PAPER

Implementation of Educational Technology Based on Gamification in Interactive Monopoly Games in the 4.0 Era

Boedy Irhadtanto(✉),
Ima Isnaini Taufiqur Rohmah,
Junarti, Muhammad Rinov
Cuhanazriansyah, Yuniana
Cahyaningrum

IKIP PGRI Bojonegoro,
Bojonegoro, Indonesia

boedyirh@
ikippgribojonegoro.ac.id

ABSTRACT
Recent advancements in technology and information have profoundly influenced the realm of education, prompting a transformation in the learning process. This shift has become imperative due to the impact of the pandemic a few years ago, which necessitated the utilization of online technology for education. Given this situation, the conventional, monotonous learning approach now requires diversification to cater to various learning preferences. This evolution aligns with the need to tailor learning methods to students' current interests and hobbies. Consequently, the adoption of educational technology based on gamification in the era of Industry 4.0 emerges as a solution to address these educational demands. There are several strategies to implement gamification effectively, aimed at fostering students' enthusiasm for learning. In essence, Industry 4.0 has ushered in profound changes across all sectors by optimizing resources and production costs. The research method employed here is gamification, which revolves around the concept of game-based learning. The outcome of this research is an interactive monopoly game designed for integration into the learning process.

KEYWORDS
gamification, monopoly games, technology, education, learning

1 INTRODUCTION

In the modern age of digitization, information technology exerts a significant impact on virtually every industry, with education being no exception. Education serves as a transformative journey, offering students the chance to nurture their self-realization and enhance their potential. To enhance this process, several measures can be taken to facilitate its fulfillment. To facilitate the integration of education, careful planning is essential, aimed at enhancing its quality across various dimensions [1].

The government's response to the COVID-19 pandemic has necessitated the implementation of a policy that involves the closure of schools and encourages individuals to conduct all their activities from home. The primary objective of this government policy is to disrupt the transmission of COVID-19. Traditional in-school learning activities have had to transition to an online format, commonly referred to as distance learning (PJJ). Online learning methods have emerged as a practical solution for facilitating distance education. Typically, the interaction between teachers and students in distance learning occurs virtually, utilizing a platform provided by the school or a platform that the teacher is proficient in. In this setup, teachers primarily deliver content through lectures and discussions, followed by assigning practice questions as part of the coursework. Consequently, this approach often leads to students becoming disinterested in the ongoing learning process [2].

As technology and information advance into the 4.0 era, it's conceivable that education will evolve in parallel with these developments. Technology holds a pivotal role within the realm of education, particularly in the context of distance learning. Proficiency in technological literacy is now a prerequisite for both teachers and students engaged in this learning approach. Technology simplifies the educational process, providing a convenient means for teachers and students to engage in learning activities. The incorporation of technology in education has the potential to inject excitement into the learning process and bolster student motivation. Leveraging information technology can be achieved through various platforms commonly employed for communication purposes [2].

Numerous types of media can be employed within this instructional approach, such as books and educational aids. However, the media currently utilized falls short of meeting established educational standards since it primarily consists of text, which may be considered less engaging for students, resulting in a less stimulating and somewhat tedious learning experience. Consequently, there is a demand for innovative learning resources that are efficient, effective, captivating, easy to create, and aligned with students' daily routines. In the millennial generation, a significant portion of individuals are heavily reliant on technology, including gadgets, due to their multifunctional capabilities, including gaming and storage features [3].

One of the benefits stemming from the utilization of digital technology today is the incorporation of gamification, presented under the guise of play. This approach serves to boost enthusiasm for learning, showcase educational concepts, and tackle various challenges encountered during the learning journey. A game, by definition, is an activity conducted following specific rules. In contrast, gamification employs game-like elements to stimulate interest, encouraging a mindset akin to playing [4].

The monopoly game stands as one of the world's most renowned and widely enjoyed games. One of its distinctive features lies in its utilization of cards like "chance cards" to depict elements that resemble our everyday surroundings [5]. Additionally, as stated in [5], monopoly ranks among the most popular board games played both at home and in group settings worldwide. The game's objective revolves around comprehending various property dealings, including renting, selling, and purchasing, all of which are grounded in simplified economic principles. This game accommodates a range of two to six players, with the initial player commencing by rolling a pair of dice and moving a corresponding number of spaces. Participants have the option to acquire unowned property parcels, eventually constructing houses and accommodations in subsequent turns. When a player lands on someone else's property or hotel, they are obligated to pay rent in accordance with the specifications outlined on the property card. If a player lands on the card deck space, they must draw a card from the deck positioned at the center of the board and then follow

the instructions provided. It's worth noting that this game typically extends over a considerable duration, with the winner being the participant who accumulates the highest amount of money or assets [6].

The interactive monopoly game represents a modified version of the traditional Monopoly, incorporating high school-level science and technology topics typically taught in conventional educational settings. The fundamental objective of this game remains consistent with the traditional monopoly, which is to gain control. To excel in this game, players must not only grasp the game mechanics but also acquire proficiency in the subject matter featured on the monopoly cards and game board. Nevertheless, there are several distinctions between the interactive monopoly and the conventional monopoly, encompassing variations in the game board design, the quantity of squares allocated for cards within the game, and the currency or points utilized in the interactive monopoly.

Employing the gamification approach presents an opportunity for all students to actively engage more effectively in their learning experiences. It encourages students to participate interactively and offers swift feedback on their learning progress and outcomes. Gamification involves the process of integrating, altering, and operating service systems and human-computer interactions, drawing inspiration from elements found in games, thereby enhancing the learning process by infusing it with enjoyable game-like elements. The utilization of the gamification method in designing a learning platform that incorporates gamification elements for evaluating student learning outcomes has the potential to furnish instructors with valuable insights from the assessment results, which can be visualized through leaderboards, enabling them to recognize and reward students with commendable academic achievements or, conversely, provide support and guidance to those with less favorable learning outcomes [7]. Moreover, the use of educational games as a learning medium is an intriguing subject. In this context, games serve as a vehicle for conveying knowledge from educators to students, eliciting varying degrees of enthusiasm from the learners.

2   METHODOLOGY

The methodology used in this research uses the system development life cycle (SDLC) method. The waterfall SDLC approach is defined by a sequential nature, where each phase must be completed before moving on to the subsequent one. This methodology emphasizes dedicated attention to each phase, ensuring that work is executed optimally without concurrent tasks [8]. It commences with the planning phase, followed by analysis, design, implementation, and testing (see Figure 1).
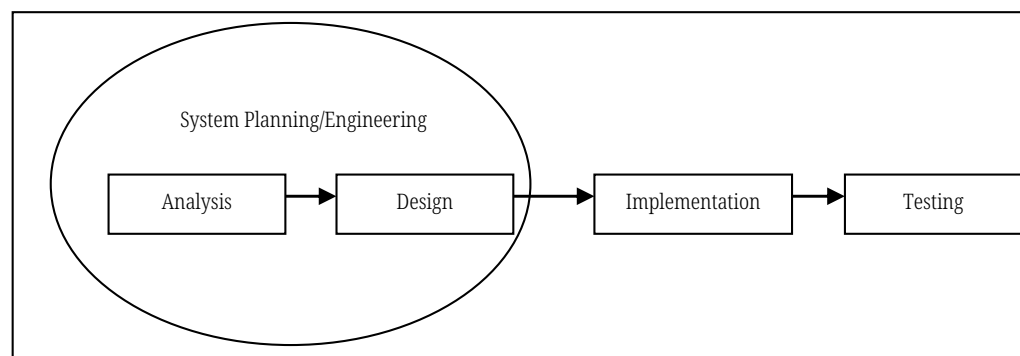

Fig. 1. SDLC method overview

2.1 Planning

The initial phase to be undertaken is the planning stage, encompassing various activities such as evaluating costs and benefits, setting schedules, and estimating and allocating resources. In this stage, the development team gathers input from multiple stakeholders, including customers, both internal and external experts, as well as managers, in order to formulate a comprehensive software requirements specification document [9]. This document serves as a blueprint, establishing shared expectations and objectives that facilitate the project's planning process [10]. Teams proceed by generating cost estimates, crafting schedules, and formulating detailed strategies to accomplish their objectives [11].

2.2 Analysis

At this stage, a needs and problem analysis are carried out, which is the most basic and main requirement in SDLC. In this stage, *the engineer* or *developer* receives all incoming input, including from customers, salespersons, industry, and programmers [12].

Following the input data, the engineer will engage in an evaluation of the system's strengths and weaknesses. The primary aim during this phase is to enhance the current system.

2.3 Design

During the design phase, software engineers assess the requirements and determine the most suitable approach for crafting the software [13]. This could involve examining options such as incorporating existing modules, making technology selections, and pinpointing the necessary development tools [14]. Engineers also explore the optimal way to seamlessly integrate the new software into any pre-existing IT infrastructure within the organization.

2.4 Implementation

During the deployment phase, the development team engages in coding the product. They break down the requirements into smaller coding tasks that can be tackled on a daily basis, ultimately leading to the final product.

2.5 Testing

During this phase, numerous tests are conducted, encompassing assessments of the software's logic and functionality. These tests aim to verify that all components have been thoroughly examined, with the overarching goal of minimizing errors and guaranteeing that the produced output aligns with the intended expectations.

3 GAMIFICATION MODEL FRAMEWORK

The model framework for implementing gamification-based educational technology in interactive monopoly games in the 4.0 era can be seen in Figure 2.
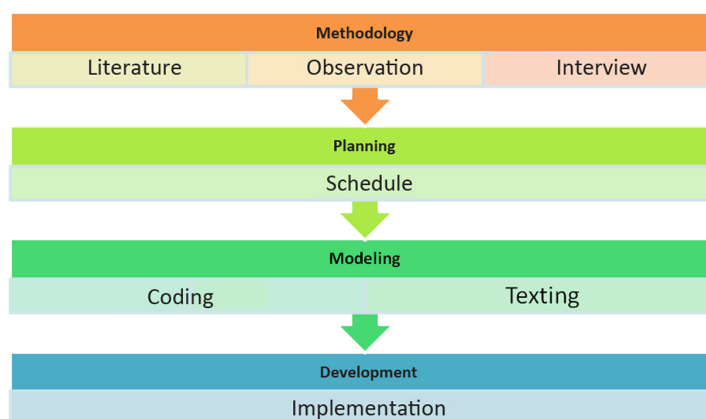

Fig. 2. Gamification model framework

4 RESULTS AND DISCUSSION

The outcome of this study is an interactive monopoly game that incorporates scientific and technological topics typically taught in high school, following traditional educational approaches. The primary objective of this game remains unchanged compared to a conventional monopoly, which is to gain control. In interactive monopoly, aside from becoming proficient in the game mechanics, there is an additional need to grasp the content presented on the monopoly cards and game board. It is anticipated that this game will not only enhance cognitive abilities but also serve as a source of knowledge enrichment for students in the respective subjects.

The media created in the form of an *Android*-based *game application* as an alternative media to support learning in science and technology subjects at the high school level has gone through trials of validity, practicality, and effectiveness. The validity trial was carried out by asking for the opinions of experts, namely media experts and material experts, regarding the *Android-based game learning application media* being developed. Practicality trials were carried out by asking subject teachers and students for opinions through questionnaires. Meanwhile, the effectiveness test was carried out by looking at the comparison between student learning outcomes before using *Android-based game learning application media* and student learning outcomes after using *Android-based game learning application media.*

The initial phase involves planning, encompassing activities like needs assessment, student evaluation, material examination, concept analysis, and the establishment of learning goals. Subsequently, the second phase comprises design analysis and design, which entails the development of game rules, media selection, and the initial draft creation. After this stage is the stage for carrying out product testing, which is carried out to obtain feedback from the answers obtained through the monopoly *game application medium.* The initial display page of the monopoly game application media is as follows.

4.1 Intro page

The introductory page serves as the initial interface when launching the monopoly game application. This introduction includes essential features such as the play button for initiating the game, the help button for accessing game rules, and the material button for accessing educational content related to high school science and technology subjects. You can observe the visual representation of this intro page in Figure 3.

Fig. 3. Intro page

4.2 Monopoly game page

In this monopoly game, participants aim to accumulate the highest number of points while diminishing the points held by other players. Victory is achieved by acquiring property boards, which subsequently generate income from other players who land on those properties or through the use of card tiles integrated into the game. The game concludes when only one player remains, and if you wish to commence another round, you can simply click on the "play again" button, as depicted in Figure 4 on the monopoly game page.
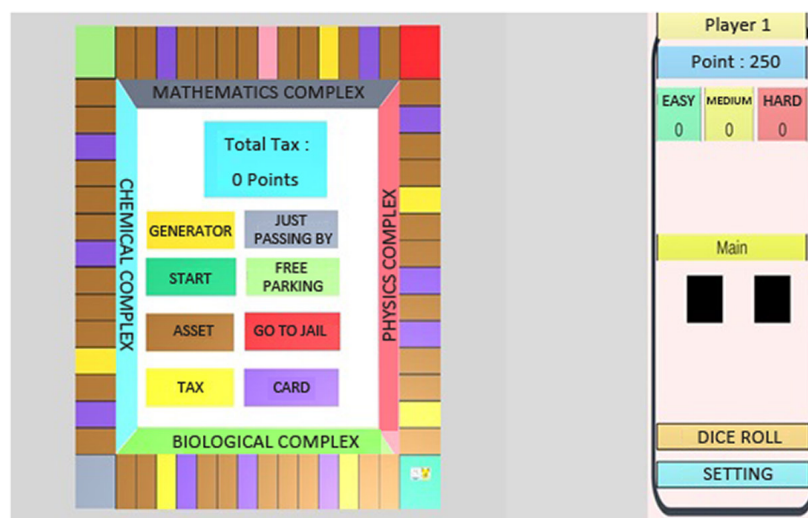

Fig. 4. Monopoly game page

Within this monopoly game, players immerse themselves in a game environment comprising various plots, including generator plots, asset plots, card plots, prison plots, start plots, free parking plots, and tax plots. On each of these plots, players engage in actions such as purchasing, paying fees, or executing transfers in accordance with the plot-specific instructions. The start plot serves as the players' initial position, and upon entering it, players receive additional points. Additionally, the free parking plot presents players with two options: they can either collect the entire payment from the tax, generator, or card plots, or they can freely advance to a plot of their choosing.

In this game, players may find themselves incarcerated if they roll the same dice value three times consecutively. To secure their release from the prison plot, a player must either roll the dice with the same value three times again or patiently wait for three rounds involving other players. On the other hand, in the case of asset plots, players have the opportunity to purchase these plots, thereby gaining ownership rights that allow them to collect points from other players who land on these acquired plots. Furthermore, players can enhance their owned assets by reinvesting in them during subsequent rounds, generating additional points from other players who interact with these upgraded assets.

4.3 Material page

The material page offers a selection of accessible educational resources. This section comprises four science subjects: mathematics, biology, physics, and chemistry, all-encompassing content relevant to high school-level science education. Upon selecting a specific subject, players will be promptly redirected to the corresponding educational websites. You can visualize the layout of the material page in Figure 5.
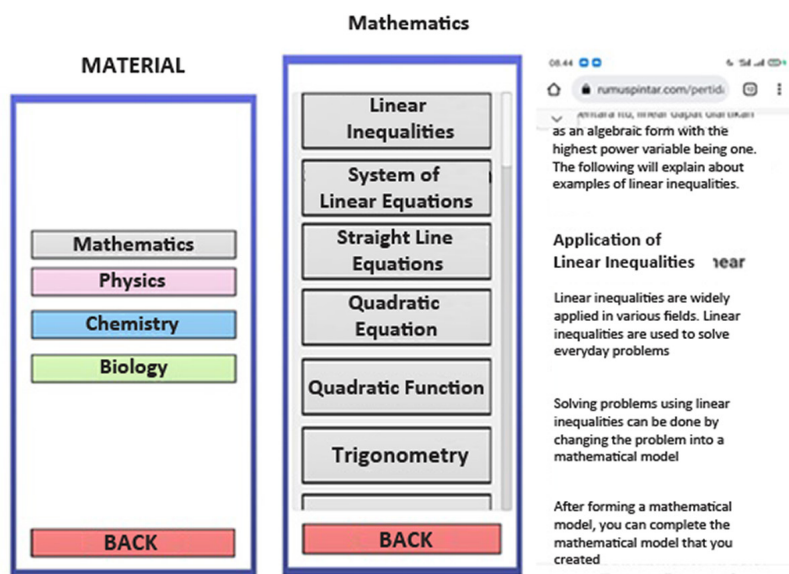

Fig. 5. Material page

An Android-based educational gaming application was created as a response to several prevalent educational challenges faced within schools. These challenges encompass the need for more advanced and diversified learning applications in alignment with technological advancements. Furthermore, there remains room for

improvement in terms of the richness and variety of available learning resources, as well as the need to enhance students' comprehension. Additionally, there's a deficiency in adequate learning materials, and the utilization of media that can effectively boost student motivation in the learning process has been suboptimal.

Students encounter numerous challenges when it comes to comprehending fundamental competencies, data communication standards, and processes related to data communication in networks. Moreover, they face a scarcity of learning resources and instructional materials, especially in the context of the traditional classroom-based teaching and learning approach that hasn't fully embraced technology. In the realm of gamified education, the utilization of a monopoly game-based learning application can serve as a viable alternative for distance learning or when there is a need for direct, in-person instruction. This monopoly game learning application effectively aids students in grasping and mastering the subject matter. It accomplishes this by providing theoretical content derived from textbooks, engaging visuals and animations, and also offering competency assessments in the form of practice questions.

The development process of the monopoly game learning application media unfolds through several stages, including planning, analysis, design, implementation, and testing. During the planning phase, a range of activities take place, such as needs assessment, student evaluation, task analysis, concept examination, and the formulation of learning objectives. The outcomes of this study shed light on the practicality of the learning application medium. Notably, 85% of respondents categorized it as "very practical" when evaluating the practicality of the media from the teacher's perspective. Similarly, based on student responses, as indicated in the student response questionnaire, 81% found it to be in the "very practical" category. These responses reflect the viewpoints of both students and teachers regarding the utilization of the Android-based system in learning. Overall, the feedback underscores the high practicality of the method, aligning effectively with the learning objectives. This emphasizes the importance of practicality and user-friendliness in facilitating the attainment of educational goals.

The effectiveness of the Android-based game learning application was assessed through a pretest and posttest evaluation. After analyzing the posttest results, it was determined that 88.50% of students achieved the minimum passing score (KKM) for their learning outcomes. Comparing the pretest and posttest scores, a gain score of 0.33, indicating a moderate improvement, was observed. In summary, it can be concluded that the Android-based game learning application is a highly effective educational tool for high school-level science and technology subjects.

5   CONCLUSION

From the description above, it can be concluded as follows:

1. The development process, spanning from the analysis stage to testing in this research, has yielded an Android-based game-based learning application. This product is accessible for installation by both teachers and students, offering the flexibility of use anytime and anywhere, without constraints on space or time. It serves as a valuable resource for both distance and face-to-face learning scenarios.
2. The creation of Android-based game learning application media carries significant implications for both students and educators. It prompts a shift in teaching methodologies to align with the current curriculum and national educational objectives. This entails fostering the capacity to integrate media into the teaching

process and utilizing it as an informational resource within the educational sphere, emphasizing its role in facilitating the learning process.

3. The Android-based game learning application media that has been developed can be employed in the educational process. Its utilization creates opportunities for students to foster educational patterns and enhance their critical thinking skills. This represents an endeavor to encourage interactive and innovative learning material exploration.

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7 AUTHORS

Boedy Irhadtanto, ST, M.Pd. (Information Technology Education, IKIP PGRI Bojonegoro) (E-mail: boedyirh@ikippgribojonegoro.ac.id).

Dr. Ima Isnaini Taufiqur Rohmah, S.Pd., M.Pd. (English Language Education, IKIP PGRI Bojonegoro) (E-mail: isnainiima@ikippgribojonegoro.ac.id).

Dr. Junarti, M.Pd. (Mathematics Education, IKIP PGRI Bojonegoro) (E-mail: junarti@ikippgribojonegoro.ac.id).

Muhammad Rinov Cuhanazriansyah, ST, M.Pd.T. (Information Technology Education, IKIP PGRI Bojonegoro) (E-mail: mrinov_cuhanazriansyah@ikippgribojonegoro.ac.id).

Yuniana Cahyaningrum, S.Kom., M.Kom. (Information Technology Education, IKIP PGRI Bojonegoro) (E-mail: yuniana@ikippgribojonegoro.ac.id).