# Application of Gamification for Learning Biology Materials in Junior High School

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**Abstrak–** Pendidikan merupakan fondasi utama dalam pengembangan individu, dan belajar adalah inti dari proses tersebut. Kegiatan belajar, yang esensinya adalah upaya seseorang untuk memperluas wawasan, memperdalam pengetahuan, serta mengkonstruksi perubahan perilaku, sering kali dihadapkan pada berbagai tantangan implementasi. Metode pembelajaran konvensional yang masih banyak diterapkan, seperti penggunaan papan tulis sebagai media utama, dinilai kurang efektif dalam mengakomodasi dinamika belajar siswa. Pembelajaran dengan metode tradisional ini memiliki beberapa kelemahan signifikan, antara lain penurunan konsentrasi siswa dalam menyerap materi teori yang disampaikan oleh guru, serta timbulnya kesan monoton dan membosankan yang dapat menghambat minat belajar. Permasalahan ini menjadi sangat krusial terutama dalam pembelajaran biologi, yang mana materi tentang tumbuhan lumut dapat diintegrasikan ke dalam bab "Klasifikasi Makhluk Hidup" atau "Ekologi dan Pelestarian Lingkungan" di kelas VII (sesuai Kurikulum Merdeka) yang cenderung abstrak dan memerlukan visualisasi yang baik. Di tengah tantangan tersebut, gamifikasi muncul sebagai solusi inovatif. Gamifikasi, yang memanfaatkan elemen permainan dalam konteks non-permainan, terbukti efektif meningkatkan motivasi belajar siswa. Pendekatan ini mengubah pembelajaran yang membosankan menjadi pengalaman menyenangkan dan menarik. Dengan teknologi, gamifikasi menghadirkan materi sulit menjadi lebih mudah dicerna dan memberikan pengalaman belajar interaktif. Penelitian ini bertujuan untuk mengevaluasi efektivitas pendekatan pembelajaran berbasis gamifikasi yang memanfaatkan QR code dan multimedia untuk meningkatkan motivasi dan pemahaman siswa SMP pada materi yang berkaitan dengan tumbuhan lumut dalam konteks bab klasifikasi makhluk hidup dan ekologi sesuai Kurikulum Merdeka. Aplikasi ini menggunakan QR code untuk akses subtopik biologi, khususnya tumbuhan lumut. Sistem gamifikasi menerapkan mekanisme reward untuk meningkatkan daya tarik siswa. Setiap QR code mengarahkan siswa pada subtopik berbeda, menciptakan alur belajar dinamis. Metode penelitian meliputi: (1) analisis konteks penelitian, (2) identifikasi partisipan (siswa SMP), (3) perancangan model pembelajaran gamifikasi, dan (4) evaluasi motivasi belajar. Data dikumpulkan melalui wawancara mendalam dan kuesioner pada 17 siswa SMP usia 12-14 tahun. Wawancara menggali pengalaman belajar, sementara kuesioner mengukur motivasi belajar sebelum dan sesudah penggunaan aplikasi. Penelitian ini mengintegrasikan platform KAHOOT! untuk evaluasi pembelajaran, yang menyajikan evaluasi dalam bentuk multimedia interaktif. Hasil penelitian menunjukkan bahwa pembelajaran dengan pendekatan gamifikasi dan integrasi KAHOOT! memberikan dampak positif terhadap peningkatan motivasi belajar siswa. Temuan ini mengindikasikan bahwa gamifikasi memiliki potensi besar sebagai alternatif metode pembelajaran yang efektif dan menarik dalam konteks pendidikan modern..

**Kata Kunci:** Gamifikasi, Kode QR, Mata Pelajaran Biologi, Tanaman Lumut, KAHOOT!

**Abstract–** Education is a fundamental pillar in individual development, and learning is at the core of this process. Learning activities, which essentially involve expanding one's horizons, deepening knowledge, and constructing behavioral changes, often face various implementation challenges. Conventional teaching methods, such as using blackboards as the primary medium, are considered less effective in accommodating students' learning dynamics. These traditional methods have significant drawbacks, including decreased student concentration in absorbing theoretical material presented by teachers, as well as creating monotonous and boring impressions that can hinder learning interest. This problem is particularly crucial in biology education, where material about moss plants can be integrated into the "Classification of Living Things" or "Ecology and Environmental Conservation" chapters in 7th grade (according to the Kurikulum Merdeka), which tends to be abstract and requires good visualization. Amidst these challenges, gamification emerges as an innovative solution. Gamification, which utilizes game elements in non-game contexts, has proven effective in increasing student motivation. This approach transforms boring learning into a fun and engaging experience. With technology, gamification makes difficult material easier to digest and provides interactive learning experiences. This research aims to evaluate the effectiveness of a gamified learning approach that utilizes QR codes and multimedia to enhance junior high school students' motivation and understanding of material related to moss plants in the context of the classification of living things and ecology chapters according to the Kurikulum Merdeka. This application uses QR codes to access biology subtopics, particularly moss plants. The gamification system implements a reward mechanism to enhance student appeal. Each QR code directs students to different subtopics, creating a dynamic learning flow. The research methods include: (1) analysis of the research context, (2) identification of participants (junior high school students), (3) design of a gamification learning model, and (4) evaluation of learning motivation. Data was collected through in-depth interviews and questionnaires from 17 junior high school students aged 12-14 years. Interviews explored learning experiences, while questionnaires measured learning motivation before and after using the application. This research integrates the KAHOOT! platform for learning evaluation, which presents evaluations in interactive multimedia format. The research results show that learning with a gamification approach and KAHOOT! integration has a positive impact on increasing student learning motivation. These findings indicate that gamification has great potential as an alternative, effective, and engaging learning method in the context of modern education.

**Keywords**: Gamification, QR Code, Biology Subject, Lichen Plants, KAHOOT!

# 1. INTRODUCTION

Learning is an activity and a human need to add insight and change behavior and demand humans towards maturity, humans are also known as homo educandum or educated humans. Learning provides humans with a deep understanding of a field. The importance of this learning needs to be supported by a good learning system. In the learning process, sometimes a tool is needed to make it easier to understand what will be learned, for example the use of digital technology such as gamification which is applied by several researchers in science education [1]. Technology can be used in the learning process to improve learning effectiveness and student skills [2], [3], [4]. Biology is the study of life forms involving humans, plants and animals. Biology also helps humans to understand how to care for animals and plants in the right way [5]. In terms of learning about biological material, some subject matters are difficult to remember or understand by students. While specific mention of moss plants may not be present as a standalone topic, related concepts can be integrated into chapters like "Classification of Living Things" and "Ecology and Environmental Conservation" within the 7th-grade biology curriculum (Kurikulum Merdeka) [6]. However, the abstract nature of these biological concepts, coupled with traditional teaching methods, often presents challenges for educators in engaging students effectively.

Traditional lessons are a challenge for teachers, particularly when dealing with abstract concepts. Studies show that traditional methods can lead to decreased student concentration and a lack of engagement [cite studies showing lack of engagement in traditional biology lessons]. We propose a practical way of learning that is easy, efficient and less boring than the typical regular class using gamification [7]. The use of gamification in the learning process has many positive impacts on student achievement and student learning activeness [8]. The positive impact generated in the application of gamification can also be felt by all students, both male and female students [9]. In addition, the good effects of gamification implementation are also shown in several studies produced on similar topics by researchers in various countries and provide satisfactory results [10]. Learning games provide an interesting learning mechanism and increase students' enthusiasm for learning [11]. Education through digital games is an example of using technology as an educational tool that contributes positively to students when they engage in activities they enjoy. Due to the development of a teacher-focused teaching paradigm has been moved to student intrusion, where both teachers and students are actively involved in learning activities [12]. From some research results, it is mentioned that most students and teachers feel the benefits of using gamification for the learning process [13], [14]. One of the studies showed students' interest in the use of gamification after using it and students proposed that this method could be applied by other teachers so that other students could feel the same benefits [15].

In a previous study, gamification was defined as a form of service integrated with games to enhance user experience [16]. Gamification is classified into 5 dimensions, namely (1) performance/measurement, in this dimension gamification is associated with user or environmental responses, (2) Ecological, this dimension describes the environment in which gamification is used, (3) social, this dimension relates gamification between the influence of the social environment and students, (4) personal, this dimension describes the personal elements of students in gamification, and (5) fictional, this dimension is a combination of user and environment [17]. Gamification applies a reward system like a game in general that aims to attract interest and provide a fun experience for participants [13], [18]. Rewards are one type of reward to appreciate the results of a person's performance. Giving a reward can significantly improve the quality of a person's work because the person feels that the results of their performance are appreciated. Even gamification has a long-term effect in changing a person's behaviour [19]. Therefore, it is crucial to find ways to effectively implement gamification in specific contexts, such as biology education. Gamification applications do not apply the whole game concept but only take some elements contained in the game that are likely to be applied in real life [17].

QR codes or quick response codes are cryptographic techniques that rely on optical technology in hiding messages or data. QR codes are a popular cryptographic technique to use because they can decrypt noise-free data from encryption [20]. Given the potential of gamification to enhance learning and the utility of QR codes for accessing information, combining these two approaches could offer a novel solution for engaging students with challenging topics related to plant life, as covered within the "Classification of Living Things" and "Ecology and Environmental Conservation" chapters. QR codes have several advantages, such as having a large data capacity, relatively small, superior tags, and can scan at high speed. Although QR codes have many advantages compared to other cryptographic techniques, QR codes have several weaknesses, according to several researchers, the weaknesses that exist in QR codes include requiring an internet connection, requiring gadgets, and even problems related to the users themselves [21]. This research was prepared with the aim of investigating the effectiveness of a gamified learning approach that combines QR codes and multimedia elements to enhance student motivation and understanding of biological concepts related to plant life, as integrated into the "Classification of Living Things" and "Ecology and Environmental Conservation" chapters. This study seeks to address the challenges of teaching abstract biological concepts by leveraging the interactive and motivating features of gamification and readily accessible technology."

# 2. RESEARCH METHODS

The methodological framework of this study, as depicted in Figure 1, is meticulously structured into four interconnected stages: (1) research context, (2) research participants, (3) learning model, and (4) motivation assessment. This multi-faceted and rigorous approach ensures a comprehensive investigation into the impact of gamification on student learning, specifically within the realm of biology education focusing on concepts related to plant life, as covered in the "Classification of Living Things" and "Ecology and Environmental Conservation" chapters. Each stage is designed to address distinct, yet related, aspects of the research question, enabling a holistic understanding of the phenomena under study. This framework ensures transparency, facilitating replicability and providing a robust foundation for the interpretation of results.

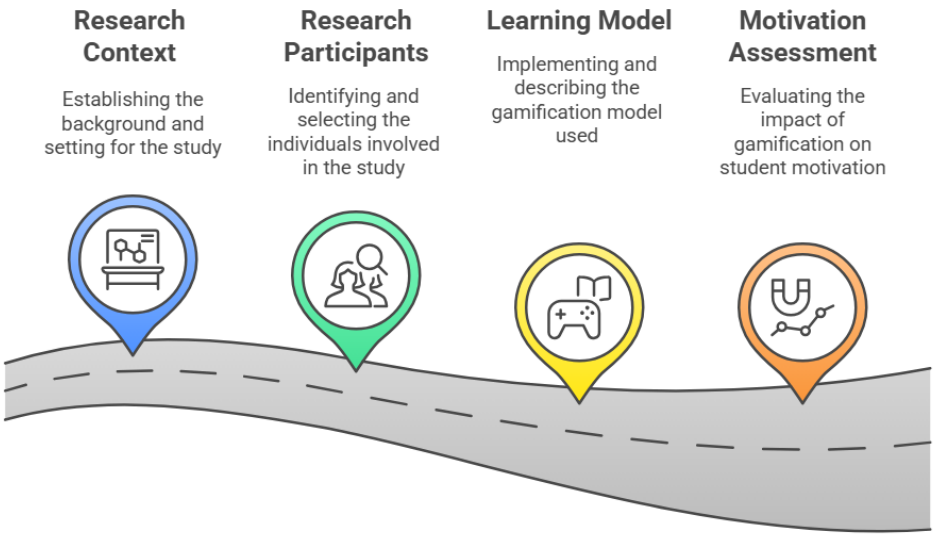


**Figure 1.** Research Methods.

### 2.1 Research Context

The initial stage, research context, is crucial for establishing a clear understanding of the specific setting in which the study was conducted. Unlike a broad overview of multiple educational contexts, this research is deliberately focused on a specific learning environment. This stage provides an in-depth examination of this particular setting. Specifically, this study is constrained to a focused curriculum: concepts related to plant life, which can be integrated into the "Classification of Living Things" and "Ecology and Environmental Conservation" chapters, aligning with the standards stipulated in the Kurikulum Merdeka at XYZ Junior High School. This school, though identified as XYZ for anonymity, provides a controlled environment for exploring the effects of gamification on a pre-defined educational objective. This research was conducted in 2025, when the Kurikulum Merdeka was being implemented in XYZ Junior High School as part of the Mandiri Belajar phase. The Kurikulum Merdeka, as the governing curriculum for the school, dictates the scope and depth of learning for these particular biology topics, setting the boundaries for the content to be taught. The context of this research is therefore set by adherence to this syllabus, which determines what the students should learn about plant life within the framework of these chapters. This section will carefully examine the scope and depth of the relevant concepts within the Kurikulum Merdeka. This ensures that the study aligns with the standardized educational expectations. In addition to the school's reliance on the Kurikulum Merdeka, an in-depth analysis of the resources available in the classroom specifically for learning these biology concepts is presented in this section. The specific teaching approaches employed for the topic in typical classroom settings at XYZ Junior High School prior to this study is also explored to create a baseline reference. The research context is not only concerned with the curriculum but also provides an understanding of the resources available for learning including textbooks, lab facilities, and other supplementary resources that are in place. This section includes a discussion on how these resources typically are employed for learning the content. This allows for a direct comparison between traditional teaching and the gamification method. This carefully circumscribed research context enables a focused and nuanced analysis of gamification's impact within a well-defined setting.

### 2.2 Research Participants

The second stage, research participants, centers on the individuals participating in the study, providing a detailed profile of the student group involved. In this study, the participant group consists of a total of 17 students. The participants are carefully selected from junior high schools located in Yogyakarta and Palangka Raya, Indonesia. This selection provides a valuable cross-section of students from diverse geographic locations within Indonesia, allowing the researchers to understand whether the approach of the study is widely applicable across different educational settings. While these locations are different, the participants are all within the same educational level (junior high school) and within the same age range. The study ensures each student participating will experience a complete gamification-based learning process that begins with the usage of QR codes and concludes with KAHOOT! used as an evaluation tool. This section therefore provides an overview of the study method. This study is designed for junior high schoolers; therefore, all participants are within the age range of 12 to 14 years old. The concepts related to plant life, while not explicitly taught as a standalone unit on moss plants, are typically introduced in the 7th grade as part of the "Klasifikasi Makhluk Hidup" and "Ekologi dan Pelestarian Lingkungan" chapters within the Kurikulum Merdeka. The age range makes sure that the study focuses on learners that are typically learning these concepts. A brief description of each of the locations of the participating schools is presented, and includes any other information on other key differences that might be significant for the study. The demographic information also includes gender distribution and other potentially relevant background information of students. It also clarifies the process used to select participants, ensuring their understanding that the study is focused on learning concepts related to plant life using QR codes and KAHOOT!, and that their feedback is valuable for the research. A description of the ethical considerations involved in the recruitment of participants is also given. This includes the procedure used to obtain consent from both the students and their guardians in both Yogyakarta and Palangka Raya, and the mechanisms that were used to ensure that the students have the right to withdraw from the study at any time without negative consequences. The section also clarifies if the participants had previous experience with gamification before this study, which allows for a comparison between participants who have or have not experienced gamification before. The research also attempts to clarify previous science and biology grades to provide additional context to the analysis.

### 2.3 Learning Model

The third stage, learning model, outlines the practical application of gamification within the research framework. The learning model is specifically designed to integrate QR codes for access to learning materials and utilizes KAHOOT! for learning evaluation. The learning model is therefore gamification-based. The section begins by detailing the process of content creation for the gamified system, ensuring alignment with the Kurikulum Merdeka and its emphasis on integrating concepts related to plant life into the "Klasifikasi Makhluk Hidup" and "Ekologi dan Pelestarian Lingkungan" chapters. The first step is searching and extracting all available material on plant life that is relevant to the standards and the objectives of the curriculum, focusing on how these concepts are presented within the chosen chapters. The second step involves taking all the identified materials and converting them into quiz questions. The conversion includes carefully designing questions that align to the key learning objectives of the curriculum. The quiz formats also include several question types and levels of challenge. In the third step, a detailed explanation is given on the process used to generate the QR codes. It also explains how they link to a learning website that provides access to learning materials and quiz questions, which ensures access is easy and seamless. The final part of the learning model centers on the use of KAHOOT! as an evaluation tool. This also specifies how the quizzes are integrated into the KAHOOT! platform, including the type of questions used, scoring methods and overall design of quizzes for both learning and testing. This entire learning model is explained, including the flow of learning from the use of QR codes, to the study materials, and then the quizzes and evaluations. This section also provides information on the technical aspects of the learning process and gives information on how technology is used to ensure an effective and engaging learning environment. The section also discusses in more detail the steps in Figure 2 which illustrates the learning model. It also highlights the various stages of the learning activity and how it is aligned to the research objectives. This section provides clarity on the mechanics and procedures behind the learning process.

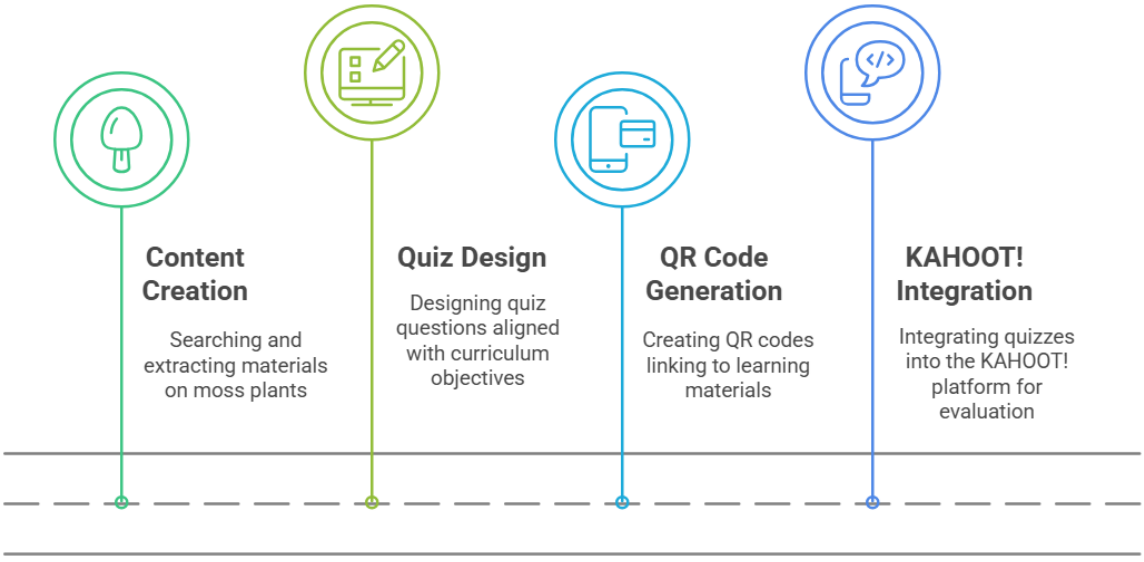


**Figure 2.** Learning Model.

### 2.4 Motivation Assessment: Measuring the Impact

The fourth and final stage, motivation assessment, remains consistent with the prior detailed description of the methods for data collection related to student motivation. This section focuses on the specific methods for data collection and analysis of student enthusiasm for learning both before and after using the gamified model.

## 3. RESULTS AND DISCUSSION

This section presents a comprehensive analysis of the findings derived from the implementation of the gamification-based learning approach, integrating both quantitative and qualitative observations to evaluate its effectiveness. The results will be presented systematically, followed by an in-depth discussion that interprets the findings in relation to the research questions and existing literature. The structure of this section mirrors the chronological sequence of the learning process, starting with the gamified learning using QR codes and then moving on to the learning evaluation using KAHOOT!.

### 3.1 Gamification-Themed Learning Using QR Codes: An Immersive Experience

The implementation of gamified learning through QR codes formed a crucial part of this research, aiming to make the concepts related to plant life, as integrated into the "Classification of Living Things" and "Ecology and Environmental Conservation" chapters of the Kurikulum Merdeka, more tangible and engaging for junior high school students. The initial stage of the learning process involved the students actively using their smartphones to interact with their learning environment. Each student was instructed to bring a smartphone to the learning session, equipped with a functional QR code scanning application. This was designed not only to be a method of delivering learning material but also as a step towards integrating technology into daily learning activity. Prior to the actual learning, the researchers had prepared multiple plant pots, each containing different species of plant. This was a key element of the learning approach; the use of real plants allows for sensory engagement as students are able to touch, observe and interact with the actual plants, making the learning process more concrete. The real plants helped to bridge the gap between conceptual learning and the tactile experience of the subject matter. QR codes were strategically placed on each plant pot, transforming the learning environment into an interactive learning space, connecting the physical presence of plants to the digital world. As seen in Figure 3, students were actively engaged in scanning these QR codes. This interaction was not a passive one, requiring the students to take initiative and move around the learning environment, further encouraging active engagement.

Each QR code acted as a portal, providing a Uniform Resource Locator (URL) address that led directly to a carefully constructed learning website. This website was specifically designed for this research, taking into

account the educational objectives and learning styles of the students. The website served as a centralized repository of knowledge which was accessed through the QR codes. The content on the website was carefully tailored and compiled to align perfectly with the Junior High School level Curriculum Standards, specifically those that related to the biology of plant life within the "Classification of Living Things" and "Ecology and Environmental Conservation" chapters of the Kurikulum Merdeka. This alignment ensured that the research findings were directly applicable to a real-world educational environment. The website included information regarding the structure, life cycle, classification, and ecological significance of plants. This was done using a combination of textual descriptions, high-resolution images, and in some cases, short informative videos, to cater to diverse learning styles.

The learning materials were constructed in an easy-to-understand format, ensuring that students of various learning styles could readily engage with the content. The information was carefully broken down into manageable segments, each focusing on different parts of plant biology to avoid information overload. The multimedia elements were used not only to enhance understanding but also to maintain student engagement and interest, and to ensure the content was visually stimulating. The visual content included detailed diagrams of plant structures, photographs of different plant species, and other relevant visual aids. The learning material on the website wasn't simply a digital textbook; instead, it was designed to encourage active learning by using interlinking segments, with clear navigational tools to ensure that students could easily explore the information at their own pace. This aligns with the research objective of incorporating multimedia elements to create an engaging and practical learning experience, specifically through the use of text, images, videos, animations, and interactive simulations.

Upon accessing the website through the QR codes, students encountered not only learning materials but also interactive quizzes. These quizzes, as shown in Figure 4, were specifically designed to assess and reinforce the knowledge students had acquired from the learning material. This method ensured students were actively engaging with the learning material rather than just passively reading. The quizzes were presented in multiple choice formats as well as short answers, ensuring that they aligned with the diverse educational testing standards used in the junior high school level and also encouraged students to think critically about the material they just studied. The students responded to the quizzes either on their smartphones or the laptops they were provided with during the research. This method of learning enabled students to be proactive in their own learning journey. The quizzes were strategically positioned at regular intervals within the website content, acting as checkpoints to make sure the learning was being understood and retained. This ensured that the learning material was not simply memorized by students but actively analyzed, as students were given a chance to check their understanding in real-time. These quizzes also served as an opportunity for the researcher to gather immediate feedback on the effectiveness of the learning materials. The system provided immediate feedback to the students and, also for the researcher, by recording the students' responses, which created a mechanism that identified the areas where students did not perform well. This made it possible to refine the material for the next learning session. The method of learning allowed students to move freely around the learning setting, scanning different QR codes, exploring different topics and quizzes which made for an engaging and student-centered learning environment. This approach allows students to personalize their own learning experience, based on their areas of interest.

### 3.2 Evaluation of Learning Using KAHOOT!: A Gamified Assessment

The evaluation of the learning process involved the use of the KAHOOT! platform, which provided a fun, engaging, and competitive assessment method, which also aligns with several studies [22], [23] that indicate that the use of such practical applications can enhance the learning experience of the students. Previous research consistently highlights the power of gamification as an effective method of increasing engagement and enhancing learning outcomes. KAHOOT!, as a popular and widely used educational tool, fits perfectly within the framework of the research as it facilitates interactive learning [24], [25]. In this study, however, KAHOOT! was utilized specifically as an evaluation tool, rather than a general learning tool, in the final phase of the learning activity. The quizzes were prepared based on the material that was made available through the QR code learning system and focused on evaluating students' knowledge about the learning materials.

After the previous learning activities which involved scanning of QR codes, reading material on websites and taking online quizzes, the students moved to KAHOOT!. In this phase of the research, the students were all given a shared screen where they saw a series of quiz questions, all designed to assess their grasp of the material learnt through the QR code system. The questions were designed to evaluate the understanding of the various aspects of plant biology including structure, life cycle, ecology and classification. As seen in Figure 5, the design of the quizzes was deliberately simple and straightforward to ensure easy usability for all students. The quizzes utilized multimedia components, which included text and image-based questions, to make the learning activity more engaging. All quiz questions were directly related to the plant material they had previously encountered via the QR code learning process, thereby creating a seamless link between the learning phase and the testing phase. The timing and format of the questions was carefully calibrated to ensure that all students had sufficient time to read the questions, and provide answers.

After completing the KAHOOT! quizzes, the system automatically calculated the results, and in addition (as shown in Figure 6, the quiz process) provided awards and rankings to the students (as seen in Figure 7). This ranking was presented in a format that emulated common gaming methods, by displaying student names on a leaderboard along with their scores. This element of competition has the potential to not only stimulate student interest but also foster a competitive attitude among students which promotes engagement in the learning activities. This study corroborates previous findings that awards and ranking systems can lead to a learning experience that is highly engaging and fosters a positive competitive environment [26]. In addition, the use of KAHOOT! as an evaluation platform enabled a dynamic, interactive assessment that promotes student enjoyment, and also provided data which gave a clear indication of each student's performance during evaluation.

**Figure 3.** Students Scan QR Codes.

### 3.3 Discussion of Results and Implications

The findings of this study strongly indicate that the incorporation of gamification into the learning process, utilizing QR codes and KAHOOT!, has a profound positive impact on student engagement and their overall learning experience. The multi-faceted approach, combining physical interaction, digital exploration, and interactive quizzes, succeeded in transforming concepts related to plant life, as integrated into the "Classification of Living Things" and "Ecology and Environmental Conservation" chapters, into an engaging and interactive experience. The use of QR codes provided students autonomy in their learning journey, giving them control over their learning pace and allowing them to explore topics at their own level of interest. The strategically placed quizzes on the learning website were effective in reinforcing learning outcomes by acting as consistent checkpoints. The integration of real plants within the learning environment further elevated learning engagement by creating practical, hands-on experience which complemented the digital learning. The KAHOOT! quizzes provided an engaging method for evaluation, allowing a combination of competition with collaborative learning.

The key findings from this research highlight that technology integration is not just a supplementary approach, but a core element in enhancing engagement and learning. These results underscore that gamification, implemented with the careful selection of technologies, has the ability to transform the overall learning experience from the perception of a passive learning activity, to one where the students are active and engaged learners. The detailed learning activities described, and also the process of assessment demonstrates a strong connection between innovative teaching and improved student interest. The findings are also consistent with previous studies [22],[23],[24],[25],[26] which show that the practical application of technology enhances student engagement, motivation and learning. The results from the questionnaires, as shown in Table 1, further substantiate these findings by highlighting significant changes in student motivation across all four indicators: Interest, Relevance, Confidence, and Satisfaction. The data indicates a substantial increase in positive responses after the gamified intervention. For instance, the percentage of students expressing Interest in the subject matter increased from 29% to 94%. Similarly, the percentage of students finding the material Relevant increased from 18% to 88%, those expressing Confidence in their ability to learn the material increased from 12% to 82%, and those reporting Satisfaction with the learning experience increased from 24% to 90%. This dramatic improvement clearly demonstrates that the approach used in the study, combining technology, gamification, and practical learning experiences, has a significant positive impact on student enthusiasm to learn. This suggests that the use of digital

devices, along with the practical learning techniques, can significantly enhance student engagement. These positive shifts in motivation are crucial as they are key determinants of learning, indicating that this approach not only leads to better outcomes but also makes the learning process more enjoyable for students. The table clearly shows a combination of practical learning with the use of technologies such as QR codes, web-based resources and gamification via KAHOOT! has the potential to drastically improve motivation.

**Figure 4.** Students Answer Quizzes.

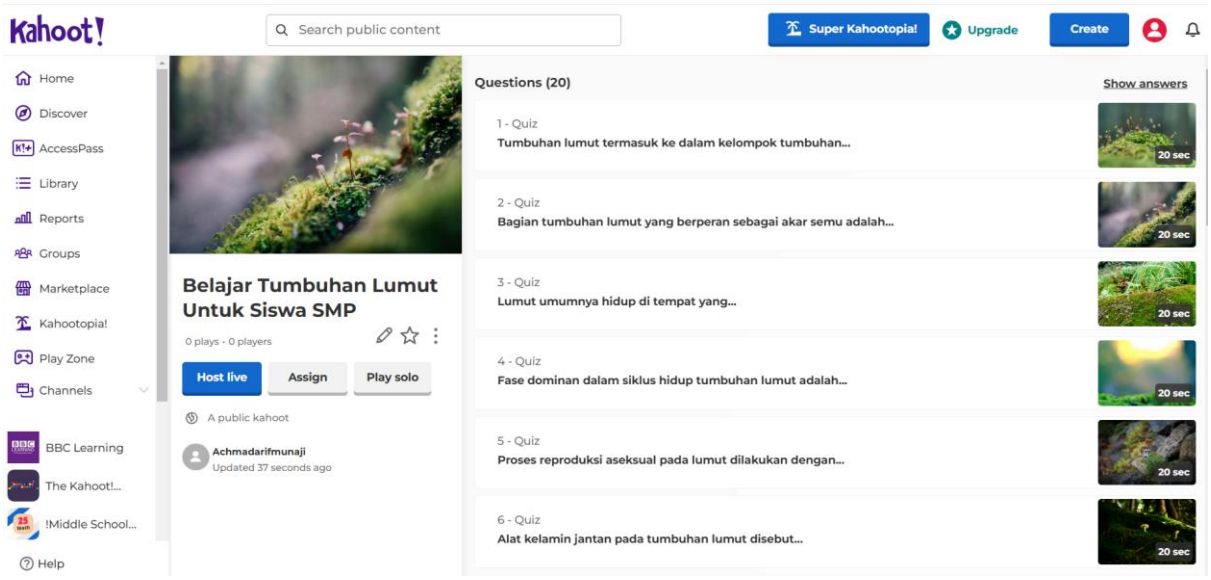


**Figure 5.** Evaluation quiz with KAHOOT!.

This finding is also particularly relevant in the field of biology where some concepts can be complex, or abstract. By transforming this learning into a fun, gamified experience, this research was able to bridge the gap between the conceptual aspects of learning and the students actual engagement. The findings underscore that a combination of theory, practical learning, technological aids, and gaming elements can create a learning environment that is both educational and enjoyable, particularly for topics that are seen as difficult. The research also highlights the important role that technology plays in making learning more easily accessible, as it allows for flexible learning at the student's own pace. The integration of KAHOOT! not only made the assessment fun but also provided an element of competition, which also motivated students to perform well. In addition, it also provides a good feedback mechanism for instructors, to allow them to further enhance their teaching strategies. The results indicate student performance during the KAHOOT! evaluation has a strong correlation to student's participation levels during the QR code learning activities. This underscores the impact that a good learning experience has on evaluation outcomes, as a result of this gamified system. The results have significant

implications for future educational strategies, indicating that educators should focus on integrating gamification and technology to create a learning environment that motivates students to learn. This study provides clear evidence for using similar methods of gamification in other subject areas and at different levels of education. The findings encourage educators to move beyond traditional methods and embrace newer methods that incorporate the use of technologies and game-based learning, to enhance the overall learning process for the students. Future research should build on this study, and focus on longer-term studies to investigate the long-term effects of such gamified learning and its impact on student retention and attitudes towards biology and science. In addition, research can also explore ways in which these findings can be utilized in different learning areas, or for different educational levels to evaluate the wide-ranging impact of this approach. Research can also focus on incorporating different types of technologies to make the learning experience more engaging. The research shows a strong correlation between motivation and gamification and it is important to look into the nuances of this relationship.

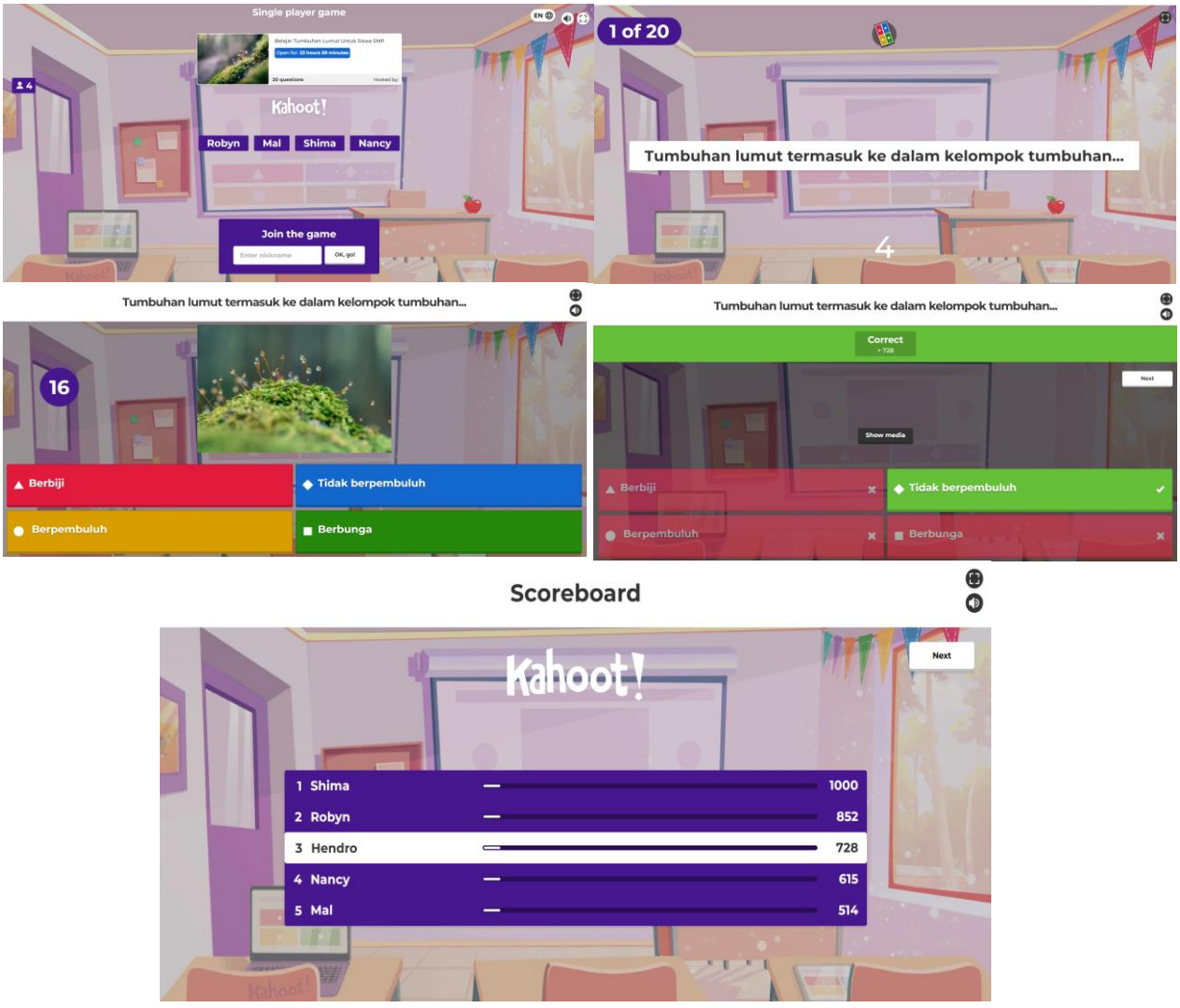


**Figure 6.** Kahoot! Quiz on Mosses: Game Progress.


**Figure 7.** Kahoot! Game Ranking Display.

**Tabel 1.** Student Motivation to Learn

| Motivation Indicator | Before Gamification (N=17) | After Gamification (N=17) |
|---|---|---|
| Interest | 29% | 94% |
| Relevance | 18% | 88% |
| Confidence | 12% | 82% |
| Satisfaction | 24% | 90% |

## 4. CONCLUSION

This research has provided compelling evidence for the potential of gamification as a transformative approach to learning biology in the junior high school setting. The findings demonstrate that integrating game mechanics into the curriculum not only elevates student motivation but also fosters a more engaging and interactive learning environment. The statistically significant increase in student motivation across all four indicators (Interest, Relevance, Confidence, and Satisfaction), as evidenced by the data in Table 1, clearly establishes that gamification can address the challenge of disengagement often encountered with traditional teaching methodologies. Specifically, the study demonstrates that the gamified learning approach, utilizing QR codes and multimedia elements integrated into the "Classification of Living Things" and "Ecology and Environmental Conservation" chapters of the Kurikulum Merdeka, significantly enhanced student interest (from 29% to 94%), relevance (from 18% to 88%), confidence (from 12% to 82%), and satisfaction (from 24% to 90%).

Furthermore, the positive student responses and increased motivation scores suggest that the gamified learning media developed in this study were successful in attracting students' interest and creating a more engaging learning experience. The use of QR codes provided easy access to learning materials, while the integration of multimedia elements catered to diverse learning styles and made the learning process more interactive and enjoyable. The KAHOOT! quizzes provided a fun and competitive assessment method that further enhanced student engagement and reinforced learning outcomes.

However, the successful implementation and widespread adoption of gamification is contingent upon the meticulous consideration of several pivotal factors. It is imperative that we recognize that simply introducing game elements into the classroom will not automatically result in optimal learning experiences; a more nuanced and thoughtful approach is required. As such, this conclusion will not only summarize our findings but will also highlight the key areas of focus that warrant further scholarly inquiry. One of the primary considerations that has

emerged is Infrastructure Availability. The efficacy of gamification is often intrinsically linked to the accessibility of technology, particularly personal devices, which form a cornerstone of many gamified learning systems. While this research demonstrates the benefits of integrating technology into learning, it also underscores the challenge of creating a truly inclusive environment when disparities in technology access exist. Unequal distribution of resources could inadvertently widen the learning gap, leaving students without access at a disadvantage. It is incumbent upon educational researchers and institutions to explore avenues that ensure equitable access to the essential tools for gamified learning. Future research should focus on developing models for resource allocation, investigating cost-effective solutions for device provision, or perhaps exploring alternative gamification strategies that do not rely heavily on technology. The aim is to create an environment where all learners can fully participate and benefit from the potential of gamification, regardless of their socio-economic circumstances.

A further critical factor is the Stakeholder Readiness for the transition to a gamified learning paradigm. The shift requires not only students, but also educators, parents, and administrators to embrace a new approach to education. Educational researchers need to evaluate the existing preparedness and adaptability of all stakeholders, and to design targeted interventions that can address the challenges of implementing this innovative teaching method. This includes: assessing the training needs of educators to equip them with the skills and knowledge required to design effective gamified learning experiences; developing student-centered learning programs that incorporate gamification; and providing parents with guidance on how to support gamified learning at home. Through comprehensive surveys and qualitative analyses, we can gain deeper insights into the complexities of implementing gamification within different school contexts and communities. This will enable the design of programs and training that are specifically tailored to the varying needs of all those involved.

Furthermore, this research has brought into sharp focus the Analysis of Gadget Use Implications. While this research has demonstrated how technology can empower learning through engagement, it is crucial to acknowledge the inherent challenges associated with excessive gadget use. Issues such as diminished attention spans, potential health implications, and the distraction it brings to the classroom cannot be overlooked. The research community must now direct its focus toward the nuanced impact of technology on learners. Future research should investigate both the positive and negative dimensions of technology integration and should propose clear guidelines that outline responsible technology use in learning. This may involve setting time constraints, monitoring student interaction, promoting mindful engagement, and integrating offline activities to maintain balance in learning methods. Finally, our findings highlight the rich potential inherent in the Integration of Advanced Technologies to further amplify the impacts of gamification. As technology continues to advance, AR, VR, and AI offer promising avenues for transforming the way in which we design learning experiences. Specifically, the interactive potential of these advanced technologies offers unprecedented opportunities to make education more immersive and personalized. These immersive methods are not just about presenting content in a novel way but offer interactive opportunities to engage with concepts, allowing learners to experiment, discover, and gain a more profound understanding of the subject matter. Future research should investigate the most effective means of harnessing these technologies to create learning environments that are engaging, accessible, and adaptive to the unique needs of every learner. It's crucial to explore ethical considerations of these emerging technologies to ensure that they are implemented responsibly and do not further exacerbate inequalities in access to quality education.

In conclusion, this study contributes valuable empirical insights into the potential for gamification to enhance student learning. By showcasing the positive impact on student motivation and understanding, this research further substantiates the potential of gamification in transforming educational approaches. However, it also serves to highlight the critical importance of addressing challenges relating to infrastructure, stakeholder readiness, the impact of gadget use, and the integration of advanced technologies. Future research should continue to investigate these key areas to make gamification not only an innovative educational strategy but also a sustainable and inclusive approach to learning. Through further research, collaboration, and thoughtful implementation, gamification offers an opportunity to create transformative learning experiences that cultivate a love of learning, and prepare students for success in a rapidly evolving world.

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