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Gamification in Statistics Education: Enhancing Learning Engagement in Madrasah Ibtidaiyah

Gamifikasi dalam Pendidikan Statistika: Meningkatkan Keterlibatan Belajar di Madrasah Ibtidaiyah

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Abstract

Statistics education plays a crucial role in developing students' numeracy, reasoning, and data literacy skills from an early age. However, statistics is often perceived as abstract and challenging by elementary students, particularly in Madrasah Ibtidaiyah settings. This study aims to examine the pedagogical potential of gamification in enhancing statistics learning through a qualitative library research approach. Relevant literature was collected from academic books, journal articles, and educational databases and analyzed thematically to identify key patterns and pedagogical implications. The findings indicate that gamification can increase student engagement, learning motivation, participation, and conceptual understanding by integrating game elements such as challenges, rewards, collaboration, and feedback into learning activities. Furthermore, gamification aligns with constructivist learning principles and supports the development of twenty-first-century competencies. Nevertheless, its effectiveness depends on appropriate instructional design and contextual implementation. The study highlights gamification as a promising pedagogical strategy for making statistics learning more meaningful and engaging in Madrasah Ibtidaiyah.

Keywords: Gamification; Statistics Education; Student Engagement; Madrasah Ibtidaiyah; Pedagogical Innovation

Abstrak

Pendidikan statistika memiliki peran penting dalam mengembangkan kemampuan numerasi, penalaran, dan literasi data peserta didik sejak usia dini. Namun, statistika sering dipersepsikan sebagai materi yang abstrak dan menantang bagi siswa sekolah dasar, termasuk di lingkungan Madrasah Ibtidaiyah. Penelitian ini bertujuan mengkaji potensi pedagogis gamifikasi dalam meningkatkan kualitas pembelajaran statistika melalui pendekatan studi pustaka kualitatif. Data diperoleh dari buku akademik, artikel jurnal, dan berbagai sumber ilmiah yang relevan, kemudian dianalisis secara tematik untuk mengidentifikasi pola dan implikasi pedagogis utama. Hasil kajian menunjukkan bahwa gamifikasi dapat meningkatkan keterlibatan, motivasi belajar, partisipasi, serta pemahaman konsep siswa melalui integrasi elemen permainan seperti tantangan, penghargaan, kolaborasi, dan umpan balik ke dalam aktivitas pembelajaran. Selain itu, gamifikasi sejalan dengan prinsip pembelajaran konstruktivistik dan mendukung pengembangan kompetensi abad ke-21. Meskipun demikian, efektivitasnya sangat bergantung pada desain pembelajaran dan konteks implementasinya. Kajian ini menegaskan gamifikasi sebagai strategi pedagogis yang menjanjikan untuk pembelajaran statistika di Madrasah Ibtidaiyah.

Kata Kunci: Gamifikasi; Pendidikan Statistika; Keterlibatan Siswa; Madrasah Ibtidaiyah; Inovasi Pedagogis



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INTRODUCTION

Statistics has become one of the most important fields of knowledge in the twenty-first century.¹ In an era characterized by rapid technological advancement, digital transformation, and the continuous generation of large volumes of data, statistical literacy is increasingly recognized as a fundamental competency that individuals need in order to participate effectively in society.² Statistics enables people to collect, organize, analyze, interpret, and communicate data in meaningful ways. These skills are essential not only in scientific research but also in everyday decision-making processes, such as evaluating information, understanding trends, comparing alternatives, and solving practical problems.³ Consequently, educational institutions have a responsibility to introduce statistical concepts at an early stage of learning to prepare students for future academic and social challenges.

At the elementary school level, statistics serves as an important component of mathematics education. The teaching of statistics is not limited to numerical calculations; rather, it involves developing students' abilities to observe phenomena, collect data, classify information, identify patterns, and draw conclusions based on evidence.⁴ Through statistics education, students learn how to make sense of information presented in tables, charts, graphs, and other visual representations. These competencies contribute significantly to the development of logical reasoning, analytical thinking, critical thinking, and problem-solving skills.⁵ Furthermore, statistics provides opportunities for students to connect mathematical concepts with real-life situations, thereby making learning more meaningful and relevant.

In the context of Madrasah Ibtidaiyah (MI), statistics education plays a strategic role in supporting the objectives of national education and the development of students' numeracy skills. Numeracy is increasingly emphasized as an essential competency for the twenty-first century because it enables individuals to use mathematical knowledge effectively in various contexts. Statistics contributes directly to numeracy by helping students understand data-based information and make informed decisions. Therefore, improving the quality of statistics learning in MI is essential for fostering students' mathematical competence and preparing them to become active and informed citizens.

Despite its importance, statistics is often perceived as one of the most challenging and less attractive topics in mathematics education. Many students experience difficulties when learning statistical concepts because these concepts are frequently presented in abstract and procedural ways. Traditional instructional approaches tend to emphasize memorization, repetitive exercises, and teacher-centered explanations. In many classrooms, students are expected to learn statistical concepts through lectures and textbook activities without sufficient opportunities for

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- 1 Nurul Rahmaini and Salsabila Ogyilva Chandra, "Pentingnya Berpikir Kritis Dalam Pembelajaran Matematika," *Griya Journal of Mathematics Education and Application* 4, no. 1 (March 29, 2024): 1–8, <https://doi.org/10.29303/griya.v4i1.420>.
 - 2 Nurdin Arifin and Eudia Fortuna, "Etnomatematika Pada Kebudayaan Suku Dayak Bentian Dalam Menumbuhkan Kembangkan Literasi Matematis," *Jurnal Pengabdian Ahmad Yani* 1, no. 1 (2021): 58–67, <https://doi.org/10.53620/pay.v1i1.16>.
 - 3 Roslani Supinah and Joko Soebagyo, "Analisis Bibliometrik Terhadap Tren Penggunaan ICT Pada Pembelajaran Matematika," *JNPM (Jurnal Nasional Pendidikan Matematika)* 6, no. 2 (2022): 276, <https://doi.org/10.33603/jnpm.v6i2.6153>.
 - 4 Yuni Azura et al., "Integrasi Deep Learning Dan Pendekatan Konstruktivisme Untuk Penguatan Karakter Islami Di Era Pembelajaran Abad 21," *Jurnal Pendidikan Dasar* 13, no. 2 (2025): 360–73, <https://doi.org/10.46368/jpd.v13i2.4749>.
 - 5 Sanggiti Bawadi, Heni Pujiastuti, and Maman Fathurrohman, "Pemahaman Konsep Matematika Dengan Teknik Scaffolding: Systematic Literature Review," *MENDIDIK: Jurnal Kajian Pendidikan Dan Pengajaran* 9, no. 1 (2023): 7–18, <https://doi.org/10.30653/003.202391.2>.

exploration, experimentation, or hands-on engagement. As a result, students often fail to develop a deep understanding of the concepts being taught.

The challenges associated with statistics learning become even more significant when considering the developmental characteristics of elementary school students. According to Piaget's theory of cognitive development, children between the ages of seven and eleven are generally in the concrete operational stage. At this stage, learners understand concepts more effectively when they are presented through concrete experiences, visual representations, and direct manipulation of objects. Abstract explanations and symbolic representations alone may not be sufficient to facilitate meaningful learning. Consequently, instructional strategies that rely heavily on verbal explanations often fail to meet the cognitive needs of young learners.⁶ Research in mathematics education consistently demonstrates that students learn more effectively when they actively participate in the learning process. Constructivist learning theory suggests that knowledge is not simply transmitted from teachers to students but is actively constructed through interaction with the environment, learning materials, and peers.

This perspective emphasizes the importance of student-centered learning environments that encourage exploration, inquiry, collaboration, and reflection. In the context of statistics education, students should be provided with opportunities to collect data, organize information, create representations, analyze patterns, and communicate findings through meaningful learning activities.⁷ Unfortunately, many classrooms still struggle to create such learning environments. Statistics lessons are often perceived as monotonous and disconnected from students' daily experiences. Consequently, students may lose interest, become less motivated, and develop negative attitudes toward mathematics.⁸ Low motivation is particularly problematic because motivation plays a crucial role in determining learning outcomes. Students who are motivated tend to participate more actively, persist when facing difficulties, and invest greater effort in learning activities. Conversely, students with low motivation often exhibit limited engagement and lower achievement.

To address these challenges, educators have increasingly explored innovative instructional approaches that can enhance student motivation and engagement. One promising approach is gamification. Gamification refers to the application of game elements and game design principles in non-game contexts, including education. Rather than transforming learning activities into games, gamification incorporates features such as points, badges, levels, challenges, rewards, missions, and leaderboards into instructional processes. These elements are designed to increase learners' motivation, participation, and enjoyment while maintaining educational objectives.

The concept of gamification has gained considerable attention in educational research over the past decade.⁹ Numerous studies have reported positive effects of gamification on student engagement, motivation, learning satisfaction, and academic performance. By incorporating

6 Jusuf Blegur et al., "Pelatihan Kepemimpinan Transformasional Calon Guru: Konsep, Integrasi, Dan Evaluasinya Dalam Pembelajaran," *Jurnal Visi Pengabdian Kepada Masyarakat* 5, no. 2 (August 10, 2024): 80–105, <https://doi.org/10.51622/pengabdian.v5i2.2269>.

7 Agung Prabowo et al., "Penyuluhan Cara Meneliti Dan Menulis Hasil Penelitian Bidang Matematika Bagi Guru-Guru MGMP Matematika SMP Kabupaten Banyumas," *ULIL ALBAB : Jurnal Ilmiah Multidisiplin* 2, no. 9 (July 18, 2023): 4100–4106, <https://doi.org/10.56799/jim.v2i9.2119>.

8 Arif Rahman Hakim and Fauzi Mulyatna, "Sejarah Matematika: Perkembangan Bilangan Matematika Empiris," *Prosiding Diskusi Panel Nasional Pendidikan Matematika* 9, no. 80 (2023): 471–78, <https://proceeding.unindra.ac.id/index.php/DPNPMunindra/article/view/6555>.

9 Arifin Karim and Joko Soebagyo, "Pemetaan Bibliometrik Terhadap Trend Riset Matematika Terapan Di Google Scholar Menggunakan Vosviewer," *Teorema: Teori Dan Riset Matematika* 6, no. 2 (September 30, 2021): 234–41, <https://doi.org/10.25157/teorema.v6i2.5835>.

elements commonly associated with games, educators can create learning experiences that are more interactive, enjoyable, and meaningful.¹⁰ Gamification has been successfully implemented across various educational levels and subject areas, including mathematics, science, language learning, and social studies. In mathematics education, gamification is particularly valuable because it addresses many of the motivational challenges commonly associated with the subject. Mathematics is often viewed as difficult, stressful, and intimidating by students. Gamification can help transform these perceptions by creating a learning environment that emphasizes exploration, achievement, and enjoyment.¹¹ Through carefully designed challenges and rewards, students are encouraged to participate actively and view learning as an engaging process rather than an obligation.

The application of gamification in statistics learning offers several specific advantages. First, gamification can increase student motivation by providing clear goals, immediate feedback, and recognition for achievement. Students become more willing to engage in learning activities when they perceive them as enjoyable and rewarding. Second, gamification promotes active participation by encouraging students to complete tasks, solve problems, and collaborate with peers. Third, gamification facilitates experiential learning by allowing students to interact directly with statistical concepts through structured activities and challenges. Fourth, gamification can support differentiated instruction by enabling students to progress through levels or missions at their own pace.¹² Examples of gamification in statistics learning include data collection missions, classification challenges, graph construction competitions, and problem-solving quests. Students may earn points for successfully collecting data, badges for completing tasks, or rewards for demonstrating mastery of concepts.¹³ Such activities transform statistical learning from a passive process into an active and engaging experience. Furthermore, gamified learning activities can connect statistical concepts with real-world contexts, making learning more relevant and meaningful.¹⁴

The implementation of gamification is also consistent with the principles of the Merdeka Curriculum and the 2013 Curriculum, both of which emphasize active learning, student participation, creativity, collaboration, and critical thinking. These curricula encourage teachers to create learning environments that support the holistic development of students. Gamification aligns with these objectives by providing opportunities for students to engage cognitively, socially, and emotionally in the learning process. In addition, gamification contributes to the development of twenty-first-century skills, including communication, collaboration, creativity, and problem-solving.¹⁵

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- 10 M Haryani et al., "Studi Literatur: Penerapan Media Pembelajaran Augmented Reality Dalam Pembelajaran Matematika Guna Meningkatkan Kemampuan Pemecahan Masalah Siswa," *PRISMA, Prosiding Seminar Nasional Matematika* 7 (2024): 359–67, <https://proceeding.unnes.ac.id/prisma/article/view/2975>.
 - 11 Beni Junedi, St. Budi Waluya, and Wardono, "The Programme for International Student Assessment: Tinjauan Literasi Matematika Dan Implementasi Pada Pembelajaran Matematika Di Indonesia," *PRISMA, Prosiding Seminar Nasional Matematika* 7 (2024): 834–40, <https://proceeding.unnes.ac.id/prisma/article/view/3037>.
 - 12 Yuni Azura, Hadi Thoyib, and Suhendry, "Pengenalan Kalimah Isim Surah Al-Fatihah Bagi Anak-," *Jurnal Pengabdian Masyarakat Pembangunan Sosial, Desa Dan Masyarakat Volume* 6 (2025): 229–37.
 - 13 Risma Diana, Dedi Kuswandi, and Saida Ulfa, "Konsep Pembelajaran Tringo Pada Mata Kuliah Model Pengembangan Kurikulum," *Jurnal Kajian Teknologi Pendidikan* 2, no. 2 (June 22, 2019): 90–95, <https://doi.org/10.17977/um038v2i22019p090>.
 - 14 Nunung Suryati et al., "Curriculum Development of Postgraduate Study Program Based on Life-Based Learning Philosophy and Disruption Technology," in *International Conference On Information Technology And Education (ICITE 2020) Curriculum*, vol. 508, 2020, 434–36, <https://doi.org/10.2991/assehr.k.201214.273>.
 - 15 Muhamad Jeni Permana, Aan Hendrayana, and Maman Fathurrohman, "Pengaruh Pengelolaan Beban Kognitif Terhadap Peningkatan Kecakapan Matematis Siswa," *Jurnal Pendidikan Matematika* 2, no. 3 (2015): 41–60, <https://doi.org/10.56916/jp.v4i2.1393>.

Despite its potential benefits, the implementation of gamification in Madrasah Ibtidaiyah remains relatively limited. Several factors contribute to this situation.¹⁶ First, many teachers have limited knowledge and experience regarding gamification strategies. Second, there is a common misconception that gamification requires sophisticated digital technologies, which may not always be available in schools. Third, practical guidelines and examples for implementing gamification in statistics learning are still relatively scarce. These challenges highlight the need for further research and development efforts to support teachers in adopting gamification effectively.¹⁷

Moreover, there is a need to explore how gamification can be adapted to the specific context of Madrasah Ibtidaiyah. Educational innovations should be sensitive to local cultural values, institutional characteristics, and student needs. Therefore, studies focusing on gamification in MI settings can provide valuable insights into effective implementation strategies and contribute to the development of contextually relevant educational practices.

Based on these considerations, this study examines the utilization of gamification as an approach for creating enjoyable and meaningful statistics learning experiences in Madrasah Ibtidaiyah.¹⁸ The study aims to explore the theoretical foundations, practical applications, benefits, and challenges associated with gamification in statistics education. Specifically, the objectives of this study are: (1) to analyze the role of gamification in enhancing students' motivation and engagement in statistics learning; (2) to examine how gamification supports conceptual understanding of statistical concepts among elementary school students; and (3) to identify opportunities and challenges in implementing gamification within the context of Madrasah Ibtidaiyah.

The findings of this study are expected to contribute both theoretically and practically to the field of mathematics education. Theoretically, the study enriches the literature on innovative instructional approaches for elementary statistics education. Practically, it provides teachers with insights and recommendations for designing effective gamified learning experiences that support students' cognitive, affective, and social development. Ultimately, the study seeks to demonstrate that gamification is not merely a trend in educational technology but a meaningful pedagogical approach capable of transforming statistics learning into an engaging, enjoyable, and educationally valuable experience for students in Madrasah Ibtidaiyah.

Method

This study employed a qualitative library research approach to examine the utilization of gamification in statistics learning at Madrasah Ibtidaiyah (MI). Library research was chosen because the study aimed to explore and synthesize various theoretical perspectives and research findings related to gamification in educational settings, particularly in elementary statistics learning.¹⁹ The data sources consisted of scholarly books, peer-reviewed journal articles, conference proceedings, and other academic publications relevant to gamification, statistics education, mathematics learning, and elementary education. Literature was collected through

16 Mamika Ujianita Romdhini et al., "Bimbingan Teknis Penggunaan Artificial Intelligence (AI) Dalam Membuat Manuskrip Artikel Ilmiah Di Fakultas MIPA Universitas Mataram," *Jurnal Pengabdian Magister Pendidikan IPA* 4, no. 1 (2024): 17–23, <https://jppipa.unram.ac.id/index.php/jpmpi/article/view/6412>.

17 Femmy Effendy et al., "Penggunaan Pembayaran Seluler Dengan VOSviewer," *Jurnal Interkom: Jurnal Publikasi Ilmiah Bidang Teknologi Informasi Dan Komunikasi* 16, no. 1 (2021): 10–17, <https://ejournal.rosma.ac.id/index.php/interkom/article/view/92>.

18 Prapti Octavia Ningsih et al., "Aktualisasi Nilai Al-Qur'an Bagi Generasi Muda Yang Berkualitas Dan Berwawasan," *ABDISOSHUM: Jurnal Pengabdian Masyarakat Bidang Sosial Dan Humaniora* 4, no. 2 (June 9, 2025): 140–50, <https://doi.org/10.55123/abdisoshum.v4i2.5028>.

19 Mestika Zed, *Metode Penelitian Kepustakaan* (Yayasan Pustaka Obor Indonesia, 2008).

searches in academic databases such as Google Scholar, Scopus, ERIC, SpringerLink, and ScienceDirect using keywords related to gamification, statistics learning, student motivation, and Madrasah Ibtidaiyah.

The collected literature was analyzed using a qualitative descriptive approach. The analysis process involved reading, classifying, comparing, and interpreting relevant sources to identify key themes and patterns concerning the implementation of gamification in statistics learning. The selected literature was then organized into several thematic categories, including the concept of gamification, its role in enhancing learning motivation and engagement, its contribution to students' conceptual understanding, and the challenges of its implementation in educational practice. Through this approach, the study seeks to provide a comprehensive understanding of the opportunities and challenges of applying gamification in statistics learning at Madrasah Ibtidaiyah. The findings are expected to serve as a reference for educators, researchers, and curriculum developers in designing more engaging, meaningful, and student-centered learning experiences.

RESULTS AND DISCUSSION

The Potential of Gamification in Statistics Learning at Madrasah Ibtidaiyah

The literature indicates that gamification has considerable potential to improve statistics learning in Madrasah Ibtidaiyah. Statistics is often perceived as a difficult and abstract subject because students are required to collect, classify, interpret, and represent data while applying analytical thinking skills. When statistical concepts are taught through conventional teacher-centered approaches, students frequently experience boredom and limited participation. Gamification offers an alternative instructional strategy by integrating game elements such as points, badges, levels, rewards, and missions into learning activities. According to Ningsih et al., these elements can create a more interactive learning environment and encourage students to participate actively in classroom activities.²⁰ Similarly, Nurjanah et al. emphasize that game-based challenges stimulate curiosity and increase students' willingness to engage in mathematical learning tasks.²¹

One of the most significant contributions of gamification is its influence on students' learning motivation. Motivation plays a crucial role in determining learning outcomes because motivated students tend to demonstrate greater persistence, concentration, and participation. From the perspective of Self-Determination Theory, learners are intrinsically motivated when their needs for autonomy, competence, and relatedness are fulfilled. Risma Chulashotud Diana, Prapti Octavia Ningsih argue that gamified learning environments provide opportunities for students to make choices, complete challenges, and receive immediate feedback regarding their performance.²² In addition, collaborative activities embedded in gamification strengthen social interaction among students, thereby fostering a sense of belonging and increasing enthusiasm toward statistics learning. As a result, students tend to view learning activities as meaningful and enjoyable experiences rather than compulsory academic tasks.

20 Prapti Octavia Ningsih et al., "Implementasi Media Pembelajaran Interaktif Berbasis Genially Untuk Meningkatkan," *Al-Irsyad Journal of Mathematics Education* 5, no. 1 (January 12, 2026): 352–64, <https://doi.org/10.58917/ijme.v5i1.566>.

21 Maulidiyah Tutut Nurjanah, Cholis Sa'dijah, and Susiswo Susiswo, "Representasi Skematis Siswa Dalam Menyelesaikan Masalah Trend in International Mathematics and Science Study (TIMSS) Ditinjau Dari Self Efficacy," *Jurnal Pendidikan: Teori, Penelitian, Dan Pengembangan* 6, no. 4 (April 30, 2021): 622–34, <https://doi.org/10.17977/jptpp.v6i4.14725>.

22 Yuni Azura Risma Chulashotud Diana, Prapti Octavia Ningsih, "Mathematics Learning In The Difusi Era: Strategies And Challenges In Madrasah Ibtidaiyah," *PIONIR Jurnal Pendidikan* 15, no. 1 (2026): 14–26, <https://jurnal.ar-raniry.ac.id/index.php/Pionir/article/view/31707>.

Gamification also contributes significantly to students' conceptual understanding of statistical concepts. Statistics requires learners to recognize patterns, organize information, interpret data, and draw conclusions based on evidence. These competencies are often difficult to develop through passive instructional methods. According to Nafisah and Winoto, active learning experiences allow students to interact directly with learning materials and construct knowledge independently.²³ Through gamified activities, students may engage in data collection missions, classify information, and present findings using tables or graphs. Such activities provide opportunities for experiential learning and encourage students to connect statistical concepts with real-life situations. Herlina and Juandi further explain that meaningful understanding develops when learners actively participate in the learning process rather than merely receiving information from teachers.²⁴

The effectiveness of gamification can also be understood through cognitive development theories. Piaget explains that elementary school students are generally in the concrete operational stage, where learning occurs most effectively through direct experiences and observable objects. Gamified learning activities often involve manipulation of data, visual representations, and collaborative problem-solving tasks that align with these developmental characteristics. Furthermore, Bruner's theory suggests that learning progresses through enactive, iconic, and symbolic representations. Through gamification, students may first engage in concrete activities, then interpret visual representations such as graphs, and eventually understand abstract statistical concepts. Consequently, gamification serves as an instructional bridge that supports students' cognitive development while facilitating the learning of complex statistical concepts.

Another important finding identified in the literature is the positive influence of gamification on student engagement. Classroom engagement encompasses cognitive, behavioral, and emotional dimensions that contribute to successful learning outcomes. Risma Chulashotud Diana, Prapti Octavia Ningsih note that gamified activities encourage students to analyze information, solve problems, and make decisions, thereby enhancing cognitive engagement. Behavioral engagement is strengthened through active participation in missions and collaborative challenges, while emotional engagement emerges from feelings of enjoyment, curiosity, and achievement. The integration of game elements creates a positive learning atmosphere that motivates students to remain involved in learning activities and persist when encountering difficulties. Consequently, students often develop more positive attitudes toward statistics and mathematics as a whole.

In addition to improving academic learning, gamification contributes to the development of twenty-first-century skills. Contemporary education emphasizes the importance of communication, collaboration, critical thinking, creativity, and problem-solving. Rahmadhani explains that interactive learning environments provide opportunities for students to exchange ideas, discuss findings, and collaborate in solving problems.²⁵ Within gamified statistics learning, students are encouraged to interpret data critically, justify conclusions based on evidence, and communicate results effectively. Furthermore, activities such as designing surveys, creating

23 Elok Nafisah and Yunus Winoto, "Perpustakaan Digital Dalam Publikasi Jurnal Internasional : Digital Library in International Journal Publications :," *Nusantara Journal of Information and Library* ... 5, no. 1 (2022): 1–14, <http://119.235.17.41/index.php/JILS/article/view/1510> <http://119.235.17.41/index.php/JILS/article/1510>.

24 Sari Herlina and Dadang Juandi, "Systematics Literature Review: Pengembangan Mathematical Proficiency Dalam Pembelajaran Matematika," *Jurnal Cendekia : Jurnal Pendidikan Matematika* 6, no. 2 (2022): 2122–33, <https://doi.org/10.31004/cendekia.v6i2.1417>.

25 Elfi Rahmadhani, "Ethnomathematics Dan Permainan Tradisional Dalam Pendidikan Matematika," *JPMI – Jurnal Pembelajaran Matematika Inovatif* 5, no. 1 (2022): 81–94, <https://doi.org/10.22460/jpmi.v5i1.81-94>.

graphical representations, and proposing solutions to data-related problems foster creativity and innovation. Therefore, gamification not only supports students' mastery of statistical concepts but also prepares them with essential competencies required for lifelong learning and participation in modern society.

Implementation and Challenges of Gamification in Statistics Learning at Madrasah Ibtidaiyah

The successful implementation of gamification in statistics learning requires careful planning and alignment with instructional objectives. The literature suggests that gamification should not merely focus on entertainment but should function as a pedagogical strategy that supports meaningful learning experiences. In the context of Madrasah Ibtidaiyah, teachers can integrate game elements such as points, badges, levels, missions, rewards, and leaderboards into classroom activities to increase student participation and motivation. According to Ningsih et al, the effectiveness of gamification depends on how well these elements are connected to learning outcomes and students' developmental characteristics. Therefore, teachers need to design learning experiences that balance educational goals with engaging activities, ensuring that students remain focused on understanding statistical concepts while enjoying the learning process.

One practical strategy identified in the literature is mission-based learning. In this approach, students complete a sequence of activities structured as missions, with each mission targeting a specific statistical competency. For example, students may begin by collecting data from classmates, followed by organizing the information into tables, constructing graphs, and finally interpreting the results. Such a sequence allows students to experience the complete process of statistical investigation in an engaging and systematic manner. The use of points and badges can further reinforce participation by providing recognition for completed tasks and achievements. These rewards encourage students to remain actively involved throughout the learning process while fostering a sense of accomplishment and progress.

In addition to mission-based activities, role-playing and collaborative challenges can be effectively incorporated into statistics learning. Students may assume the roles of researchers, journalists, surveyors, or data analysts who are responsible for solving real-world problems using statistical information. Islamiah et al. explain that contextual and problem-oriented activities can enhance students' understanding by connecting academic concepts with authentic experiences.²⁶ Through classroom quests and group challenges, students are encouraged to communicate, negotiate, and collaborate while analyzing data and presenting findings. Such activities not only strengthen conceptual understanding but also create enjoyable learning experiences that increase students' interest in statistics and mathematics.

An important finding from the literature is that gamification does not necessarily require sophisticated digital technology. Although educational applications and online platforms can support gamified learning, effective implementation can also be achieved through simple classroom resources. Teachers may use stickers, cards, tokens, charts, worksheets, or classroom scoreboards to create gamified learning environments. This finding is particularly relevant for Madrasah Ibtidaiyah with limited technological infrastructure. By utilizing accessible and low-cost materials, teachers can still implement meaningful gamification strategies without depending on advanced technological resources. Consequently, gamification can be adapted to various educational contexts and school conditions.

26 Maulidi Arsih Umaroh Islamiah et al., "Analisis Pemecahan Masalah SPLTV Berdasarkan IDEAL Problem Solving Ditinjau Dari Gaya Belajar Visual-Auditorial-Kinestetik (VAK)," *Journal of Mathematics Education and Learning* 2, no. 1 (March 30, 2022): 74, <https://doi.org/10.19184/jomeal.v2i1.25589>.

Despite its potential benefits, the implementation of gamification presents several challenges. One major challenge is teacher readiness. Effective gamification requires teachers to possess sufficient knowledge of instructional design, classroom management, and game-based learning principles. Teachers must be able to select appropriate game elements, design engaging activities, and ensure that learning objectives remain the primary focus of instruction. Kuswandi et al. emphasize that insufficient preparation may lead to the ineffective use of gamification, where game elements become distractions rather than tools for enhancing learning.²⁷ Therefore, teacher competence plays a crucial role in determining the success of gamified instruction.

Another challenge involves limitations of time and educational resources. Designing gamified learning activities often requires additional preparation compared to conventional teaching methods. Teachers need time to create missions, prepare materials, develop assessment criteria, and monitor student progress. Furthermore, schools may face constraints related to learning materials, facilities, or technological support. The literature also highlights the importance of maintaining a balance between learning and entertainment. Excessive emphasis on rewards, competition, or leaderboards may shift students' attention away from educational objectives. Consequently, gamification should be implemented carefully to ensure that game elements support rather than overshadow the learning process.

The findings of this study have several implications for educational practice in Madrasah Ibtidaiyah. Teachers are encouraged to adopt more student-centered approaches that promote active participation, collaboration, and meaningful learning experiences. Professional development programs should provide opportunities for teachers to learn about gamification principles and instructional design strategies. Curriculum developers may also consider integrating gamification concepts into learning materials and classroom activities to support competency-based education. Furthermore, school administrators should create supportive environments that encourage innovation and experimentation in teaching practices. As noted by Junedi et al. (2024), educational innovation is more likely to succeed when supported by institutional commitment and continuous professional development. Therefore, collaboration among teachers, schools, and curriculum stakeholders is essential for maximizing the potential of gamification in statistics learning at Madrasah Ibtidaiyah.

CONCLUSION

This study examined the pedagogical potential of gamification in statistics learning within the context of Madrasah Ibtidaiyah through a qualitative library research approach. The findings indicate that gamification offers significant opportunities to address the challenges commonly associated with statistics education at the elementary level, particularly students' low motivation, limited engagement, and difficulties in understanding abstract concepts. By integrating game elements such as challenges, rewards, missions, collaboration, feedback, and progression systems into instructional activities, gamification can create more interactive and meaningful learning experiences. The reviewed literature consistently suggests that gamified learning environments encourage active participation, foster positive attitudes toward learning, and support conceptual understanding by transforming abstract statistical concepts into concrete and engaging experiences. Furthermore, gamification aligns with constructivist learning principles and the developmental characteristics of Madrasah Ibtidaiyah students, who generally learn more effectively through experiential, contextual, and interactive activities. Beyond improving learning engagement, gamification also has the potential to promote communication, collaboration, creativity, critical thinking, and problem-solving skills that are increasingly emphasized in twenty-first-century education.

27 Dedi Kuswandi et al., "Development Of Life-Based Curriculum Model Designs In The Global Era," in *Proceeding on International Conference of Science Management Art Research Technology (IC-SMART)*, vol. 1, 2020, 26–32, <https://doi.org/10.31098/ic-smart.v1i1.23>.

The study contributes to the growing body of literature on educational innovation by providing a focused synthesis of gamification research within the relatively underexplored context of statistics education in Madrasah Ibtidaiyah. While previous studies have largely concentrated on gamification in general mathematics education or technology-enhanced learning environments, this study highlights its specific pedagogical relevance for teaching statistics to young learners in Islamic elementary schools. The findings contribute theoretically by connecting gamification with constructivist learning theory, cognitive development perspectives, and student-centered pedagogical approaches. Practically, the study demonstrates that meaningful gamification does not necessarily depend on sophisticated digital technologies but can also be implemented through low-cost and contextually appropriate learning activities. Nevertheless, the findings should be interpreted with caution. As a literature-based study, this research relies on existing scholarly sources rather than direct classroom observations or empirical interventions. Consequently, the conclusions reflect patterns identified across the literature and cannot fully capture the complexity of classroom implementation, contextual variations, teacher readiness, resource availability, or differences in student characteristics across educational settings.

Given these limitations, future research should move beyond conceptual and literature-based discussions toward empirical investigations that examine the actual effectiveness of gamification in statistics classrooms. Experimental, quasi-experimental, mixed-method, and design-based research approaches are needed to evaluate the impact of specific gamification strategies on students' statistical reasoning, conceptual understanding, learning retention, and long-term motivation. Future studies should also explore how different game elements contribute to distinct learning outcomes and investigate the conditions under which gamification may be most effective or less effective. Comparative studies across grade levels, school contexts, and technological environments would further enrich understanding of its pedagogical value. In addition, researchers are encouraged to develop and validate gamification models specifically designed for statistics learning in Madrasah Ibtidaiyah, taking into account curricular objectives, developmental characteristics, and local educational needs. Such efforts would strengthen the evidence base for gamification and support the development of more engaging, inclusive, and pedagogically sound statistics education practices in elementary Islamic schools.

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