

Dynamics of Gamification in Tertiary Mathematics Education in the Philippines

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Abstract: Gamification has become a transformative educational approach, utilizing game design elements to enhance learning experiences and outcomes. This study employed a systematic review to examine gamification dynamics in tertiary mathematics education in the Philippines. Findings showed five (5) emerging themes on dynamics of gamification in tertiary mathematics education in the Philippines, namely; (1) Enhance Engagement and Motivation; (2) Improve Conceptual Understanding and Retention; (3) Promote Collaborative Learning; (4) Foster a Positive Attitude towards Mathematics; and (5) Adapt to Technological Advances and Accessibility. The study of gamification in tertiary mathematics education in the Philippines highlights its significant benefits in enhancing student engagement, motivation, understanding, retention, collaborative learning, and attitudes, transforming traditional challenges into interactive and enjoyable learning experiences that prepare students for future technological and professional challenges. To maximize the benefits of gamification in tertiary mathematics education in the Philippines, it is recommended that educators receive training, further research be conducted on long-term effects, institutions invest in accessible platforms, and collaboration between policymakers, educators, and developers be strengthened to promote widespread adoption.

Keywords—gamification; tertiary mathematics education; Philippines

1. INTRODUCTION

Gamification has emerged as a transformative educational approach, leveraging game design elements to enhance learning experiences and outcomes (Huang et al., 2020). In recent years, significant attention has been devoted to exploring its application across various educational contexts. However, the dynamics of gamification in tertiary mathematics education, particularly within the Philippines, remain underexplored (Mandal & Morados, 2023). This gap in the literature presents a compelling case for examining how gamification can be effectively implemented in higher education mathematics courses in the Philippines, a country with unique educational challenges and opportunities.

Firstly, while numerous studies have documented the positive impacts of gamification on student engagement and motivation, these investigations have predominantly focused on primary and secondary education or subjects other than mathematics (Buckley & Doyle, 2016). Tertiary education, with its distinct learning environment and more complex subject matter, poses different challenges that existing gamification strategies may not adequately address (Sabornido et al., 2022). There is a need for research that specifically targets the higher education sector to understand how gamification can be tailored to meet the needs of university students tackling advanced mathematical concepts (Melgar et al., 2021).

Moreover, the cultural context of the Philippines presents unique variables that may influence the effectiveness of gamification (Wu et al., 2022). The educational system in the Philippines is characterized by diverse socioeconomic backgrounds, varying levels of technological access, and

distinct cultural attitudes toward education and gaming (Lin, 2022). While some international studies provide insights into the general benefits of gamification, they often do not account for these local factors. Consequently, there is a significant gap in understanding how these cultural and contextual differences affect the implementation and outcomes of gamified learning in Philippine tertiary institutions (Kadri et al., 2011).

Another critical gap in the literature pertains to the longitudinal effects of gamification on learning outcomes in mathematics (Sailer & Homner, 2019). While short-term studies have shown improvements in engagement and immediate academic performance, there is limited research on the long-term retention of mathematical concepts and skills fostered through gamified learning (Petrovic-Dziedz, 2019). For tertiary students, who are preparing for professional careers that require robust and enduring mathematical proficiency, it is essential to evaluate whether gamification provides sustainable benefits throughout their academic and professional lives (Celis et al., 2023).

Additionally, there is a scarcity of empirical data on the practical challenges and best practices for integrating gamification into the curriculum of tertiary mathematics courses (Damaševičius & Sidekersniene, 2023). Educators often face hurdles such as limited resources, resistance to change, and the need for professional development to effectively utilize gamified teaching methods (Duggal, Gupta, & Singh, 2021). Comprehensive studies that explore these practical aspects are crucial for developing feasible and scalable gamification strategies that can be widely adopted in Philippine universities.

In summary, while the potential of gamification in enhancing educational experiences is widely recognized,

significant gaps remain in the literature concerning its application in tertiary mathematics education in the Philippines. These gaps include the need for context-specific research, understanding the long-term impacts, and addressing practical implementation challenges. Addressing these gaps will not only contribute to the academic discourse but also provide valuable insights for educators and policymakers aiming to improve mathematics education in the Philippines through innovative approaches.

2. METHODS

This study employed a systematic review (Strech & Sofaer, 2011) to examine gamification dynamics in tertiary mathematics education in the Philippines, using a comprehensive search strategy across various databases, academic journals, and books. The search focused on the terms "*Dynamics of Gamification in Tertiary Mathematics Education in the Philippines*" and prioritized peer-reviewed English publications from 2000-2024. An initial broad search yielded numerous articles, which were then screened by titles and abstracts, narrowing down to twenty-five (25) articles for detailed review.

This thorough analysis revealed common themes and patterns, providing a comprehensive understanding of gamification dynamics in Philippine tertiary mathematics education. The systematic approach integrated diverse research, offering valuable insights and effective strategies for fostering gamification in mathematics education, with identified themes aimed at informing future research, discussions, and strategic decisions.

3. RESULTS AND DISCUSSION

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Theme 1: Enhance Engagement and Motivation

Gamification in tertiary mathematics education significantly boosts student engagement and motivation (Luzano, 2024). Traditional mathematics instruction often faces challenges such as student disinterest and perceived irrelevance, which can lead to disengagement. By incorporating gamified elements like leaderboards, badges, and point systems, educators can transform the learning environment into an interactive and competitive space (Çakıroğlu, Ü., Basibüyük, B., Güler, M., Atabay, M., & Memiş, B. (2017). This shift not only makes learning more enjoyable but also encourages students to actively participate and strive for mastery of mathematical concepts (Plass et al., 2013). Studies have shown that when students are motivated by game mechanics, they are more likely to put in the effort required to solve complex problems and persist through challenging tasks (Nadolny, Nation, & Fox, 2019).

Moreover, gamification taps into intrinsic and extrinsic motivational factors (Mitchell, Schuster, & Jin, 2018). Intrinsically, students find joy in the gameplay itself and the satisfaction of overcoming challenges. Extrinsically, the

rewards and recognition associated with gamification can drive students to perform better. In the context of the Philippines, where educational resources may vary widely, gamification provides an accessible means to enhance learning without the need for expensive materials (Bai, Hew, & Huang, 2020). The competitive yet collaborative nature of gamified learning also fosters a sense of community and peer support, which is crucial in maintaining student interest and motivation in a subject as demanding as mathematics (Mahmud, Husnin, & Soh, 2020).

Theme 2: Improve Conceptual Understanding and Retention

Another significant theme is the improvement in student's conceptual understanding and retention of mathematical concepts through gamification (González-González et al., 2014). Traditional teaching methods often emphasize rote learning and procedural fluency, which may not effectively promote deep understanding (Romorosa et al., 2023). Gamification, however, encourages active learning and problem-solving, which are essential for grasping complex mathematical ideas (García-Iruela et al., 2020). For instance, incorporating puzzles and problem-based scenarios in a game format requires students to apply their knowledge, analyze situations, and derive solutions, thereby reinforcing their understanding.

Retention of mathematical concepts is also enhanced through the repetitive and incremental nature of gamified tasks (Petrovic-Dziedz, 2019). As students progress through levels or stages in a game, they repeatedly encounter and practice core concepts, which aids in transferring knowledge from short-term to long-term memory (Wang, Tan, & Teow, 2017). In the Philippine educational context, where students may face varying degrees of exposure to quality mathematics instruction, gamification can serve as an equalizer by providing consistent and engaging practice opportunities (Lanuza, 2020). This approach not only helps in solidifying foundational knowledge but also prepares students for more advanced mathematical challenges (Luzano & Ubalde, 2023).

Theme 3: Promote Collaborative Learning

Gamification in mathematics education promotes collaborative learning, which is crucial for developing critical thinking and problem-solving skills (Zainuddin, 2023). Many gamified educational platforms and activities are designed to be collaborative, requiring students to work in teams to achieve common goals (Aranzo et al., 2023; Casanova et al., 2023). This collaborative aspect mirrors real-world scenarios where teamwork and communication are essential. In mathematics education, group tasks and competitions foster a cooperative learning environment where students can share diverse problem-solving strategies and learn from each other's perspectives (Luzano & Ubalde, 2023).

The collaborative nature of gamification also helps in building a supportive learning community (Bilgin & Gul, 2019). In the Philippine context, where collectivist values are prevalent, leveraging collaboration in education aligns well

with cultural norms (Postholm, 2016). Students are more likely to engage deeply and persist in their studies when they feel a sense of belonging and mutual support (Nallada et al., 2024). Furthermore, collaborative gamified activities can bridge gaps between different levels of student ability, as stronger students can help peers, thereby reinforcing their understanding while assisting others (Jagušt, Botički, & So, 2018). This peer-to-peer interaction is invaluable in creating a dynamic and inclusive classroom environment.

Theme 4: Foster a Positive Attitude towards Mathematics

Gamification can significantly alter students' attitudes towards mathematics, transforming it from a subject often associated with anxiety and frustration to one viewed as enjoyable and approachable (Yildirim, 2017). Many students develop a negative attitude towards mathematics due to past failures or the perception that it is inherently difficult (Perales, 2019; Luzano, 2024). Gamified learning experiences, with their emphasis on fun and interactive elements, can help change these perceptions by presenting mathematics in a more positive light (Solekhah, Kutni, & Pamungkas, 2023). Success in game-based tasks can build confidence and reduce anxiety, making students more willing to engage with the subject (Luzano, 2023).

In the Philippines, where educational attitudes can be heavily influenced by cultural and societal factors, fostering a positive attitude towards mathematics is particularly important (Luzano et al., 2024). A gamified approach can help break down psychological barriers and encourage a growth mindset (Luzano, 2020). When students see that they can succeed in gamified tasks, they begin to believe in their ability to tackle traditional mathematical problems as well (Kovshova & Yarovaya, 2022). This shift in attitude can have long-lasting effects, influencing not just academic performance but also students' future career choices and their willingness to engage in lifelong learning (Díez-Palomar et al., 2020).

Theme 5: Adapt to Technological Advances and Accessibility

The integration of gamification in mathematics education aligns well with the increasing emphasis on technological literacy and accessibility (Elmawati, Martadiputra, & Samosir, 2023). With the rapid advancement of digital tools and resources, educators in the Philippines have the opportunity to leverage technology to enhance learning outcomes (Tortola, 2021; Pang-an et al., 2022). Gamified educational platforms are often designed to be user-friendly and accessible across various devices, making them suitable for a wide range of educational settings, including those with limited resources (Maher, Moussa, & Khalifa, 2020). This adaptability is crucial for addressing the diverse needs of students in different regions.

Furthermore, gamification prepares students for a technology-driven world by enhancing their digital literacy skills (Dehghanzadeh et al., 2019). As students engage with gamified learning tools, they become more proficient in navigating digital environments, which is an essential skill in

the modern workforce (Murillo-Zamorano et al., 2021). In the context of the Philippines, where there is a strong push towards integrating technology into education, gamification serves as a practical and effective method to achieve this goal (Subhash & Cudney, 2018). By familiarizing students with technology through engaging and educational games, educators can ensure that students are not only learning mathematics but also becoming adept at using technology in their daily lives (Chang et al., 2015).

4. CONCLUSION AND RECOMMENDATION

The study of gamification in tertiary mathematics education in the Philippines reveals significant benefits in enhancing student engagement, motivation, conceptual understanding, retention, collaborative learning, and attitudes towards mathematics. Gamification addresses the traditional challenges of disengagement and rote learning by transforming the educational experience into an interactive and enjoyable process. By incorporating game elements such as leaderboards, badges, and problem-based scenarios, students are encouraged to actively participate and deepen their understanding of complex mathematical concepts. Furthermore, the collaborative nature of many gamified activities fosters a supportive learning environment, aligning well with the collectivist values prevalent in the Philippines. These findings suggest that gamification is not only effective in improving immediate academic outcomes but also plays a crucial role in preparing students for future technological and professional challenges.

To maximize the benefits of gamification in tertiary mathematics education in the Philippines, several recommendations can be made. Firstly, educators may receive professional development and training on effectively integrating gamified elements into their teaching practices. This will ensure that the implementation of gamification is both strategic and impactful. Secondly, further research may be conducted to explore the long-term effects of gamification on students' mathematical proficiency and career readiness. This will provide deeper insights into the sustainability of gamified learning outcomes. Additionally, educational institutions may invest in accessible and user-friendly gamified platforms that cater to diverse student needs, including those with limited technological resources. Finally, collaboration between policymakers, educators, and technology developers is essential to create supportive frameworks that promote the widespread adoption of gamification in higher education, thereby enhancing the overall quality of mathematics education in the Philippines.

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