



Students' Perceptions of Role-Playing Games in Mathematics Learning: A Descriptive Study

Naqiyah Nurrosyadah, Ely Susanti*, Somakim

Department of Mathematics Education, Sriwijaya University, Indonesia.

*Corresponding author's email: ely_susanti@fkip.unsri.ac.id

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ABSTRACT

This study aims to describe students' perceptions of the use of a role-playing game (RPG), *Arithmetic Adventure: The Mystery of Polaria Village*, in mathematics learning on arithmetic sequences and series. A quantitative descriptive research design was employed, involving 34 tenth-grade students at SMA Negeri 10 Palembang selected through purposive sampling based on their participation in RPG-based learning activities. Data were collected using a closed-ended Likert-scale questionnaire covering four aspects: motivation and engagement, perceived learning effectiveness, social interaction and collaboration, and challenges encountered during learning. Content validity was established through expert judgment, while instrument reliability was confirmed using Cronbach's Alpha coefficients ranging from 0.77 to 0.91, indicating acceptable to excellent internal consistency. Descriptive analysis showed that students perceived the RPG positively in terms of motivation, engagement, and learning effectiveness, while challenges related to technical constraints and game complexity were reported at a moderate level. The integration of narrative-based gameplay with mathematical thinking stages—specializing, generalizing, conjecturing, and convincing—was perceived as supporting students' reasoning and problem-solving processes. These findings suggest that RPG-based learning can serve as a meaningful and engaging instructional medium in mathematics, although its implementation requires careful design considerations and adequate technical support.

Keywords: Students Perception, Mathematics Learning, Role-Playing Games, Mathematical Thinking, Arithmetic Sequences and Series

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INTRODUCTION

Mathematics plays a fundamental role in developing systematic and critical thinking skills that are essential for solving real-world problems and fostering innovation (Wang & Abdullah, 2024). Beyond its quantitative characteristics, mathematics serves as a means of developing accuracy, consistency, and creative reasoning that enable students to generate generalizations and justify relationships between concepts (Sinaga et al., 2023). However, despite the importance of mathematics, many students still perceive it as a difficult and intimidating subject, which reduces their confidence, limits participation, and negatively affects achievement (Saha et al., 2024). The effectiveness of mathematics learning is therefore closely related to how teachers design and implement teaching strategies. Teachers act not only as facilitators of knowledge but also as motivators who shape students'

learning characters through approaches that promote engagement, conceptual understanding, and long-term comprehension (Xiong, [2025](#)).

One crucial but challenging topic is arithmetic sequences and series, which build on prior understanding of number patterns and form the basis for more advanced mathematical concepts (Chan et al., [2021](#)). This topic is directly related to practical applications, such as calculating simple and compound interest, installments, and population growth (Shah, [2024](#)). Nevertheless, various studies have shown persistent learning difficulties in this area. Students often struggle to connect the abstract properties of arithmetic sequences and series to real-life contexts (Aminah et al., [2023](#)), have difficulty deducing and applying formulas for the n th term and the sum of the series (Dwi Ferdiani et al., [2022](#)), and make mistakes in interpreting patterns or solving contextual problems (Hidayat et al., [2022](#)). These findings indicate that existing instructional approaches and digital learning media have not fully supported students in bridging abstract concepts with contextual reasoning, which may influence students' learning experiences and perceptions of mathematics instruction.

Classroom observations at SMA Negeri 10 Palembang indicate that many 10th grade students experience similar challenges, particularly in representing arithmetic sequences algebraically, applying formulas correctly, and reasoning through higher-level contextual problems. These problems are related to limited reflective and logical thinking skills (Kablan & Günen, [2021](#)), compounded by students' negative attachments and low confidence in mathematics (Sukasno et al., [2024](#)).

These issues reflect deeper problems in pedagogical approaches. Traditional mathematics teaching often emphasizes mechanical calculation and procedural mastery over conceptual understanding (Shongwe, [2024](#)). As a result, students tend to focus on getting answers rather than exploring the reasoning behind them. However, meaningful mathematics learning should aim to support mathematical thinking processes such as specializing, generalizing, conjecturing, and convincing (Ishartono et al., [2022](#)). These skills are essential for students to identify patterns, make generalizations, propose conjectures, and justify the truth of concepts through logical arguments. Unfortunately, current practices are still dominated by teacher-centered and less interactive approaches (Setiana et al., [2021](#)), causing students to become passive recipients of information. This limits opportunities for exploration, collaboration, and self-constructed understanding, which ultimately results in low learning outcomes and limited higher-order thinking skills (Susanti et al., [2025](#)). Thus, there is a clear need for learning media that not only deliver content but also actively engage students in mathematical thinking processes.

The integration of technology into mathematics learning has become a strategic approach to overcoming students' difficulties in understanding complex concepts while providing more interactive and meaningful learning experiences (Cirneanu & Moldoveanu, [2024](#)). One innovation increasingly developed is the use of game-based learning media, particularly Role-Playing Games (RPGs). Through a combination of storylines, contextual challenges, and decision-making, RPGs create an immersive

learning environment that engages students both emotionally and cognitively (Huynh et al., [2020](#)). RPGs blend gameplay with role-taking, placing students in real-life-like situations where they practice communication and solve mathematical problems in meaningful ways (Masruroh et al., [2025](#)). Compared to other forms of digital media, RPGs offer sustained interaction and narrative continuity, which may better support concept exploration rather than short-term task completion.

Role-Playing Games (RPGs) are pedagogically valuable because they combine elements of problem-based learning, experiential learning, and collaborative inquiry within a structured yet flexible environment. Their gameplay mechanism require players to analyze information, plan strategies, and make systematic decisions that align with mathematical reasoning skills (Patiño et al., [2023](#)). In addition, RPGs maintain student motivation and focus by embedding learning within meaningful narratives, encouraging persistence and reflection (Rozi & Firdausiah, [2021](#)). Therefore, beyond entertainment, RPGs serve as a form of serious play that supports conceptual understanding, creativity, and higher-order thinking through authentic problem-solving scenarios. However, the effectiveness of RPG-based learning is influenced not only by design quality but also by how students perceive and experience the learning process.

To evaluate these innovations effectively, student perceptions become a key indicator. Perceptions refer to students' subjective interpretations, assessments, and experiences related to learning activities (Curelaru et al., [2022](#)). In the context of RPG-based mathematics learning, this includes students' views on ease of use, motivation, engagement, and relevance to learning objectives. Positive perceptions indicate that students find the learning process meaningful and enjoyable, which in turn increases their cognitive engagement and academic achievement (Cheung & Ng, [2021](#)). Conversely, negative perceptions may hinder even well designed innovations. Therefore, understanding student perceptions is essential to assess the feasibility and acceptance of educational technology (Huseinović, [2023](#)), as its success depends on content alignment, curriculum integration, and suitable pedagogical strategies (Gakime et al., [2025](#)). Focusing on perception is particularly important in early-stage or exploratory implementations, where learning outcome measurements may be confounded by factors such as limited exposure time and novelty effects.

Research has highlighted the potential of educational games to increase motivation, engagement, and conceptual understanding (Zhao et al., [2022](#)). Specifically, RPGs are considered capable of developing strategic and logical thinking skills through narrative-based interaction and meaningful challenges (Gui et al., [2023](#)). However, research that specifically examines students' perceptions of RPG use, especially in arithmetic sequences and series, remains limited. This represents a significant research gap, as perception data can provide valuable feedback for improving instructional design and adjusting it to students' learning needs.

For that reason, this research aims to describe students' perceptions of the use of RPGs in mathematics learning, particularly on the topic of arithmetic sequences and series. It is expected to provide insights into how students evaluate RPGs in terms of learning experience, motivation, engagement, conceptual understanding, and challenges faced, while contributing to the development of innovative media that supports interactive, meaningful, and higher-order-thinking mathematics learning.

METHOD

Research Design

This study employed a quantitative descriptive research design aimed at describing students' perceptions of the use of Role-Playing Games (RPGs) in mathematics learning, specifically on the topic of arithmetic sequences and series. This design was chosen because the study did not seek to examine causal relationships or learning effectiveness, but rather to capture students' responses and experiences after participating in RPG-based learning.

Participants

The participants were tenth-grade students at SMA Negeri 10 Palembang who had participated in mathematics learning using RPG-based media. A purposive sampling technique was applied, with the selection criterion being students' direct involvement in the RPG-based learning activities. This approach ensured that all respondents had sufficient exposure to the learning media being evaluated. A total of 34 students participated in the study.

Learning Media Description

The learning media used in this study was a Role-Playing Game (RPG) entitled Arithmetic Adventure: The Mystery of Polaria Village. The game was developed using RPG Maker MV and designed to support mathematics learning on the topics of arithmetic sequences and arithmetic series for tenth-grade students. The RPG integrates mathematical content into a narrative-driven environment in which students take the role of explorers tasked with solving mathematical problems to restore order in Polaria Village. Learning activities are embedded in storylines, character dialogues, and contextual challenges, allowing to interact with mathematical concepts in a meaningful and immersive way.

The game consists of two main missions corresponding to the targeted mathematical topics: arithmetic sequences and arithmetic series. Each mission is structured into four sequential stages representing indicators of mathematical thinking, namely specializing, generalizing, conjecturing, and convincing. These stages are designed to guide students progressively from observing numerical patterns to formulating general rules and justifying them logically.

In the arithmetic sequence mission, students observe regular patterns in contextual objects presented in the game environment, identify the first term and common difference, and apply the general formula of arithmetic sequences to solve problems. In the arithmetic series mission, students extend their

understanding by determining the sum of terms through contextual scenarios, leading to the formalization and verification of the arithmetic series formula. Throughout gameplay, students receive feedback from in-game characters, make decisions that influence their progression, and complete tasks that require both calculation and reasoning. The game is designed as a single-player experience but is implemented in a classroom setting that allows discussion and interaction among students during learning activities. This design supports individual exploration while still enabling social learning through peer discussion.

Research Instrument

Data were collected using a closed-ended questionnaire developed by the researchers. The questionnaire employed a five-point Likert scale consisting of Strongly Agree (5), Agree (4), Neutral (3), Disagree (2), and Strongly Disagree (1) (Sugiyono, 2013). The questionnaire measured four aspects:

1. Students' motivation and involvement,
2. Perceived effectiveness of RPG-based,
3. Social interaction and collaboration, and
4. Challenges and obstacles experienced in using RPG-based learning media.

Instrument Validity and Reliability

Content validity of the questionnaire was established through expert judgment involving mathematics education experts to ensure relevance, clarity, and alignment with the research objectives. Revisions were made based on expert feedback prior to data collection. Instrument reliability was tested using Cronbach's Alpha coefficient, calculated using the following formula:

$$\alpha = \frac{k}{k-1} \left(1 - \frac{\sum S_i^2}{S_t^2} \right)$$

Where k represents the number of items, S_i^2 is the variance of each item, and S_t^2 is the total variance. The interpretation of Cronbach's Alpha followed the rule of thumb proposed by Izah et al. (2024), which classifies $\alpha \geq 0.90$ as excellent, $0.90 > \alpha \geq 0.80$ as good, and $0.80 > \alpha \geq 0.70$ as acceptable. A Cronbach's Alpha value of at least 0.70 indicates acceptable internal consistency. The reliability analysis showed that all questionnaire aspects had Cronbach's Alpha coefficients ranging from 0.77 to 0.91, indicating acceptable to excellent reliability.

Data Collection Procedure

Data collection was conducted after students had completed the RPG-based learning sessions. The procedure included: (1) explaining the purpose of the questionnaire to students, (2) distributing the questionnaire in printed or digital form, (3) ensuring that responses were completed independently, and (4) collecting the completed questionnaires for analysis.

Data Analysis

Quantitative data were analyzed using descriptive statistical techniques. Mean scores were calculated for each questionnaire item and aspect, and then converted into percentages using

$$\text{Percentage} = \frac{\text{Average Score}}{\text{Maximum Score}} \times 100\%$$

The resulting percentages were interpreted using the following criteria:

- 81–100% = Very Good
- 61–80% = Good
- 41–60% = Sufficient
- 21–40% = Less
- 0–20% = Very Poor

This analysis provides an overview of students' perceptions of RPG-based learning in terms of acceptance, perceived benefits, and challenges encountered.

RESULTS & DISCUSSION

Result

Overview of the Game Implementation

The RPG-based learning media used in this study was titled Arithmetic Adventure: The Mystery of Polaria Village. The game was developed using RPG Maker MV and designed to support mathematics learning on the topics of arithmetic sequences and arithmetic series. The learning content was embedded in a narrative-driven adventure in which students acted as explorers tasked with solving mathematical problems to restore balance in Polaria Village.

The game structure was organized into two main missions: (1) arithmetic sequences and (2) arithmetic series. Each mission was designed based on four indicators of mathematical thinking, namely specializing, generalizing, conjecturing, and convincing. These stages guided students through a progressive reasoning process, beginning with pattern recognition and observation, followed by abstraction, prediction, and formal verification. Through this structure, students were expected to engage with mathematical concepts contextually and actively rather than procedurally.

Instrument Validity and Reliability

Prior to data analysis, the quality of the questionnaire was evaluated through validity and reliability testing. Content validity was established through expert judgment involving mathematics education experts to ensure that each item was relevant, clear, and aligned with the research objectives. Revisions were made based on expert feedback before the questionnaire was administered to students.

Table 1. Reliability of Questionnaire Based on Cronbach's Alpha

Aspect	Cronbach's Alpha (α)	Reliability Category
Motivation and Engagement	0.91	Excellent
Learning Effectiveness	0.89	Good
Social Interaction and Collaboration	0.83	Good
Challenges and Obstacles	0.77	Acceptable

Based on the reliability analysis presented in Table 1, all questionnaire aspects demonstrated satisfactory internal consistency. The motivation and engagement aspect obtained the highest Cronbach's Alpha value ($\alpha = 0.91$), indicating excellent reliability. The learning effectiveness ($\alpha = 0.89$) and social interaction and collaboration ($\alpha = 0.83$) aspects showed good reliability, while the challenges and obstacles aspect reached an acceptable reliability level ($\alpha = 0.77$). These results indicate that the items within each aspect consistently measured the same underlying construct, confirming that the questionnaire was reliable for capturing students' perceptions of RPG-based mathematics learning.

Students' Perceptions toward RPG-Based Learning

After completing the RPG-based learning sessions, students were asked to respond to the questionnaire. The results are presented descriptively based on four measured aspects: motivation and engagement, learning effectiveness, social interaction and collaboration, and challenges and obstacles.

(1) Motivation and Engagement

Table 2 presents students' responses regarding motivation and engagement when learning mathematics using RPG-based media.

Table 2. Student Motivation and Engagement

No.	Question	Percentage
1.	I am more motivated to learn when using games.	63,5%
2.	Game elements like points, levels, or badges make me want to keep learning.	68,2%
3.	I feel like learning time goes by faster and is more fun with games.	66,5%
4.	Games keep me from getting bored easily when studying difficult material.	67,1%
5.	I prefer to learn math using games rather than just lecture methods.	65,9%
Average		66,24%

The motivation and engagement aspect obtained an average score of 66.24%, which falls into the Good category. These results indicate that most students perceived RPG-based learning as motivating and engaging, particularly due to the presence of game elements that encouraged sustained participation.

(2) Learning Effectiveness

Students' perceptions of learning effectiveness are summarized in Table 3.

Table 3. Learning Effectiveness

No.	Question	Percentage
1.	I find it easier to understand difficult concepts through simulations/games.	62,9%
2.	Games help me remember the material longer than regular methods.	65,9%
3.	I can apply knowledge from the game to real situations.	66,5%
4.	The game provides feedback that helps me correct mistakes.	64,7%
5.	Games encourage me to think critically and look for problem-solving strategies.	67,1%
Average		65,41%

The learning effectiveness aspect achieved an average percentage of 65.41%, categorized as Good. This suggests that students perceived RPG-based learning as supportive of conceptual understanding, retention, and problem-solving processes.

(3) Social Interaction and Collaboration

Table 4 shows the results to social interaction and collaboration during RPG-based learning.

Table 4. Social Interaction and Collaboration

No.	Question	Percentage
1.	I discuss with friends more often when using educational games.	61,8%
2.	Games encourage teamwork (e.g., group challenges)	67,1%
Average		64,41%

The social interaction and collaboration aspect obtained an average score of 64.41%, which is categorized as Good. These findings indicate that RPG-based learning facilitated peer interaction and cooperative learning, even though the game was primarily designed for individual play.

(4) Challenges and Obstacles

Students' perceptions of challenges encountered in RPG-based learning presented in Table 5.

Table 5. Challenges and Obstacles

No.	Question	Percentage
1.	I am having trouble understanding how to play educational games.	50.6%
2.	Unstable internet connection disrupts the learning experience with games	67.6%
3.	My device (cellphone/laptop) does not support educational games.	54.7%
4.	Games sometimes divert focus from learning goals.	58.8%
5.	I have trouble understanding math material if the game is too complicated.	57.6%
Average		57.88%

The challenges and obstacles aspect obtained an average score of 57.88%, which falls into the Fair category. The most frequently reported issue was unstable internet connectivity, followed by concerns related to distraction and device limitations.

Discussion

Overview of Findings and Interpretive Framework

This study explores students' perceptions of RPG Arithmetic Adventure: The Mystery of Polaria Village as a learning medium for arithmetic sequences and series. Overall, the findings indicate positive student perceptions across motivational, cognitive, and social dimensions, with most aspects exceeding the "Good" interpretation threshold. However, these findings should be interpreted cautiously, as the data reflect students' subjective experiences rather than direct measures of learning outcomes or causal effects. In this sense, the results provide insight into how students experience and perceive RPG-based learning environments, which is a critical factor influencing learning engagement and sustainability.

The positive perceptions suggest that the integration of narrative elements, game mechanics, and mathematical tasks helps bridge abstract mathematical concepts with contextual and meaningful learning experiences. This finding supports the view that game-based learning environments can address both cognitive and affective dimensions of learning by fostering interest, reducing anxiety, and promoting sustained engagement (Abd-Alrazaq et al., [2022](#); Adipat et al., [2021](#)). In line with this, these findings also support the widely recognized view that alignment between learning media and students' characteristics is a prerequisite for effective instructional design, particularly within technology-enhanced and game-based learning contexts (Choi-Lundberg et al., [2023](#)).

Student Motivation and Engagement

Students' positive perceptions of motivation and engagement indicate that Arithmetic Adventure: The Mystery of Polaria Village successfully creates an immersive learning environment that encourages active participation. Rather than functioning merely as a digital worksheet, the RPG integrates storyline progression, challenges, and immediate feedback, which collectively sustain students' attention throughout the learning process. These elements appear to stimulate intrinsic motivation by providing students with a sense of purpose and achievement as they advance through the game (Li et al., [2024](#)).

This finding aligns with previous studies showing that game-based learning environments can enhance student engagement by offering interactive challenges, timely feedback, and a playful atmosphere that contrasts with conventional instruction (Hellín et al., [2023](#)). In the context of mathematics learning, where students often experience anxiety or disengagement, RPGs offer a unique advantage by embedding mathematical tasks within meaningful narratives and problem-solving situations (Anagnostopoulou, [2023](#)). The motivational impact observed in this study suggests that RPGs can serve as an effective entry point for engaging students with abstract mathematical content, particularly when designed to balance challenge and enjoyment.

Learning Effectiveness and Conceptual Understanding

Students' perceptions of learning effectiveness indicate that the RPG supports not only engagement but also conceptual understanding of arithmetic sequences and series. This perceived effectiveness can be interpreted through the structure of the game, which implicitly guides students through stages of mathematical thinking, including specializing, generalizing, conjecturing, and convincing. By encountering patterns in contextual missions and gradually formalizing them into symbolic representations, students experience mathematics as a process of discovery rather than rote memorization.

Learning is understood as an active process in which learners build knowledge through exploration and reflection, as reflected in studies emphasizing the role of reflective experiences in supporting learning processes (Zhang et al., [2024](#)). The RPG design aligns with this view by allowing students to interact with mathematical ideas in a contextualized and iterative manner. Contextual tasks embedded in the game narrative help strengthen the connection between symbolic procedures and real-life interpretations, which is essential for developing meaningful mathematical understanding. These findings are consistent with prior research showing that well-designed educational games can improve conceptual understanding and support higher-order thinking skills in mathematics (Christopoulos et al., [2024](#); Purwaningsih & Sarwanto, [2024](#)). Nevertheless, it is important to emphasize that the effectiveness discussed here refers to perceived learning support rather than empirically measured achievement gains, which warrants further investigation through experimental or mixed-methods approaches.

Social Interaction and Collaboration

Although RPGs are often designed as single-player experiences, the findings of this study reveal that students perceived a relatively high level of social interaction and collaboration during gameplay. Informal discussions emerged naturally as students exchanged strategies, clarified solutions, and reflected on challenges encountered in the game. This suggests that even individually played digital games can foster collaborative learning when implemented in classroom settings that encourage peer interaction.

This result supports previous studies indicating that educational games can enhance communication skills, participation, and collaborative problem-solving by creating shared learning experiences, even within digital environments (Zhang et al., [2025](#)). Moreover, the use of RPGs in mathematics classrooms may contribute to the development of 21st-century skills, such as collaboration and communication, when teachers intentionally facilitate discussion and reflection around gameplay (Untari, [2022](#)). These findings imply that the social dimension of game-based learning is not solely determined by game mechanics, but also by instructional context and teacher mediation, which deserves further exploration.

Challenges and Technical Obstacles

Despite the generally positive perceptions, students also reported challenges related to technical and design aspects of the RPG. Issues such as device performance, network stability, and the complexity of game mechanics were perceived as potential barriers to smooth learning experiences. These challenges highlight that the success of educational games is closely tied to technical readiness and infrastructure, particularly in school settings with diverse student backgrounds (Ahmad et al., [2022](#)).

Additionally, some students perceived that complex mechanics could occasionally distract them from learning objectives, suggesting a risk of increased cognitive load when game elements are not optimally aligned with instructional goals. This finding is consistent with research emphasizing the importance of balancing cognitive challenge and usability in educational game design to avoid overwhelming learners (Chrysafiadi et al., [2023](#)). However, when appropriately adapted to students' abilities and contexts, educational games remain effective in sustaining motivation and engagement (Zourmpakis et al., [2023](#)). These challenges underscore the need for iterative design refinement and contextual adaptation in RPG-based learning implementations.

Implications for Mathematics Education

The findings of this study suggest that RPGs hold strong potential as pedagogical tools for supporting motivation, conceptual understanding, and reflective thinking in mathematics learning. The effectiveness of RPG-based learning, however, depends on the thoughtful integration of narrative design, mathematical content, and technological feasibility. By embedding stages of mathematical thinking within a cohesive storyline, *Arithmetic Adventure: The Mystery of Polaria Village* demonstrates that educational games can function as meaningful learning environments rather than mere entertainment tools.

From a practical perspective, these findings highlight the importance of improving collaborative features, simplifying interface navigation, and ensuring technical compatibility to support students with varying levels of digital readiness. This study reinforces previous research emphasizing that the educational impact of game-based learning is strongly influenced by design quality, contextual relevance, and technological accessibility (Ishak et al., [2023](#)). Furthermore, the alignment between students' perceptions and the implementation of mathematical thinking stages suggests that well-designed gameplay can guide learners through structured cognitive processes while maintaining engagement (Pasqualotto et al., [2023](#)).

Finally, the technical and design challenges identified in this study point to the need for future research focusing on infrastructure support, teacher facilitation strategies, and longitudinal impacts of RPG-based learning. Exploring how perceived benefits translate into measurable learning outcomes would strengthen the empirical foundation of RPG use in mathematics education, providing a clearer basis for broader implementation.

CONCLUSION

This study explored students' perceptions of the Role-Playing Game (RPG) Arithmetic Adventure: The Mystery of Polaria Village in learning arithmetic sequences and series. The results indicate that students generally perceived the RPG positively in terms of motivation and engagement, learning effectiveness, and social interaction, while challenges were reported at a moderate level. These findings suggest that RPG-based learning can create a supportive learning environment that combines enjoyment with meaningful mathematical engagement. Beyond students' positive perceptions, this study highlights the pedagogical contribution of integrating RPG gameplay with stages of mathematical thinking, specializing, generalizing, conjecturing, and convincing. Embedding these stages within a narrative structure allows students to experience mathematical reasoning as a progressive and contextual process, indicating that RPGs can function not only as motivational media but also as tools to support mathematical thinking. However, this study is limited by its descriptive design, reliance on self-reported data, and technical constraints such as internet access, device availability, and game complexity. Therefore, future studies are encouraged to employ experimental or mixed-method approaches to examine learning outcomes and cognitive processes more deeply. Overall, this study confirms the potential of RPG-based learning as an innovative medium for mathematics education, provided that instructional design, technical readiness, and student characteristics are carefully considered.

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