International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Enriching Grade 6 Learners Mathematical Word Problem Solving Skills Through XPLORAMATH (Exploration with Math) Gameboard

[a]Rustico P. Mission, [b]Airace M. Ycot, [c]Feia R. Solasco, [d]Janaine G. Sabanal, [e]Jewel M. Iguas, [f]Gretchen L. Montero, [g]Dr. Marnel M. Bullo, [h]Dr. Richard C. Ching, [i]Lester V. Gonzales

[a,b,c,d,e,f,g,h,i] Cataingan Municipal College, Cataingan, Masbate Philippines.

A B S T R A C T:

This research sought to enhance the mathematical word problem-solving abilities of Grade 6 pupils at Emilio Boro Sr. Central School, Cataingan West District, Schools Division of Masbate, Philippines, by utilizing the XPLORAMATH Game Board, a gamified educational resource. The study aimed to assess the effectiveness of the game board in improving problem-solving skills by evaluating the performance of students who engaged with the game-based approach against those who underwent conventional teaching. A quasi-experimental design was employed with 38 Grade 6-Cobalt students, split evenly into control and experimental groups via stratified random sampling according to previous academic achievement. The duration of the intervention was four weeks. Throughout this time, the experimental group utilized the XPLORAMATH Game Board, integrating math challenges with an interactive map of Masbate, whereas the control group underwent traditional teaching methods. Both groups took a pre-test and a post-test to assess learning outcomes. Data were examined utilizing paired and independent sample t-tests via Jamovi software. Findings indicated that both groups demonstrated notable enhancement from pre-test to post-test; however, the experimental group obtained considerably higher post-test scores ($t = -13.0$, $p < 0.001$), reflecting the favorable effect of the game-based intervention. The pre-test comparison indicated no statistically significant difference ($p = 0.530$), confirming that both groups were similar prior to the intervention. To sum up, the XPLORAMATH Game Board demonstrated itself as an efficient teaching resource for improving students' mathematical problem-solving abilities. Its student-focused and interactive method not only enhanced academic outcomes but also encouraged active participation and learning. These results indicate that integrating gamified approaches into the elementary math curriculum can enhance learning results and create a more inclusive and engaging classroom atmosphere.

Keywords: XPLORAMATH Game Board, mathematical word problem-solving, gamified instruction, quasi-experimental design

Introduction

In today's complex and data-focused environment, solving mathematical problems is not just a skill for the classroom; it is a fundamental ability essential for lifelong education and engaged citizenship. As global educational systems transition to equip students for the challenges of the 21st century, the capacity to analyze, reason, and tackle mathematical problems emerges as a vital educational objective (OECD, 2018). Students proficient in mathematical problem-solving are more inclined to thrive in science, technology, engineering, and mathematics (STEM) disciplines and are better prepared to make informed choices in their daily lives (Boaler, 2016). Nonetheless, despite curricular reforms and a focus on problem-solving teaching methods, numerous students still view mathematics as an abstract, inflexible, and challenging subject, resulting in low motivation and achievement (Zainuddin et al., 2020).

This persistent negative perception might be associated with the disadvantages of traditional teaching methods, which often depend significantly on rote learning and procedural guidance. Research shows that these approaches do not foster profound comprehension or critical thinking abilities. Li and Schoenfeld (2019) suggest that teacher-centered approaches could hinder students from fully engaging with mathematical content, particularly in problem-solving contexts. Students frequently absorb information passively, limiting their chances to develop reasoning strategies and collaborative skills vital for mathematics. This gap in education requires creative teaching approaches that achieve academic objectives while also promoting student engagement and excitement.

Gamification has emerged as a strong educational method that integrates game features—like points, tiers, challenges, and incentives—into educational settings. The objective is to create an interactive learning environment that enhances engagement, motivation, and immersion in the educational experience (Dichev & Dicheva, 2017). Numerous studies have confirmed that gamified instruction enhances learners' concentration, participation, and memory of mathematical principles (Hamari et al., 2016; Zainuddin et al., 2020). Additionally, learning through games has been associated with increased learner autonomy and enjoyment, both of which are vital factors in improving academic achievement. Importantly, gamification shifts the learning experience from passive reception to active participation, rendering mathematics more accessible and fun. In the realm of education in the Philippines, gamified learning tools have gained popularity because of their ability to contextualize abstract concepts and foster active engagement. Razon et al. (2020) found that engaging in games greatly improved students' motivation and performance in mathematics. Moreover, integrating

localized and culturally significant content in games enhances their educational impact. Cruz and Taguibao (2021) emphasized that incorporating aspects from learners' environments—like local landmarks or cultural practices—helps students create stronger connections to the material.

Inspired by these results, this research presents the xploramath Game Board—a gamified teaching resource aimed at enhancing the mathematical problem-solving abilities of Grade 6 students. The game combines math obstacles with a travel-themed quest, allowing players to explore famous tourist spots in Masbate via a 3D board modeled after the mobile game "Stickman Party 1234." The game seeks to make learning enjoyable, relatable, and efficient by incorporating math problems into an engaging and culturally relevant setting. It acts not just as a resource for educational growth but also as a venue for enhancing local tourism and cultural recognition. The primary aim of this research is to verify the efficacy of the XPLORAMATH Game Board in improving the mathematical problem-solving abilities of Grade 6 students from Emilio S. Boro Central School. With this intervention, the researchers intend to enhance the expanding literature on gamification in education and provide evidence-backed insights into creating contextually relevant, engaging, and educationally effective instructional resources. Ultimately, this research aims to show that with appropriate methods and resources, mathematics can transform into a field that students are eager to delve into.

1.1 Statement of the Problem

This research aimed to improve the mathematical problem-solving abilities of Grade 6 students at Emilio S. Boro Central School by utilizing the XPLORAMATH Game Board, addressing the increasing needs of a more dynamic society. This goal was pursued by implementing an intervention that used the XPLORAMATH Game Board as a gamified teaching resource. The research specifically sought to evaluate the mathematical word problem-solving abilities of Grade 6-Cobalt students before and after the intervention was applied. Furthermore, the research examined whether a significant difference existed between the pre-test and post-test outcomes of the students after their interaction with the game-based learning tool.

Methods

2.1 Research Design

This research utilized a quasi-experimental approach to assess the impact of the XPLORAMATH Game Board on improving the mathematical word problem-solving abilities of Grade 6 students at Emilio S. Boro Central School. The study involved 38 students from Grade 6-Cobalt, split into two equal sections: 19 in the experimental group and 19 in the control group. To achieve comparability among the groups, stratified random sampling was employed considering learners' prior mathematical abilities and traits, which helped minimize selection bias and ensure a fair comparison (Creswell & Creswell, 2018). The data collection process consisted of three stages: a pre-test to evaluate baseline problem-solving abilities, an intervention during which the experimental group was taught using the XPLORAMATH Game Board while the control group utilized conventional teaching approaches, and a post-test to assess learning results following the intervention. Test scores were used to gather quantitative data, while qualitative observations were recorded to enhance the understanding of learner engagement

2.2 Data Sources

The study utilized both primary and secondary data sources to provide a comprehensive understanding of the effectiveness of the XPLORAMATH Game Board in improving mathematical problem-solving skills among Grade 6 learners. The primary data were obtained directly from the 38 learner-participants through pre-tests and post-tests, which were designed to assess their mathematical word problem-solving skills before and after the intervention. Additional primary data were collected through classroom observations, researcher field notes, and informal learner feedback during the implementation period, which helped capture qualitative aspects such as engagement, motivation, and participation. The secondary data included relevant literature, previous research studies, and curriculum standards which provided contextual background and theoretical grounding for the intervention. These sources helped inform the design of the instructional materials and guided the interpretation of results. Secondary references included published studies on gamification in education (e.g., Dichev & Dicheva, 2017; Zainuddin et al., 2020), mathematical pedagogy (Boaler, 2016), and educational technology tools such as Jamovi for data analysis (Love et al., 2019; Fox, 2020). Together, these data sources supported a robust and evidence-based evaluation of the intervention's impact.

2.3 Research Procedure

The study was conducted using a quasi-experimental design to evaluate the effectiveness of the XPLORAMATH Game Board on the mathematical word problem-solving skills of Grade 6 learners. The researchers began by identifying 38 participants from Section Cobalt of Emilio S. Boro Central School. These learners were divided equally into two groups: the experimental group and the control group. Stratified random sampling was employed to ensure that both groups were balanced based on prior academic performance and learner characteristics. Before the intervention, consent letters were distributed to parents and guardians, and approval from school officials was secured. The researchers also prepared and validated the research instruments, including the pre-test and post-test, which were aligned with the learning competencies for problem-solving in the elementary mathematics curriculum.

During the first phase, a pre-test was administered to both the experimental and control groups to establish a baseline of their mathematical word problem-solving skills. This was followed by the intervention phase, which lasted four weeks. The experimental group was introduced to the

XPLORAMATH Game Board, a gamified instructional tool designed to make learning mathematics more engaging. The game incorporated educational challenges within a simulated 3D travel map of Masbate, combining mathematics and local tourism themes. Meanwhile, the control group received conventional instruction through lectures and workbook exercises without the integration of any gamified elements. To maintain instructional consistency, the same teacher facilitated both groups.

Following the intervention phase, both groups were given a post-test that was identical in format to the pre-test. The researchers subsequently gathered and encoded the findings for examination. Data were analyzed with Jamovi, a statistical program designed for educational research. Paired sample t-tests were utilized to analyze the intra-group differences between pre-test and post-test scores, whereas independent sample t-tests were performed to examine any notable differences between the experimental and control groups. Classroom observations and anecdotal notes were examined as well to enhance the quantitative results with perspectives on student involvement and conduct during the intervention. These methods guaranteed a structured and reliable examination of the effects of the XPLORAMATH Game Board.

Results and Discussion

3.1 Comparison of Pre-Test Results Between Control and Experimental Groups

The comparison of the pre-test results of Grade 6–Cobalt learners between the control and experimental groups indicated no statistically significant difference ($p = 0.530$). This result suggested that both groups had equivalent levels of mathematical word problem-solving skills prior to the implementation of the intervention. Establishing equivalence at baseline is critical in quasi-experimental designs to ensure internal validity and eliminate potential confounding variables (Fraenkel et al., 2019). The absence of a significant difference confirmed that any changes observed in the post-test scores could be reasonably attributed to the intervention itself, rather than to pre-existing discrepancies.

This finding held meaningful implications for teaching and learning. A pre-assessment provided teachers with baseline data to better understand students' prior knowledge and design instruction accordingly. As Slavin (2002) emphasized, comparable starting points between groups allow educators to evaluate the true effectiveness of new teaching strategies. It also reinforced the importance of diagnostic assessments in guiding instruction and measuring progress. In practice, this affirmed that pre-tests are not merely assessment tools but foundational to evidence-based pedagogy.

From a reflective perspective, the result highlighted the importance of beginning any instructional intervention with an understanding of learners' initial abilities. Black and Wiliam (2009) noted that formative assessment provides a basis for improving student learning by identifying where learners are in their development and what strategies would support them most effectively. As such, pre-testing served both research and instructional purposes, enabling teachers to plan targeted interventions and measure their impact objectively.

Table 1
Mean Score of Control & Experimental in Pretest

Control & Experimental Groups	N	Stat	df	P-value	Interpretation
Pretest-pretest	**19**	**0.641**	**18.0**	**0.530**	**Statistically not significant**

3.2 Problem-Solving Skill Level Before and After the Intervention

After the intervention was implemented, both the control and experimental groups showed statistically significant advancements from pre-test to post-test. Table 2 demonstrates that both the control group ($t = -13.0$, $p < 0.001$) and the experimental group ($t = -17.7$, $p < 0.001$) exhibited improvements. Nevertheless, the elevated test statistic in the experimental group indicated a greater enhancement, suggesting that the XPLORAMATH Game Board was superior to conventional teaching methods in boosting problem-solving abilities.

This discovery highlighted the impact of instructional quality on learning results. Rosenshine (2012) claimed that both conventional and novel approaches can result in effective learning when applied properly. Although conventional teaching was advantageous, the more significant improvements observed in the experimental group corresponded with research endorsing the impact of interactive and game-based learning on enhancing student involvement and comprehension (Gee, 2017). Game-based resources such as XPLORAMATH engage students in building knowledge through exploration, thus enhancing the significance of mathematical learning.

For teaching and learning, this result emphasized the potential of integrating game-based methods into the curriculum. Means et al. (2013) highlighted how technology-enhanced learning strategies, when aligned with learning goals, can significantly improve educational outcomes. Teachers might be inspired to diversify their teaching methods by including interactive and learner-centered strategies that not only complement traditional instruction but also boost student motivation and performance. Reflection on these results encouraged educators to find a balance between conventional and innovative practices to maximize learning for all students.

Table 2
Pre-Test and Post-Test Results for Control and Experimental Groups

Group	N	t	df	p-value	Interpretation
Control	**19**	**-13.0**	**18**	**<0.001**	**Statistically significant**
Experimental	**19**	**-17.7**	**18**	**<0.001**	**Statistically significant**

3.3 Post-Test Comparison Between Control and Experimental Groups

Table 3 displayed the comparison of post-test results between the control and experimental groups. The findings revealed a statistically significant distinction ($t = -13.0$, $p < 0.001$), suggesting that the participants in the experimental group instructed via the XPLORAMATH Game Board surpassed those in the control group undergoing conventional teaching methods. The significant difference verified that the intervention resulted in greater advancements in mathematical problem-solving abilities. This finding was backed by studies on the success of focused interventions. For instance, Hattie (2009) recognized feedback, engagement, and interactive teaching as factors with significant effect sizes in enhancing academic achievement. Game-based learning, as a component of a structured approach, included these aspects and led to improved success. In a similar vein, Kulik and Fletcher (2016) found that computer-based learning, such as educational games, was associated with improved learning results when applied thoughtfully and suitably.

In reality, the results indicated that well-organized and purposeful interventions such as XPLORAMATH can enhance learning more efficiently than conventional techniques by themselves. Teachers are urged to investigate teaching designs that are flexible, focused on students, and guided by data. Upon reviewing the implementation, the effectiveness of the intervention was linked to its connection with wider educational objectives, customized teaching, and timely execution. Darling-Hammond et al. (2020) highlighted the importance of making instructional choices based on evidence that cater to student requirements, underscoring the significance of reflective teaching methods in creating and implementing effective interventions Beyond the statistical significance, the meaningful difference between the two groups pointed to the pedagogical advantages of game-based learning environments in fostering higher-order thinking skills. Mathematical word problems require learners not only to perform calculations but also to comprehend, analyze, and apply mathematical reasoning in real-life contexts. The interactive features of the XPLORAMATH Game Board likely enhanced cognitive engagement by allowing learners to visualize problems, manipulate variables, and receive immediate feedback—factors known to support metacognitive development (Boekaerts, 2016). By encouraging active participation and collaboration, the intervention nurtured both the cognitive and affective domains of learning.

Moreover, the XPLORAMATH Game Board addressed diverse learning needs by providing differentiated challenges and multi-sensory approaches, which may have particularly benefited learners with varied proficiency levels. Studies have shown that game-based platforms create inclusive learning environments where students feel safe to take risks, make mistakes, and learn at their own pace (Plass et al., 2015). This approach contrasts with traditional instruction, which can sometimes be rigid and less responsive to individual learner differences. Thus, the stronger performance of the experimental group could be attributed not only to increased motivation but also to a more responsive and supportive learning context.

Finally, the effectiveness of the intervention demonstrated the potential of educational innovation in foundational subjects like mathematics. The use of a game board contextualized learning in a way that was both educational and enjoyable, potentially shifting students' attitudes toward mathematics from anxiety to curiosity. As emphasized by Bragg (2012), integrating games in mathematics can demystify complex concepts and promote positive emotional experiences, which are crucial for sustained academic engagement. The success of the XPLORAMATH Game Board, therefore, reaffirmed the role of instructional creativity and research-based strategies in enhancing not just performance, but the overall learning experience.

Table 3
Post-Test Comparison Between Control and Experimental Groups

Group	N	t	df	p-value	Interpretation
Post-test (C vs. E)	**19**	**-13.0**	**18**	**<0.001**	**Statistically significant**

4. Conclusion

This research aimed to improve the mathematical word problem-solving skills of Grade 6 students at Emilio S. Boro Central School by utilizing the XPLORAMATH Game Board. The results of the study clearly showed that the intervention was successful. Students in the experimental group, instructed through the game-based method, exhibited considerably greater improvements in their post-test scores than those in the control group who were taught through traditional teaching methods. This result confirmed that the XPLORAMATH Game Board positively influenced students' mathematical problem-solving abilities.

The analysis of pre-test results showed no notable difference between the two groups at the study's start, indicating that both possessed comparable proficiency levels prior to the intervention. This established a solid basis for linking the noted advancements to the game-based teaching approach. Following the intervention, while both groups showed progress, the experimental group exceeded the control group significantly, highlighting the efficacy of the xploramath Game Board in improving learner results.

In addition to academic achievement, the use of the game board fostered increased engagement, motivation, and active involvement in learning tasks. The game's interactive and visual components assisted learners in comprehending and utilizing problem-solving techniques more effectively. Furthermore, the organized and student-focused design of the game fostered a more welcoming and adaptive learning atmosphere. In light of these results, teachers are advised to think about incorporating gamified resources like the XPLORAMATH Game Board into math teaching to enhance learning effectiveness, enjoyment, and relevance to students' requirements.

REFERENCES

1. Black, P., & Wiliam, D. (2009). Developing the theory of formative assessment. *Educational Assessment, Evaluation and Accountability, 21*(1), 5–31. https://doi.org/10.1007/s11092-008-9068-5
2. Boaler, J. (2016). *Mathematical mindsets: Unleashing students' potential through creative math, inspiring messages and innovative teaching*. Jossey-Bass.
3. Creswell, J. W., & Creswell, J. D. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches* (5th ed.). SAGE Publications.
4. Darling-Hammond, L., Flook, L., Cook-Harvey, C. M., Barron, B., & Osher, D. (2020). Implications for educational practice of the science of learning and development. *Applied Developmental Science, 24*(2), 97–140. https://doi.org/10.1080/10888691.2018.1537791
5. Dichev, C., & Dicheva, D. (2017). Gamifying education: What is known, what is believed, and what remains uncertain: A critical review. *International Journal of Educational Technology in Higher Education, 14*(1), 9. https://doi.org/10.1186/s41239-017-0042-5
6. Fox, J. (2020). *Applied regression analysis and generalized linear models* (4th ed.). SAGE Publications.
7. Fraenkel, J. R., Wallen, N. E., & Hyun, H. H. (2019). *How to design and evaluate research in education* (10th ed.). McGraw-Hill Education.
8. Gee, J. P. (2017). *What video games have to teach us about learning and literacy*. St. Martin's Griffin.
9. Hattie, J. (2009). *Visible learning: A synthesis of over 800 meta-analyses relating to achievement*. Routledge.
10. Kulik, J. A., & Fletcher, J. D. (2016). Effectiveness of intelligent tutoring systems: A meta-analytic review. *Review of Educational Research, 86*(1), 42–78. https://doi.org/10.3102/0034654315581420
11. Love, J., Selker, R., Marsman, M., Jamil, T., Dropmann, D., Verhagen, J., ... & Wagenmakers, E.-J. (2019). JASP: Graphical statistical software for common statistical designs. *Journal of Statistical Software, 88*(1), 1–17. https://doi.org/10.18637/jss.v088.i01
12. Means, B., Toyama, Y., Murphy, R., & Baki, M. (2013). The effectiveness of online and blended learning: A meta-analysis of the empirical literature. *Teachers College Record, 115*(3), 1–47. https://doi.org/10.1177/016146811311500307
13. OECD. (2018). *The future of education and skills: Education 2030*. OECD Publishing. https://www.oecd.org/education/2030/
14. Rosenshine, B. (2012). Principles of instruction: Research-based strategies that all teachers should know. *American Educator, 36*(1), 12–19. https://www.aft.org/sites/default/files/periodicals/Rosenshine.pdf
15. Slavin, R. E. (2002). Evidence-based education policies: Transforming educational practice and research. *Educational Researcher, 31*(7), 15–21. https://doi.org/10.3102/0013189X031007015
16. Zainuddin, Z., Chu, S. K. W., Shujahat, M., & Perera, C. J. (2020). The impact of gamification on learning and instruction: A systematic review of empirical evidence. *Educational Research Review, 30*, 100326. https://doi.org/10.1016/j.edurev.2020.100326