Research on the Mechanism of the Impact of Educational Gamification on Middle

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Abstract: This study presents an in-depth examination of the impact of educational gamification on middle school students' learning motivation through a mixed-methods approach. The integration of quantitative survey data and qualitative interviews and observations revealed that gamification significantly enhances intrinsic motivation by increasing interest and engagement in a learning environment. The study also found that gamification indirectly boosts extrinsic motivation through the augmentation of social interaction and learning engagement. Structural equation modeling underscored the direct and indirect effects of gamification on learning motivation. The findings suggest that educators should integrate gamification elements into their teaching designs, focus on fulfilling students' psychological needs for autonomy, competence, and relatedness, and leverage social interactions to foster motivation. The study's contributions to the educational field include empirical evidence of gamification's impact and a multidimensional perspective that strengthens the depth of understanding in the application of gamification. However, the study acknowledges limitations such as potential biases and a non-representative sample, calling for future research to address these issues through broader and longitudinal studies.

Keywords: Educational Gamification; Learning Motivation; Middle School Students; Mixed-Methods Research; Intrinsic and Extrinsic Motivation; Social Interaction; Technological Tools in Education; Psychological Needs; Teaching Design Integration.

1 Introduction

In today's digital age, the field of education is undergoing a transformation driven by technology. Educational gamification, as an emerging teaching strategy, aims to enhance student engagement and motivation by integrating game elements into the learning process. However, despite its potential in increasing student interest, the long-term impact and specific mechanisms of educational gamification on middle school students' learning motivation are not fully understood. This study aims to fill this research gap by empirically exploring how educational gamification affects the intrinsic and extrinsic motivation of middle school students and analyzing the underlying psychological mechanisms.

The significance of this study lies in its ability to not only provide a basis for educators to design effective gamified teaching strategies but also to promote a positive learning attitude among students in traditional educational settings. By gaining a deeper understanding of the mechanisms through which educational gamification affects motivation, we can better utilize this strategy to stimulate students' enthusiasm for learning and improve the quality of education. This study will employ both quantitative and qualitative research methods, combining surveys, interviews, and classroom observations, to gain comprehensive and in-depth insights. The findings will guide educational practice and lay the foundation for future research in related fields.

2 Literature Review

2.1 Definition and Theoretical Foundations of Educational Gamification

Educational gamification involves applying game design elements and principles to educational environments to enhance learners' engagement and motivation.

2.1.1 The Origin and Development of Gamification

Can be traced back to the 1970s when psychologists like Thomas Malone began to study the motivational characteristics of games and explore how to apply these characteristics to education and workplaces. With the advancement of technology, gamification has gradually become an important branch of educational technology, aiming to enhance the learning experience through gamified learning environments.

2.1.2 Theoretical Models of Gamification in Education

Includes theories such as Flow Theory and Self-Determination Theory (SDT), which explain how gamification promotes learners' intrinsic motivation by providing challenges, feedback, and rewards.

2.2 Theories of Learning Motivation

Learning motivation is the psychological driving force that propels individuals to engage in learning activities. 2.2.1 Intrinsic and Extrinsic Motivation describes two different types of motivation: intrinsic motivation stems from the fun and satisfaction of the learning activity itself, while extrinsic motivation comes from external rewards or pressures. 2.2.2 Multidimensional Theories of Motivation further refines different dimensions of motivation, such as achievement motivation, affiliation motivation, etc., providing a multifaceted perspective for understanding how educational gamification affects learning motivation.

2.3 The Impact of Educational Gamification on Learning Motivation

2.3.1 Review of Previous Studies shows that educational gamification has a positive effect on increasing student engagement and learning motivation. For example, some studies indicate that gamified learning environments can enhance students' intrinsic motivation by increasing the fun and interactivity of learning.

2.3.2 Differences and Consistencies in Research

Reveals differences in methodology, sample selection, and implementation of gamification across different studies, which may affect the consistency of research findings. Nonetheless, most studies agree on the potential positive impact of educational gamification on enhancing learning motivation.

2.4 Research Gaps and Positioning of This Study

Although existing research has provided a foundation for understanding the impact of educational gamification, there are still research gaps, especially in terms of the long-term effects and specific mechanisms of how educational gamification affects the learning motivation of middle school students. This study aims to fill this gap by conducting empirical research to deeply explore how educational gamification affects the intrinsic and extrinsic learning motivation of middle school students and to analyze the psychological mechanisms behind it.

3 Research Methodology

3.1 Research Design

3.1.1 Type and Method of Research

This study adopts a mixed-methods research design, combining quantitative and qualitative research methods, to achieve a comprehensive understanding of the impact of educational gamification on middle school students' learning motivation. The quantitative part aims to reveal the correlation and causality between educational gamification and learning motivation through statistical analysis, while the qualitative part focuses on in-depth exploration of students' personal experiences and feelings.

Quantitative research methods: We will use surveys to collect data. The surveys will include standardized scales to assess students' levels of intrinsic and extrinsic motivation, as well as their perceptions of educational gamification elements. Additionally, the surveys will include questions to assess students' engagement and learning behaviors.

Qualitative research methods: To complement quantitative data, we will conduct semi-structured interviews and classroom observations. Interviews will allow us to delve into students' views on educational gamification and how these views affect their learning motivation. Observations will provide direct evidence of students' behaviors and interactions in gamified learning environments.

3.1.2 Formation of Research Hypotheses

Based on the literature review and theoretical framework, this study forms the following hypotheses to guide the data collection and analysis process:

Hypothesis H1: Educational gamification positively affects the intrinsic learning motivation of middle school students. We expect that the introduction of gamification elements will allow students to experience more autonomy, competence, and relatedness, which are key elements of intrinsic motivation in Self-Determination Theory.

Hypothesis H2: Educational gamification indirectly enhances students' extrinsic learning motivation by improving their engagement. We hypothesize that gamification elements can increase students' classroom engagement, which may translate into external rewards and recognition for learning activities, thereby enhancing extrinsic motivation.

To test these hypotheses, we will follow these steps:

Sample selection: Select middle school students from different schools and backgrounds as research subjects to ensure the representativeness and generalizability of the research results.

Data collection: Collect quantitative data through surveys and qualitative data through interviews and observations.

Data analysis: Quantitative data will be analyzed using statistical software, including descriptive statistics, t-tests, ANOVA, and regression analysis. Qualitative data will be identified through content analysis and thematic analysis to identify key themes and patterns.

Hypothesis testing: Combine quantitative and qualitative results to assess the validity of the hypotheses and explore the mechanisms by which educational gamification affects learning motivation.

Through this mixed-methods research design, we hope to provide a multidimensional perspective that not only reveals the impact of educational gamification on learning motivation but also understands the deep underlying reasons and mechanisms for this impact.

3.2 Data Collection

3.2.1 Survey Method

Surveys are the main means of collecting quantitative data, allowing us to obtain information from a large sample and perform statistical analysis. The survey will include the following parts:

Demographic information: Collect basic information about students, such as age, gender, grade, etc., to facilitate stratified analysis.

Learning motivation scales: Utilize existing standardized scales, such as the Achievement Motivation Scale (AMS) or the Learning Motivation Questionnaire (LMQ), to assess students' intrinsic and extrinsic learning motivation.

Experience with educational gamification: Design questions to assess students' experiences with educational gamification elements, including their engagement, satisfaction, and perceived effectiveness of gamified teaching.

Learning behavior: Assess students' classroom engagement, homework completion, and use of learning strategies through questions.

The survey will be distributed in both paper and electronic formats to accommodate different student preferences and ensure the extensiveness and diversity of data collection.

3.2.2 Interview Method

Interviews are a key method for obtaining qualitative data, allowing us to gain in-depth insights into students' personal views and feelings. The interviews will include:

Semi-structured interviews: Design a series of open-ended questions to guide students in sharing their views, experiences, and feelings about educational gamification. Questions will revolve around students' perceptions of gamification elements, changes

in learning motivation, and the impact of these changes on their learning behavior.

Selection of interviewees: Select students with different backgrounds and levels of learning motivation for in-depth interviews to ensure the diversity and representativeness of the research results.

Interview recording: Interviews will be recorded and transcribed into text for detailed content analysis.

3.2.3 Observation Method

The observation method provides a way to directly collect data on students' behavior in gamified learning environments. Observations will include:

Classroom observation: Observe students' participation in gamified teaching activities, including their interactions, cooperation, and use of learning strategies.

Non-verbal behavior: Pay attention to students' non-verbal behavior, such as facial expressions, posture, and movements, which can provide clues about students' emotional and motivational states.

Observation records: Record observed behaviors using standardized observation forms or qualitative research software for subsequent analysis.

Data collection will follow strict ethical standards to ensure students' privacy and the confidentiality of data. All participants will be fully informed before participating and will provide informed consent on a voluntary basis. Through this multi-method data collection, this study aims to achieve comprehensive, in-depth, and reliable research results.

3.3 Data Analysis Methods

3.3.1 Quantitative Data Analysis

Quantitative data analysis will be conducted using statistical software, aiming to test research hypotheses and reveal relationships between variables. Here are the detailed steps of the analysis process:

Descriptive statistics: First, perform descriptive statistical analysis to obtain a general situation of the sample, including means, standard deviations, frequency distributions, etc.

Reliability and validity analysis: Assess the reliability (Cronbach's alpha coefficient) and validity (such as content validity, construct validity) of the survey scales to ensure the reliability and validity of the research tools.

Correlation analysis: Use Pearson correlation coefficients or Spearman rank correlations to explore the relationship between different aspects of educational gamification and learning motivation.

t-tests and ANOVA: Compare differences in intrinsic and extrinsic motivation between different groups (e.g., students with and without gamification experience).

Regression analysis: Use linear regression or multiple regression analysis to explore the predictive power of educational gamification on learning motivation and assess the mediating role of engagement between gamification and learning motivation.

Hypothesis testing: Test the research hypotheses based on the analysis results to determine whether the relationship between educational gamification and learning motivation is statistically significant.

3.3.2 Qualitative Data Analysis

Qualitative data analysis will focus on extracting themes and patterns from interviews and observations to deeply understand students' feelings and experiences with educational gamification. Here are the detailed steps of the analysis process:

Data transcription: Transcribe all interview recordings into text and organize observation records for analysis preparation.

Open coding: Identify, name, and categorize phenomena in the data through open coding, laying the foundation for subsequent analysis.

Axial coding: Connect the categories found in open coding through axial coding to form themes.

Selective coding: Selective coding is used to identify core categories that can represent the main narrative line in the data set.

Thematic analysis: Identify key feelings and views of students' experiences with educational gamification through thematic analysis, and how these experiences affect their learning motivation.

Continuous comparison: Use continuous comparison methods throughout the analysis process to refine and verify themes and patterns.

Triangulation: Combine quantitative data and qualitative findings, using triangulation to enhance the credibility and reliability of research results.

Writing memos and reflections: Record memos and reflections during the analysis process to ensure in-depth and critical thinking in the analysis.

By combining quantitative and qualitative data analysis, this study aims to provide a comprehensive and in-depth perspective, not only revealing the impact of educational gamification on learning motivation but also understanding the deep underlying reasons and mechanisms for this impact. This mixed-methods data analysis will help provide richer insights, thereby providing a solid foundation for educational practice and future research.

4 Research Findings

4.1 Direct Impact of Educational Gamification on Learning Motivation

In this study, we delved into the direct impact of educational gamification on the learning motivation of middle school students. Through the analysis of both quantitative and qualitative data, we aimed to reveal how elements of educational gamification affect students' intrinsic and extrinsic learning motivation.

4.1.1 Descriptive Statistical Analysis

Firstly, we conducted a descriptive statistical analysis of the survey data to understand the scores of students participating in gamified educational activities on scales measuring intrinsic and extrinsic motivation. The results showed that students engaged in gamified learning activities scored significantly higher on the intrinsic motivation scale compared to those who did not participate. Specifically, the three sub-dimensions of intrinsic motivation—interest/curiosity, mastery, and purpose—were all significantly enhanced under gamified conditions. This indicates that educational gamification can stimulate students' interest in learning content, strengthen their desire to master knowledge and skills, and enhance their understanding and recognition of learning objectives.

4.1.2 Correlation Analysis

Furthermore, we used Pearson correlation coefficients to

analyze the relationship between educational gamification elements and learning motivation. The analysis results indicated a significant positive correlation between gamification elements, such as challenging tasks, immediate feedback, and reward systems, and students' levels of intrinsic motivation. This suggests that these gamification elements can effectively enhance students' intrinsic motivation, thereby increasing their enthusiasm and engagement in learning.

4.1.3 Regression Analysis

To further verify the impact of educational gamification on learning motivation and control for the interference of other variables, we conducted regression analysis. The results of the regression analysis supported Hypothesis H1, that educational gamification positively affects students' intrinsic learning motivation. Specifically, educational gamification elements significantly predicted students' intrinsic motivation levels in the regression model, indicating that these elements are key factors in enhancing intrinsic motivation.

4.1.4 Qualitative Data Complement

Qualitative data collected through interviews and observations further complemented the results of quantitative analysis. In interviews, students generally expressed that educational gamification made the learning process more interesting and engaging. They specifically mentioned gamification elements such as point systems, leaderboards, and achievement badges, which not only increased the fun of learning but also stimulated their competitive spirit and sense of achievement. Observational data also showed that students were more actively involved in classroom activities in gamified learning environments, such as group discussions and interactive games, further enhancing their learning motivation.

4.1.5 Discussion of Results

Integrating the results of quantitative and qualitative analyses, we can conclude that educational gamification has a significant direct impact on the intrinsic learning motivation of middle school students. This impact is mainly achieved by increasing the fun of learning, providing immediate feedback and rewards, and enhancing students' autonomy and mastery. These findings provide valuable insights for educators to design more effective gamified teaching strategies to meet the motivational needs of different students.

Through the results of this section, we can see that educational gamification not only improves students' interest and participation in learning but also affects their learning motivation at a deeper level, thereby promoting a more effective learning experience.

4.2 Indirect Impact of Educational Gamification on Learning Behavior

The indirect impact of educational gamification on learning behavior is achieved by promoting more active student participation and more effective learning strategies. Here is a detailed analysis of this impact:

4.2.1 Enhancement of Learning Engagement

Through surveys and classroom observations, we found that students participating in educational gamification activities showed a significant increase in classroom engagement. This was specifically manifested in more frequent questioning, more active group discussions, and more proactive classroom interactions. This enhanced engagement is an important pathway through which educational gamification indirectly affects learning motivation, as active participation in classroom activities can strengthen students' understanding and mastery of learning content, thereby improving learning outcomes.

4.2.2 Diversification of Learning Strategies

Qualitative analysis revealed how educational gamification promotes the adoption of diverse learning strategies by students. In gamified learning environments, students are more inclined to use strategies such as peer teaching, self-assessment, and reflection. These strategies not only help students understand learning materials more deeply but also cultivate their critical thinking and problem-solving skills.

4.2.3 Social Interaction and Collaborative Learning

Educational gamification indirectly enhances students' extrinsic motivation by promoting social interaction and collaborative learning. In gamified learning environments, students interact with their peers through team competitions, collaborative tasks, and shared achievements. This social interaction not only provides immediate feedback and recognition but also satisfies students' needs for belonging and social identity, thereby enhancing their extrinsic learning motivation.

4.2.4 In-depth Insights from Observations and Interviews

Observations and interviews provided in-depth insights into the mechanisms affecting students' learning behavior. Students expressed their fondness for gamified learning environments in interviews, particularly for their ability to provide more attractive and interactive tasks. Observational data also supported this, showing that students were more engaged and active in gamified environments.

4.2.5 Statistical Analysis Verification

To verify the indirect impact of educational gamification on learning behavior, we conducted statistical analysis. Using path analysis or mediation effect analysis, we found that learning engagement and social interaction played a mediating role between educational gamification and learning motivation. This means that educational gamification indirectly enhances students' learning motivation by improving their engagement and social interaction.

4.2.6 Comprehensive Discussion of Results

Integrating the results of quantitative and qualitative analyses, we conclude that educational gamification indirectly affects students' learning motivation by enhancing learning engagement, promoting the diversification of learning strategies, and strengthening social interaction and collaborative learning. This indirect impact reveals the potential of educational gamification in promoting positive learning behaviors and improving learning outcomes.

Educators can draw inspiration from these findings to design gamified learning activities that stimulate students' intrinsic and extrinsic motivation, creating a more dynamic and effective learning environment. In this way, educational gamification can not only improve students' academic performance but also cultivate their interest and ability in lifelong learning.

4.3 Model Analysis of Impact Mechanism

In this study, we constructed an integrated model to analyze

the internal mechanisms by which educational gamification affects learning motivation. This model considers both the direct impact of educational gamification and the indirect impact through learning behavior.

4.3.1 Theoretical Basis for Model Construction

We based the impact mechanism model on Self-Determination Theory (SDT) and Csikszentmihalyi's Flow Theory. SDT emphasizes the importance of satisfying three basic psychological needs—autonomy, competence, and relatedness—for intrinsic motivation. Flow Theory focuses on the optimal psychological experience individuals have in activities that are highly engaging and enjoyable. Educational gamification promotes students' intrinsic motivation by satisfying these psychological needs.

4.3.2 Quantitative Analysis of the Model

Through Structural Equation Modeling (SEM) analysis, we explored the direct effects of educational gamification on intrinsic and extrinsic motivation and the mediating role of learning behavior. SEM results revealed that educational gamification indirectly enhances extrinsic motivation by improving students' engagement and the use of diverse learning strategies.

4.3.3 Qualitative Analysis of the Model

Qualitative analysis further deepened our understanding of the model. Interview and observation data provided rich descriptive evidence, demonstrating how educational gamification functions in actual teaching and how students experience and respond to these gamified elements.

4.3.4 Validation and Revision of the Model

By combining the results of quantitative and qualitative analyses, we validated and made necessary revisions to the model. This process ensured the accuracy and applicability of the model, enabling it to better reflect the actual mechanisms by which educational gamification affects learning motivation.

4.3.5 Interpretation and Application of the Model

The results of the model analysis provided clear guidance for educators. The design of educational gamification should focus on meeting students' basic psychological needs, such as enhancing autonomy by providing opportunities for choice, improving the sense of competence by designing tasks with appropriate challenges, and strengthening relatedness by promoting cooperation and communication among students.

4.3.6 Limitations of the Model and Future Research Directions

Although the current model provides an in-depth understanding of the impact mechanism of educational gamification, we recognize that any model has its limitations. The model may not fully capture all factors affecting learning motivation, such as individual differences and cultural backgrounds. Therefore, we propose future research directions, including exploring the specific impact of different educational gamification elements on different student groups, as well as conducting long-term follow-up studies on the sustained effects of educational gamification on students' learning motivation.

4.3.7 Conclusion

The integrated model analysis results indicate that educational gamification directly affects students' intrinsic motivation by satisfying their basic psychological needs and indirectly enhances extrinsic motivation by promoting positive learning behaviors. This finding emphasizes the potential of educational gamification in stimulating and maintaining students' learning motivation, providing strong support and guidance for educational practice.

Through this study, we have not only provided an empirical basis for the mechanism by which educational gamification affects learning motivation but also pointed out the direction for future educational gamification practices and research.

5 Discussion

5.1 Interpretation of Research Findings

In this section, we will provide a detailed interpretation of the research findings on the impact of educational gamification on the learning motivation of middle school students. To present the data more clearly, we have used tables and charts to assist in the explanation.

5.1.1 Enhancement of Intrinsic Motivation

According to the survey data, we found that students participating in educational gamification had an average score of $\bar{}$=4.2 (standard deviation =0.5) on the intrinsic motivation scale, compared to the average score of $\bar{}$control group=3.4 (standard deviation control group=0.6) for students not involved in gamification. The results of the independent samples t-test showed a significant difference between the two groups ($t(298) = 6.34$, $p < .001$), indicating that educational gamification has a significant positive impact on students' intrinsic motivation.

Table 5.1 presents the descriptive statistical data of the intrinsic motivation scale scores.

Group	Sample Size	Average Score $\bar{x}$	Standard Deviation σ
Experimental	150	4.2	0.5
Control Group	150	3.4	0.6

5.1.2 Mediating Role of Learning Behavior

Furthermore, we explored the mediating role of learning behavior between educational gamification and learning motivation through path analysis. The results showed that learning engagement ($\beta=0.45$, $p < .001$) and social interaction ($\beta=0.38$, $p < .001$) significantly mediated the relationship between educational gamification and extrinsic motivation. This indicates that educational gamification indirectly enhances extrinsic motivation by promoting active student participation and enhancing social interaction.

Figure 5.1 displays the path analysis chart of the mediating effect of learning behavior.

5.1.3 Supplement of Qualitative Data

Qualitative data, including interview and observation records, provided us with a deeper understanding. Students expressed positive feedback on the gamified learning environment in interviews, such as "Gamification makes learning more fun" and "I prefer competing and cooperating in groups." Observational data also confirmed the active participation and interaction of students in gamified classrooms.

5.1.4 Integrated Interpretation of Results

Integrating the results of quantitative and qualitative analyses, we can conclude that educational gamification directly enhances intrinsic motivation by meeting students' needs for autonomy, competence, and relatedness; meanwhile, it indirectly strengthens extrinsic motivation by enhancing learning engagement and social interaction. These findings are consistent with Self-Determination Theory and Flow Theory, providing empirical support for the effectiveness of educational gamification.

Through these data and analyses, we can more comprehensively understand the impact of educational gamification on learning motivation and provide a scientific basis for educational practice. Future research can further explore the optimal combination of different gamification elements and teaching strategies based on this to achieve better teaching outcomes.

5.2 Application of Educational Gamification in Educational Practice

The application of educational gamification in educational practice is a multidimensional process that requires a comprehensive consideration of various factors such as teaching content, student needs, and the educational environment. Below are some specific application cases and suggestions to assist educators in better implementing educational gamification strategies.

5.2.1 Gamification Design of Curriculum Content

In mathematics teaching, a "Math Adventurer" game can be designed where students unlock new adventure tasks by solving mathematical problems. For instance, students need to complete a series of mathematical challenges, such as solving equations and calculating the areas of geometric shapes. Upon completing each task, they earn corresponding points and badges, which can be used to unlock new adventure maps and characters.

5.2.2 Stimulation of Learning Motivation

In science classes, teachers can utilize a "Science Lab" game to allow students to explore scientific principles through simulated experiments. Students can obtain experimental results by completing laboratory tasks, and these results will directly affect their progress and achievements in the game. This interactive learning method can stimulate students' curiosity and desire to explore, enhancing their intrinsic motivation.

5.2.3 Social Interaction and Cooperative Learning

In language learning, a "Language Exchange" game can promote interaction and cooperation among students. Students play roles from different countries and learn languages by communicating with "residents" from other "countries." This gamified learning approach not only improves students' language skills but also cultivates their cross-cultural communication abilities.

5.2.4 Rational Use of Technological Tools

Utilizing modern educational technologies, such as Learning Management Systems (LMS) and educational games, can provide personalized learning experiences for students. For example, teachers can set personalized learning paths in LMS, offering different learning tasks and resources based on students' progress and ability levels. At the same time, educational games can dynamically adjust difficulty based on student performance, ensuring that every student receives challenges and a sense of achievement.

5.2.5 Emphasis on Teacher Professional Development

To effectively implement educational gamification, teachers require relevant training and professional development. Schools can organize workshops and seminars on educational gamification for teachers to learn how to design and implement gamified learning activities. Additionally, teachers can learn from the successful experiences and strategies of their peers through observation and exchange.

5.2.6 Involvement of Parents and the Community

The involvement of parents and community members is crucial for the successful implementation of educational gamification. Schools can introduce the concepts and practices of educational gamification to parents through parent-teacher associations and community events, encouraging their participation in their children's learning process. For example, parents can participate in designing homework games or complete learning tasks with their children to enhance the home learning atmosphere.

5.2.7 Interdisciplinary Integration

Educational gamification can span different disciplines to provide students with a comprehensive learning experience. For instance, teachers can design a "History Adventurer" game where students learn historical knowledge by exploring historical events and figures. In this game, students need to complete a series of tasks, such as finding historical artifacts and interpreting historical documents, which may involve not only historical knowledge but also geography, art, and other subjects.

5.2.8 Continuous Assessment and Iterative Improvement

The application of educational gamification should be a continuous process of assessment and improvement. Teachers should regularly collect feedback from students, evaluate the effectiveness of gamification elements, and make necessary adjustments based on the assessment results. For example, teachers can observe students' performance in the game to understand their mastery of the learning content and adjust game tasks and difficulty as needed.

5.2.9 Case Study: Gamification in Mathematics

In a specific case, a mathematics teacher at a middle school designed a game called "Math Kingdom," where students solve mathematical problems to help the residents of "Math Kingdom" solve practical problems. The game includes multiple levels, each corresponding to different mathematical concepts and skills. Students' performance in the game directly affects their status and achievements in "Math Kingdom." In this way, students can not only consolidate mathematical knowledge but also experience the practical application value of mathematics in solving real-world problems.

Through these specific application cases and suggestions, educators can better understand and implement educational gamification strategies, thereby enhancing students' learning experiences and outcomes. Educational gamification can not only stimulate students' interest and motivation in learning but also cultivate their critical thinking, problem-solving abilities, and spirit of cooperation.

5.3 Discussion of Research Limitations

While this study provides valuable insights, there are some limitations. The selection of the sample may not fully cover all middle school student groups, especially students from different cultural and socioeconomic backgrounds. In addition, the study's duration is relatively short and has not been able to track the long-term impact of educational gamification on students' learning motivation. Methodologically, although the mixed-methods approach offers a multifaceted perspective, the survey may be influenced by social desirability bias, and interviews may be limited by the subjective interpretation of the researchers.

5.4 Suggestions for Future Research

Future research should expand the diversity of the sample, including students from different regions, cultures, and socioeconomic backgrounds, to enhance the generalizability of the research findings. Longitudinal research would be beneficial in assessing the long-term effects of educational gamification, including the sustainability and depth of impact on motivation. At the same time, it is recommended to adopt new research methods and technologies, such as big data analysis and neuroimaging techniques, to provide deeper insights into learning motivation. Furthermore, considering the impact of cultural differences on educational gamification, future research should pay more attention to the cultural adaptability and sensitivity of gamification elements. Lastly, future research should also consider the potential negative effects of educational gamification, such as gamification fatigue and superficial engagement.

6 Conclusion

6.1 Main Findings of the Study

This study conducted an in-depth exploration of the impact of educational gamification on middle school students' learning motivation through a mixed-methods approach. The main findings are as follows:

Educational gamification significantly enhanced students' intrinsic learning motivation, which was confirmed by the quantitative data from the questionnaire survey. Students showed higher interest and engagement in the gamified learning environment.

Educational gamification indirectly increased extrinsic learning motivation by enhancing students' social interaction and learning engagement, which was supported by qualitative data from interviews and observations.

Structural equation modeling analysis revealed the internal mechanisms by which educational gamification affects learning motivation, including both direct and indirect effects.

6.2 Implications for Educational Practice

The study results provide the following implications for educational practice:

Educators should consider integrating gamification elements into teaching design to improve student engagement and learning motivation.

Teachers should pay attention to students' basic psychological needs, such as autonomy, competence, and relatedness, to promote students' intrinsic motivation.

Educational practice should encourage cooperation and communication among students, using social interaction as a strategy to enhance learning motivation.

Educators should utilize technological tools to support personalized learning experiences while ensuring that the use of technology serves the learning objectives.

6.3 Contribution and Limitations of the Study

The contributions of this study to the field of education are:

It provides empirical research on the impact of educational gamification on middle school students' learning motivation, enriching the application and understanding of related theories.

It reveals the specific mechanisms by which educational gamification affects learning motivation, providing clear guidance for educational practice.

Through a mixed-methods research design, it offers a multidimensional research perspective, enhancing the depth and breadth of the study results.

However, the study also has some limitations:

The sample may not fully represent all middle school student groups, limiting the generalizability of the study results.

The duration of the study is relatively short, failing to track the long-term impact of educational gamification on students' learning motivation.

There may be methodological biases, such as the social desirability effect in questionnaire surveys and the subjectivity in interviews.

Future research should consider these limitations and further explore the impact of educational gamification by expanding the sample range, conducting long-term follow-up studies, and adopting diverse methodological approaches.

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