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Systematic Literature Review: Gamification as a Strategy to Enhance Motivation in Learning Mathematics

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ABSTRACT

This study aims to identify and analyze existing studies on the implementation of gamification in mathematics learning as a strategy to enhance students' learning motivation. The method used is a Systematic Literature Review (SLR) with the SALSA approach (Search, Appraisal, Synthesis, and Analysis) to obtain a comprehensive and systematic synthesis of findings. A total of 17 scholarly articles published between 2015 and 2025 were analyzed based on four main focuses: the effectiveness of gamification, implementation challenges, types of learning media used, and gamification components that contribute to increased learning motivation. The analysis results show that gamification generally has a positive impact on learning motivation in the context of mathematics education. The application of elements such as points, levels, badges, leaderboards, challenges, immediate feedback, and visual narratives has been proven to enhance students' attention, self-confidence, engagement, and learning satisfaction. However, the effectiveness of this strategy highly depends on the learning context, student characteristics, types of media used, and the quality of gamification design. Identified challenges include infrastructure limitations, low teacher competence in educational technology, misalignment of materials with the curriculum, and potential social and psychological impacts from the competitive systems implemented.

Keywords**:** *Gamification, learning motivation*, *mathematics education.*

Tinjauan Literatur Sistematis: Gamifikasi sebagai Strategi untuk Meningkatkan Motivasi dalam Pembelajaran Matematika

ABSTRAK

Penelitian ini bertujuan untuk mengidentifikasi dan menganalisis penelitian yang telah ada mengenai penerapan gamifikasi dalam pembelajaran matematika sebagai strategi meningkatkan motivasi belajar siswa. Metode yang digunakan adalah *Systematic Literature Review* (SLR) dengan pendekatan *Search, Appraisal, Synthesis, and Analysis* (SALSA) untuk memperoleh sintesis temuan yang komprehensif dan sistematis. Sebanyak 17 artikel ilmiah yang dipublikasikan dalam rentang waktu 2015 hingga 2025 dianalisis berdasarkan empat fokus utama, yaitu efektivitas gamifikasi, tantangan implementasi, jenis media pembelajaran yang digunakan, serta komponen gamifikasi yang berkontribusi

terhadap peningkatan motivasi belajar. Hasil analisis menunjukkan bahwa gamifikasi secara umum memberikan dampak positif terhadap motivasi belajar dalam konteks pembelajaran matematika. Penerapan elemen-elemen seperti poin, level, lencana, papan peringkat, tantangan, umpan balik langsung, dan narasi visual terbukti mampu meningkatkan aspek perhatian, kepercayaan diri, keterlibatan, dan kepuasan belajar peserta didik. Meskipun demikian, efektivitas strategi ini sangat bergantung pada konteks pembelajaran, karakteristik peserta didik, jenis media yang digunakan, serta kualitas desain gamifikasi. Tantangan yang diidentifikasi meliputi keterbatasan infrastruktur, rendahnya kompetensi pendidik dalam teknologi pembelajaran, ketidaksesuaian materi dengan kurikulum, serta potensi dampak sosial dan psikologis dari sistem kompetitif yang diterapkan.

Kata Kunci**:** *Gamifikasi, motivasi belajar, pembelajaran matematika*.

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1. Introduction

Mathematics is a fundamental discipline that supports logical thinking and problem-solving skills essential in daily life. Yet, many students show low motivation and interest in learning mathematics, which affects their engagement and academic performance. Dwi and Audina (2021) note that students who do not like mathematics usually feel anxious, which complicates their learning of the subject and eventually results in low performance in the subject. In the same manner, Asriyanti and Purwati (2020) indicated that one of the main reasons for the poor performance in mathematics is the absence of interest and motivation among the students.

Many factors can affect the lack of interest and motivation to study mathematics. Al Kamil et al. (2024) discovered that the main reason why people are lowly motivated is the old, boring, and in most cases irrelevant way of teaching in classrooms. A great number of educators continue to depend on one-way lectures, rote memorization of formulas, and mechanical problem-solving without any meaningful comprehension (Mulyanti and Puspitasari, 2022; Wahyuningsih et al., 2024). Consequently, students find it hard to learn mathematical concepts in a comprehensive manner resulting in poor learning performance.

Thus, the motivation to learn mathematics should become one of the priorities of the learning process. According to the study conducted by Wigfield and Eccles (2020), academically motivated students are likely to record higher academic outcomes and demonstrate increased interest in learning processes. This aligns with the results of Fahrurazi and Jayawardaya (2024) who stressed that academic motivation is the significant factor in student performance and classroom interaction. Learning motivation is therefore critical in the improvement of the quality of mathematics education.

Gamification has been considered as one of the methods that have had a high potential in enhancing motivation and student engagement. Suparmini et al. (2024) have indicated that gamification is a new technology that will be able to boost learning motivation. Su and Cheng (2015) define gamification as the utilization of the game components, including points, badges, and challenges, into the learning process to make it more participatory and exciting. With the

help of these aspects, Ariffin (2022) stated that the purpose of gamification is to make students more active and interested in the learning process.

Gamification differs from game-based learning in its fundamental approach. Whereas game-based learning involves the use of games as the main means of delivering content (Cahyaningrum, 2023), gamification, as defined by Aji and Napitupulu (2018), is a process that involves the incorporation of the elements of games in the current educational systems but does not focus on games to deliver the content. By using gamification, educators are able to introduce learning resources and activities in a competitive structure, e.g. by awarding points or other forms of rewards, to increase student motivation to learn (Ekawati, et al., 2024).

Practically, gamification in the classroom may take two shapes, namely digital and non-digital. Digital gamification can be defined as the application of technology (e.g. educational apps, online education platforms or computer and smartphone-specific educational games). These platforms include interactive features such as points, leaderboards, badges, and virtual challenges to make the students more engaged in an interactive and enjoyable manner (Atin et al., 2022). Digital gamification provides a more interactive learning experience via the use of technological advances and enables students to learn as they play and compete in a virtual world (Jusuf, 2016).

Conversely, gamification may also be implemented without digital tools and can be carried out with physical tools and manual approaches to incorporate games into the learning process (Setambah, 2024). As an example, a whiteboard used to show leaderboards, awarding points or other rewards as incentives, or challenges by groups may encourage teamwork and motivation. Game components like math challenges, levels, and rewards can be used effectively in a conventional classroom environment in this approach as well.

Despite much research which has demonstrated the positive effect of gamification, the effectiveness is not always similar. In a case study, Pehlivan and Arabacioglu (2023) had no significant finding regarding the difference in academic motivation among students as a result of gamification. It positively, however, affected such learning strategies as elaboration and peer collaboration. According to Suparmini et al. (2024), the design of game elements, the traits of learners, and the implementation of context and goals is a crucial factor in the success of gamification. In other instances, gamification that is not well-designed may cause pressure or distraction of the students to the actual learning content.

So, this paper seeks to survey and review past literature that explores the application of gamification in mathematics education, especially regarding the development of student learning motivation. This literature review will be systematic in that it will examine how gamification has been used under different educational settings as is the case with studies on game-based learning in elementary schools (Nahampun et al., 2024). Moreover, the review will determine the most commonly used game elements, and to what degree this strategy can boost motivation, according to the results of the study on the effects of gamification on the motivation of students in mathematics courses (Rojabi and Wang, 2024). It is hoped that the results of this review will contribute useful information to educators, educational software developers, and researchers in Indonesia in the development and implementation of more effective and measurable gamification in mathematics teaching.

2. Research Method

The present study uses the Systematic Literature Review (SLR) as the main method to thoroughly examine the use of gamification in increasing motivation in mathematics learning. The systematic literature review (SLR) method is chosen since this methodology inherently serves to minimize bias in the process of literature selection and makes sure that the entire range

of available research is taken into account, which is one of the primary principles that are stressed in systematic research methodology (Gough et al., 2017).

The first step of the process is to develop research questions as a basis on which the whole process of literature search and analysis would be conducted. These questions help inform the direction and scope of the systematic review to make sure the literature that is acquired is relevant and conforms to the purpose of the research. The formulated research questions include how effective gamification is in increasing learning motivation, what challenges are encountered in the implementation of gamification, what types of learning media are used in gamification applications, and what components of gamification contribute to enhancing learning motivation.

The literature was collected through searches in several reputable scientific databases, such as Google Scholar, SpringerLink, Wiley Online Library, and Taylor & Francis Online. Articles published between 2015 and 2025 were searched using English keywords such as "gamification," "gamification in mathematics education," and "mathematics learning motivation." However, the search was also conducted using equivalent terms in Indonesian.

The article selection process involved several inclusion criteria. The relevant criteria applied were topic relevance, recency of publication and credibility of the source, and further analyzed (Subhaktiyasa, 2024). The chosen articles should be devoted to the idea of gamification implementation in the field of mathematics learning and offer conclusions regarding its efficiency in terms of student motivation to learn. Moreover, the articles were required to adopt quantitative, qualitative, or mixed methodology, be published in the given time frame, and be in either Indonesian or in English. Bibliometric studies were also not included in the review, as this study is aimed at empirical research which gives data on the application and results of gamification in learning institutions.

Search, Appraisal, Synthesis, and Analysis (SALSA) framework was used to guide the process of literature selection, making the review process methodologically sound, well-organized, extensive, and replicable (Sahoo et al., 2025). Search stage entailed the identification of articles using keywords and publication year. The Screeening of titles and abstracts was part of the Appraisal stage, and then the full-text review to verify the adherence to the inclusion criteria. In the Synthesis phase, the information has been pulled out of the chosen articles, such as author, year, research method, participant characteristics, type of gamification (digital/non-digital), and the elements of gamification applied. The Analysis phase was presented in a descriptive manner in order to determine the patterns, trends, and difficulties of implementing gamification in mathematics learning, especially in terms of improving the motivation of students.

3. Results and Discussion

3.1. Effectiveness of Gamification

In the analysis of 17 studies that have been done about the effectiveness of gamification in stimulating student motivation, it would be concluded that gamification, in most cases, positively affects student motivation. Nonetheless, this effect is different depending on the situation of implementation, the form of gamification used, and the nature of the students.

3.1.1. Significant Effectiveness of Gamification in Increasing Student Motivation

A number of research have shown that gamification works in enhancing student motivation in different educational settings. Among the main discoveries is the rise in the scores of student motivation, which is indicated in the article by Irnawati et al. (2024), where the scores of motivations increased by 2.69 to 3.23, and the concentration of learning improved by 97.45%.

A different study by Tyaningsih et al. (2022) revealed that post-test scores rose by 30.3 percent as a result of gamification, which enhanced student learning. Gamification features like leaderboards, badges and competition-based challenges have been shown to generate student excitement, engage them more, and make the learning experience more interesting.

In addition, other areas affected positively by gamification include student confidence and satisfaction. Vargas et al. (2021) found out that gamification enhances motivation in the form of attention, relevance, and confidence. The availability of other elements like direct feedback and reward systems will make the students feel more secure and pleased with their development. Gamification can also eliminate boredom during the learning process, as was discovered by Ariffin et al. (2022), students were more willing to engage actively in the classroom. Particularly in the learning of mathematics, the research by Yığ and Sezgin (2021) demonstrated that gamification makes learning mathematics more interactive and entertaining besides increasing concentration to the students. It was also found that gamification led to impressive improvement in student academic performance and motivation (Setambah et al., 2024). Altogether, gamification is an effective tool to make the learning process more interactive, enjoyable and motivating, which eventually leads to an increased academic performance.

3.1.2. Effectiveness of Gamification Depends on Context and Strategy

The study on the effectiveness of gamification also shows that the results strongly rely on the learning environment and the learning strategies. A number of studies focus on the significance of choosing the right gamification elements that can be modified according to student traits and the curriculum. Indicatively, Su and Cheng (2015) have established that there is a significant change in intrinsic motivation in cases where gamification is implemented in learning activities that arouse curiosity and interest. Gamification in outdoor education, including exploration and working directly with the surrounding environment, may enhance motivation and learning success since the students are more engaged with the content.

Also, the effects of gamification will depend on the integration of game elements in learning strategies. Pehlivan and Arabacioglu (2023) determined that despite the fact that gamification does not necessarily lead to a significant growth in academic motivation, the use of the method has a positive effect on some learning strategies of students, including elaboration and collaboration learning. This implies that gamification works better as a tool to support the already existing learning methods, including improving student cooperation or promoting further involvement with the content through play.

Other factors such as student age and education level also influence gamification's effectiveness. As an example, Aji and Napitupulu (2018) discovered that gamification via e-learning is more difficult to apply to junior high school students who still need direct teacher instruction, so this method is more appropriate to older students or those who are used to studying independently. On the other hand, Ariffin et al. (2022) demonstrated that gamification has the potential to decrease the level of boredom and enhance student motivation in an engaging and interactive learning process, making the learning process more enjoyable and entertaining.

Altogether, the efficacy of gamification cannot be regarded as universal. It should be adjusted to the learning situation and plans in order to deliver the best impact. The ability to select the right elements of gamification, student characteristics, and the subject matter can make the difference with regards to the success of gamification in boosting student motivation and learning outcomes.

3.2. Challenges in Implementing Gamification

After examining 17 articles concerning the implementation of gamification in learning, it was discovered that despite the enormous potential of gamification to improve student motivation and engagement, the implementation of gamification encounters numerous complicated issues. All these challenges may be divided into seven major categories: technical, design, teacher competence, user adaptation, appropriate content, learning evaluation, and social and psychological challenges.

The former is the technical challenge and school facilities. A significant number of schools and learners do not have access to proper gadgets like smartphones or laptops, as well as a stable internet connection (Tyaningsih et al., 2022; Nurjannah et al., 2021). Leveraging Unity 3D needs a lot of technical expertise and device requirements (Wijaya et al., 2022). Moreover, not every gamification application has built-in content update functionality or a sufficient data storage mechanism (Atin et al., 2022).

The second obstacle concerns the process of design and development of gamification. The creation of an engaging gamification system based on the learning goals will take time, imagination, and knowledge of pedagogy and game mechanics (Papp, 2017; Setambah et al., 2024). Educators should develop meaningful gamification aspects that are aimed not only at entertainment but also at the effectiveness of learning (Ariffin et al., 2022).

Also, the competence of teachers plays a key role in the effectiveness of gamification. A good number of teachers do not have enough knowledge or technological expertise to incorporate gamification in the learning process (Yığ and Sezgin, 2021). They must be imaginative when devising quizzes, stories, and interactive contents that are pertinent to the learning environment (Setyaningrum et al., 2023; Tyaningsih et al., 2022).

The fourth obstacle is the user adaptation, students and teachers. Game-based learning methods do not suit every student; some students still prefer the conventional approach like lectures or exercises (Satriawan and Abdullah, 2025). Moreover, the digital platform takes time to adjust both teachers and students (Nurjannah et al., 2021). In terms of content appropriateness and curriculum-level fit, gamification should be aligned with learning goals and student requirements. Learning can be impeded by too simple or non-contextual or not meeting the curriculum content (Su and Cheng., 2015; Yabut et al., 2020). It is also significant to adjust the material to the contexts of daily life and make it more relevant and attractive (Aji and Napitupulu, 2018).

Based on the evaluation and learning effectiveness perspective of objectively measuring learning outcomes, there are challenges in doing this. Numerous studies are more concerned with how to enhance student motivation but have not assessed the effect of gamification on academic achievement in quantifiable outcomes (Wijaya et al., 2022). Hence, the role of teacher feedback and designing activities on the basis of goals should be reinforced (Vargas et al., 2021).

Lastly, one should not ignore social and psychological issues because gamification competitive systems can cause anxiety or jealousy in students (Pehlivan and Arabacioglu, 2023). In other scenarios, learners will be more preoccupied with earning points or badges instead of building a profound knowledge of the content (Setambah et al., 2024). To address these undesirable outcomes, teachers may include collaborative group work and interesting narrative, which, in addition to the decrease in unhealthy competition, will also facilitate cooperation, meaningful interaction, and intrinsic involvement in the learning process (Vargas et al., 2021).

Overall, although gamification offers a fun approach to learning, its implementation requires thorough preparation in infrastructure, pedagogical design, and teacher competence support. By

understanding these challenges, future gamification development can be carried out more effectively, adaptively, and sustainably.

3.3. Learning Media Used in Gamification

3.3.1. Digital Gamification Media

Based on an analysis of 17 journals related to the implementation of gamification in learning, various types of digital media have been used to support the learning process. These media can be categorized into several main groups, namely quiz-based media, mobile applications, videos/tutorial visuals, e-learning/LMS, simulations/puzzles, and e-modules. Below is a discussion of each type of media used.

3.3.1.1. Quiz-Based Media / Interactive Games

One of the most popular types of digital gamification media is quiz-based and interactive game media. This media is used to test students' understanding directly through interactive questions. Platforms like Kahoot and Quizizz are often used in studies as tools to deliver quizzes in a fun and competitive way. Several studies implementing quiz-based media include Irnawati et al. (2024), Pehlivan & Arabacioglu (2023), Vargas et al. (2021), Nurjannah et al. (2021), and Tyaningsih et al. (2022). The main advantage of this media is its ability to motivate students to participate actively and compete healthily, while also reinforcing the material being taught.

3.3.1.2. Mobile Applications (M-Learning / Game Apps)

Mobile applications are one of the main media used in digital gamification, especially for mobile learning (m-learning). Mobile-based applications allow students to learn anywhere and anytime while still experiencing fun game elements. Some examples of applications used in research are the Android app "Math's Going On," PolyMath™, and various other m-learning apps discussed by Wijaya et al. (2022), Su & Cheng (2015), and Atin et al. (2022). This media is very effective in facilitating flexible learning and can adapt to the different needs and learning styles of students. The use of mobile apps in gamification also increases accessibility to learning outside the classroom.

3.3.1.3. Video / Tutorial Visuals

Another study is the use of learning videos and tutorial visuals as a form of gamification as a part of learning strategies. The lesson content is commonly delivered through this media in an exciting visual way that can provide students with an enriching learning experience. Lecture videos distributed through such platforms as WhatsApp and YouTube were used in studies by Pehlivan and Arabacioglu (2023) and Atin et al. (2022), and tutorial videos, in which the material is presented graphically, were also used by Atin et al. (2022). Media in the form of video proves highly successful in clarifying concepts that are hard to learn through text and aid students in learning more actively.

3.3.1.4. E-learning / LMS (Learning Management System)

E-learning or digital learning management platforms are also very important media in gamification implementation. Some studies use platforms like Google Classroom, Microsoft Teams, and Classcraft to manage learning and gamification in an integrated way. For example, Aji & Napitupulu (2018) and Ariffin et al. (2022) used these platforms to distribute learning materials, manage interactions between teachers and students, and conduct assessments. LMS allows for more structured and organized teaching and can monitor students' progress in real-time.

3.3.1.5. Simulation / Puzzle / Digital Games

Game-based or digital simulation media are used to provide more practical and problem-solving learning experiences. PolyMath™, used by Tan et al. (2020), and various math crossword puzzles and math simulations mentioned by Vargas et al. (2021), give students the opportunity to learn in a fun way focused on problem-solving. Digital games like these allow students to explore and solve math problems directly while developing critical and logical thinking skills.

3.3.1.6. E-Module / Digital Worksheets

E-modules and digital worksheets are media used to present material interactively in the form of digital learning modules. Irnawati et al. (2024) used Live Worksheet to help students practice questions digitally, while Setyaningrum et al. (2023) developed e-modules as part of the gamification process. These e-modules facilitate independent learning with interactive features that can enrich students' learning experiences. The main advantage of this media is its ability to provide more structured material accessible to students anytime.

3.3.2. Non-Digital Gamification Media

Although digital technology plays a major role in modern gamification, some studies also adopt non-digital approaches in gamification to support the learning process. These non-digital media rely on simpler game elements but remain effective in creating engaging and interactive learning experiences. Based on the analysis, two types of non-digital media used in studies are physical games (role-playing) and visual fraction cards.

3.3.2.1. Physical Games (Role-Playing) and Rewards

Role-playing is a type of non-digital gamification employed where students are engaged in simulations that enable them to adopt different roles in some situations. This media is employed to provoke the interaction and enhance conceptualization by direct experience. One of such researchers, who employed role-playing, physical leaderboards, worksheets, and the rewards of candies to motivate the students, is Papp (2017). This method stresses on healthy competition and participation whereby the students are rewarded physically and thus they are motivated to work harder. Benefits of the non-digital method are that students and instructors interact directly, so immediate and more personalized feedback is possible. In addition, physical rewards reinforce student performances thereby providing them with a more concrete feeling of achievement and encouraging them to keep participating in learning process.

3.3.2.2. Visual Fraction Cards

Visual fraction cards is another non-digital media employed in gamification. Setambah et al. (2024) designed DSK fraction cards that are used to display fractions graphically, which allows students to learn the concepts of fractions more concretely and with less effort. These cards enable students to view visual images of fractions, which adds more learning to the process and makes it more enjoyable and memorable. The DSK fraction cards are highly applicable in the learning of math concepts, particularly the visualization of fractions which are usually hard subjects to students. In this manner, students will be able to connect directly to the concepts of math, enhancing their comprehension by means of more straightforward and easier to comprehend visual representations.

3.4. Gamification Components in Mathematics Learning

Findings of a systematic review of 17 articles suggest that different elements of gamification have been successfully applied in the learning of mathematics to promote student motivation.

Most of the widely used elements of gamification are points, levels, badges, leaderboards, mission or challenges, symbolic rewards, instant feedback, and compelling storylines or narratives.

The use of points, levels and badges is one of the fundamental aspects that represents the recognition of student achievements, learning progress indicators. Motivation to take part in learning activities and to constantly upgrade skills has proven to be achieved through the awarding of points and badges. Irnawati et al. (2024) observed that scoring systems, level, and challenges can contribute positively to the concentration, engagement, and curiosity of the students during the learning process.

Another popular feature is leaderboards, which are used to promote healthy competition motivation. A number of studies (Nurjannah et al., 2021; Ariffin et al., 2022; Yığ and Sezgin, 2021) concluded that leaderboards motivate students to aim at higher positions, thus, becoming more confident and persistent in their efforts to solve mathematical problems.

The other significant element is the incorporation of challenges and missions which make learning activities meaningful and leveled. Such missions may be in the form of puzzles, games, or exercise levels as in the works of Tan et al. (2020) and Setyaningrum et al. (2023). These activities bring a feeling of achievement and great encouragement to the students to do them in an active manner.

Timely feedback is an important element of digital gamification as well. Such platforms as Kahoot! and Quizizz provide immediate feedback, thus allowing students to track their performance instantly. This contributes to the development of self-confidence and speeds up the self-assessment process (Tyaningsih et al., 2022; Setambah et al., 2024).

In addition, aesthetic and visual narrative can be used to improve the attention of the students. The application of appealing visual designs, animation, music, and narratives in gamified applications employed by Wijaya et al. (2022) and Vargas et al. (2021) has turned out to enhance attention and relevance by being in line with existing learning preferences of students.

Autonomy and freedom of learning is also provided by gamification where students have the choice of the sequence of missions, re-reading the materials, and flexibility in time spent studying. This element has been demonstrated to increase the intrinsic motivation of the students as they feel in control of their learning process (Aji and Napitupulu, 2018; Setambah et al., 2024).

The collaborative and social aspect is also important. The cooperation and collective responsibility provided by the team or group mode (e.g. Classcraft or Kahoot!), contribute to intrinsic motivation, which is further reinforced by the use of the team or group mode. Vargas et al. (2021) demonstrated that group tasks with shared problems may stimulate interaction and develop a group learning atmosphere.

On the whole, these elements of gamification have been demonstrated to positively affect a variety of factors of student motivation, which could be referred to as the ARCS model: Attention (students focusing on materials and activities), Relevance (relation of the material to student needs and experiences), Confidence (students being sure that they can overcome the challenge), and Satisfaction (students being grateful because of the positive outcomes of learning and the rewards). Additionally, certain articles reported that gamification encourages intrinsic motivation (including enjoyment, pride, and curiosity) and extrinsic motivation (including rewards, scores, and social recognition) in the learning of mathematics (Papp, 2017; Atin et al., 2022).

Accordingly, the adequate incorporation of gamification elements can establish a learning environment that supports the active engagement of students, develops their sense of confidence, and, overall, improves the learning motivation. Gamified mathematics learning

development must take into account the correspondence between the elements of games and the learning goals to produce the best influence.

4. Conclusion

This study aimed to answer four key research questions related to the implementation of gamification in mathematics education, particularly in terms of its impact on students' learning motivation. Using the SALSA framework (Search, Appraisal, Synthesis, and Analysis), the research examined 17 available scientific papers that were published between 2015 and 2025, and involved the components of effectiveness, challenges, learning media, and gamification.

One can conclude that gamification is a useful method of increasing the learning motivation of students, especially in mathematics learning. Elements like points, badges, levels, leaderboards, challenges, immediate feedback, and visual narratives are always used to enhance the level of student engagement, self-confidence, and satisfaction with the learning process. Gamification has also been established to arouse intrinsic motivation, including enjoyment and curiosity, as well as extrinsic motivation, including the need to have rewards and social recognition.

However, the implementation of gamification still faces various challenges that need to be addressed. These challenges include technical barriers, limited facilities and infrastructure, insufficient teacher skills, user adaptation to new approaches, misalignment between content and the curriculum, and difficulties in objectively assessing learning outcomes. In addition, social and psychological aspects such as anxiety caused by excessive competition may arise if gamification is not carefully designed.

In practice, various learning media are used to support gamification. Commonly used digital media include quiz platforms such as Kahoot and Quizizz, mobile learning applications, instructional videos, learning management systems such as Google Classroom and Classcraft, interactive simulations, as well as electronic modules and digital worksheets. In addition, non-digital media such as role-playing activities and visual cards have also been proven effective in helping students understand mathematical concepts in a more concrete and engaging way.

Some of the gamification elements that play key roles in increasing learning motivation are point systems, badge rewards, learning levels, leaderboards, progressive challenges, instant feedback, appealing visual designs, and allowing autonomy in the management of the learning process. Moreover, group-based activities contribute to further motivating students to enhance their motivation levels by making them feel more responsible and collaborative. When these gamification elements are carefully combined with instructional objectives, students will be able to enjoy, interact, and learn in more meaningful ways.

In conclusion, gamification holds great potential in improving the quality of mathematics education. To achieve optimal and sustainable outcomes, careful planning, understanding of student characteristics, availability of infrastructure, and improved teacher competencies in designing and implementing gamification are essential.

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