Challenges Faced by Mathematics Teachers in Implementing Game-Based Learning at the Elementary Level in Odisha

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Abstract

Game-Based Learning (GBL) has emerged as an innovative pedagogical approach to enhance students' engagement and conceptual understanding in mathematics at the elementary level. The present study titled "Challenges of Mathematics Teachers while Implementing Game-Based Learning at Elementary Level in Odisha" seeks to explore the realities faced by mathematics teachers in integrating GBL into classroom practices. The study is guided by three major objectives: to identify the instructional strategies currently used by mathematics teachers at the elementary level; to examine teachers' opinions regarding the effectiveness of game-based learning in promoting student engagement; and to investigate the specific challenges encountered during its implementation. Adopting a descriptive research design, the study focuses on understanding teachers' experiences, perceptions, and classroom practices in the context of elementary schools in Odisha. The findings are expected to reveal the extent to which traditional and innovative instructional strategies coexist, teachers' attitudes toward the pedagogical value of GBL, and barriers such as limited resources, lack of training, time constraints, and classroom management issues. The study aims to provide insights for policymakers, curriculum planners, and teacher educators to strengthen support systems and promote effective integration of game-based learning in mathematics classrooms.

Keywords: Game Based Learning, Elementary Level Students, Elementary Level Mathematics Teachers, Challenges for Implementing Game Based Learning.

Backdrop

Mathematics is a foundational subject at the elementary level, shaping learners' logical thinking, problem-solving ability, and analytical skills. However, it is often perceived by students as abstract, difficult, and less engaging. In recent years, Game-Based Learning (GBL) has emerged as an innovative instructional approach aimed at making mathematics more interactive, meaningful, and student-centred. By integrating structured games with curricular objectives, teachers can create learning environments that foster motivation, collaboration, and active participation among young learners.

The emphasis on experiential and joyful learning highlighted in the National Education Policy 2020 further strengthens the need to adopt engaging pedagogical strategies in elementary classrooms. In the context of Odisha, where diverse classroom settings and varying resource availability exist, the implementation of GBL presents both opportunities and challenges. While many teachers recognize the potential of games to enhance engagement and conceptual clarity, practical constraints may hinder effective integration.

Therefore, it becomes essential to examine the instructional strategies currently used by mathematics teachers, understand their perceptions regarding the effectiveness of GBL, and identify the specific challenges they encounter. Such an inquiry will contribute to improving pedagogical practices and strengthening mathematics education at the elementary level.

Review of Related Literature

In order to gain deeper understanding over the topic the investigator reviewed available literature pertaining to the topic and categorised them into following dimensions:

- **Teachers' Perceptions and Attitudes towards game-based learning**

Research indicates that teachers generally hold positive attitudes toward GBL. Huizenga et al. found that secondary teachers perceived digital games as effective tools for enhancing students' motivation, engagement, and conceptual understanding. Students were eager to participate and valued what they learned. Similarly, (Avdiu, 2019) reported that history teachers demonstrated good knowledge of digital games and expressed supportive attitudes toward their integration in formal education. A comparative study by Bado (2019) across Italy, Turkey, and the UK revealed that teachers particularly in the UK recognized the pedagogical benefits of GBL.

- **Pedagogical Integration and Classroom Practices for game-based learning**

Studies show that teachers integrate GBL to enrich curriculum and instructional practices. Vogt (2018) observed that middle school teachers used Digital Game-Based Learning (DGBL) to engage students, promote teamwork, individualize learning, and provide feedback. Qian and Clark (2016) demonstrated the application of Minecraft: Education Edition in social science teacher training, highlighting its role in innovative history pedagogy.

- **Academic Performance and Motivation among the Students**

Empirical evidence confirms that GBL positively influences academic outcomes and intrinsic motivation among the students. Korkmaz and Öztürk (2020) reported improved academic performance and high levels of motivation among university students using gamified DGBL. Borsos (2018) similarly found that gamification increased elementary students' interest and engagement in history learning.

- **Skill Development and Competencies among Teachers**

GBL fosters 21st-century skills such as collaboration, creativity, problem-solving, critical thinking, and visual-spatial abilities. Studies emphasize its contribution to developing adaptive and professional competencies relevant to contemporary educational contexts (Erhel & Jamet, 2013).

- **Challenges and Implementation Barriers**

Despite positive outcomes, challenges include technical difficulties, time constraints, limited teacher self-efficacy, and concerns about student distraction (Filsecker & Hickey, 2014). Overall, literature supports GBL and gamification as effective pedagogical strategies, while highlighting the need for structured implementation and teacher support.

Rationale of the Study

The present study is anchored in the positivist paradigm. This paradigm emphasizes practical solutions and utility, which is based on quantitative methods to address real educational concerns. By focusing on actionable outcomes, the study seeks to generate contextually relevant insights into Challenges of Mathematics Teachers while Implementing Game Based Learning at Elementary Level in Odisha.

This study is significant as it aligns with the vision of the National Education Policy 2020, which promotes experiential, activity-based, and joyful learning in schools. It also supports the pedagogical recommendations of the National Council of Educational Research and Training and initiatives under Samagra Shiksha that emphasize innovative teaching and teacher capacity building. Additionally, the study contributes to the goals of the NIPUN Bharat Mission by exploring strategies to strengthen foundational numeracy through Game-Based Learning. The findings can guide policymakers and educators in improving mathematics teaching practices at the elementary level in Odisha.

In this context, addressing challenges is essential for building accurate conceptual foundations in mathematics learning at elementary level. Reducing them that enhances critical thinking, knowledge retention, confidence, and informed decision-making. Furthermore, limited research on game-based learning at elementary level in Odisha underscores the necessity of this study, making it both academically relevant and regionally significant.

Research Questions

1. What instructional strategies are used by mathematics teachers in elementary-level classrooms?

2. What are the opinions of elementary mathematics teachers regarding the effectiveness of game-based learning in enhancing students' engagement?

3. What specific challenges do elementary mathematics teachers encounter while implementing game-based learning in their classrooms?

Research Objectives

1. To find out the instructional strategies used by mathematics teachers in their classroom at elementary level.

2. To gather opinion of mathematics teacher on the effectiveness of game-based learning in enhancing students' engagement at elementary level.

3. To identify the specific challenges mathematics teachers, encounter while implementing game-based learning in their classroom at elementary level.

Methodology

- **Design**

Keeping in mind the objectives of the research, the researcher was adopting descriptive study of quantitative research.

- **Population**

In present study, the Population for the study was all teachers from Elementary schools in Odisha. The Accessible Population for this study was Elementary school mathematics teachers of South-East Zone, Bhubaneswar, Odisha.

- **Sample**

In the present study, the researcher was using purposive sampling technique on the ground that these schools have high student enrolment possessing excellent academic track record which in turn helps to develop deeper understanding pertaining to game-based learning among teachers. The sample is all the mathematics teachers of South-East Zone, Bhubaneswar, Odisha, and the sample size is N= 320 comprising the total number of mathematics teachers.

- **Tools**

Keeping in mind the objective of this research, the researcher in consultation with the experts in the field of game-based learning and research, decided to collect the data through self-developed questionnaire meant for Elementary school Mathematics teachers which was based on standardized tools.

- **Data Analysis and Interpretation**

For the present study, the researcher is analyzing the data using frequency and percentage, analysis techniques for the respective quantitative data. The frequency of each response for a particular item as given by the respondents are calculated. The responses are analysed on the basis of scoring key available and thereafter the results, findings and interpretations are derived.

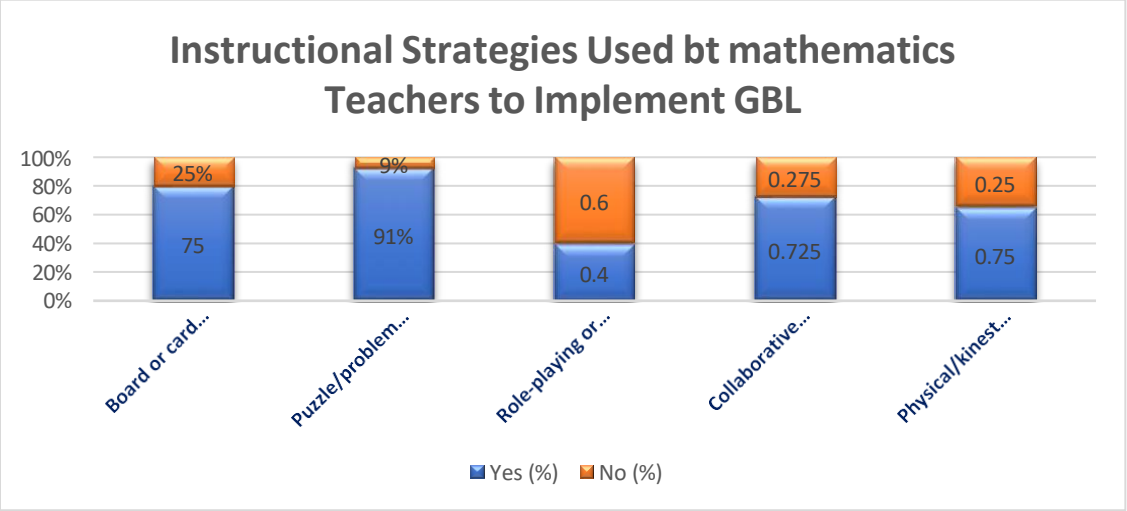
Major Findings

Objective 1: To find out the instructional strategies used by mathematics teachers in their classroom at elementary level.

(Table 1: Mathematics Teachers' understanding of GBL concepts)

Most teachers understand GBL as active, interactive, student-centered learning based on "learning by doing." However, some still perceive it mainly as educational games, indicating minor conceptual misconceptions.

Sl. No.	Statements	Yes (%)	No (%)
1	GBL means learning from educational games	75	25
2	GBL is a form of active learning	91	9
3	GBL is interactive in nature	90	10
4	GBL is a student-centered approach	88.5	11.5
5	GBL involves "learning by doing"	93	7



(Table 1.2: Instructional strategies used by mathematics Teachers to implement GBL)

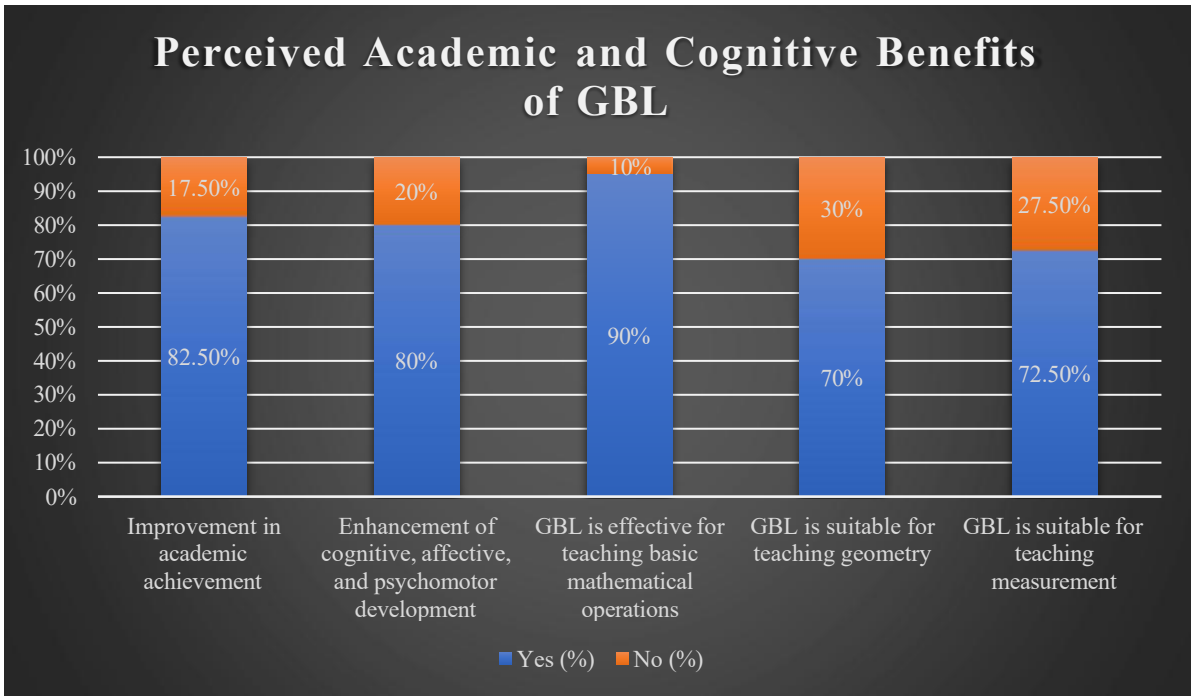
Mathematics teachers commonly use puzzles, board games, and team challenges. Role-play and simulations are less used, likely due to time, space, and classroom management constraints.

Objective 2: To gather opinion of mathematics teacher on the effectiveness of game-based learning in enhancing students' engagement at elementary level.

Statement	Yes (%)	No (%)
GBL makes mathematics learning enjoyable	**96.5%**	**3.5%**
GBL increases student's engagement	**93%**	**7%**
GBL encourages collaboration among students	**92.5%**	**7.5%**
GBL enhances students' confidence	**83%**	**17%**
GBL boosts creativity and problem-solving skills	**87.7%**	**12.3%**

(Table 1: Impact of GBL on Students Engagement)

Mathematics teachers strongly agree that GBL makes mathematics enjoyable, increases engagement, and promotes collaboration, creativity, confidence, and problem-solving skills among elementary learners.



(Table 2: Perceived Academic and Cognitive benefits of GBL)

GBL is perceived to improve academic achievement and cognitive development. It is most effective for basic operations, slightly less effective for geometry and measurement topics**.**

Objective 3: To identify the specific challenges mathematics teachers, encounter while implementing game-based learning in their classroom at elementary level.

Challenge faced by mathematics teachers	Agree (%)	Neutral (%)	Disagree (%)
Difficulty aligning games with curriculum	78%	15%	7%
Adapting games for different learning abilities	70%	22.5%	7.5%
Time constraints during classroom implementation	82.5%	10%	7.5%
Difficulty managing discipline during gameplay	63.5%	20%	16.5%
Inadequate training on GBL	82.5%	10%	7.5%

(Table 1: Pedagogical challenges faced by Mathematics Teachers in Implementing GBL)

Mathematics teachers face challenges such as inadequate training, time constraints, curriculum alignment issues, classroom discipline concerns, and adapting games for diverse students.

Statement	Agree (%)	Neutral (%)	Disagree (%)
Lack of access to GBL materials	**90%**	**7.5%**	**2.5%**
Limited time to plan and prepare resources	**80%**	**10%**	**10%**
Lack of physical space for group or kinesthetic games	**65%**	**22.5%**	**12.5%**
Lack of ready-made and culturally relevant games	**61%**	**25%**	**14%**
Limited low-cost/no-cost game resources	**80.5%**	**14.5%**	**5%**

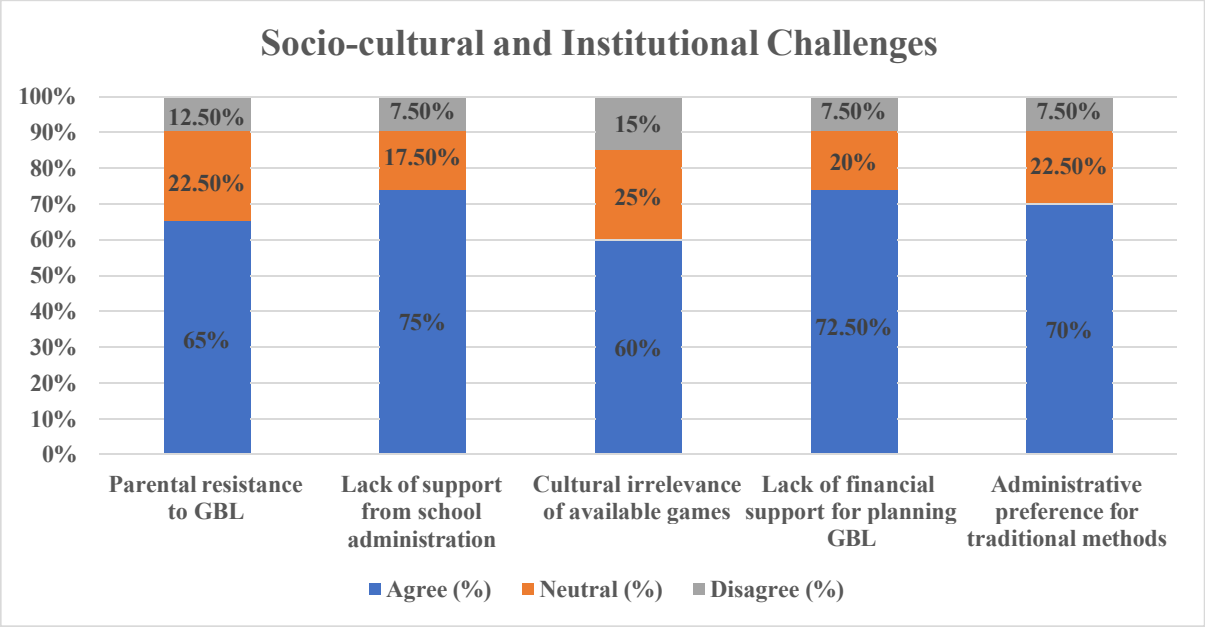
(Table 2: Resources and Infrastructural Challenges)

Limited access to materials, insufficient preparation time, lack of space, financial constraints, and absence of culturally relevant games hinder effective GBL implementation.

Statement	Agree (%)	Neutral (%)	Disagree (%)
Difficulty in assessing individual progress during gameplay	77.5%	12.5%	10%
Struggle with non-traditional assessment like observation	72%	18%	10%
Challenges in providing immediate feedback during games	72.5%	15%	12.5%
Difficulty balancing formative and summative assessment	80.5%	12.5%	7%
Documentation of learning progress during gameplay	79%	13.5%	7.5%

(Table 3: Assessment related Challenges faced by Mathematics Teacher)

Assessing individual progress, giving immediate feedback, maintaining documentation, and balancing formative and summative assessment during gameplay are major challenges.



(Table 3: Socio cultural and Infrastructural Challenges)

Parental resistance, administrative preference for traditional teaching, limited institutional support, financial barriers, and lack of culturally relevant resources affect GBL adoption.

Educational Implications

- Integrate games with specific mathematics concepts and competencies.
- Design age-appropriate and inclusive game activities.
- Provide continuous professional development for teachers.
- Encourage collaborative and peer-learning approaches.
- Use locally available, low-cost teaching-learning materials.
- Allocate dedicated time for game-based activities in lesson plans.
- Develop clear rules and assessment criteria for games.
- Promote reflective practices and regular feedback for improvement.

Suggestions for Further Research

- Future research may focus on developing localized, low-cost, and curriculum-aligned game kits for Mathematics learning.
- Studies can explore students' perspectives on GBL to provide a learner-centered evaluation for Implementing the strategies.
- Research may also explore demographic variable (gender differences) in GBL preferences and effectiveness.
- Analysis of the integration of GBL in the National Curriculum Framework and NEP 2020 implementation can be explored.

Conclusion

The study highlights that Game-Based Learning (GBL) holds significant potential to transform mathematics teaching at the elementary level by promoting active engagement, conceptual understanding, and positive attitudes toward the subject. Mathematics teachers in Odisha employ a combination of traditional and innovative instructional strategies; however, the integration of structured games remains limited due to practical constraints. While teachers generally perceive GBL as an effective approach for enhancing students' participation and interest, they encounter challenges such as inadequate training, limited instructional time, lack of appropriate resources, large class sizes, and assessment-related difficulties. These findings suggest the need for systematic professional development programs, institutional support, and access to contextually relevant teaching materials to strengthen the implementation of GBL. Encouraging collaborative practices and aligning game-based strategies with curriculum objectives can further enhance effectiveness. Overall, addressing these challenges can contribute to creating more engaging, joyful, and meaningful mathematics classrooms at the elementary level in Odisha.

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