affect the effectiveness of the gamification method, such as social-cultural backgrounds and home learning atmospheres. It is recommended to adopt a quasi-experimental research design, setting up experimental and control groups, and accurately measuring the impacts and effects of specific elements (such as game reward mechanisms and competitive elements) in the gamification method on students' learning motivation, knowledge acquisition, and classroom participation through pre-tests and post-tests. Subsequent research should preferably adopt a comprehensive research design combining qualitative and quantitative methods. By means of questionnaires, in-depth interviews, classroom observations, and other methods, it should comprehensively analyse the factors influencing students' participation in the gamification method, and explore innovative ways to stimulate students' interest in gamified learning of mathematics and related subjects based on the existing factors. Considering that this study only targets lower-grade primary school students, future research could expand the sample scope to cover all primary school grades and secondary school stages, so as to improve the gamification teaching strategies for different educational stages<sup>[36]</sup>.

## 7. Conclusion

As conclusion of this chapter, it shows that the gamification method has achieved some initial results in the application of primary school mathematics classrooms, but it has also revealed many problems. These problems, such as the imbalance in classroom order management, the cognitive biases of teachers and students towards the gamification method, and the low achievement rate of teaching objectives, involve multiple aspects including the classroom environment, teachers' and students' cognition, and teaching implementation effects.

The study systematically analyzes the root causes of the problems from the two dimensions of teachers and students, and proposes a series of improvement strategies covering aspects such as updating teaching concepts, innovating game forms, strengthening students' subject status, optimizing the classroom environment, deepening teaching reflection, and improving the evaluation mechanism. These strategies have been demonstrated to have theoretical feasibility and practical operability.

Overall, the gamification method has great potential in

the field of primary school mathematics education. However, its efficient implementation depends on the collaborative efforts of multiple stakeholders, including teachers, students, and schools. In the future, continuous in-depth exploration and practice are needed to continuously optimize the paths and methods of the gamification method, so as to fully unleash its educational value, improve the quality of primary school mathematics teaching, and promote the comprehensive improvement of students' mathematical literacy and comprehensive abilities.

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