The Game They Play: The Alternative Approach to Learning Mathematics in ALS

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ABSTRACT:
The study explores the implementation and impact of game-based learning in Alternative Learning System (ALS) in teaching mathematics. Four key themes emerged from the findings. Firstly, ALS coordinators employed innovative teaching strategies by integrating game-based learning into their teaching methods. This approach aimed to enhance student motivation and understanding of mathematical concepts while fostering a supportive and inclusive learning environment. Secondly, the study highlighted the importance of incorporating effective measures of student performance within game-based activities. Thirdly, the results showed that game-based learning effectively improved students' performance skills in mathematics by enhancing problem-solving abilities, critical thinking skills, and overall academic achievement. The findings also revealed the situational factors and struggles faced by ALS coordinators in implementing game-based learning, such as designing meaningful game mechanics and addressing technological constraints. These themes provide a comprehensive framework that promotes the successful implementation of game-based learning in ALS mathematics education leading to improved student performance skills in mathematics.

Keywords: game-based learning, Alternative Learning System (ALS), gamification, learner engagement, mathematics education

INTRODUCTION

Background of the Study

The study is anchored in the broad field of technology-mediated instruction in mathematics education, with a specific focus on the use of game-based learning (Vankúš, 2021; Hui & Mahmud, 2023). Technology-mediated instruction refers to the use of technology to enhance the teaching and learning process, and it has become increasingly popular in recent years, particularly in the field of mathematics education (Vusić & Geček, 2018). The study sought to explore the effectiveness of game-based learning as a technology-mediated approach to teaching mathematics in the context of alternative learning systems (Hui & Mahmud, 2023). Game-based learning is an innovative approach to teaching that involves the use of games as a teaching tool (Vusić & Geček, 2018). This approach has been found to be effective in enhancing student engagement, motivation, and learning outcomes (Vankúš, 2021). The study sought to explore the use of game-based learning in the ALS program, which is an alternative learning system designed for individuals who were not able to complete their formal education (Yasoña, 2023). By examining the

experiences and perceptions of ALS students and teachers regarding game-based learning, the study aimed to contribute to the development of effective teaching strategies for mathematics education in the context of technology-mediated instruction in the ALS program (Hui & Mahmud, 2023; Yasoña, 2023). The study sought to provide insights into the use of game-based learning as a technology-mediated approach to teaching mathematics in alternative learning systems, with the goal of improving the learning outcomes of ALS students in mathematics (Vankúš, 2021; Yasoña, 2023).

Game-based learning (GBL) in mathematics education has been widely explored in recent literature, highlighting its potential to enhance learning outcomes (Mahinay, 2025; Mikrouli, Tzafilkou, & Protogeros, 2024; Meylani, 2025). Studies have examined both the effectiveness and practical applications of GBL, including its use in teaching primary mathematics (Arciosa, 2021) and integrating digital platforms for interactive learning (Dan, Trung, Nga, & Dung, 2024; Yulianto, Situmeang, Anwar, & Puspitasari, 2025). Specific applications, such as mobile-based games for practicing fractions, have further demonstrated GBL's capacity to engage students and improve performance (Mikrouli et al., 2024; Sulpico et al., 2025). Collectively, these investigations provide a comprehensive understanding of GBL's educational benefits and its versatility in mathematics instruction (Mahinay, 2025; Meylani, 2025). In this context, the present study seeks to examine the effectiveness of GBL in teaching mathematics to learners in the Alternative Learning System Program, thereby addressing gaps in current research and situating findings within the broader discourse on technology-mediated mathematics education (Sulpico et al., 2025; Yulianto et al., 2025).

Game-based learning (GBL) has gained increasing attention in mathematics education due to its potential to improve students' engagement, motivation, and learning outcomes (Hui & Mahmud, 2023b; Arciosa, 2021). Several studies have demonstrated the effectiveness of GBL in teaching mathematics to primary and secondary school students (Sulpico et al., 2025b; Arciosa, 2021). However, limited research has explored the experiences and perceptions of educators in implementing GBL within Alternative Learning System (ALS) programs, which cater to out-of-school youth and adult learners who cannot attend regular school due to factors such as poverty, work, or distance (Hui & Mahmud, 2023b).

The Alternative Learning System (ALS) is an education program in the Philippines that provides non-formal education opportunities to out-of-school youth and adults who were unable to complete basic education (Javillonar & Elma, 2021; Baccal & Ormilla, 2021; Albert, Mendoza, Cabalfin, Mahmoud, & Muñoz, 2024). The program aims to provide a second chance for these individuals to acquire functional literacy and life skills, thereby increasing their chances of finding employment or pursuing higher education (Espejon et al., 2024; Casingal, 2025). One of the core subjects in the ALS curriculum is mathematics, which is essential for everyday life and a range of professional fields. However, teaching mathematics to non-traditional learners such as ALS students can be challenging due to factors including poverty, lack of access to technology, and limited prior educational experiences (PhDEM & Linga, 2025; Baccal & Ormilla, 2021). Additionally, pedagogical approaches used in the traditional education system may not always be effective for these learners (Casingal, 2025). Game-based learning (GBL) has been suggested as a strategy to engage and motivate ALS students in mathematics, providing immersive and interactive learning experiences tailored to their interests and needs (Sulpico et al., 2025; Yaman, Sousa, Neves, & Luz, 2025; Zabala-Vargas, Ardila-Segovia, García-Mora, & De Benito-Crosetti, 2020).

The evidence of the problem is further justified by the limited studies on the implementation of GBL in ALS programs and the unique challenges and opportunities within this context (Yaman et al., 2025; Zabala-Vargas et al., 2020). Literature indicates that most GBL studies in mathematics education focus on primary and secondary school students, while only a few investigate the experiences of educators in alternative education settings (Sulpico et al., 2025; PhDEM & Linga, 2025). Based on this research gap, the present study aims to investigate the experiences and

perceptions of ALS coordinators in implementing GBL in teaching mathematics. Specifically, the study explores the challenges and opportunities that arise when using GBL in ALS programs and examines how coordinators adapt GBL to meet the needs of their learners (Casingal, 2025; Sulpico et al., 2025; Yaman et al., 2025).

Purpose of the Study

Game-based learning (GBL) has the potential to be an effective and engaging approach for teaching mathematics, which could benefit ALS learners (Nuraeni, Jupri, & Nurlaelah, 2025; Meylani, 2025). As a relatively new method in the context of ALS, there is a need to better understand how GBL is being implemented and its impact on learners (Mahinay, 2025; Vankúš, 2021). By examining how ALS coordinators integrate GBL in their teaching, insights can be gained into its effectiveness, challenges, and opportunities for improvement (Orbon & Sapin, 2022). ALS coordinators play a crucial role in delivering educational services to marginalized learners, and studying their experiences can highlight areas where additional training or support may be required (Meylani, 2025). Despite the potential benefits, there is limited research on how ALS coordinators specifically apply GBL in teaching mathematics, and without this understanding, opportunities to optimize the approach for ALS learners may be missed (Nuraeni et al., 2025).

This study focused on the experiences and perspectives of ALS coordinators, aiming to identify the benefits, challenges, and effective practices associated with GBL in mathematics instruction (Mahinay, 2025; Orbon & Sapin, 2022). Through qualitative methods such as interviews and observations, the study generated rich information on coordinators' experiences, offering insights into how GBL can enhance mathematics teaching in ALS contexts (Vankúš, 2021; Nuraeni et al., 2025). The findings are relevant to educators, policymakers, and researchers interested in improving the quality of education for marginalized learners, and may contribute to evidence-based recommendations for integrating GBL into ALS and other educational programs (Meylani, 2025; Mahinay, 2025).

Objectives of the Study

This qualitative research study aimed to explore and understand the experiences of ALS coordinators in integrating game-based learning as an innovative approach in teaching mathematics.

It sought to answer the central question:

"What are the experiences and perceptions of ALS coordinators in implementing game-based learning in teaching mathematics?"

Specifically, it sought to answer the following sub-questions:

1) What are ALS coordinators experiences on their use of instructional games as a teaching strategy in mathematics?

2) What are the perceived benefits and challenges of using game-based approach in teaching mathematics in the ALS program?

METHOD

Research Design

The research design for this study is a qualitative phenomenological approach, which is deemed suitable as it enables an in-depth exploration of the experiences and perceptions of ALS coordinators in implementing game-based learning in teaching mathematics (Alviso & Tacadena, 2023; Javillonar & Elma, 2021). Phenomenology allows for a deep investigation into the essence of the phenomenon, aiming to uncover the meanings and lived experiences of participants (Ucab & Luzano, 2023). By adopting this design, the study seeks to capture the intricate and nuanced aspects of coordinators' encounters with game-based learning within the context of the Alternative Learning System program (Alviso & Tacadena, 2023; Ucab & Luzano, 2023). Through this qualitative phenomenological inquiry, a rich and comprehensive understanding of the phenomenon was achieved, providing insights into coordinators' subjective experiences and the significance they ascribe to the implementation of game-based learning in mathematics education in ALS settings (Javillonar & Elma, 2021).

Participants and Research Site

The study was focused on the experiences and perceptions of ALS coordinators in implementing game-based learning in teaching mathematics. Game-based learning is an innovative teaching approach that uses games to promote active and engaging learning experiences that can enhance learners' motivation, interest, and comprehension of mathematical concepts. The ALS program provides an ideal setting for this study, as it is a non-formal education system that aims to provide flexible learning opportunities that are accessible and relevant to learners' needs and contexts. Additionally, the program has recently adopted game-based learning as a teaching strategy for mathematics, which makes it an opportune time to investigate the experiences and perceptions of ALS coordinators in implementing this approach.

Homogeneous sampling was used to select participants who have experience in using game-based learning in teaching mathematics. This sampling strategy ensures that the participants have a common characteristic, which is relevant to the research question. Four ALS coordinators are implementing game-based strategies in their teaching in the eastern part of Pangasinan, Philippines.

The collaboration between the researcher and participants in this study ensured that the data collected accurately reflects the experiences and perceptions of ALS coordinators in implementing game-based learning in teaching mathematics. The participants were expected to provide accurate and honest information about their experiences and perceptions of using game-based learning in teaching mathematics. The researcher established trust and rapport with the participants by creating an open and non-judgmental environment that encouraged the participants to share their experiences and perceptions. Collaborative approaches were used, such as active listening, asking open-ended questions, and providing feedback to the participants to encourage their participation in the study. The researcher was sensitive to the participants' cultural background, language, and educational level to ensure that the data collected was appropriate and respectful. The researcher ensured that the participants benefited from the study by providing them with a summary of the findings and recommendations that can be used to improve their practice.

The access and permission procedures in this study ensured that ethical standards were followed, and the participants' rights were protected. Before commencing the study, the researcher obtained informed consent from the ALS coordinators. This involved providing the participants with detailed information about the study, including its purpose, research questions, methods, and potential risks and benefits of participation. The participants were informed that their participation was voluntary, and they could withdraw at any time. The researcher ensured that the participants' confidentiality and anonymity were protected by using pseudonyms to identify them in the study. The researcher ensured that the data collected was stored securely.

Instrumentation and Data Collection

The data collection methods involved semi-structured interviews with ALS coordinators who have experience in implementing game-based learning in teaching mathematics. The interview questions were developed based on the research question and were open-ended to allow participants to provide in-depth responses. This method allowed the researchers to gain a deeper understanding of the participants' experiences and perceptions. In addition, document analysis was also used to supplement the data collected through the interviews. The documents include program guidelines, lesson plans, and assessments for the past five months (July-November 2025) that incorporate game-based learning.

The researcher recorded the interview using a recording device with the participant's consent with the researcher taking notes during the interview as a backup. The notes were used to supplement the recorded data. In document analysis, the researcher scanned/take photos of the documents with the consent of the participant. In all cases, the data recording procedures ensured the confidentiality and anonymity of the participants.

To ensure the credibility of the study, triangulation was used by collecting data from multiple sources, such as interviews, observations, and document

analysis. This helped to identify patterns and themes in the data, which can increase confidence in the findings. To ensure the transferability of the study, a detailed description of the research context, participants, and research process was provided. This can help other researchers to understand the context and settings of the study and replicate it in similar settings. To ensure the confirmability of the study, reflexivity was used by the researcher to reflect on their role and biases in the study. The researcher maintains a reflexive journal to document their thoughts, reflections, and emotions throughout the research journey. This serves as a tool for self-reflection and helps capture insights into the researcher's own biases, values, and decision-making processes. This helped to ensure that the findings were based on an objective and unbiased analysis of the data.

Analysis of Data

The data analysis followed a thematic analysis approach. The researcher identified the significant themes that emerged from the data and examined their relationships with each other. The analysis process involved data immersion, code development, theme identification, and refinement. The researcher used the code weaving method in data analysis.

During the transcription process, the researcher listened to the audio recordings of the semi-structured interviews with the ALS coordinators and transcribed using a mixed verbatim and intelligent transcription method. This provided a written record of the interviews that could be analyzed and allowed the researcher to identify key ideas and themes that emerged from the data. After the transcription process, the researcher used a priori codes to analyze the data and other emerging codes from the transcription. The researcher used these codes to categorize the data and to identify key concepts that were relevant to the research questions. Document analysis was also used to analyze data on the types of games used, their frequency of use, the learning outcomes targeted, and the challenges and successes encountered in implementing game-based learning in teaching mathematics.

Memoing involves writing notes about the data as it is analyzed. This process helped the researcher to keep track of their thoughts and ideas as they analyzed the data. Memoing can include observations, questions, and ideas that arise during the analysis process. These notes helped the researcher to organize their thoughts and to develop a deeper understanding of the data. After coding and memoing, the researcher identified the significant themes that emerged from the data. Then these themes were categorized into larger, more coherent categories. The researcher used a thematic analysis approach to identify the themes and to analyze their relationships with each other.

The themes were organized into a simulacrum to visualize the interconnected relationships of the themes and create a coherent and meaningful narrative. This process allowed the researcher to gain a deeper understanding of the experiences and perceptions of ALS coordinators in implementing game-based learning in teaching mathematics. This process allowed the researcher to communicate their findings effectively and to provide meaningful insights into the research questions.

RESULTS AND DISCUSSION

There were four themes that emerged from the analysis of data. The games they play in ALS are 1) strategies as an innovative teaching method through game-based learning, 2) summing-up measures of students' performance, 3) successfully improved students' performance skills, and 4) situational factors and struggles in implementing game-based learning in teaching mathematics. The central concept that encompasses the themes is focused on the components of Alternative Learning System (ALS) mathematics education through game-based learning as an alternative teaching approach.

The games they play serve as innovative teaching strategies through game-based learning (GBL) implemented by ALS coordinators. This theme consists of two dimensions: the integration of game-based learning in teaching and learning, and the creation of a supportive and inclusive learning environment. Gamification in teaching involves the strategic design of educational experiences that incorporate elements such as challenges, rewards, and interactivity to enhance engagement (Adipat et

al., 2021; Chen & Hwang, 2014). These strategies may include the use of educational games, simulations, and gamified activities embedded within the instructional process. The ALS program recognizes the potential of games to improve student motivation and deepen understanding of mathematical concepts (Yasoña, 2023). Moreover, the games implemented by ALS coordinators contribute to fostering a supportive and inclusive learning environment. Gamification promotes collaboration, teamwork, and healthy competition, thereby strengthening peer interaction and community building (Fonseca et al., 2023). By integrating social elements and multiplayer features, educational games encourage learners to support one another and actively participate in shared learning experiences. ALS aims to cultivate a safe and inclusive setting where students feel supported and motivated to engage in learning (Lalanan et al., 2025). Through nurturing a positive learning atmosphere, ALS enhances students' engagement, motivation, and overall learning experiences in mathematics (Yasoña, 2023; Fonseca et al., 2023).

The games they play also serve as summative and formative measures of students' performance from the perspective of ALS coordinators. "Summing up measures" refers to the methods used to evaluate and assess student progress, achievements, and overall learning through multiple indicators and feedback mechanisms. In game-based learning environments, performance measures may include formative assessments, in-game feedback systems, and self-assessment tools that provide immediate insights into learners' understanding and mastery of mathematical concepts (Trujillo et al., 2016; Flemban, 2024). Research highlights that digital games can embed assessment seamlessly within gameplay, allowing educators to monitor progress efficiently and authentically (Flemban, 2024). Within the ALS context, student evaluation emphasizes monitoring progress, identifying learning gaps, and providing feedback to support learners' educational development (PhDEM & Linga, 2025). This suggests that ALS employs varied assessment approaches to gauge students' knowledge, skills, and outcomes. However, findings from document analysis and onsite observations revealed that only two out of four coordinators implemented alternative assessments such as performance-based or self-reflection methods. Most assessments observed were not inherently game-based but instead relied on traditional formative approaches such as quizzes and written tests administered after gameplay. While these methods still support monitoring and feedback, they indicate that the integration of authentic game-based assessment strategies remains limited in practice.

The games they play successfully improve students' performance skills in mathematics. The ultimate goal of game-based learning (GBL) in the ALS program is to enhance students' mathematical performance by strengthening their understanding, problem-solving abilities, critical thinking skills, and overall academic achievement (Debnath, 2025; Jutin & Maat, 2024). Research indicates that when educational games are carefully designed and aligned with instructional objectives, they significantly increase learners' motivation, engagement, and knowledge retention (Lagmay et al., 2024; Meylani, 2025). By making learning interactive and enjoyable, gamification promotes deeper conceptual understanding and improved academic outcomes in mathematics (Mursalin, Saputra, & Ali, 2024; Orbon & Sapin, 2022). Findings from the document analysis further support these claims, as students' test results obtained after the implementation of game-based learning assessments demonstrated higher scores. This aligns with previous studies showing that structured and well-integrated GBL strategies positively influence mathematics achievement (Debnath, 2025; Lagmay et al., 2024). The evidence suggests that integrating effective game mechanics, fostering self-assessment opportunities, and cultivating a supportive learning environment collectively contribute to measurable improvements in students' mathematical performance within the ALS context.

The games they play also reveal situational factors and struggles encountered by ALS coordinators. While gamification can be a powerful instructional tool, the implementation and design of effective educational games present significant challenges (Ghosh, 2022; Harviainen & Meriläinen, 2019). These challenges include developing meaningful

and relevant game mechanics, aligning game activities with curricular objectives, and maintaining an appropriate balance between entertainment and educational value (Tolentino, 2025; Tabassum, 2024). In the ALS context, additional constraints such as a limited number of students, limited technological access, insufficient funding, and scarcity of instructional resources further complicate the integration of game-based learning. Research emphasizes that successful gamification requires thoughtful instructional design, continuous evaluation, and adequate teacher preparation (Harviainen & Meriläinen, 2019; Tolentino, 2025). Without proper support, educators may struggle to maximize the pedagogical benefits of game-based approaches. Recognizing these situational factors underscores the importance of professional development, collaborative planning, and reflective practice to address implementation barriers (Ghosh, 2022). By systematically responding to these challenges, ALS coordinators can better optimize the educational potential of game-based learning while adapting it to the realities of their instructional environment.

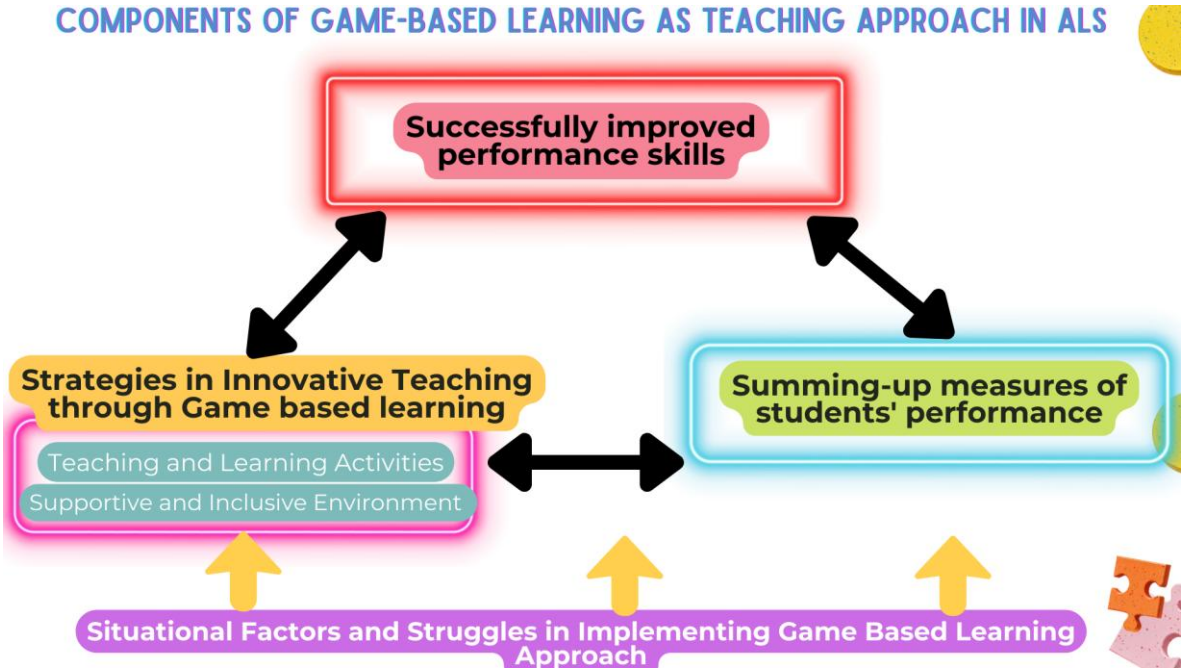

Figure 1. The Components of Game Based Learning as Teaching Approach in the Alternative Learning System Program.

Figure 1 presents the key components of integrating the Game-Based Learning (GBL) approach in teaching mathematics within the Alternative Learning System (ALS) program. The framework illustrates the interrelationship among the four major themes identified in the study and reflects a student-centered, constructively aligned instructional design (Coleman & Money, 2019; Gupta, 2025).

The model begins with ALS coordinators identifying situational factors and implementation challenges that may influence the integration of GBL, such as resource limitations and contextual constraints (Yaman et al., 2025). Recognizing these factors allows coordinators to develop creative and adaptive solutions. Following this, coordinators determine the desired performance skills or learning goals in mathematics, ensuring that instructional strategies are aligned with intended outcomes (Ramli, Maat, & Khalid, 2022). Subsequently, coordinators select and implement effective gamified teaching and learning activities that promote engagement while fostering a supportive and inclusive learning environment (Meylani, 2025; Sulpico et al., 2025). These activities are designed not only to enhance motivation but also to strengthen learners' mathematical competencies. After implementation, appropriate summative and formative measures, including feedback and

assessment procedures, are formulated to evaluate student performance and monitor learning progress (Moon et al., 2024; Ramli et al., 2022).

The bidirectional arrows in the framework signify the dynamic and reciprocal relationship among learning goals, instructional activities, and assessment. This alignment reflects the principle that instructional decisions are continuously refined based on assessment results and contextual realities. Collectively, these interconnected components form a comprehensive framework that supports the effective implementation of GBL in ALS mathematics instruction. By integrating strategic planning, inclusive practices, meaningful assessment, and adaptive problem-solving, ALS coordinators can create engaging learning experiences that ultimately enhance students' mathematical performance skills.

I. The Games They Play are Strategies in Innovative Teaching through Game-Based Learning

The research findings indicate that ALS coordinators utilized game-based learning (GBL) as an innovative instructional approach in teaching mathematics within the Alternative Learning System (ALS) program. Instructional games were incorporated as strategic tools to enhance student engagement and motivation in mathematics learning. This finding aligns with previous studies demonstrating that game-based instructional materials significantly improve students' mathematical performance and participation (Orbon & Sapin, 2022). The integration of games was perceived as an effective way to make mathematics learning enjoyable, interactive, and meaningful for learners. Furthermore, the use of play-based and game-oriented activities has been shown to create dynamic learning environments that foster deeper understanding and active involvement in mathematical tasks (Narciso et al., 2024).

I.A Teaching and Learning Activities

The transcribed interviews and document analysis revealed that game-based learning (GBL) is an effective and innovative instructional tool for teaching mathematics to elementary-level learners in the Alternative Learning System (ALS). ALS coordinators reported employing a variety of instructional games, including board games, card games, dice games, and puzzle-based activities, to make mathematics lessons more interactive and engaging. These games were intentionally designed to develop essential mathematical competencies such as number recognition, counting, addition, subtraction, multiplication, mental computation, problem-solving, critical thinking, logical reasoning, pattern recognition, and speed. The alignment of these game-based activities with identified learning objectives reflects structured instructional planning consistent with principles of effective GBL implementation (Arciosa, 2021; Erşen & Ergül, 2022).

Document analysis of program guidelines and lesson plans over the past five months (four samples per ALS coordinator) provided further evidence of how GBL was systematically integrated into mathematics instruction. The documents revealed variation in both the types and frequency of games used. Some lesson plans consistently incorporated games as core instructional strategies, while others utilized them as supplementary reinforcement tools. The range of gamified activities included board and card games, puzzle-based tasks, and memory-enhancement activities. These findings are consistent with research indicating that diverse game formats can effectively support the development of mathematical understanding and learner engagement (Narciso et al., 2024; Yulianto et al., 2025).

Moreover, the targeted learning outcomes extended beyond basic arithmetic operations to include higher-order skills such as problem-solving, critical thinking, number sense, geometry, and algebraic reasoning. This supports prior evidence that well-designed game-based interventions contribute to improved mathematical performance and conceptual understanding across various grade levels (Sulpico et al., 2025). Collectively, the findings demonstrate that GBL in the ALS context is not merely recreational but pedagogically grounded, strategically implemented, and aligned with curricular objectives, thereby reinforcing its effectiveness as a learner-centered approach in mathematics education.

ALS coordinators provided concrete examples of the games they implemented in mathematics instruction. As shared in the interviews, "*Some of the games I have used include board games and card games,"* while another noted *using "card games and puzzle guessing games. I also use Quizizz and Kahoot in assessment."* One coordinator described a dice game in which students solved equations based on numbers rolled, promoting active engagement and spontaneous problem-solving. Others emphasized the effectiveness of card games in strengthening foundational skills: *"I use card games to teach basic arithmetic skills like addition and subtraction,"* and *"card games help students improve their number recognition, counting, addition, and subtraction skills."*

The integration of online platforms such as Kahoot and Quizizz further enhanced engagement by providing immediate feedback and reinforcing learning through interactive assessment. Research supports the effectiveness of digital and non-digital game-based applications in improving arithmetic proficiency and conceptual understanding among primary learners (Aljojo, 2018; Xasanovna, 2025). Additionally, studies have shown that game-based mathematics learning positively influences students' academic achievement and motivation (Lagmay et al., 2024; Orbon & Sapin, 2022; Sulpico et al., 2025). The coordinators' practices align with these findings, demonstrating a balanced integration of hands-on and technology-assisted games to reinforce mathematical competencies.

The motivation to adopt game-based learning stemmed from the coordinators' recognition that traditional teaching approaches were often insufficient in sustaining learner engagement. As one participant observed, *"traditional teaching methods can be dry and boring."* Through seminars, research, and professional development, coordinators became aware that game-based learning can reinforce mathematical concepts while simultaneously enhancing enjoyment and retention. One coordinator emphasized, *"By incorporating a variety of games and activities, I can make learning enjoyable, engaging, and meaningful for my students."* This perspective reflects evidence that GBL fosters deeper conceptual understanding by increasing active participation and intrinsic motivation (Lagmay et al., 2024; Sulpico et al., 2025).

A significant component of this theme is the coordinators' emphasis on creativity, flexibility, and intentional game selection to meet the diverse needs of ALS learners. The process of selecting appropriate games involved consulting colleagues, conducting online research, and evaluating materials based on clearly defined criteria. These criteria included level of difficulty, alignment with curriculum standards, relevance to learning objectives, engagement potential, and the capacity to accommodate diverse learning needs. Such systematic evaluation reflects principles of effective GBL design, ensuring that games are pedagogically aligned rather than merely recreational (Aljojo, 2018).

The integration of game-based learning in ALS mathematics represents an innovative instructional strategy within a non-traditional educational setting. Given the ALS program's mission to provide alternative and inclusive educational opportunities for learners with limited access to formal schooling, GBL serves as an effective approach to enhance engagement, motivation, and learning outcomes. The findings indicate that when carefully selected and aligned with instructional goals, game-based strategies significantly contribute to improved mathematical performance and a more dynamic learning environment for elementary ALS learners.

I.B Supportive and Inclusive Environment

The ALS coordinators reported overwhelmingly positive learner experiences with instructional games in mathematics lessons. Learners were actively engaged and highly motivated during game-based activities, demonstrating enthusiasm and sustained interest in mathematical tasks. Coordinators observed that learners who were previously disengaged or struggling with mathematics showed noticeable improvements in participation when games were integrated into instruction. The competitive and interactive nature of games fostered a sense of accomplishment, particularly when learners achieved high scores or successfully completed challenges. As one coordinator emphasized, *"By incorporating a variety of games and activities, I can make learning enjoyable, engaging, and meaningful for my students,"* while another noted that integrating various math games "made a

significant impact on student engagement and motivation." These observations align with research indicating that game-based learning positively influences both student attitudes and achievement in elementary mathematics (White & McCoy, 2019; Orbon & Sapin, 2022).

Beyond engagement, ALS coordinators highlighted that instructional games fostered a supportive and inclusive learning environment. Game-based activities encouraged peer collaboration, communication, and shared problem-solving, thereby promoting a positive classroom climate. One coordinator shared that *"game-based learning has facilitated a collaborative learning environment where learners work together, share ideas, and learn from each other,"* while another emphasized that games *"promote teamwork and collaboration… where everyone can participate."* These findings reflect the learner-centered nature of GBL, where students actively construct understanding through social interaction and cooperative learning. Furthermore, coordinators noted that games allowed for differentiated instruction, accommodating learners with diverse needs and abilities. By adjusting difficulty levels and pacing, educators were able to ensure broader participation and equitable learning opportunities.

The coordinators also emphasized affective benefits associated with game-based learning. Mathematics, often perceived as intimidating, became more approachable and enjoyable through interactive activities. Games reduced anxiety, increased confidence, and provided low-stress opportunities for practice and reinforcement. Coordinators described games as *"fun and interactive activities"* that *"reduce students' anxiety and increase their confidence."* They further observed that learners were "*much more motivated to learn when they're having fun and feel in control of their own learning."* These findings support evidence that GBL enhances both cognitive outcomes and positive mathematical dispositions by increasing intrinsic motivation and self-efficacy (White & McCoy, 2019).

Learners embraced game-based mathematics instruction with enthusiasm and confidence. GBL helped transform mathematics into a more accessible, less intimidating, and engaging subject while fostering a safe environment where learners felt comfortable taking risks and learning from mistakes. By converting lessons into interactive, student-centered experiences, game-based learning nurtured not only mathematical skills but also positive attitudes toward learning, ultimately contributing to improved engagement and performance among ALS students.

II. The Games They Play are Summing-up Measures of Students' Performance

Assessment and feedback were identified as critical components of game-based learning in mathematics for ALS learners. ALS coordinators employed a variety of formative and summative assessment strategies to evaluate student learning during and after gameplay. These strategies included observation, reflections, discussions, quizzes, written assessments, and online platforms such as Kahoot and Quizizz, which allowed coordinators to monitor learners' understanding and provide immediate feedback in an engaging format. Document analysis of assessment practices over the past five months (sample of five per coordinator) revealed that approximately 80% of assessments were formative, such as written quizzes, quick checks for understanding, and online quizzes, while 20% were alternative or performance-based assessments, including self-assessment and rubric-based evaluations. These alternative assessments complemented the game-based learning approach by enabling learners to demonstrate mastery of mathematical concepts in practical and interactive ways.

Coordinators emphasized the importance of immediate feedback during gameplay to guide learners and reinforce understanding. One coordinator shared, *"Many games allow students to work at their own pace and receive immediate feedback, which can help them to identify their strengths and weaknesses and focus their learning accordingly."* Others explained their diverse assessment strategies: *"To assess student learning when using game-based teaching strategies, I often use informal assessments such as quick quizzes. These assessments allow me to check for understanding and provide immediate feedback to students,"* and *"To assess student learning when using game-based teaching strategies, I use a mix of traditional and alternative assessments. I also provide students with opportunities for self-reflection and peer*

feedback." Another coordinator noted, *"When using game-based teaching strategies, I assess student learning through observation and participation in the games, as well as through traditional assessments such as quizzes and tests."* In addition, one coordinator highlighted the combination of assessment types: *"I use a combination of formative and summative assessments to evaluate student learning when using game-based teaching strategies.* Observation of participation during games was also used to assess engagement and comprehension. This diversified approach is consistent with findings that game-based assessment enhances formative evaluation by providing real-time data and increasing student motivation (Divrik & Topal, 2024; Muna et al., 2023). The integration of online tools such as Kahoot and Quizizz further strengthened assessment practices by making evaluation interactive and engaging. Studies indicate that gamified online tools increase learner participation, provide immediate performance analytics, and support formative assessment processes (De San Agustín De Arequipa Peru & Maraza-Quispe, 2024; Widyaningrum, 2019). Additionally, structured feedback mechanisms embedded in game-based assessment environments can motivate continuous learner improvement (Leonardou et al., 2020).

The findings demonstrate that ALS coordinators intentionally utilized multiple assessment approaches, both offline and online, to ensure not only conceptual understanding but also the development of metacognitive and self-regulatory skills. Encouraging reflection, self-assessment, and peer feedback empowered learners to take ownership of their learning while fostering critical thinking, collaboration, and problem-solving abilities.

This theme underscores the value of moving beyond traditional testing toward dynamic and interactive assessment strategies that complement game-based instruction. Within the ALS mathematics context, immediate feedback, active participation, and diversified evaluation methods collectively contributed to improved learner engagement, deeper understanding, and enhanced mastery of mathematical skills.

III. The Games They Play Successfully Improved Performance Skills in Mathematics

The study revealed that game-based learning (GBL) positively impacts learners' performance and skills in mathematics within the Alternative Learning System (ALS) program. ALS coordinators observed improvements in fundamental mathematical operations, including addition, subtraction, multiplication, division, as well as in decimals and percentages. Learners who previously struggled with mathematics demonstrated enhanced understanding, retention, and problem-solving skills through the interactive and engaging nature of instructional games. One coordinator remarked, *"Through the use of instructional games, I have seen an increase in my learners' performance in mathematics. They are more confident and competent in solving math problems"* (Alrefaei, 2025). The interactive, competitive, and hands-on characteristics of the games motivated learners to strive for higher achievement, creating a positive and dynamic learning environment. Coordinators reported that games such as card games, dice-based arithmetic activities, and puzzle games allowed learners to practice and reinforce key concepts repeatedly.

Additionally, games involving fractions, decimals, and percentages enabled students to apply mathematical concepts in practical, real-world contexts. As one coordinator explained, *"Games help students develop critical thinking and problem-solving skills as they work to solve puzzles and overcome challenges in the game"* (Nanchadee et al., 2025). Game-based learning was also found to align with 21st-century learning principles by promoting critical thinking, collaboration, and strategic problem-solving. Coordinators noted that learners were more willing to take risks, engage in creative thinking, and retain knowledge compared to traditional methods. One coordinator highlighted, *"I have also seen improvements in students' understanding of math concepts and their ability to apply those concepts to real-world situations"* (Xasanovna, 2025). Overall, the study emphasizes that game-based learning not only strengthens specific mathematical skills but also enhances learners' confidence, engagement, and cognitive development. By transforming mathematics into a more accessible, meaningful, and interactive experience, GBL supports learner-centered

instruction even in small or individualized ALS classes (Drigas & Pappas, 2015).

IV. The Games They Play Accompanied by Situational Factors and Struggles

While game-based learning (GBL) has demonstrated significant benefits in teaching mathematics within the ALS program, enhancing student engagement, motivation, and mastery of concepts, ALS coordinators reported several challenges in its implementation, particularly given the small class sizes commonly found in ALS sessions. Most sessions are conducted individually or in groups of two to three learners, with only a few sessions involving five or more students, which limits opportunities for collaboration and interactive gameplay (Yaman et al., 2025).

A primary challenge identified was the selection of appropriate instructional games. Coordinators reported difficulty in finding games that were simultaneously engaging, educational, and aligned with the ALS curriculum and learners' age and ability levels. One coordinator remarked, *"There are limited instructional games available that are suitable for our ALS learners, and it's a challenge to find ones that are aligned with our curriculum."* Other coordinators highlighted that this process required extensive research, trial-and-error, and significant preparation time, as well as careful consideration of accessibility and curriculum alignment (Casingal, 2025; T, 2025).

Technology-related constraints further limited the use of digital and online games. Many ALS learners lacked access to reliable devices or internet connectivity, with coordinators noting *"limited access to technology and devices"* and *"no internet connection"* as key barriers (Yaman et al., 2025). Funding limitations compounded these challenges, requiring coordinators to rely on improvised or donated resources to implement GBL effectively.

Additionally, integrating game-based learning with other teaching strategies posed difficulties, particularly in individualized or very small classes. Coordinators emphasized the challenge of balancing gameplay with other instructional approaches while ensuring that all learners could participate meaningfully and develop the intended skills (Orbon & Sapin, 2022).

Despite these obstacles, ALS coordinators demonstrated creativity and adaptability in implementing GBL. They modified games to fit small group sizes, often using board games, dice, card games, or improvised materials to maintain engagement. One coordinator noted that they managed these limitations by *"relying on donated resources and creative solutions to make game-based learning feasible."* These adaptive strategies underscore the coordinators' commitment to providing effective, engaging, and learner-centered mathematics instruction, even within the constraints of small class sizes, limited resources, and technological challenges (Casingal, 2025; T, 2025).

CONCLUSION

The analysis of data revealed four key themes regarding the implementation of game-based learning (GBL) in ALS mathematics education.

The first theme highlights the importance of innovative teaching strategies, where ALS coordinators use GBL as an engaging approach to deepen students' understanding of mathematical concepts. Through educational games, simulations, and gamified activities, educators enhance motivation, foster collaboration, and create a supportive, inclusive learning environment. The second theme emphasizes assessment and feedback, with coordinators employing a variety of strategies, including formative assessments, alternative assessments, self-assessment, and traditional quizzes and tests. These measures allow educators to monitor student progress, provide targeted feedback, and support individualized learning. The third theme underscores the positive impact of GBL on students' mathematical performance. By combining engaging instructional strategies with supportive learning environments and effective assessments, educators promote improved problem-solving, critical thinking, and overall achievement in mathematics. The fourth theme highlights situational challenges, such as designing meaningful game mechanics, aligning games with curricular goals, and addressing technology or resource limitations. Despite these challenges, educators can overcome barriers through professional development, collaboration, and

reflective practice, thereby maximizing the benefits of GBL.

Collectively, these themes contribute to a comprehensive framework for enhancing mathematics education in the ALS program. By integrating innovative strategies, appropriate assessment measures, and adaptive solutions to challenges, game-based learning emerges as a valuable approach that boosts student motivation, understanding, and academic achievement in mathematics.

RECOMMENDATION

Based on the findings of this study, several recommendations can be made to enhance the implementation of game-based learning in teaching mathematics within the Alternative Learning System (ALS) program:

1. Develop or adapt instructional games and activities aligned with the ALS mathematics curriculum to support effective game-based learning.
2. Offer professional development, workshops, mentoring, and ongoing support to ALS coordinators and teachers in integrating GBL.
3. Foster collaboration among ALS coordinators, teachers, administrators, curriculum developers, and policymakers, sharing best practices, consulting on game selection, and conducting further research ensures continuous enhancement of GBL implementation and its long-term impact on learners' motivation, understanding, and achievement in mathematics.
4. Improve learners' access to devices such as tablets or computers and explore partnerships with local community centers or libraries.

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