

The Technology of Educational Games for Support Science Learning in the Classroom: A Preliminary Study

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Abstrak— Seiring berkembangnya teknologi banyak bermunculan teknologi pembelajaran dalam dunia pendidikan yang sering dinamakan game edukasi. Game edukasi merupakan salah satu instrumen teknologi pembelajaran dalam mendukung minat siswa. Game edukatif hadir dengan fitur-fitur seru yang membuat siswa semakin tertarik untuk belajar, khususnya dalam pembelajaran IPA. Permainan edukatif dalam pembelajaran IPA memberikan nuansa yang berbeda pada proses pembelajaran—pembedaan ini dibentuk dalam suatu sistem yang dapat menarik minat dan perhatian siswa. Tulisan ini hadir untuk memberikan gambaran tentang pentingnya permainan edukatif dalam pembelajaran IPA. Belajar sains biasanya dianggap tidak menarik oleh peserta didik karena banyak yang melibatkan proses berpikir dan berhitung. Pembelajaran sains dengan menghadirkan sistem baru berupa game edukasi ternyata mempunyai nuansa tersendiri. Dalam pembelajaran IPA, game edukasi disajikan dalam bentuk kuis atau game. Penelitian ini menggunakan penelitian kualitatif pada artikel review yang bersumber dari jurnal dan buku. Peneliti menggunakan jurnal, baik jurnal nasional maupun internasional, sebagai sumber referensi utama dalam melakukan penelitian. Hasil analisis menemukan bahwa setiap siswa dapat menaikkan level permainan jika mereka dapat menyelesaikan masalah ilmiah yang diberikan. Oleh karena itu, hadirnya game edukasi mendukung pembelajaran di kelas sehingga proses pembelajaran lebih menyenangkan.

Kata kunci— game edukasi, kahoot, quizizi, quizlet, pembelajaran berbasis game

Abstract— Many learning technologies have emerged in education, often called educational games, along with technological development. Educational games are one of the learning technology instruments to support student interest. Educational games have exciting features that make students more interested in learning, especially science. Educational games in science learning give a different nuance to the learning process—this distinction is formed in a system that can attract students' interest and attention. This paper is here to provide an overview of the importance of educational games in science learning. Students usually consider learning science unattractive because it involves

thinking and counting processes. Learning science by presenting a new system in educational games turns out to have its nuances. In science learning, educational games are presented in quizzes or games. This study uses qualitative research on review articles sourced from journals and books. Researchers use journals, both national and international journals, as the main reference source in conducting research. The analysis results found that each student can raise the level of the game if they can solve the given scientific problem. Therefore, educational games support learning in the classroom so that the learning process is more fun.

Keyword— educational games, kahoot, quizizi, quizlet, games-based learning

I. INTRODUCTION

Educational activities are inseparable from the process of teaching and learning activities in class. One of the subject matter taught in class is science. Science consists of mechanics, heat, light and other radiation, sound, electricity, magnetism, and atomic structure. Broto Sisworo [1] explains that in science, there are six scientific sciences, namely: (1) Curiosity, (2) Cooperation, (3) Reproductive, (4) consistent reasoning, (5) open, and (6) Observable. Game-based interactive learning media is still rarely developed, especially for science learning. Learning develops skills or attitudes where an individual interacts with new information and environment [2], [3]. Sukmadinata [4] and Suyono [5] explain that there are four main elements in learning, namely: (1) Objectives: Learning begins because of a goal to be achieved; (2) This goal can be a critical need; (3) Readiness: For learning to be implemented well, students must have physical, psychological, or preparation availability, which can be maturity to do something related to the learning experience; (4) Situation. The learning process must be, by the case in the learning process. The condition can involve the place, environment, tools and learning materials, teacher, and head. One of the lessons done at school is Science

learning. Science learning is often associated with events or observed phenomena, simply explaining facts [6]. In Science learning, the most emphasized thing is understanding concepts, principles, and laws relating to the symptoms of phenomena experienced [7]–[9] so that students are expected to express themselves in their language according to their level of thought patterns, maturity, and intellectual development [10]. The most crucial aspect of learning science is how students can construct the experiences they get into a concept that can be applied.

Science learning is based on three domains, namely cognitive, affective and psychomotor [11], [12]. The cognitive area is related to understanding in analyzing a concept and the affective domain relating to attitudes and patterns of behavior towards the environment with the design of ideas. In learning science, the most important thing is how students can actively learn. Teachers are expected to master the subject matter to be taught and understand students' conditions so that they can pursue according to students' level of ability. It is intended that the learning carried out can be achieved according to the expected science learning objectives.

Therefore, to support this, an additional alternative is needed to support learning. The option is in the form of educational games in the learning process.

Educational games involve students in all aspects, whether individual or group. Through educational games stimulate students to enjoy implementing learning. Also, educational games can train children's motor sensors, so children prefer knowledge. *Games* are crucial for the development of the human brain. A human will begin to think if it is facing a problem.

Meanwhile, in a game, we are faced with various kinds of issues, and we are required to solve them in such a way that we can solve, or even we can win the game/game that we play. The importance of a match is present in education because it can foster interest in students and provide new nuances in learning, especially for children who are difficult to be invited to learn. It is natural because child psychology is playing. They learn more when playing. So the use of games as an educational tool is the right choice to solve this problem [13]

Educational games are exciting to use - There are several advantages of educational games over conventional educational methods. One of the main advantages of educational games is the visualization of real problems. The Massachusetts Institute of Technology (MIT) has proven that games are handy for improving players' logic and understanding of a problem through a game project called Scratch. Based on previous research results, there is no doubt that educational games can support the educational process. Educational games are superior in several aspects when compared to conventional learning methods. One significant advantage is animations that can improve

memory so that children can store subject matter for a longer time compared to conventional teaching methods.

As reported by [14] about educational games using Research and Development design using qualitative and quantitative descriptive data on the problem-solving aspects of mathematics lessons in 8th grade SMP Pekanbaru shows that implementing educational games in mathematics is very useful with effectiveness levels up to 80% with a practical level reaching 85,42%). It is supported by research by Khouna et al. [15], which explains that educational games as a learning tool seems to be an exciting approach to be analyzed in the context of pedagogy based on competence, and given its contribution that is relevant to teaching science. Furthermore, Sari et al. [16] reported that applying educational games to colloidal learning motivated and even increased the effects of learning processes and literacy abilities, evidenced by the analysis results of the highest *R-value* of 0,93, while the lowest *r-value* was 0,60 with an average *R-value* of 0,77 for all aspects of assessment.

Therefore, the author is interested in studying educational games to support Science learning. The benefits of this study are to provide information on the role of educational games to support education, one of which is learning science. This study can impact educational games' knowledge, good/bad, in applying educational games in the learning process. This study aims to provide information about educational games in science learning and several types of ICT-based educational games in science learning.

II. RESEARCH METHODOLOGY

A. Type of Research

The type of research uses qualitative study with descriptive analysis based literature review. Literature review studies are conducted by gathering data or sources relevant to a subject from different sources such as publications, books, the internet, and other literature.

B. Research Design

1) Searching Database

Sources of such studies and books exploring journals through the old databases Direct Science, Proquest, ERIC, Google Scholar, and Scopus are limited to 2000–2019. Initial studies on the extraction by two independent investigators. I searched the database based on the title and abstract with keywords, learning models, cooperative educational games for science, educational games for science, enhanced technology, and mobile games. Furthermore, the results of the journal review it has been obtained so that it is obtained how the form of game-based learning model design, the benefits of games, the advantages and disadvantages of implementing games in learning, and records of educational games that can be implemented in the learning process in the classroom.

2) Selection process

The selection phase begins with the collection of journals and books. We have collected 250 initial reference studies because it is by the scope to be studied. After a thorough review and study of screening, 170 were excluded because it does not comply with the inclusion criteria (type educational games, educational design games). The remaining 80 full study texts remain; 80 was taken because it was by the needs in the form of educational games, educational game designs, advantages and disadvantages of educational games. Furthermore, in the final phase of the study, I analyzed 25 texts and declared them eligible for review. The final stage remained 55 titles consisting of the comprehensive research full text and met the existing data on inclusion indicators. To further explain, presented in Figure 1.

3) Analysis Process

At this stage, the data were analyzed using Nvivo software. The process of data analysis is the data coding process by taking a core topic in each article. The analysis results were made mentoring related to each category to clear that the topic gap was used. These analyses serve as the primary educational games, mobile learning, mobile games, and enhanced technology.

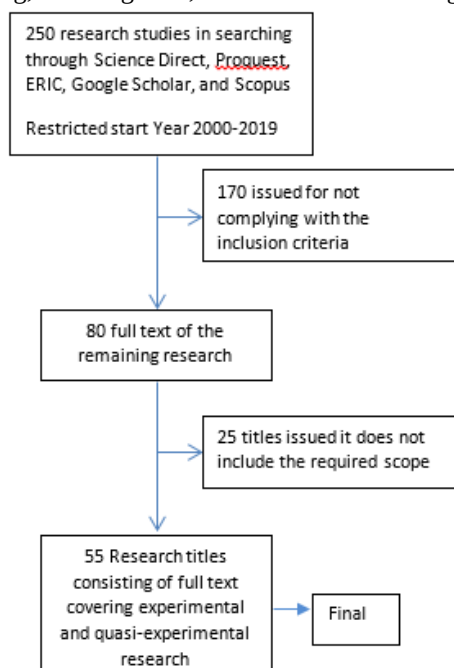


Figure 1. Flow chart of the search, selection & determination process

III. RESULTS

The analysis results can be related to educational games, the design of learning models based on educational games, and the importance of games in learning. Then, from the results of the journal review, it was also found the advantages and disadvantages of educational games and the types of educational games that can be implemented in classroom learning.

A. Definition of Educational Games

Educational games are designed to teach students about specific subjects and objects and equip them with an ability [17]. Also, educational games are designed to help someone on a particular subject that functions to broaden concepts, strengthen understanding, understand historical events or culture and help students with a skill [18]. Furthermore, Miller [19] suggests that educational games are explicitly designed with educational goals or educational value. Therefore, educational games can be a learning method designed to help students understand a concept and increase motivation, interest in learning, a collaboration that contains elements of pedagogy and learning material.

Educational games have been used primarily in education to support the practice of factual information in which there is a process to foster knowledge construction and deepen understanding. Next is the design of educational games, as shown in Figure 2 [20].

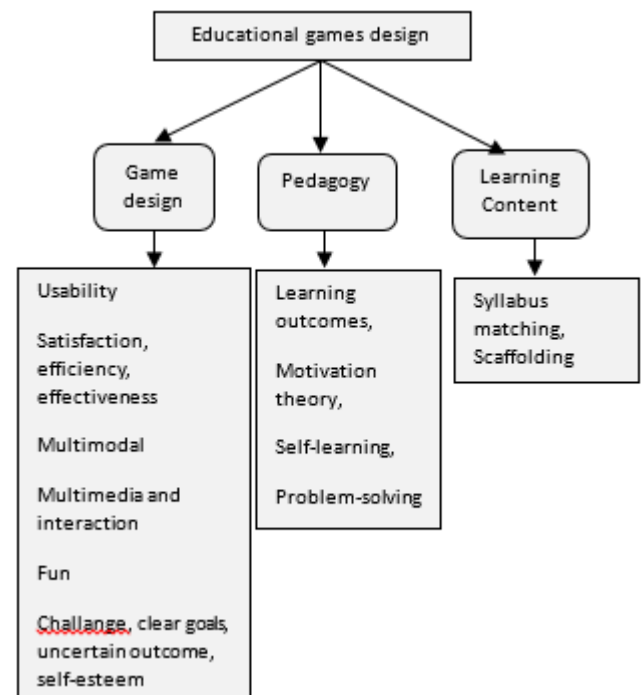


Figure 2. Model Design of Educational Games

As explained in Figure 2, there are three main factors in educational games: game design, pedagogy, and learning content modeling. Based on game design factors, usability will focus on not many researchers conducting usability studies for educational games [21]. The essential items are effectiveness, efficiency, and satisfaction. The game combines several media such as text, graphics, audio, video, and animation. While pedagogical factors are focused on how many games will fulfill learning outcomes. The game will be designed based on subjects chosen according to the learning outcomes of Bloom's Taxonomy.

B. The Importance of Educational Games

Educational games aim to increase students' interest and motivation, and involvement in the learning process can be done effectively and achieve the expected learning goals [22]. Also, using educational games will impact learning experiences gained by students and increase mental and student interest [23], [24]. Students feel entertained by using educational games in the learning process, so students do not feel bored with the learning process.

The primary purpose of using games (education) in learning is to develop students' intrinsic motivation to play and increase interest in learning [25], [26]. The level of intrinsic motivation has consequences for students' cognitive. A high level of fundamental interest will show a higher level of attention or vice versa [27], [28]. It will have an impact on better learning outcomes [29]. Several factors can influence students to play online games, namely intrinsic and extrinsic. Intrinsic: (a) want to get high scores in playing, (b) feel bored at home or school, (c) are more concerned with playing online games than others, (d) lack of self-control when playing. Extrinsic: (a) playing because of peer pressure, (b) lack of good social relations, (c) being depressed by parents who have high expectations for students

Through educational games, students will increase interest in learning, involvement in the learning process, increase learning achievement, have high memory, increase student activity in the learning process, and improve collaboration [30]–[32]. Educational games will lead to various interactional organization levels based on skills, collaboration, and argumentation that produce interactions oriented to competency development [33].

Educational games are up-and-coming to stimulate intrinsic motivation and enable knowledge transfer from simulation to the natural environment [34], [35]. *Educational games* can be considered environmental narratives that allow players to make an association, experience events, absorb information, or collectively construct meaning [36]. Students would be more likely to learn if instructional games are used because they will offer a learning experience and inspire creativity. Representations can lead to new levels of comprehension[31].

Students are given a scientific problem through educational games that will be solved in the form of puzzles or puzzles aimed at providing intuitive knowledge in problem-solving [37]. Furthermore, Carvalho et al. [38] & Vito [39] that by using educational games, students will be given freedom, fun, experimentation, manipulation, and obey and respect the rules, implement strategies and plans, solve problems, find unknown challenges for students and others. *Educational games* can create internal motivation by including aspects such as challenges, control, fantasy, and curiosity. In contrast, competition, collaboration, and recognition [40], [41].

It was concluded that educational games are crucial because they will stimulate students to develop problem-solving skills and help students increase their enjoyment in learning; enjoy learning, flexibility, and no tension in the learning process, leading to courageous arguing.

C. Strengths and Weaknesses of Educational Games

A model certainly has advantages and disadvantages. Following are some of the advantages and disadvantages outlined in Table 1.

TABEL I
STRENGTHS AND WEAKNESSES OF EDUCATIONAL GAMES

No	Strengths	Weakness
1	Applying the game in the learning process will be more interesting for students	The class became noisy and noisy
2	The use of various types of instructions	Not all subject matter can be explained in the game process
3	Increased teamwork and interpersonal skills	The game is monotonous, so it tends to be just that and adds to the impression of boring
4	Can increase student interest and initiative in learning	-----
4	Cheaper and more flexible	-----
5	They increase motivation.	-----
6	They help evaluate students in many ways.	-----

D. Tools of Educational Games

1. Quiz Games

Quiz games are designed or created to stimulate thinking, including increased concentration and solving problems [42]. A quiz game is one type of media used to provide teaching. It adds to the knowledge of its users through unique and exciting media. *Quiz game* is made with specific objectives as an educational tool, to learn to recognize colors, recognize letters and numbers, mathematics, to learn foreign languages.



Figure 3. Quiz Games

Games with educational purposes like this can be used as educational media with a learning pattern of learning by doing. Based on the game models, players

are required to learn so that they can solve existing problems. Game status, instructions, and tools provided by the game will actively guide players to explore information to enrich their knowledge and strategies while playing.

Based on the results of previous research studies, there is no doubt that quiz games can support the educational process [24], [43], [44]. Quiz games excel in several aspects when compared to conventional learning methods. One significant advantage is animations that can improve memory so that children can store subject matter in a long time compared to traditional teaching methods [45], [46].

Game Quiz is a game used in the learning process. The set contains elements of educating or educational values quiz game to be developed Arcade genre, which trains user dexterity in classifying garbage. Moreover, it has the essence of simulation to get used to disposing of trash in its place and type.

2. Kahoot!

Kahoot! is a free game-based learning platform that allows instructors to give interactive quizzes (Kahoot!) fun but brings some competition to the game [47]. Kahoot! is a new generation of a student response system that focuses on student motivation and involvement through gameplay [48]. A game-oriented platform will be integrated with specified learning elements and learning outcomes related to a particular lesson's teaching and learning objectives or series of lessons.

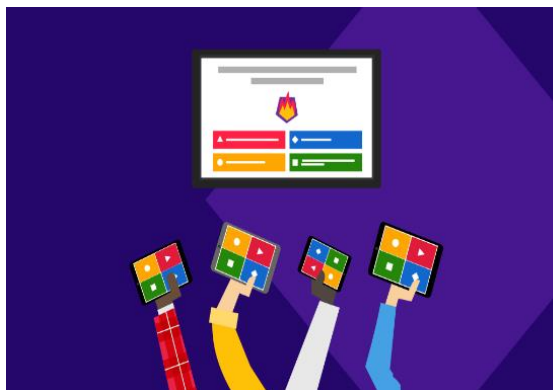


Figure 4. Display of Kahoot!

Licorish [49] & Licorish [50] reports that the use of Kahoot! in learning can foster interaction and creativity and involvement during the learning process by answering questions, participating in quizzes. Use Kahoot! -Encouraging broader participation in the classroom compared to conventional classes where a few extra-student students often dominate the discussion.

They are using Kahoot! Users can create, play, and share games in quizzes and assign games in the learning process. Kahoot! It is a flexible and simple tool that works on any device and can be accessed easily at no cost. This is interesting because it supports the process of social learning in various ways. Also, new game features have been introduced, offering a different

approach to the gaming experience [51]. Broader student participation in classrooms also encourages deeper involvement in the learning environment. Kahoot! is a form of tool to measure cognitive levels. It can direct students to become more involved, think more deeply about the subjects studied, and facilitate building knowledge and reflection [52]. Kahoot! has been widely used in the learning process in developed countries, Florida, United States. In that country, Kahoot! is a favorite learning tool in the classroom, which helps university professors who want to add to teaching tools to make learning exceptional. Kahoot! is easy to use in formats such as games and is gaining popularity throughout the country [53]. Singer [53] reports that of the approximately 55 million elementary and secondary school students in the United States, around 20 million of them use Kahoot! To some extent.

Kahoot! Uses educational trends to capitalize on the popularity. This education trend includes gamification and student involvement. The Kahoot! application can help teachers create a fun and cheerful learning process and provide morning ease for teachers (www.Kahoot!.com). The following is an expression given by Chrissy Cachero, Pre-Service Teacher, Saint Leo University, Florida.

"When a teacher uses Kahoot! I know student learning is significant to them. A teacher who uses Kahoot! demonstrates the importance of real learning and understanding, incorporating technology, and a sense of community."

Marissa Molish Pre-Service Teacher, Saint Leo University Florida" in making a Kahoot! We, as students, are part of the creation. Adding well thought out questions can help the class succeed as a whole, as well as getting our creative juices flowing."

Game-based learning has become more prevalent in education. One of the game-based learning platforms used in educational institutions is Kahoot!.

3. Quizlet

Quizlet is one of the largest educational websites in the world. Besides Quizlet, there are Schoology, Quipper School, Teacher's Room, and many others. Some of these applications are free, but some are paid. Quizlet access is complimentary on the website or app. Therefore, the affordability of this device cannot be doubted[54].



avatars, themes, memes, and entertaining music in the learning process[58].

Figure 5. Display of Quizlet

Although free, Quizlet is well organized, the facilities provided are in the form of virtual class services ranging from managing multiple folders that contain a group of flashcards in a particular topic or material, providing restrictions on user members to access it, to record the score of users when running the existing modes. A series of flashcards that have been made can be printed, including tests [55].

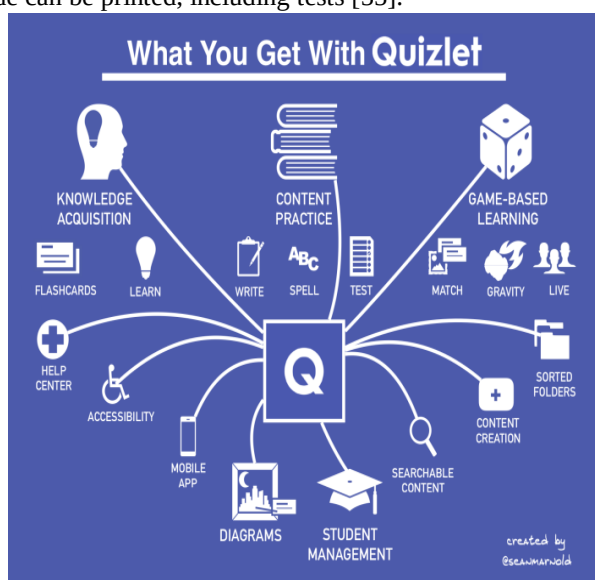


Figure 6. Web-Based Study Application Quizlet

As a support service and means to make it easier to remember, Quizlet provides facilities equipped with audio-visual[56]. Users can listen to the pronunciation of existing words while paying attention to the image when the flashcard is played[57].

4. Quizizz

Quizizz is a game-based educational application, which brings multi-player activities to the classroom and makes it an interactive and fun practice class. By using Quizizz, students can do exercises in the school on their electronic devices. Unlike other educational applications, Quizizz has game characteristics such as



Figure 7. Display of Quizizz

Quizizz also allows students to compete with one another and motivate them to learn. Learners take quizzes at the same time in class and see their live ranking on the leaderboards. Instructors can monitor the process and download reports when exams are completed to evaluate student performance. Instructors can monitor the process and download reports when quizzes are created to assess performance[59].

Implementation using Quizizz Game, students can do exercises in the classroom on their electronic devices. Unlike other educational applications, Game Quizizz has game characteristics such as avatars, themes, memes, and entertaining music in the learning process [60]. Quizizz also allows students to compete and motivate them to learn so that learning outcomes can improve. Students take quizzes simultaneously in class and see their live ranking on the leaderboards instructor or teacher can monitor the process and download the results when the exam is finished to evaluate student performance [61]. Quizizz games can help students' motivation to learn and improve learning outcomes [62]. This is in line with [14], who said that game-based learning has good potential to be used as a practical learning media because it can stimulate visual and verbal components.

5. Puzzle Games

The puzzle is a game that requires patience and perseverance in arranging children. Accustomed to playing puzzles, children will gradually become calm, determined, and patient in getting things done[63]. A puzzle is a simple game in the form of a puzzle. The puzzle is designed as entertainment by presenting difficulties that must be resolved with ingenuity and patience [64]. A puzzle is a game in which players are challenged to solve issues while having fun. The main objective of this game is to find the correct answer. There are three types of puzzle games developed in their development: logic puzzles, word puzzles, and visual puzzles [65].



Figure 8. Science Puzzle Game

The puzzle game is one genre of casual game that has much demand. This genre has a simple goal which is to solve the puzzle [66]. Furthermore, Solved puzzles can be matched colors, find the right place for an item, arrange blocks, etc. The rules and gameplay of the puzzle genre are also very diverse. Examples of puzzle games include Angry Birds, Tetris, and Bobble Puzzles.

IV. CONCLUSION

Based on the investigation results with journal review, it was found that educational games contribute to supporting learning. This is evidenced by the design of the learning model in terms of learning outcomes, motivation, self-learning, and problem-solving. In addition, educational games will stimulate students to develop skills in solving problems. Educational games can help students increase their fun in learning, enjoyment in learning, flexibility in the learning process, and the courage to argue.

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