

Teachers' Awareness, Perceptions, and Professional Development towards Game-based Learning in Primary School Mathematics

A Needs Analysis

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ABSTRACT

This study explores primary school Mathematics teachers' perspectives on the use of Game-based Learning (GBL), as an instructional strategy. Using a survey design, data were collected from 149 Mathematics educators in Vadodara through a structured questionnaire comprising Likert scale items. The study aimed to assess teachers' awareness, perceptions, willingness, confidence, prior experience, and views on the need for further training and research related to GBL in Mathematics. Findings revealed that while most teachers are aware of GBL and believe in its potential to enhance student engagement, many lack confidence and adequate training to implement it effectively. Teachers expressed strong interest in professional development and emphasised the importance of access to quality resources. The study also highlights the necessity of aligning GBL strategies with constructivist principles and real-life applications to make Mathematics more meaningful for students. Based on the insights gained, the study offers recommendations for policy makers and school leaders to support the integration of GBL in primary Mathematics education through targeted training, resource development, and ongoing research. These findings contribute to understanding the support systems required to enhance Mathematics learning through innovative and student-centred teaching approaches.

Keywords: Game-based Learning, School Mathematics, Professional Development of Teachers

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Introduction

Globally, educational practices are undergoing a transformation, shifting from traditional, teacher-led instruction to more engaging, learner-centered models. One such approach gaining increasing attention is Game-based Learning (GBL). GBL integrates digital, physical, or hybrid games with educational objectives, promoting active participation, collaboration, timely feedback, and decision-making. These characteristics are especially beneficial in fostering deeper conceptual understanding and sustained motivation among students. The relevance of GBL is particularly strong in primary school Mathematics, where young learners often find abstract concepts difficult to grasp. Traditional methods, which rely heavily on rote learning and repetitive practice, frequently lead to disengagement, anxiety, and shallow comprehension. This gap between curriculum expectations and student outcomes highlights the need for more innovative strategies like GBL, which make learning both meaningful and enjoyable.

Recent studies (Abdul and Felicia, 2015; Alotaibi, 2024) support the idea that GBL enhances cognitive and emotional engagement when rooted in principles such as autonomy, challenge, and feedback. These characteristics are especially effective in primary settings, where children benefit most from hands-on, playful experiences. In the Indian context, researchers like Bhadawkar and Gupta (2023) and Shukla (2020), have demonstrated that GBL improves student performance and classroom collaboration, reinforcing the method's value in Mathematics education. In the context of this study, school Mathematics refers to the formal Mathematics curriculum taught at the primary level, typically encompassing foundational concepts in number operations, geometry, measurement, and problem-solving. It is often structured and assessment-driven, yet requires creativity and contextualisation to make abstract concepts meaningful to young learners.

In this study, student engagement refers to the level of attention, curiosity, and active involvement students show while learning Mathematics through games. Educators' perspectives include their attitudes, experiences, and perceptions about the feasibility, effectiveness, and implementation challenges of GBL in Mathematics classrooms. Additionally, two key concepts—willingness and confidence—are central to understanding teacher readiness. Willingness reflects teachers' openness to integrating GBL into their current practices, while

confidence pertains to their belief in their own ability to design and use game-based strategies effectively. Professional development of teachers, in this study, encompasses the training, mentoring, resources, and reflective opportunities that help educators build their capacity to implement GBL effectively. This includes not only the acquisition of technical skills but also pedagogical confidence, ongoing support, and exposure to best practices aligned with curriculum goals.

Despite growing evidence in support of GBL, its adoption in Indian primary schools remains limited. Studies by Munirah et al., (2020) and Verma (2019), have pointed to a lack of localised resources and professional training, which hinders implementation. Furthermore, Plass et al., (2015) and Adipat et al., (2021) underscore that successful GBL aligns with constructivist principles, where learning is rooted in real-world context, autonomy, and reflection.

This study, therefore, explores how primary school Mathematics teachers perceive GBL—examining their awareness, confidence, willingness, and professional development needs. It aims to provide a needs-based analysis of their preparedness and challenges in implementing GBL. This is especially relevant in the light of the National Education Policy (NEP) 2020 and the National Curriculum Framework for School Education (NCF-SE) 2023, which advocates for experiential, competency-based, and joyful learning experiences. By investigating teacher perspectives in the city of Vadodara, the study contributes context-specific insights toward integrating GBL meaningfully in Indian classrooms.

Review of Related Literature

GBL Education

GBL has widely been recognised as an innovative educational approach that combines the structure of games with instructional objectives to enhance engagement, motivation, and learning outcomes. In their systematic review, Abdul and Felicia (2015) concluded that effective GBL frameworks foster cognitive and emotional engagement through challenge, feedback, and autonomy. These features are essential in creating learner-centred classrooms, especially at the foundational level.

Similarly, Alotaibi (2024) conducted a meta-analysis in early childhood education and found that GBL not only enhances skill acquisition but also encourages positive learner attitudes,

creativity, and collaboration. This is especially important in primary education, where playful learning strategies align with children's developmental stages.

These studies demonstrate that GBL, when implemented with clear objectives and learner involvement, can lead to meaningful and sustainable educational outcomes serving as a base for exploration in subject-specific domains like Mathematics.

GBL in School Mathematics

In Mathematics education, traditional methods often rely heavily on repetition and memorisation, which can limit interest and understanding. GBL has been found effective in mitigating this issue. In an Indian context, Bhadawkar and Gupta (2023) conducted an experimental study showing that game-based strategies significantly improved both achievement and motivation among middle school Mathematics learners.

Shukla (2020) observed through his study that the use of educational games in Mathematics classrooms fostered deep student collaboration and deeper conceptual understanding. These findings align with international research by Groff et al., (2010) and Bottino et al., (2014) who found that integrating games led to higher student participation and retention of concepts.

These studies underscore the role of games not just as supplementary tools, but as an integral component to achieve curriculum objectives—especially when aligned with learner needs and classroom realities.

GBL in Primary School Mathematics

Primary school students benefit most importantly from hands-on and exploratory learning approaches. Bragg (2007) highlighted students' enthusiasm toward Mathematical games but cautioned that their learning potential must be clearly articulated by educators. In the Indian setting, Munirah et al., (2020) and Verma (2019), noted a shortage of localised game-based resources and highlighted the importance of designing culturally relevant GBL materials.

Moreover, evidence that is global from Fengfeng Ke (2008) and Ku et al., (2014) confirms that GBL supports learners of varying or different ability levels by fostering confidence, engagement, and application-based understanding.

These findings are directly relevant to the present study, which explores the preparedness of the teacher or how teachers

perceive their preparedness to use GBL effectively and efficiently in Mathematics at the primary level.

Learning Principles Underlying GBL

GBL is based upon constructivist learning theory, which emphasises learning through meaningful experiences. According to Plass et al., (2015) successful GBL integrates multimedia learning principles with instructional design, allowing learners to explore, make decisions, and receive timely feedback.

Adipat et al., (2021) identified five core principles for GBL success: relevance, motivation, learner control, social interaction, and active reflection. These findings align with the goals of the NEP 2020 and the NCF-SE 2023, which call for experiential and competency-based learning environments. The current study builds on these theoretical underpinnings by examining whether teachers understand and are ready to implement such principles within real classroom settings.

Mathematics Games and Real-life Integration

One of GBL's greatest strengths lies in contextualising abstract mathematical concepts through real-world problem-solving. Sujatha and Kasi Vinayakan (2023), reviewed practical methods of integrating everyday tasks—like budgeting or measuring—into mathematical instruction, and found this led to improved comprehension and skill application.

Choirudin et al., 2021 emphasised that real-world simulation through games not only enhances creativity but makes learning personally meaningful for young students. Games, like shopping simulations or classroom economy activities, helped bridge the abstract with the concrete. These insights validate the present study's emphasis on understanding teachers' perspectives on using such real-life GBL applications in Indian primary Mathematics classrooms.

Gaps in Literature and Relevance to the Present Study

While global studies have shown positive student outcomes through GBL, Nguyen et al., (2024) pointed out that teacher-centric studies—particularly around training, readiness, and classroom integration—remain scarce. Hidayat et al., (2024) also found that while students enjoy online GBL, teachers often lack the digital literacy and pedagogical confidence to use these tools effectively.

This study addresses these gaps by focusing on teachers' awareness, perceptions, confidence, and developmental needs,

especially in the Indian city of Vadodara. It also aligns with NEP 2020 and NCF-SE 2023, which advocates for teacher empowerment, joyful learning, and integration of technology in primary education.

Furthermore, the lack of structured professional development programmes, tailored specifically to GBL, limits many teachers' ability to implement such approaches confidently and effectively. The current study investigates not only teachers' familiarity with GBL, but also their perceived training needs and expectations, from institutional support and national education policies in promoting professional development.

Rationale of the Study

Mathematics is often regarded by young learners as abstract and challenging; leading to decreased motivation, passive engagement, and limited conceptual understanding. To address these challenges, educators and policymakers have increasingly advocated for innovative, student-centered pedagogies that promote joy in learning, critical thinking, and deeper conceptual engagement. GBL has emerged as one such approach, offering interactive and experiential ways for students to explore mathematical ideas through play, collaboration, and problem-solving.

This study is especially relevant in the context of the NEP 2020, which envisions transforming education through competency-based, experiential, and joyful learning. The NEP 2020 emphasises Foundational Literacy and Numeracy (FLN) as an urgent national mission and encourages the integration of play-based and discovery-based learning approaches at the primary level. GBL aligns strongly with these recommendations by enabling active, meaningful participation and the application of mathematical concepts in real-life contexts.

Furthermore, NCF-FS 2022 and the NCF-SE 2023 reinforce these ideas. The NCF-SE 2023 emphasises connecting learning to real-life experiences, using contextually relevant pedagogies, and promoting student autonomy and agency. GBL supports all of these goals by engaging children in exploration and decision-making while strengthening mathematical learning through joyful, interactive experiences.

Although various studies have highlighted the potential of GBL to enhance learning outcomes and motivation, there remains limited understanding of how prepared, confident, and willing primary teachers are to implement GBL strategies, especially within the

Indian school context. Much of the existing literature focuses on student outcomes or technologically advanced classroom settings, without addressing the practical challenges teachers face—such as lack of access to suitable resources, inadequate training, and limited familiarity with GBL tools.

This study addresses that gap by examining the awareness, perceptions, confidence, and training needs of 149 primary school Mathematics teachers in Vadodara. It further investigates the barriers to implementation and provides evidence-based recommendations to support teachers' professional development and the creation of localised, relevant GBL materials.

Ultimately, the rationale for this study lies in its potential to support the effective implementation of NEP 2020 and NCF-SE 2023 by equipping teachers with the knowledge, confidence, and resources they need to integrate GBL in primary Mathematics classrooms. In doing so, it contributes to national goals of making education more inclusive, engaging, and meaningful for all learners.

Research Objectives

The research objectives of this study are as follows:

1. To investigate teachers' awareness and understanding of GBL strategies in primary school Mathematics education.
2. To explore teachers' perceptions regarding the benefits and effectiveness of GBL.
3. To assess the willingness and confidence of primary school Mathematics teachers in adopting and implementing GBL approaches.
4. To examine teachers' prior experience and ability to assess student learning outcomes when using GBL strategies in Mathematics instruction.
5. To identify the professional development needs and research gaps perceived by teachers for the effective implementation of GBL in primary school Mathematics education.

Methodology

This study employed a quantitative research design using the survey method to examine primary school Mathematics teachers' perspectives on GBL. The design was selected to gather numerical data across a broad sample and identify trends related to teachers' awareness, perceptions, willingness, confidence, experience, and professional development needs concerning GBL.

Sampling

The sample consisted of 149 primary school Mathematics teachers from Vadodara, Gujarat, selected through random sampling. This method was chosen to reduce sampling bias and ensure that participants represented diverse institutional types (government and private), years of teaching experience, and familiarity with educational technologies. The sample size was considered adequate for a pilot study to observe patterns and collect baseline data relevant to the local educational context.

Tools Used

A structured questionnaire was developed by the researcher based on a review of related literature and aligned with the study's five research objectives. The questionnaire included 15 statements, grouped into the following five key dimensions:

1. Awareness and understanding of GBL.
2. Perceptions of GBL.
3. Willingness and confidence to implement GBL strategies.
4. Previous experience and assessment practices.
5. Need for further development and research in GBL.

Each statement used a 5-point Likert scale, ranging from Strongly Agree (1) to Strongly Disagree (5), enabling the quantification of teachers' attitudes and beliefs.

Tool Validity and Reliability

To ensure content validity, the draft questionnaire was reviewed by a panel of three experts in educational technology and pedagogy. Based on their suggestions, refinements were made to ensure clarity, item relevance, and alignment with the research objectives. A pilot test was conducted with 10 primary school Mathematics teachers (not included in the main sample). Their responses confirmed that the items were understandable, unambiguous, and appropriate for the target participants. The questionnaire was administered to 149 primary Mathematics teachers. The scores were analysed using Cronbach's Alpha. The value was found to be 0.84. This indicates high internal consistency. The 15-item tool was grouped into five dimensions reflecting the key constructs of the study: awareness, perception, willingness and confidence, prior experience, and professional development needs related to GBL.

The high reliability score and validated structure confirm that the tool was both statistically sound and practically appropriate for full-scale data collection in this context.

Data Analysis

Responses were analysed using percentage analysis, an appropriate method for identifying trends and relative frequencies in categorical Likert-type data. This statistical approach enabled the researcher to interpret the levels of agreement or disagreement with each item and supported the quantitative examination of the study's objectives. The results of each objective were presented dimension-wise in tabular form, followed by a discussion of findings in light of existing literature, enabling evidence-based conclusions and educational recommendations.

Analysis and Interpretation

Table 1: Teachers' Awareness and Understanding of GBL Strategies

Item No.	Statements	SA	A	N	DA	SD
		Response in (percentage)				
1.	I am aware of GBL strategies in Mathematics education.	51	78	17	1	2
		34.2	52.3	11.4	0.7	1.3
2.	I have a clear understanding of how GBL can enhance students' engagement in Mathematics.	52	72	20	4	1
		34.9	48.3	13.4	2.7	0.7

Interpretation

The majority of teachers in this study, comprising 86.5 per cent, either strongly agreed or agreed that they are aware of GBL strategies in Mathematics education. This indicates a substantial level of awareness and knowledge regarding this teaching approach. Teachers demonstrated a high level of understanding regarding how GBL can enhance students' engagement in Mathematics, with 83.2 per cent either strongly agreeing or agreeing. The positive response suggests that teachers recognise the potential benefits of this approach in promoting engagement in Mathematics education. These findings from Table 1 indicate a strong foundation in teachers' awareness and understanding of GBL strategies, emphasising their knowledge and comprehension of this innovative teaching method in Mathematics education. This level of awareness and understanding is crucial for the successful implementation of GBL strategies in the classroom.

Table 2: Perceptions towards GBL

Item No.	Statements	SA	A	N	DA	SD
		Response in (percentage)				
3.	I am familiar with the benefits of using GBL strategies in Mathematics instruction.	44	87	14	2	2
		29.5	58.4	9.4	1.3	1.3
4.	I am aware about the different types of GBL resources available for Mathematics.	25	73	39	10	2
		16.8	49	26.2	6.7	1.3
5.	I believe that GBL strategies are effective in promoting students' engagement in Mathematics.	79	56	10	2	2
		53	37.6	6.7	1.3	1.3

Interpretation

We examine teachers' perceptions of GBL, including their familiarity with the benefits, awareness of available resources, and belief in the effectiveness of this teaching approach in promoting students' engagement in Mathematics.

Statement 3: The majority of teachers, accounting for 87.9 per cent, either strongly agreed or agreed that they are familiar with the benefits of using GBL strategies in Mathematics instruction. This indicates that teachers recognise the advantages of this teaching approach.

Statement 4: The data shows that while the majority of teachers (65.8 per cent) either strongly agreed or agreed that they are aware of different types of GBL resources for Mathematics, a substantial proportion (26.2 per cent) expressed neutrality. This indicates that there is potential to enhance awareness and understanding of the different resources that are available. A large proportion of teachers (90.6 per cent) either strongly agreed or agreed that they consider GBL strategies to be effective in enhancing student engagement in Mathematics. This strong belief in the effectiveness of this approach underscores its potential to enhance student engagement.

Teachers demonstrated positive perceptions of GBL including their familiarity with its benefits, awareness of available resources, and belief in its effectiveness in promoting student engagement in Mathematics. These positive perceptions are essential for the successful implementation of GBL in the classroom, as they indicate a strong foundation for embracing this teaching approach.

Table 3: Willingness and Confidence in Implementing GBL Approaches

Item No.	Statements	SA	A	N	DA	SD
		Response in (percentage)				
6.	I am willing to explore and implement new approaches, such as GBL, in Mathematics instruction.	71	70	6	0	2
		47.7	47	4	0	1.3
7.	I perceive GBL strategies as valuable additions to traditional teaching methods in Mathematics.	64	71	12	0	2
		43	47.7	8.1	0	1.3
8.	I feel confident in my ability to design and implement GBL activities in Mathematics.	33	77	32	4	2
		22.1	51.7	21.5	2.7	1.3
9.	I believe I have the necessary skills to effectively utilise GBL strategies in Mathematics instruction.	35	89	19	4	1
		23.5	59.7	12.8	2.7	0.7

Interpretation

Table 3 explores teachers' willingness and confidence to embrace GBL in Mathematics instruction. It delves into their readiness to explore new teaching approaches, their perception of the value of GBL strategies, and their confidence and belief in their own abilities to design and implement GBL activities effectively.

Statement 6: A substantial majority of teachers (94.7 per cent) either strongly agreed or agreed that they are willing to explore and implement new approaches, such as GBL, in Mathematics instruction. This willingness is a positive indicator of their openness to innovative teaching methods.

Statement 7: The data shows that a majority of teachers (90.6 per cent) either strongly agreed or agreed that they perceive GBL strategies as valuable additions to traditional teaching methods in Mathematics. This positive perception reinforces the potential of GBL to complement existing teaching approaches effectively.

Statement 8: The data indicates that a significant portion of teachers (73.8 per cent) either strongly agreed or agreed that they feel confident in their ability to design and implement GBL activities in Mathematics. However, a notable number expressed neutrality, suggesting room for further development.

Statement 9: The majority of teachers (83.2 per cent) either strongly agreed or agreed that they believe they have the necessary skills to effectively utilise GBL strategies in Mathematics instruction. This belief in their skills is a positive indicator of their readiness to implement this teaching approach.

Overall teachers exhibited a strong willingness to explore new approaches like GBL, recognised the value of these strategies as an additions to the traditional teaching methods, and displayed varying degrees of confidence and belief in their ability to design, implement, and utilise GBL activities. These findings emphasise their receptivity to innovative teaching methods and the potential for professional development to enhance their confidence further.

Table 4: Learning Outcomes Using GBL Strategies

Item No.	Statements	SA	A	N	DA	SD
		Response in (percentage)				
10.	I have prior experience in incorporating technology-aided games, board games, or physical games into my Mathematics lessons.	32	68	33	14	2
		21.5	45.6	22.1	9.4	1.3
11.	I can effectively assess and evaluate students' learning outcomes when using GBL strategies in Mathematics.	31	83	28	5	1
		20.8	55.7	18.8	3.4	0.7

Interpretation

Table 4 delves into the teachers' previous experience of incorporating various GBL resources into their Mathematics lessons, and their ability to effectively assess and evaluate students' learning outcomes when using GBL strategies.

Statement 10: The data indicates that a majority of teachers (67.1 per cent) either strongly agreed or agreed that they have prior experience in incorporating technology-aided games, board games, or physical games into their Mathematics lessons. This suggests that a significant portion of the teachers have hands-on experience with these resources.

Statement 11: A substantial majority of teachers (76.5 per cent) either strongly agreed or agreed that they can effectively assess and evaluate students' learning outcomes when using GBL strategies in Mathematics. This positive self-assessment highlights their confidence in their ability to gauge the impact of these strategies on student learning.

In Table 4, teachers reported having prior experience in incorporating GBL resources into their Mathematics lessons, with a substantial majority feeling confident about their ability to assess and evaluate students' learning outcomes. These findings indicate that many teachers possess the necessary background and skills to effectively integrate GBL strategies into their teaching practices, potentially enhancing the learning experience for students.

Table 5: Need for Further Development and Research in Implementation of GBL

Item No.	Statements	SA	A	N	DA	SD
		Response in (percentage)				
12.	I would benefit from professional development opportunities focused on GBL strategies in Mathematics.	54	77	16	1	1
		36.2	51.7	10.7	0.7	0.7
13.	I believe that training programmes on GBL in Mathematics should be made available for teachers.	82	55	10	0	2
		55	36.9	6.7	0	1.3
14.	I would like to receive training on how to select and adapt GBL resources for Mathematics instruction.	62	74	10	2	1
		41.6	49.7	6.7	1.3	0.7
15.	There is a need for more research and evidence on the effectiveness of GBL strategies in primary education.	65	68	14	0	1
		43.6	45.6	9.4	0	0.7

Interpretation

Table 5 delves into teachers' perspectives on the need for professional development, training programmes, and further research related to GBL strategies in Mathematics education.

Statement 12: The majority of teachers (87.9 per cent) either strongly agreed or agreed that they would benefit from professional development opportunities focused on GBL strategies in Mathematics. This indicates their recognition of the value of continuous learning and improvement.

Statement 13: The data shows that a substantial majority of teachers (91.9 per cent) either strongly agreed or agreed that training programmes on GBL in Mathematics should be made available for teachers. This reflects their belief in the importance of such programs for professional development.

Statement 14: The majority of teachers (91.3 per cent) either strongly agreed or agreed that they would like to receive training on how to select and adapt GBL resources for Mathematics instruction. This emphasises their interest in enhancing their skills in resource selection and adaptation.

Statement 15: A significant majority of teachers (89.2 per cent) either strongly agreed or agreed that there is a need for more research and evidence on the effectiveness of GBL strategies in primary education. This highlights their recognition of the importance of research to inform and enhance teaching practices.

In Table 5, teachers expressed their openness to professional development, training programmes, and the need for further research in the field of GBL in Mathematics education. Their positive attitudes towards ongoing learning and the necessity of research and training underscore their commitment to improving their teaching methods and ensuring the effectiveness of GBL strategies.

Result and Discussion

This study offers important insights into primary school Mathematics teachers' perspectives on GBL. The findings are presented below, organised by research objectives and supported by relevant literature.

A substantial proportion of teachers (86.5 per cent) indicated awareness of GBL strategies, and 83.2 per cent demonstrated an understanding of how these strategies enhance student engagement. This reflects a strong foundational awareness of GBL among educators in Vadodara. These results align with Abdul and Felicia (2015), who highlighted that teacher awareness serves as a prerequisite for successful engagement in GBL environments. Similarly, Nguyen et al., (2024) emphasised that awareness and familiarity with GBL principles are critical in establishing readiness for its classroom implementation, particularly at the primary level. However, while conceptual understanding appears robust, it must be complemented with practical applications and scaffolded support to facilitate the actual integration of GBL into pedagogical practice.

The study found that 87.9 per cent of participants held favorable perceptions of GBL's effectiveness in promoting student engagement. However, a notable 30.82 per cent expressed neutrality regarding the availability and variety of GBL resources, indicating gaps in exposure to diverse tools. This echoes the findings of Bragg (2007), who reported that although teachers valued the pedagogical benefits of games, their limited access to curriculum-aligned resources restricted broader application. Alotaibi (2024), through a meta-analysis on early childhood education, similarly noted that, a lack of resource diversity poses a barrier to meaningful GBL implementation. The findings suggest the need for structured exposure to a wider spectrum of GBL formats—both digital and non-digital—thus, enhancing teachers' capacity for innovation and flexibility in instructional planning.

While a high percentage (94.7 per cent) of teachers expressed willingness to integrate GBL into their teaching, only 73.8 per cent felt confident in their ability to design and implement such strategies. This disparity points to a readiness gap that may inhibit actual classroom execution.

Ku et al., (2014) emphasised that teacher confidence significantly affects the successful application of GBL approaches, particularly when managing students with varied abilities. Adipat et al., (2021) also concluded that teacher training plays a crucial role in building confidence and enabling effective management of GBL activities. To bridge this gap, professional development must move beyond conceptual discussions to provide hands-on training in the creation, facilitation, and evaluation of game-based tasks tailored to local classroom contexts.

Among the surveyed teachers, 67.1 per cent reported having prior experience using games in Mathematics instruction, and 76.5 per cent expressed confidence in assessing learning through GBL methods. These findings are consistent with Plass et al., (2015) who emphasised that the success of GBL lies in the alignment of instructional design and assessment mechanisms. Rawansyah et al., (2021) further argued for the necessity of performance-based assessment models that accurately measure learning outcomes in game-based settings. Although many teachers have experimented with GBL, the study indicates a need for better-developed rubrics and assessment tools specifically designed to evaluate game-enhanced learning.

There is a strong demand for further professional development (87.9 per cent), resource selection training (91.3 per cent), and ongoing research (89.2 per cent) into GBL's effectiveness.

This aligns with Munirah et al., (2020) who highlighted a lack of structured, content-specific GBL kits for Mathematics. Bhadawkar and Gupta (2023), also underscored the need for contextualised training that addresses Indian classroom realities. Alotaibi (2024) and Ghannem et al., (2018) called for sustained research to ensure that GBL evolves in response to emerging educational needs and technologies.

These findings reinforce the need for system-level policy support, targeted resource development, and longitudinal studies to facilitate the long-term success of GBL integration in Indian primary schools.

Conclusion

This study reveals that primary school Mathematics teachers in Vadodara exhibit a strong awareness and favorable perceptions of GBL as an instructional approach. The results indicate that while educators recognise the potential of GBL to enhance student engagement and conceptual understanding, there remain significant gaps in their confidence and practical readiness to implement it effectively in classroom settings. Although the majority of teachers express a willingness to adopt GBL strategies, many lack experience in designing GBL activities, assessing student outcomes, and selecting suitable resources.

The findings also point to a substantial need for structured professional development opportunities, tailored teaching materials, and sustained research support. These needs are well-aligned with the priorities outlined in the NEP 2020 and the NCF-FS and NCF-SE, which advocate for experiential, inclusive, and competency-based learning models.

To facilitate the successful adoption of GBL in primary Mathematics education, comprehensive support systems must be established. This includes investment in capacity-building programmes, the development of accessible and curriculum-aligned game-based resources, and the promotion of research-informed practices. Addressing these areas will be essential in empowering educators to fully harness the benefits of GBL and to foster a more engaging and effective learning environment for students.

Implications

This study affirms that primary school Mathematics teachers are generally aware of and positively inclined toward GBL. Their

willingness to adopt GBL reflects its alignment with their pedagogical goals. However, gaps in confidence, resource awareness, and structured training remain significant barriers to implementation. These insights emphasise the importance of:

1. Designing targeted professional development programmes to build teacher confidence and skills.
2. Developing curriculum-aligned, accessible GBL resources for primary Mathematics.
3. Creating assessment frameworks suitable for GBL activities.
4. Encouraging contextual research and policy support in line with the NEP 2020 and NCF-SE 2023, which advocate for joyful, experiential, and competency-based learning.
5. By addressing these needs, GBL can move from being a conceptual interest to a classroom reality, transforming how Mathematics is taught and experienced in early education settings.

This study opens several avenues for future research. First, a larger-scale study across different regions of India could provide broader insights into regional variations in teachers' awareness and implementation of GBL. Second, qualitative studies involving interviews or classroom observations could deepen understanding of how teachers adapt GBL strategies in real classroom environments.

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