



Theory-Informed Gamification and Game-Based Learning for Rural Primary Mathematics: A Critical Review of Motivation, Engagement, and Equity

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Abstract

Background and Aims: Gamification and game-based learning have gained increasing attention as strategies for improving motivation, engagement, and achievement in mathematics education. However, limited synthesis exists on how digital gamification and traditional game-based approaches support rural primary mathematics learning, particularly in low-resource contexts. This study reviewed recent literature to examine the effects of game-based approaches on learner motivation, engagement, and mathematical proficiency in rural primary education.

Material and Methods: An organized literature review was conducted using peer-reviewed studies published between 2020 and 2025. Studies were selected based on their relevance to gamification or game-based mathematics interventions in rural, underserved, or primary school contexts. The selected literature was analyzed according to intervention type, learning outcomes, motivational effects, engagement patterns, and contextual factors influencing implementation.

Results: The review shows that both digital gamification and traditional game-based learning can enhance students' motivation, engagement, and mathematics learning when aligned with clear pedagogical goals. Digital gamification supports immediate feedback, progression, and interactive assessment, but its effectiveness depends on access to devices, connectivity, and teacher digital competence. Traditional game-based approaches, including board games, role play, and culturally embedded activities, offer practical advantages in rural classrooms because they are low-cost, adaptable, and socially engaging. Hybrid models that combine limited digital tools with non-digital, culturally relevant games appear especially promising for resource-constrained settings.

Conclusion: Game-based learning in rural primary mathematics is most effective when it is context-sensitive, culturally relevant, and technologically flexible. The findings highlight the need for instructional designs that balance motivation, conceptual understanding, equity, and feasibility. Future research should examine the long-term effects of hybrid game-based interventions on mathematical achievement, learner identity, and sustained engagement in rural education contexts.

Keywords: Rural Education; Primary Mathematics; Motivation; Gamification; Game-based Learning; Equity

Introduction

Mathematics is widely acknowledged as being crucial for the development of cognitive capacities, the acquisition of skills necessary for lifetime academic achievement, and meaningful participation in today's knowledge-based economy (Qamar & Shahnaz, 2025; Meylani, 2025; Dan & Co., 2024). Since early mathematics education is widely seen as essential, its quality is crucial. However, in many elementary schools, instruction has historically focused on teacher-driven strategies, rote memorisation, and assessments to gauge pupils' learning. These teaching tactics are prevalent in under-resourced and rural schools due to obstacles that prevent them from implementing new pedagogical practices (Qamar & Shahnaz, 2025; Liu, 2023; Dan & Co., 2024; Bashir & Younas, 2025). Students who learn mathematics in a repetitive, concept-based manner without making links to their real-world experiences suffer anxiety, low self-efficacy, and negative attitudes about the subject from an early age. The student's capacity to participate in mathematics and reach their full potential will be





impacted in the long run by these problems (Qamar & Shahnaz, 2025; Liu, 2023; Rahim & Mohammed, 2025; Dan et al., 2024).

Rural primary schools face several challenges that make these issues worse. Besides general educational barriers, rural areas often have limited access to digital tools, fewer teaching materials, mixed-grade classrooms, and less ongoing teacher training. These structural and socioeconomic barriers lower both achievement and motivation in mathematics. These limitations bring modern gamification's technological promises into odds with the realities of low-resource rural classrooms. Motivation problems, in particular, have a strong effect on learning outcomes (Rahim & Mohammed, 2025; Dan et al., 2024; Bashir & Younas, 2025). Thus, pedagogical techniques that could simultaneously enhance conceptual understanding, boost positive affective responses, and be practical in low-resource, culturally situated learning environments are needed to bridge these gaps in rural mathematics education.

Gamification and game-based learning (GBL) have grown in popularity as pedagogical approaches for rethinking mathematics education. According to several studies, gamification (points, badges, levels, leaderboards, challenges, and narrative) must be incorporated into non-gaming learning strategies to increase student motivation and engagement (Qamar & Shahnaz, 2025; Meylani, 2025; Jiménez-Valverde et al., 2025; Fung et al., 2024).

In contrast, constructivist and socio-constructivist learning theories that emphasise interaction, teamwork, and problem-centered learning are frequently the foundation of game-based learning, which uses full games, digital or non-digital, as essential teaching activities (Meylani, 2025; Videnovik et al., 2023; Delgado-Algarra, 2022; Dan et al., 2024). According to current systematic reviews and empirical research, well-crafted gamified and game-based treatments can improve learning outcomes at the primary level and increase motivation, engagement, and attitudes toward mathematics (Meylani, 2025; Liu, 2023; Videnovik et al., 2023).

However, the motivational potential of these approaches is often interpreted using well-known theoretical frameworks such as Self-Determination Theory (SDT), the ARCS model of motivation (Attention, Relevance, Confidence, Satisfaction), and Flow Theory (Meylani, 2025; Zabala-Vargas et al., 2021; Ojonuba et al., 2025; Sinaga, 2024; Fung et al., 2024). From an SDT perspective, by offering opportunities for social contact, meaningful choices, and activities that are optimally challenging, gamification and GBL can foster learners' autonomy, competence, and relatedness. Flow Theory states that well-calibrated game-based activities can foster deep engagement, sustained focus, and intrinsic enjoyment when task difficulty is balanced with learners' capacities (Meylani, 2025; Zabala-Vargas et al., 2021; Ojonuba et al., 2025; Sinaga, 2024). Additionally, as reported by Zabala-Vargas et al. (2021), Ojonuba et al. (2025), Sinaga (2024), and Delgado-Algarra (2022), empirical research using SDT- and ARCS-informed designs shows increases in engagement, perceived relevance, self-esteem, enjoyment, and persistence in mathematics and related subjects, along with decreases in disengagement and dropout intentions.

At the same time, the literature reveals significant flaws and inconsistencies. Recent reviews by Zabala-Vargas et al. (2021), Ojonuba et al. (2025), Sinaga (2024), Fung et al. (2024), and Ahmad & Khan (2024) suggest that gamification-related motivational gains may be transient because of novelty effects, and that when game mechanics are not well matched with meaningful learning objectives, an over-reliance on extrinsic rewards may erode intrinsic interest. Furthermore, as noted by Videnovik et al. (2023), Liang & Sitthiworachart (2023), and Dan et al. (2024), outcomes are highly dependent on design quality, curricular alignment, and implementation conditions, even though digital game-based learning (DGBL) in primary mathematics has been associated with improvements in logical reasoning, problem solving, and content mastery. These contingencies are particularly apparent in rural locations, where there may be a lack of technological infrastructure and an instructor's digital ability.

Even with the growing body of research on gamification and game-based learning, there are still a significant number of gaps in knowledge about how these strategies work in rural primary maths classrooms with few resources.

First, as noted by Meylani (2025), Videnovik et al. (2023), and Dan et al. (2024), most of the data that is currently accessible comes from metropolitan or relatively well-resourced educational





environments, with little attention paid to the particular affordances and constraints of rural elementary schools.

Second, primary mathematics is frequently included in more general K–12 or STEM-focused syntheses, which results in insufficiently detailed analyses of early learners' concept development, higher-order thinking, and motivational trajectories in rural settings, according to Videnovik et al. (2023), Liang & Sitthiworachart (2023), Dan et al. (2024), and Bashir & Younas (2025).

Third, according to recent scholarship, non-digital and culturally embedded game-based practices, which are frequently more practical in low-resource rural environments, remain under-theorized and under-evaluated despite digital gamification dominating the research landscape (Meylani, 2025; Videnovik et al., 2023; Delgado-Algarra, 2022; Dan et al., 2024).

Finally, few critical comparative studies examine how, in the face of technological and infrastructural limitations, learning outcomes, motivation, and mathematical identity are affected differently by digital gamification and traditional game-based approaches (Meylani, 2025; Videnovik et al., 2023; Ahmad & Khan, 2024; Dan et al., 2024).

Accordingly, this review addressed three research questions: In primary mathematics, it first looks at how particular game elements and game-based designs affect motivational, affective, and cognitive outcomes, such as concept building and higher-order thinking (Meylani, 2025; Zabala-Vargas et al., 2021; Videnovik et al., 2023; Rahim & Mohammed, 2025; Liang & Sitthiworachart, 2023; Dan et al., 2024; Bashir & Younas, 2025).

It also critically compares the benefits, drawbacks, and equity implications of digital gamification and traditional, non-digital game-based approaches in terms of viability and sustainability in rural school contexts (Qamar & Shahnaz, 2025; Meylani, 2025; Videnovik et al., 2023; Delgado-Algarra, 2022; Ahmad & Khan, 2024; Dan et al., 2024).

By focusing on theory, context, and equity, this review goes beyond oversimplified claims that games boost motivation. Rather, it describes the situations in which gamification and game-based learning greatly enhance rural primary learners' engagement and arithmetic comprehension, as well as the situations in which they run the risk of making already-existing inequities worse. By doing this, the review seeks to offer future research objectives and practice-oriented directions for developing low-cost, high-impact, and pedagogically sound game-based therapies suitable for rural primary mathematics classrooms.

Methodology

Review Design

Focusing on motivation, engagement, and equality, this study employs a critical review technique to analyse and synthesise both theoretical and empirical literature regarding gamification and traditional game-based learning in the context of rural primary mathematics education. To identify interventions addressing mathematics learning outcomes in rural or low-resource primary school contexts, the review critically assesses evidence from empirical studies, systematic reviews, and conceptual papers published in recent years (Nautwima et al., 2022; Tarakino, 2025; Liu, 2023). The review highlights important trends, gaps, and prospects for further study and application by fusing empirical data with theoretical viewpoints.

Inclusion and Exclusion Criteria

Studies were selected according to research type, population, intervention, outcomes, and publication characteristics to ensure methodological rigor and transparency. Only peer-reviewed studies published between 2020 and 2025 were included. Eligible studies focused on primary or elementary mathematics in rural, remote, or underserved educational contexts and reported outcomes related to motivation, engagement, or mathematics achievement. Studies were excluded if they lacked a clear theoretical foundation, did not report methodological procedures (e.g., research design, data collection, or analysis), or did not focus on gamification or game-based learning in mathematics education.

Search Strategy and Data Extraction

A structured literature search was conducted in Scopus using combinations of relevant keywords and Boolean operators (AND/OR), including gamification, game-based learning, mathematics





education, primary school, and rural education. Titles and abstracts were first screened for relevance, followed by full-text assessment. Data extracted from the selected studies included publication characteristics, research design, participant context, type of intervention, reported outcomes, and contextual factors affecting implementation. The extracted information was compiled in a structured table to ensure transparency and replicability.

Data Synthesis

The selected studies were analysed using thematic synthesis, enabling the identification of recurring patterns, conceptual relationships, and contextual constraints influencing the effectiveness of gamification and traditional game-based learning. Themes were generated through iterative comparison of study findings, focusing on motivational outcomes, engagement patterns, instructional design features, and contextual feasibility in rural primary mathematics classrooms. This approach enabled a critical interpretation of both the reported effectiveness of interventions and the theoretical mechanisms underlying their impact.

Results

The included study was subjected to a brief quality assessment that included methodological rigour, relevance to primary mathematics in rural areas, and alignment with the research focus on engagement, motivation, and equity. Both empirical research and systematic reviews from 2020 to 2025 were included in the review. The following findings are arranged thematically according to two educational approaches: traditional game-based methods and digital gamification.

Gamification and Motivation in Primary Mathematics

Although the results vary and depend on the setting, empirical research shows that gamification can improve students' motivation, engagement, and, in many situations, mathematics performance (Meylani, 2025; Ojonuba et al., 2025; Fung et al., 2024; Ahmad & Khan, 2024). Specifically, when based on SDT and Flow Theory to support autonomy, competence, and relatedness while maintaining the ideal challenge–skill balance, game features like points, badges, levels, leaderboards, and instant feedback are often linked to higher engagement (Meylani, 2025; Zabala-Vargas et al., 2021; Ojonuba et al., 2025; Sinaga, 2024; Fung et al., 2024).

When compared to traditional instruction, digital platforms and gamified formative assessment tools have been associated with improvements in conceptual understanding, higher-order thinking, and elementary mathematics achievement (Jiménez-Valverde et al., 2025; Videnovik et al., 2023; Rahim & Mohammed, 2025; Liang & Sitthiworachart, 2023; Bashir & Younas, 2025). However, studies on self-reported motivation also provide mixed results, indicating that learner traits, past gaming experience, and design sustainability affect results (Ojonuba et al., 2025; Fung et al., 2024). Meylani (2025), Sinaga (2024), and Ahmad & Khan (2024) claim that if extrinsic rewards are prioritised over significant mathematical objectives and chances for independence and collaboration, intrinsic motivation may be suppressed.

Traditional Game-Based Approaches in Rural Primary Mathematics

It has been demonstrated that non-digital game-based methods, such as board games, role-play, simulations, and culturally embedded games, promote engagement, intrinsic motivation, and conceptual learning in elementary mathematics (Videnovik et al., 2023; Delgado-Algarra, 2022; Dan et al., 2024). These methods, which emphasise cooperation, storytelling, and active engagement, are based on constructivist and socio-constructivist ideas.

Traditional game-based approaches offer practical benefits in rural settings because of their low cost, cultural adaptability, and less reliance on digital infrastructure. Evidence suggests that such approaches can encourage logical reasoning, participation, and positive affect toward mathematics, although rigorous experimental evaluations remain rare and results are sensitive to instructional alignment and teacher mediation (Liang & Sitthiworachart, 2023; Bashir & Younas, 2025).

Key studies are summarised in the table below, which emphasises the sample background, type of intervention, and main results. It gives a summary of the body of evidence and sets empirical research apart from systematic reviews.





Table 1: Summary of Studies on Gamification Interventions and Learning Outcomes in Rural Primary Education

Author(s)	Year	Context / Sample	Intervention Type	Key Outcomes
Meylani	2025	Rural primary, n=120	Digital gamification	Motivation, Engagement, and Math Performance
Rahim & Mohammed	2025	Rural mixed-grade, n=85	Non-digital board games	Conceptual understanding and Intrinsic motivation
Videnovik et al.	2023	Rural primary STEM, n=150	Gamified learning platform	Motivation and persistence
Ojonuba et al.	2025	Rural primary, n=95	Digital gamified math quizzes	Engagement has mixed effects on intrinsic motivation
Delgado-Algarra	2022	Rural primary, n=60	Culturally embedded games	Participation, and Positive affect
Bashir & Younas	2025	Rural low-resource schools, n=100	Board and role-play games	Conceptual understanding and Motivation

Thematic Patterns

1. Effectiveness of Game Features

In the analyzed research, game elements including points, badges, levels, leaderboards, incentives, and fast feedback were consistently linked to heightened student engagement and motivation. These elements foster interactive and engaging learning environments that motivate students to actively engage in mathematical tasks. The results strongly correspond with Self-Determination Theory (SDT) and Flow Theory, indicating that learners exhibit heightened motivation when they encounter autonomy, competence, achievement, and ongoing feedback in learning activities. Prompt feedback enables students to swiftly identify errors and enhance their performance, while progression systems, such as levels and badges, foster a sense of achievement that maintains learner persistence.

2. Context Sensitivity

The efficacy of gamification in rural educational environments is significantly affected by contextual elements, including internet accessibility, device availability, electrical reliability, instructor digital proficiency, and students' experience with educational technologies. Research on digital platforms indicated favorable results solely when educational institutions possessed sufficient technology infrastructure and teacher assistance. In resource-constrained rural schools, technological deficiencies frequently diminished the efficacy of digital gamification initiatives. Conventional non-digital game-based methods, such as board games, role-playing exercises, and classroom competitions, were determined to be more adaptive and sustainable due to their lower technology resource requirements, while effectively fostering engagement and collaborative learning.

3. Motivational Dynamics

Research demonstrates that gamification influences both intrinsic and extrinsic motivation; the link is intricate. Extrinsic rewards, such as points, prizes, and rankings, may initially enhance involvement and enthusiasm; nevertheless, overdependence on these external incentives might diminish students' intrinsic motivation for learning if not meticulously structured. Numerous research highlighted that gamification is most effective when gaming mechanics are purposefully incorporated with educational objectives rather than serving solely as entertainment. Hybrid methodologies that integrate significant classroom engagement, cooperative tasks, and economical digital resources seem





particularly effective in maintaining enduring motivation and conceptual comprehension among primary school students.

4. Equity Considerations

Equity surfaced as a significant theme across the analyzed research. Rural students frequently encounter systemic disadvantages, such as restricted access to educational technologies, inadequate teaching resources, and economic limitations. Effective gamification initiatives must be culturally pertinent, economically viable, and adaptable to local educational contexts. Research indicates that contextually relevant activities—such as games linked to students' daily experiences and community culture—enhance engagement and inclusivity. Economical and culturally integrated approaches demonstrated superior efficacy in promoting sustainable learning outcomes compared to technology-reliant alternatives, especially in underfunded rural educational institutions.

Discussion

The discussion synthesises theoretical, conceptual, and empirical evidence while considering theoretical mechanisms, contextual limitations, and alignment with the research aims of the study. It investigates how motivation, engagement, and learning results in rural primary mathematics are affected by both traditional game-based methods and digital gamification.

Effects of Gamification and Traditional Game-Based Strategies on Motivation and Learning in Rural Primary Mathematics

The combination of empirical research, systematic reviews, and conceptual analysis shows that both digital gamification and traditional game-based techniques can enhance motivation, engagement, and mathematics learning in primary schools. However, these advantages are highly context-specific, particularly in rural areas where structural and technological constraints restrict the fidelity of interventions (Meylani, 2025; Videnovik et al., 2023; Dan et al., 2024).

Digital gamification uses game aspects like points, badges, levels, dashboards, and quick feedback to encourage participation and conceptual comprehension. Based on motivational theories such as Self-Determination Theory (SDT) and Flow Theory, gamification can foster autonomy, competence, and relatedness while maintaining an ideal balance between challenge and skill (Meylani, 2025; Zabala-Vargas et al., 2021; Ojonuba et al., 2025; Sinaga, 2024; Fung et al., 2024). Digital platforms like Kahoot, Quizizz, and specialised DGBL environments can enhance higher-order thinking and mathematical achievement when formative assessment is integrated, according to research (Jiménez-Valverde et al., 2025; Videnovik et al., 2023; Rahim & Mohammed, 2025; Liang & Sitthiworachart, 2023; Bashir & Younas, 2025).

However, the necessity for pedagogical adaptation that extends beyond technical skill to include lesson design, scaffolding, and interactive facilitation is demonstrated by the fact that teacher digital competency, access to devices, and connectivity continue to be important factors that determine efficacy (Ahmad & Khan, 2024; Fung et al., 2024; Dan et al., 2024).

In contrast, traditional game-based techniques use full games as teaching tools, such as role-playing, board games, and culturally embedded activities. These tactics encourage intrinsic motivation, teamwork, and culturally sensitive learning and are frequently low-tech, low-cost, and flexible enough to be used in schools with limited resources (Delgado-Algarra, 2022; Dan et al., 2024; Videnovik et al., 2023). Although encouraging, there are still few empirical assessments and few systematic investigations in rural elementary mathematics environments. This emphasises the necessity of more precise theoretical expression and thorough evaluation of learning objectives.

Comparison Between Digital Gamification and Traditional Game-Based Approaches

A direct comparison highlights the complementary affordances and limitations of the two instructional strategies, suggesting that neither strategy can sufficiently address the complex contextual and motivational needs of rural learners on its own (Meylani, 2025; Videnovik et al., 2023; Delgado-Algarra, 2022; Ahmad & Khan, 2024; Dan et al., 2024). Table 2 summarises the eight primary elements, which include instructional form, motivating mechanisms, assessment approaches, resource demands, cultural responsiveness, evidence base, limitations, and overall fit for rural areas.





Table 2: A detailed comparison of key dimensions across the two approaches.

Dimension	Digital Gamification	Traditional Game-Based	References
Core instructional form	Game elements (points, badges, levels, feedback, dashboards) embedded into non-game learning environments	Complete games (board games, role-play, physical, and culturally embedded games) are used as instructional activities.	Meylani (2025); Delgado-Algarra (2022)
Dominant motivational mechanisms	Extrinsic and intrinsic motivation via feedback, progression, challenge–skill balance (SDT, Flow)	Intrinsic motivation via play, social interaction, narrative, and contextual meaning	Meylani (2025); Videnovik et al. (2023)
Assessment and feedback	Adaptive, immediate, and scalable feedback; supports formative assessment and learning analytics	Informal, teacher-mediated feedback; limited scalability and documentation	Meylani (2025); Ahmad & Khan (2024)
Resource and infrastructure demands	High dependence on devices, connectivity, platforms, and teacher digital competence	Low-cost, low-tech; feasible in resource-constrained and multigrade classrooms	Dan et al. (2024); Delgado-Algarra (2022)
Cultural responsiveness	Often generic; requires deliberate localisation to avoid cultural mismatch	Strong potential for culturally embedded narratives and local practices	Delgado-Algarra (2022); Dan et al. (2024)
Evidence-based in rural primary mathematics	Growing but uneven; limited rural-specific and longitudinal evaluations	Promising but under-theorised and under-evaluated empirically	Meylani (2025); Videnovik et al. (2023)
Key limitations	Equity risks, novelty effects, and overreliance on extrinsic rewards	Lack of systematic evaluation, theoretical articulation, and scalability	Ahmad & Khan (2024); Dan et al. (2024)
Overall suitability for rural contexts	Conditional and context-dependent	High feasibility but requires a stronger theoretical grounding	Meylani (2025); Dan et al. (2024)

Research indicates that neither strategy can adequately meet rural learners' complex contextual and motivational needs on its own. A workable alternative is provided by hybrid models, which combine low-cost digital interventions with non-digital, culturally based games. Teachers may arrange activities in a way that combines narrative-rich, cooperative games with quick online tests for instant feedback. In order to sustain curriculum alignment and conceptual coherence, such integration necessitates pedagogical preparation that strikes a balance between intrinsic social engagement and extrinsic digital reinforcement (Meylani, 2025; Videnovik et al., 2023; Delgado-Algarra, 2022; Ahmad & Khan, 2024; Dan et al., 2024).



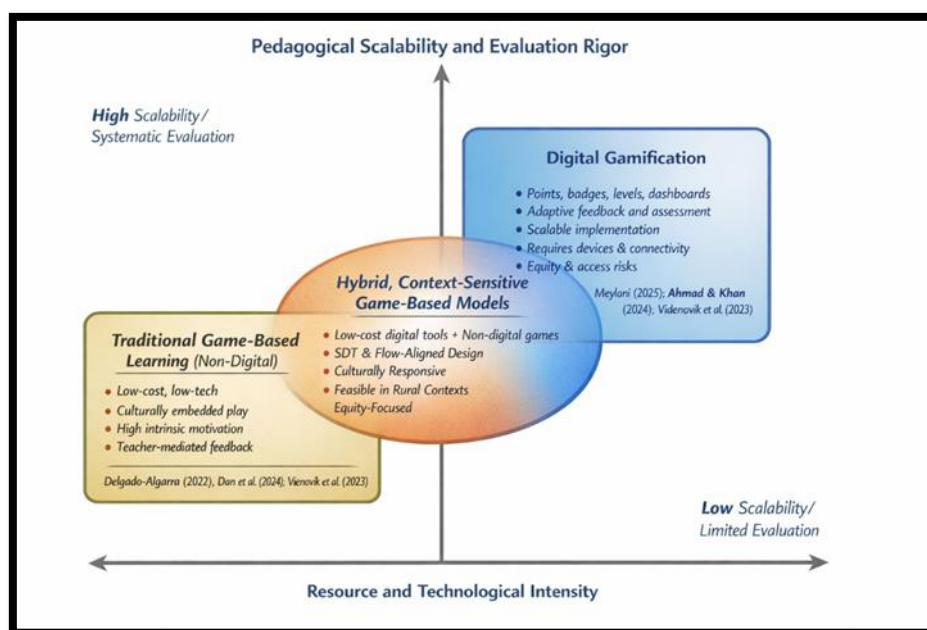


Figure 1. Pedagogical Scalability and Evaluation

The positioning of instructional techniques along the dimensions of pedagogical scalability and resource intensity is shown in Figure 1. The high-resource, high-scalability quadrant is where digital gamification is found, emphasising its powerful analytical capabilities but reliance on infrastructure. Conventional game-based approaches, which prioritise viability, intrinsic motivation, and cultural alignment, fall into the low-resource, low-scalability quadrant. Hybrid, context-sensitive treatments that maximise equity, conceptual understanding, and participation are represented by the overlapping zone.

These results are directly related to SDG 4, specifically objective 4.5, which seeks to provide inclusive education and eradicate regional inequities. The review highlights scalable and equitable techniques for promoting motivation, engagement, and mathematics competency among primary learners in underserved areas by showing how hybrid gamified and game-based treatments can adapt to low-resource rural situations.

Knowledge Contribution

This review contributes to the body of research from a theoretical perspective by showing how motivational frameworks such as SDT and Flow can be operationalised in both digital and non-digital learning contexts. It draws attention to the complex nature of motivation in rural primary mathematics, which is influenced by sociocultural background compatibility, contextual viability, and instructional design. Importantly, the findings highlight the potential for hybrid designs to deliver long-term intrinsic motivation while, when feasible, providing scalable learning analytics and caution against depending too much on extrinsic gamification elements in settings with limited resources.

Building on this synthesis, the paper suggests a Hybrid Model as a context-sensitive conceptual framework that deliberately blends inexpensive digital gamification tools with culturally relevant non-digital games. In addition to addressing the pedagogical and infrastructure limitations typical of rural primary schools, this model seeks to strike a balance between internal and extrinsic incentive factors.

To enhance motivation in rural primary mathematics, this study creates a theory-based, context-sensitive paradigm for gamification and conventional game-based learning. By focusing on motivation, equity, and contextual viability, it provides researchers and practitioners with useful insights for developing high-impact, inclusive, and sustainable interventions that go beyond surface-level engagement to foster profound conceptual understanding and long-term learner development.



Recommendation

With an emphasis on formative assessment and cultural adaptation, practice-related implications highlight the need for teacher professional development to enhance skills in both conventional and gamified game-based methods. Additionally, an equity-focused design must prioritise interventions that work with restricted technology, multigrade classrooms, and local cultural knowledge. Finally, hybrid techniques that combine meaningful non-digital games with low-cost digital tools should be employed to maintain motivation while fostering engagement and conceptual understanding.

Research implications include conducting longitudinal studies on gamified and traditional game-based strategies to assess their impact on mathematical identity and engagement, performing comparative research on effective game elements in rural settings, expanding evaluations of non-digital culturally embedded games, and investigating equity and sustainability outcomes tied to technology dependence and access issues. These elements are strongly related to the motivational mechanisms, autonomy, competence, relatedness, and optimal challenge that are outlined in SDT and Flow Theory and that influence students' sustained interest in mathematics. All of these recommendations are intended to direct inclusive activities that promote Sustainable Development Goal 4.

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