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Unveiling the Effects of Gamification on Math Learning: A Literature Review in the Philippine Context

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Abstract There is a dearth of research investigating the synthesis of the overall effects of gamification in mathematics education within the Philippine context. To address the gap, this systematic review of the literature was conducted. Out of the 256 articles gathered, 31 articles passed the criteria and were selected for review. Thematic analysis revealed that the effects of gamification were multifaceted in the Philippine setting. Positive outcomes include increased engagement and motivation, improved academic performance, and enhanced higher-order thinking skills. Several factors support the increase in student engagement and motivation including the provision of a competitive learning environment, the positive impact of collaboration, the use of rewards, and the role of interactive and immersive features in gamified interventions. Moreover, the improvement in the academic performance of students in math is supported by factors such as the integration of feedback mechanisms, gamifications' ability to meet students' diverse learning needs, and the important role of technology as an enabler of gamified interventions. However, studies conducted showed that there were limited effects, particularly on students' attitudes, anxiety, and self-efficacy toward the subject. The researchers recommend to study further the gaps found through this review.

Keywords: *Effects, Gamification, Literature Review, Mathematics Education, Mathematics Learning*

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1. Introduction

Mathematics presents an enduring challenge for Filipinos. This is evident in the poor performance results of Filipino learners in mathematics assessments both at national and international levels including the National Achievement Test, Programme for International Student Assessment, and Trends in International Mathematics and Science Survey as emphasized by previous studies [1,4,8,9] [14,16,17,21] [23,26,34,35]. For instance, the 2018 PISA results revealed that the Philippines ranked lowest in mathematics among the 79 participating countries after obtaining a mean score of 353 which is below the average score of 489 [34]. Similarly, the TIMSS findings in 2019 revealed that the Philippines performed worse than all other participating countries in mathematics and science assessments posting a score of 297 [35]. Furthermore, the learning challenges in mathematics have even intensified because of the onset of the last pandemic. This problem caused schools to shift abruptly to remote learning modalities from traditional face-to-face instruction in the Philippines [6,16,17,18,19,21,23,24]. These problems in general, highlight the need to search for innovative approaches to motivate learners and improve their performance in mathematics.

Gamification, defined as the integration of game elements in a non-game context, offers great potential to address the well-known difficulties that Filipino learners face in learning mathematics [5,16]. Gamification integrates elements such as badges, points, and leaderboards into non-game contexts to motivate learners provided by a game environment [22]. It has become popular over the years and is widely used in different areas [21]. This approach resonates well with high school students globally including in the Philippines [34]. Studies underscored the multifaceted effects of gamification on students' learning by providing engaging learning experiences and enhancing their understanding of math concepts [10,32]. It also works in conjunction with technology. Through gamified applications, students perform learning by doing which is effective in promoting participation and improving learning outcomes [10].

In the Philippine educational context, the impact of gamification on learning mathematics has been investigated by a body of research [1-31]. However, some gaps were noted. Firstly, they primarily focus on variables such as performance [1,2,4,5,6,7] [9,10,13,14] [15,16,17,19,20] [21,22,25,26,30,31] and engagement and motivation [1,2] [5-12] [16,21,22] [25,26,30,31] but less on higher-order thinking skills [2,3,6,11,15,21], attitudes [1], anxiety [9], and self-efficacy [7] toward the subject. Secondly, the majority of studies focus on high school students [1,2,4,6,7,8,9] [11,12,13,14,15,16,17] [21,25,26,27,29], while elementary [5]

[19,20,22,23,24,27,28,29], college [3,8,10,18,31], and even preschool [30] learners are relatively limited. Moreover, the varied methodologies utilized in these studies highlight the complexity of the research landscape, with quantitative [1,2,3,4,5,6,8,9] [11,15,16,18,19,21,26], qualitative [12,14,31], and mixed-method approaches [7,17,25], as well as research and development initiatives [10,13,20,22] [23,24] [27,28,29,30], contributing to our understanding of the topic. Although these studies offer valuable insights regarding the effects of gamification on learning mathematics, none have provided a synthesis of its overall effectiveness within the Philippine landscape. Synthesizing findings from existing literature would provide a holistic understanding of its effectiveness and implications in the Philippine setting. Therefore, conducting a systematic literature review is crucial.

To address the gap, this systematic review on gamification focusing on math education within the Philippine educational context is conducted. Specifically, this research seeks to answer the main research question: What are the effects of gamification on learning math in the context of Philippine education? This research seeks to identify specific gaps and limitations in existing studies. They can serve as the foundation for future empirical studies and pedagogical intervention to promote Philippine mathematics education through the strategic implementation of gamification strategies. This study also aimed to provide insights into the development of effective teaching strategies utilizing gamification supportive of the preferences and needs of Filipino learners.

2. Methodology

This systematic review follows the process introduced by Paré & Kitsiou [32]. The steps include formulation of research questions and objectives, searching for existing literature, screening for inclusion, assessing the quality of primary studies, extraction of data, and analysis of data.

After the finalization of the research question and objective, the researchers began searching relevant articles in Google Scholar using specific terms such as "Gamification" AND "Math" AND "Philippines" AND "Effects".

The inclusion criteria include studies about gamification in mathematics education conducted in the Philippine setting. These include studies that investigated its effects on students' learning of mathematics. These include experimental studies, quasi-experimental studies, qualitative research, and mixed-method studies. Academic articles written in English between 2015 and 2024 were the ones chosen in the study. This is to ensure that the most recent developments and trends in gamification are captured and to identify research gaps and limitations as a basis for future studies. Studies involving the development and implementation of gamified materials like mobile applications for learning mathematics were also selected as long as these materials receive feedback from the students or teachers after initial utilization.

In terms of the exclusion criteria, studies conducted outside the Philippines, including those conducted before 2015, and those that do not focus on gamification are excluded from the study. Literature reviews about gamification conducted by Filipino researchers but with supporting data outside the Philippine context in terms of the effects of gamification were also excluded from the study. Moreover, studies that do not report user responses or feedback on the gamified materials as well as those that do not provide empirical evidence regarding the effectiveness of gamification in learning mathematics are also considered irrelevant in the context of the study and, thus need to be excluded. These include theoretical papers and research proposals.

The researchers thoroughly examined the quality of the selected studies by reading critically the whole paper to identify if they offer valuable information for understanding the research question of the review. Out of the 256 articles gathered, 31 articles passed the criteria and were selected for review. After this, the researchers proceeded with data extraction. This is done by getting phrases or quotes from each study that highlight the effects of gamification in math education within the Philippines. Furthermore, a matrix was also created to guide the data extraction. The researchers reviewed the matrix several times to ensure consistency and accuracy.

After data extraction, the researchers continued with the analysis. Extracted qualitative data was analyzed through a thematic analysis by Braun and Clarke [33].

3. Findings and Discussion

The review was conducted to determine the effects of gamification on Mathematics learning within the Philippine context. Thematic analysis revealed four major themes including 1) increased engagement and motivation, 2) improved academic performance, 3) potential for enhancing higher-order thinking skills, and 4) limited effects on students' attitudes, anxiety, and self-efficacy toward the subject.

3.1. Increased Engagement and Motivation

Fifty-five percent (55%) of the reviewed studies highlight the potential for gamification to provide increased levels of engagement and motivation among students exposed to the intervention. This finding is supported by several factors which also emerged from the analysis including the provision of a competitive learning environment [1,2,5,6,22,25,31], the positive impact of collaboration [8,11,12,31], the use of rewards [5,7,8,9,12] [16,26,30,31], and the role of interactive and immersive features [10,21,22,26,30,31] in gamified interventions.

Gamification usually provides a competitive learning environment where students either compete with their classmates or compete within themselves facilitating their engagement and motivation in the activities [1,2,5,6,22,25,31]. This is possible through the effective use of gamification elements. For example, the use of points, badges, and leaderboards during the discussion promoted healthy competition among students [1,2,25]. Without healthy competition, activities are lonely and pretty boring [5]. Friendly competition can motivate students to excel and improve their performance through active participation and learn more effectively from their mistakes [22,31]. It also allows students to eagerly

participate in the activities to acquire more points and be on top of the rankings [2]. This only shows that a competitive learning environment in gamified intervention is helpful for learners to be actively engaged and motivated in the lesson.

Gamification normally incorporates features of collaboration that help engage and motivate students [8,11,12,31]. In one study, collaboration is valued more than earning points [12]. Collaboration encouraged students to work together towards common goals such as finishing the task ahead of time and receiving high points in return [8,11]. This collaborative aspect fosters a sense of community among students and enhances their understanding of mathematical concepts [31]. Moreover, students were engaged and confidently showed their answers in every mathematical problem activity knowing that they finished the work as a group combining the knowledge of one another [11]. This shows that collaboration in gamified intervention can be beneficial in engaging and motivating students.

The use of rewards in gamified interventions also played an important role in engaging and motivating the students as emphasized by existing studies [5,7,8,9,12] [16,26,30,31]. Rewards can help students get away from boredom feeling [26]. It can provide a sense of enjoyment among students while performing activities because they have something to look forward to [7]. It can also promote learning, exploration, and creativity [30]. By offering rewards in a gamified intervention such as advancing students to higher levels of the game, earning additional points in the final examination, or providing tangible incentives such as candies and chocolates after accomplishing a task, gamification provides a dynamic environment where students are driven to actively participate in the activities [5,8,12]. This highlights the importance of rewards in gamified intervention to keep students engaged and motivated in the lessons.

Gamified applications offer an interactive and immersive feature that may significantly contribute to students' engagement and motivation in the lesson [10,21,22,26,30,31]. These features facilitate learning by doing and improve students' mind-setting purposes as they respond to all the problems for each level [10]. The hands-on approach facilitates active learning, prompting students to explore and apply concepts actively [26]. They provide immersive learning experiences to students in an enjoyable and fun way making learning more engaging and motivating [21]. This highlights their potential to catch students' attention more effectively toward the lesson [22]. This only shows that interactive and immersive features of gamified applications developed for mathematics help engage and motivate students.

The findings suggest that gamification may help increase Filipino students' engagement and motivation in learning mathematics supported by several factors. Reviewed studies also emphasized that by enhancing motivation and engagement in the lesson, gamification helps facilitate comprehension of math concepts much easier, enhances students' retention of the lesson, and promotes enjoyment of learning activities [1,21,25]. Students also demonstrate immense commitment and perseverance to understand math lessons with the help of gamification [1]. These can help establish a growth mindset which is essential in every academic undertaking. Moreover, students have also increased their aptitude for risk-taking and assume accountability for their learning [11]. This helps develop self-confidence and dedication which are essential to succeed in problem-solving activities. This only shows that by enhancing motivation and engagement, students are more likely to invest quality time and effort to master math concepts and persist in their studies.

However, despite its huge potential, there is also a risk that gamification may lead to distractions or disruptions in the classroom if not implemented effectively [8]. It has the potential to divert students' learning focus as they rely more on the rewards they could receive. Teachers therefore need to regularly inform students that rewards are used as tools to reinforce learning but not to depend so much on them. They should also provide constructive feedback to redirect students' attention to learning goals. Moreover, gamification may also demote students' attitudes, especially for those who performed consistently below their classmates. This highlights the importance of regular monitoring of students' behavior while implementing gamified interventions and providing necessary support and encouragement accordingly.

3.2. Improved Academic Performance

Sixty-eight percent (68%) of the reviewed studies have demonstrated the effectiveness of gamification in improving students' academic performance in mathematics. This finding is supported by factors that also emerged from the analysis including the integration of feedback mechanisms playing a pivotal role in every gamified intervention [22,25,26,30], the ability of a gamified intervention to be made adaptable to meet students' diverse learning needs [2,10,13,15,22,30], and the important role of technology as an enabler of gamified interventions [1,2,5,7,9] [10,13,14,16] [19,20,21] [22,26,30,31].

Students who participate in gamified interventions normally receive feedback as they progress through tasks or solve problems. In the reviewed research articles, feedback refers to the information provided to players regarding their performance, progress, and actions within a gamified intervention. By providing real-time prompts, feedback allowed students to identify and correct their own mistakes helping them improve their comprehension of mathematical ideas [22,25,26,30]. Feedback reduces misconceptions and reinforces correct concepts, which improves learning outcomes [26,30]. It also promotes preschoolers' cognitive abilities in mathematics [30]. This suggests that feedback plays a pivotal role in gamified intervention to improve students' performance in mathematics.

Gamification can also be used to provide individualized learning experiences responsive to the diverse learning needs and abilities of students [2,10,13,15,22,30]. Providing tailored learning experiences is essential for meeting the special needs of exceptional learners, particularly those who are mute or deaf [22]. With the use of feedback, educators effectively identified the individual student's weaknesses and provided appropriate instruction for meeting the needs of these students. As a result, exceptional learners increased their class attendance and participation which led to the improvement of their

academic performance. Similarly, gamification was also effective in enhancing performance in arithmetic regardless of the students' varied proficiency levels in the topic [13]. This only shows the breadth of applicability of gamification in mathematics education. Furthermore, gamified applications developed for mathematics also have customization option which enables students to tailor the activities set to their skill level or preferences [28,30]. This personalized approach allows students to receive instruction and activities at the appropriate level of difficulty which promotes cognitive engagement [15]. Students with high levels of cognitive engagement demonstrate immense commitment and perseverance to understand lessons which are associated with improved performance [1,15]. This only shows the great potential of the gamified intervention to be made adaptable to meet student's diverse learning needs with promising outcomes for improving their performance.

Studies reviewed also emphasized the critical role that technology plays in enabling gamified interventions [1,2,5,7,9,10] [13,14,16,19] [20,21,22] [26,30,31]. Students' attention can be captured and encouraged to actively participate in learning activities through the use of technology, which can offer immersive and interactive gamified experiences [10,21,22,26,30,31]. Technology assists students in exploring abstract mathematical concepts more effectively which is crucial in understanding the lesson and in improving performance in the subject. Research also suggests that technology aids in solidifying the understanding of quadratic equations and functions [26]. By seamlessly integrating gamification elements with technology, educators can effectively align instructional objectives with the dynamic needs of students [2,10]. This finds relevance, especially during the pandemic when face-to-face instructions became prohibited and students needed intervention to learn math concepts meaningfully amidst the new learning setup. During these times, teachers utilized various technologies like online gamified applications to facilitate the teaching and learning process more effectively which resulted in notable improvements in the student's performance in mathematics [1,2,16,19,21,31]. Thus, technology serves as a powerful enabler in harnessing the potential of gamified interventions to enhance the learning outcomes of students.

The collective findings of the different research presented simply suggest the effectiveness of gamification in improving Filipino students' performance in mathematics. This finding is expected among Filipinos who are considered innately playful [8]. This makes them attracted to gamification which can help them learn concepts entertainingly [7]. However, it is also important to acknowledge some limitations being found. Accordingly, while gamification can be a valuable instructional strategy, this may not apply to all topics that require deep theoretical understanding [8]. This is because many of the abstract math concepts like those in calculus subjects and advanced mathematics involve complex relationships and structures that are hard to gamify. Simplifying these concepts through gamification may compromise the rigorousness of the math concepts involved. This can limit a deeper understanding of the lesson since complex details are missed in the gamified intervention. Moreover, abstract concepts are also not tangible making it hard to provide concrete representations. It will be challenging to translate abstract concepts through game mechanics where students can relate and play. Given this, the researchers recommend exploring synergizing gamification with other interventions like simulation so that students not only explore abstract mathematical concepts through simulation but also benefit from the fun learning experience through gamification. Further research should explore if this synergy is effective, particularly in teaching and learning abstract mathematical concepts.

It is also important to recognize that the effects of gamification on student learning outcomes can vary depending on the context and the specific characteristics of the learners involved [3,7]. This suggests that the implementation of gamified intervention should consider the needs and characteristics of the target audience to make it effective [6]. Future research should explore how contextual factors, not limited to the type of learners, impact the design and effectiveness of gamified interventions. Comparative studies can be conducted across different contexts to help identify best practices for adapting gamification strategies to diverse educational settings.

Furthermore, it is also observed that the developed gamified applications for mathematics found in previous studies [23,24,27,28,29] still lack empirical data supporting their effectiveness in the classroom. These studies initially focused on the design and validation of the applications involved whose classroom implementation is scheduled in the next phase of the study. Although the results of the initial utilization unveiled that students and teachers were satisfied with their overall features, investigating their effectiveness would provide a solid basis for classroom implementation. Therefore, the researchers recommend conducting future empirical research to establish the effectiveness of these applications in enhancing students' performance in mathematics.

3.3. Potential for Enhancing Higher-Order Thinking Skills

Nineteen percent (19%) of the reviewed studies explored the potential of gamification in enhancing higher-order thinking skills of students especially problem-solving [2,3,11,21] and creativity [6,15] in mathematics. While some research highlights positive effects, others yield contrasting results in this area.

Reviewed studies have revealed the potential of gamification to enhance the problem-solving abilities of students [2,11,21]. For instance, the collective use of gamification elements such as immediate feedback, points, time pressure, competition, and collaboration led to the improvement of all aspects of problem-solving skills such as understanding, planning, solving, and looking back at the problem result [11]. Similarly, gamification with extended reality technology can also help develop students' deductive, inductive, and analysis which are all relevant to problem-solving [21]. On the other hand, one study suggests that gamified interventions are not universally effective in promoting the mathematics problem-solving skills of students [3]. This result however is potentially affected by the limitation observed in the study. The study utilized non-routine problems whose nature requires

critical analysis and creative thinking. The difficulty level of these problems could exceed the students' cognitive abilities which resulted in low performance. Another notable limitation is the lack of a control group in the study which limits the ability to provide robust findings and generalization.

Furthermore, some studies demonstrated the potential of gamification in enhancing students' creativity in mathematics geared toward improved mathematical competence and performance [6,15]. In a physical setting, promoting creativity in mathematics can be aided by collaboration and feedback mechanisms. Collaboration enables students to share different ideas and think together about possible solutions. In addition, collective efforts due to these collaborations supported by effective feedback mechanisms make students go through cycles of discovering and verifying solutions, which could lead to more meaningful or novel solutions to mathematical problems. This makes gamification in face-to-face learning modality more capable of fostering students' creativity than modular learning modality [15]. This claim finds support in another study that reported gamified intervention as an effective strategy in promoting students' creativity, which is crucial for answering open-ended mathematical problem-solving activities integrated with the curriculum [6].

Therefore, the influence of gamification on students' problem-solving skills in math appeared to have a mixture of results in the Philippine context. Others suggest a positive effect [2,11,21], while one study found no improvements at all [3]. This indicates an ongoing debate in the literature regarding the effectiveness of gamification in enhancing students' problem-solving skills in mathematics which are affected by potential factors such as the types of students and the nature of the gamified intervention. Therefore, mathematics teachers should get to know their students well so that they may choose and use the best teaching technique and method for them [3,6]. Gamified intervention should provide an interactive and rewarding learning environment and should ensure alignment with the learning objectives and student needs [11,21]. Moreover, teachers should also regularly evaluate the effectiveness of the gamified intervention through student feedback, assessment results, and other metrics [11]. Changes and adjustments should be made as necessary to improve the learning experience.

Moreover, the potential of gamification in enhancing HOTS also extends to students' creativity in mathematics. This can be facilitated through the use of collaboration and feedback mechanisms. However, both findings may not fully capture the broader landscape of gamification research in mathematics education since its focus is primarily within the Philippine context. It is also notable that there are very limited studies involving gamification and higher-order thinking skills in mathematics. Therefore, the researchers recommend conducting empirical studies across different cultures to assess the generalizability of findings beyond the Philippine context. Future research should also explore and identify the gamification elements that provide tailored support for improving students' problem-solving skills in mathematics involving non-routine problems as well as enhancing creativity in mathematics.

3.4. Limited Effects on Attitudes, Anxiety, and Self-efficacy Toward Mathematics

Ten percent (10%) of the studies reviewed explored the potential of gamification on students' attitudes, anxiety, and self-efficacy toward mathematics during the pandemic. However, results revealed that gamification has limited effects on these areas [1,7,9].

Even though gamification may be effective in engaging and motivating students, it is not capable of strengthening students' self-efficacy and attitudes toward mathematics [1,7]. Besides, it is also unable to diminish significantly the anxiety levels of participants on the subject [9]. This indicates that self-efficacy, attitudes, and the anxiety of the students are influenced by some other factors besides gamification. One of these factors is the remote learning modality [1,7,9].

The sudden shift from face-to-face set-up to remote learning modality put an extra burden on students as they needed to make huge adjustments to continue learning. Learning at home is different from learning at school in many ways which potentially impacts their attitude toward learning [1]. During online learning, students encountered technological-related issues like poor internet connectivity, navigation issues, and affected data storage while on the exams [16,24]. Moreover, socially inclined students are also affected by the sudden feelings of isolation due to remote learning [5,21]. Students were also reported with high levels of anxiety during remote learning. They worry if they fail to meet the expectations of their parents who are closely monitoring their work [9]. Other students were more anxious especially when they encountered difficulties in their math lessons. This only shows that remote learning modality can cause frustrations and stress among learners making it hard for gamification to influence positively their attitudes and anxieties toward math.

Moreover, students' self-efficacy towards mathematics was also negatively affected due to remote learning. This is not surprising anymore since in the first place students' attitudes and anxieties towards the subject are negatively affected by the new learning setup. Both of these can influence students' perceptions of their capabilities and impact their self-efficacy levels. Moreover, self-efficacy toward mathematics also takes time to develop as it is affected by several factors including enough experience and practice. However, another limitation observed was the short duration of the study making it difficult to influence positively students' self-efficacy in math [7]. This provides further support for the findings on self-efficacy.

In conclusion, findings revealed that gamification has limited effects on students' attitudes, anxiety, and self-efficacy levels in the Philippine educational context. This finding warrants further investigation since it is observable that there are only very few studies conducted in these areas. It is also essential to explore the gamification elements suitable for online learning in enhancing students' attitudes, anxiety, and self-efficacy toward mathematics. Further research may explore the long-term effects of gamification and determine the effectiveness of tailoring gamification elements suited for improving students' attitudes, anxiety, and self-efficacy not only for online learning but also in face-to-face setups.

4. Conclusions and Recommendations

This systematic review investigated the effects of gamification in mathematics education in the Philippines. Results revealed that the effects of gamification on mathematics learning were generally positive in the Philippine context. Many studies reported an increase in students' engagement, motivation, academic performance, and higher-order thinking skills after the implementation of gamified interventions in their classes.

Several factors support the increase in student engagement and motivation including the provision of a competitive learning environment, the positive impact of collaboration, the use of rewards, and the role of interactive and immersive features in gamified interventions. Moreover, the improvements in the academic performance of students are supported by factors such as the integration of effective feedback mechanisms, the ability of a gamified intervention to be made adaptable to meet students' diverse learning needs, and the important role of technology as an enabler of gamified interventions.

However, it is also important to note that the effects of gamification were not universally positive in the country. Some studies reported limited effects of gamification on student attitudes, self-efficacy, and anxiety toward mathematics. Besides, other studies presented mixed results on the effects of gamification on problem-solving skills. These results are affected by several factors including the design of gamified activities, student learning needs and preferences, short duration of the intervention, and learning modality and context that were observed limitations in the reviewed studies.

The researchers recommend conducting teacher training and professional development to effectively implement gamification in mathematics education. Moreover, the synthesis of the existing literature allowed the researchers to identify specific gaps and limitations about the effectiveness of gamification in mathematics education in the Philippines. It is recommended to study further the gaps found through this review. Additionally, future research may include the type of motivation whether intrinsic or extrinsic, and also criterion measure of metacognitive ability in future gaming intervention. Understanding these can help educators design gamified learning activities that maximize student motivation and improve learning outcomes.

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References

[1] Antonio, J. M. A., & Tamban, V. E. (2022). Effectiveness of gamification on Learner's performance and attitude towards mathematics amidst the COVID-19 pandemic. United International Journal for Research & Technology, 3(3), 91-100. https://uijrt.com/articles/v3/i3/UIJRTV3I30013.pdf.

[2] Medico, J. O., Nepangue, D. S., & Derasin, L. M. C. (2023). THE IMPACT OF DIGITAL GAMIFICATION AND TRADITIONAL BASED LEARNING ON STUDENTS' MATHEMATICS ACHIEVEMENT: EVIDENCE FROM THE PHILIPPINES. Journal of Data Acquisition and Processing, 38(4), 2108.

[3] EJ, A. L. (2021). Math Class Gamified! Effects on the Mathematics Performance of COED Students of Eastern Samar State University, Philippines. Indian Journal of Science and Technology, 14(23), 1970-1974.

[4] Sotto, N. A. B., Geroso, M. J. S., Hofileña, H. S., Geroso, P. J. M. S., & Maguate, G. S. (2023). GAMES: Gamification and Mathematics Education Synergy. International Journal of Applied, 13(2).

[5] Pelegro, R. (2022). Gamification in Online Education. Available at SSRN 4054977.

[6] Molano, R. R. (2022). Development and validation of a gamification-based mathematics curriculum for senior high school. ASEAN Multidisciplinary Research Journal, 10, 63-92. https://paressu.org/online/index.php/aseanmrj/article/view/311.

[7] Magat, R. B. (2022). GAMIFIED MOBILE COURSEWARE'S EFFECT ON STUDENTS'COGNITIVE & NON-COGNITIVE ABILITIES: Received: 18th May 2022; Revised: 26th May 2022, 18th June 2022, 20th June 2022; Accepted: 24th June 2022. Docens Series in Education, 17-36.

[8] Lanuza, M. H. (2020). Integrative gamification technique in teaching specialization courses in mathematics. International Journal of Scientific and Technology Research, 9(4), 1275-1281.

[9] Sipin, K. Q., & Tan, D. A. COMPUTER-BASED GAMIFICATION STRATEGY ON STUDENTS' ACADEMIC PERFORMANCE AND ANXIETY IN MATHEMATICS.

[10] Garcia, J. M. S., & Sabay, R. L. (2020). GADIMATH: Gamified discrete mathematics. Philippine Social Science Journal, 3(2), 181-182.

[11] Corpuz-Sanchez, J. J., & Pasia, A. E. Gamified Learning Environment in Improving the Engagement and Mathematical Problem-Solving Ability of Grade 7 Students. https://etcor.org/storage/iJOINED/Vol.%20II(3),%20588-603.pdf.

[12] Lanuza, M. H., Mendoza, R. V., Bayan, R. J. R., Elipane, L., Dimaculangan, K. A. C., & Hilario, F. F. (2020). A gamification technique through the method of a lesson study in teaching probability. International Journal of Scientific and Technology Research, 9(4), 3734-3740.

[13] Lisondra, R. F., Jumawan, X. N. G., Anito, J. P. E., Abugan, G. R. B., Mira, R. J. T., & Patayon, U. B. (2023, November). eMATH: A Gamified Approach to Arithmetic Lessons. In 2023 International Conference on Innovation and Intelligence for Informatics, Computing, and Technologies (3ICT) (pp. 440-444). IEEE.

[14] Gillo, M. D. PERSPECTIVES OF TENTH GRADE LEARNERS ON GAMIFICATION AS TOOL FOR LEARNING PATTERNS AND ALGEBRA. https://ijehss.com/specialissue/EHS_5_sp6.pdf.

[15] Espartero, M. M., Calzada, K., & Prado, R. (2024). Analyzing the level of interest of high school students in solving mathematical problems in the modular and face-to-face learning. Environment and Social Psychology, 9(4). https:// esp.apacsci.com/index.php/esp/article/view/2167.

[16] U. Mandal, L., & T. Morados, P.J. (2023). Integration of Gamification in Teaching Measures of Position of Grade 10 – Mathematics. International Multidisciplinary Research Journal.

[17] Abuda, B. F., Balazo, G. F., & Rivera, K. D. (2021). Gamified track-based remote instruction: Its use and impact on mathematics competence. TARAN-AWAN Journal of Educational Research and Technology Management, 2(1), 25-34. https://orcid.org/0000-0001-8392-2550.

[18] Lanuza, M. H. (2021). A Gamified Module In The New Normal Classroom: A Randomized Block Research Design. Turkish Journal of Computer and Mathematics Education (TURCOMAT), 12(7), 986-999.

[19] De Leon, M. L. SCHOOLS DIVISION OFFICE OF NAVOTAS CITY.https://wawaes.depednavotas.ph/wpcontent/uploads/2023/05/De-Leon_Michelle_L.pdf.

[20] Yabut, E. R., Jamis, M. N., Manuel, R. E., & Fabito, B. S. (2019, November). Empowering elementary schools on learning math: a development of gamified educational mobile application for grade 3 students. In 2019 IEEE 11th International Conference on

Humanoid, Nanotechnology, Information Technology, Communication and Control, Environment, and Management (HNICEM) (pp. 1-5). IEEE.

[21] Aloya, B. F., Benzon, A. M., Felipe, R., Maglaya, P. G., Marcelo, R., Panergo, D. J, ... & Solis, C. (2024). XR Digital Classroom: An Innovative and Gamified Tool that Aims to Aid Learning in the New Normal. International Journal of Intelligent Systems and Applications in Engineering, 12(3s), 112-130. https:// www.ijisae.org/ index.php/ IJISAE/article/view/3668.

[22] Cruz, C. S. D., & Palaoag, T. D. (2019, March). An empirical study of gamified learning application engagement to exceptional learners. In Proceedings of the 8th International Conference on Informatics, Environment, Energy and Applications (pp. 263-267).

[23] Versoza, D. M., De Las Peñas, M. L. A. N., Sarmiento, J. F., Aberin, M. A. Q., Tolentino, M. A. C., & Loyola, M. L. (2021). Using Mobile Technology to Promote Higher-Order Thinking Skills in Elementary Mathematics. https:// archium.ateneo.edu/ mathematics-faculty-pubs/206/.

[24] Blancaflor, E. B., Camaongay, K. D. G., Chua, J. A. S., & Echanes, G. A. (2022). A Gamified Educational Learning Module for Core Subjects in an Elementary Level. International Journal of Information and Education Technology, 12(11).

[25] Deabanico, G., & Caballes, D. (2023). Revolutionizing Learning: How eGamification Assessment is Changing Teaching?. Psych Educ, 10, 1030-1034.

[26] Merle, R. S. (2024). Enhancing Proficiency in Quadratic Equations and Functions Through the MILAPlus Strategy. Journal of Contemporary Educational Research, 8(1), 221-232.

[27] Versoza, D. M., De Las Peñas, M. L. A. N., Aberin, M. A. Q., Garciano, A., Sarmiento, J. F., & Tolentino, M. A. C. (2021). Development of a Gamified Number Line App for Teaching Estimation and Number Sense in Grades 1 to 7.

[28] Versoza, D. M., De Las Peñas, M. L. A. N., Sarmiento, J. F., Tolentino, M. A. C., & Loyola, M. L. (2020). Development of a mobile ten frames app for Philippine K-12 schools. https:// archium.ateneo.edu/ mathematics-faculty-pubs/148/.

[29] De Las Peñas, M. L. A. N., Loyola, M. L., Sarmiento, J. F., Tolentino, M. A. C., & Versoza, D. M. (2020). Designing Mobile Apps to Promote Numeracy and Statistical Reasoning. https://archium.ateneo.edu/mathematics-faculty-pubs/151/.

[30] Gallera, J. M. Development and Evaluation of an Interactive Mobile Application Incorporating Gamification Technique for Enhancing Preschooler's Cognitive and Recreational Activities.

[31] SALANSAN, K. M., PALMERIA, Z. T., LEOP, S. M., MAE, R., BOYORO, D. M., & ROXAS, D. J. B. NEARPOD FOR MATHEMATICS: REALIZING FUNCTIONS AND RELATIONS BETWEEN SETS.

[32] Paré, G., & Kitsiou, S. (2017). Chapter 9: Methods for Literature Reviews. In F. Lau & C. Kuziemsky (Eds.), Handbook of eHealth Evaluation: An Evidence-based Approach [Internet].Victoria (BC): University of Victoria. https:// www.ncbi.nlm.nih.gov books/NBK481583/.

[33] Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. Qualitative research in psychology, 3(2), 77-101.

[34] CEDTyClea. (2021, January 31). Coronavirus pandemic highlights failures of Philippine education. BusinessWorld Online.

[35] Querido, D. V., Yazon, A. D., Manaig, K. A., Tamban, V. E., & Sapin, S. B. (2023). Effectiveness of Interactive Classroom Tool: A Quasi-Experiment in Assessing Students' Engagement and Performance in Mathematics 10 using ClassPoint. Applied Quantitative Analysis, 3(1), 79-92.