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The Effectiveness of Game Based Learning on The Logic Gate Topics

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Abstract. This article focuses on analyzing the effectiveness of applying Game Based Learning on Logic Gate Material to student learning outcomes. This type of research is quantitative descriptive. This study uses a one group pretest and posttest design. This study uses a one group pretest and posttest design. The treatment given in this research is the application of game based learning. Game based learning using the game "Circuit Scramble.apk. This research was conducted at the Physics Education Study Program at Lambung Mangkurat University. The research subjects are Physics education students taking digital electronics courses in 2019. Data is collected using pre-test and post-test about logic gate. Pre-test and post-test data were tested for normality then N-gain test. N-gain test results obtained a value of 0.703. Therefore, it can be concluded that the effectiveness of the application of game based learning is in the high category. Thus, Game based learning on effective logic gate material is applied to improve student learning outcomes.

1. Introduction

The 21st century is marked by the era of the industrial revolution 4.0. Education in the era of the industrial revolution 4.0 is a way to complement the phenomenon of digital integration in everyday life where humans and machines interact to solve problems and discover new innovation theories [1]. In the context of the industrial revolution, the process that can be translated is actually social and cultural changes that take place quickly and involve the basic needs of the community with the wants of the people [2]. One of them is the needs and desires of learning that are also shifting, which is more towards the use of information in a practical and digital-based way.

Learning logic gates relates to the use of various types of logic gates in various digital circuits. Digital circuits are widely used for process control (automation), ranging from industrial processes with a high level of complexity, robots, laboratory equipment, household appliances, entertainment, to children's games [3]. An innovative learning is needed that is able to increase motivation in learning while increasing student understanding so as to improve learning outcomes.

The results of previous studies indicate that the biggest obstacle in delivering logic gate material is not using media that can describe the logic gate so students can understand its use [4]. The results of the poll poll aimed at 95.6% of students were eager to get innovation in learning. 82.6% of students really need a fun and motivated learning. The results of the next poll showed that 100% of students were very



interested in the game. Therefore, in accordance with the era of the industrial revolution 4.0 researchers will apply game based learning on logic gerbag material.

Game-Based Learning is a learning method that uses game applications / games that have been specifically designed to assist in the learning process. The learning process through Game Based Learning (GBL) presents positive aspects and challenges that must be faced to support the achievement of learning objectives and knowledge creation[5]. Game Based Learning can make the learning process fun and arouse learning enthusiasm so that it can motivate and encourage students to be more creative [6].

Along with the development of science and technology today, the game used in game-based learning can not only be enjoyed on a computer device but can also be done on a smartphone based on the Android operating system. Many android applications that can simulate or based on simulation games that can be used to apply concepts and theories about electronic circuits [7]. *The game used must really be able to educate, increase knowledge and improve the skills that play it. The game used in this learning is an android-based game called "circuit scramble".*

Recent research has not yet discussed how the effectiveness of learning using game based learning on logic gate material in improving student learning outcomes. Therefore, this study focuses on analyzing the effectiveness of learning using game based learning on logic gate material in improving student learning outcomes.

2. Method

This type of research is quantitative descriptive. This study uses a one group pretest and posttest design. The treatment given in this research is the application of game based learning. Game based learning using the game "Circuit Scramble.apk" and implemented on the logic gate material. This research was conducted at the Physics Education Study Program at Lambung Mangkurat University. The research subjects are Physics education students taking digital electronics courses in 2019. The number of research subjects was 23 students. Data were collected using pre-test and post-test in the form of a description of the logic gate. Pre-test and post-test data were tested for normality then N-gain test [8]. N-gain test results will be adjusted according to its categorization to determine the level of effectiveness of the learning.

3. Results and Discussion

Learning on logic gate material is implemented by using game based learning to improve student learning outcomes. Game Based Learning is a learning method that uses game applications / games that have been specifically designed to assist in the learning process [9]. The steps of game based learning are (1) the lecturer determines the types and patterns of games in accordance with the learning material; (2) the lecturer divides the groups in the game; (3) The lecturer engages all students to participate in the game, (4) students follow, involve themselves, or control the game, (5) students celebrate victory, (6) students explain experiences both attitudes and behaviors gained during the game and their knowledge, and (7) lecturers provide feedback by emphasizing the form of experience associated with learning materials or materials [10].

The game "Circuit Scramble" provides 135 levels that must be completed by students. Each level will open if it has successfully completed the previous level. Not all levels must be completed during lecture hours. However, students still have to finish all the games outside of lecture time. This supports the independence of students in learning. Game based learning will make the player do the learning process independently [9].

This game provides a tutorial containing a summary of information about the various logic gates used. Indirect information is entirely open. However, it will open if we have used the gate. In addition, students can repeat the level they have passed to turn on the circuit more practically.

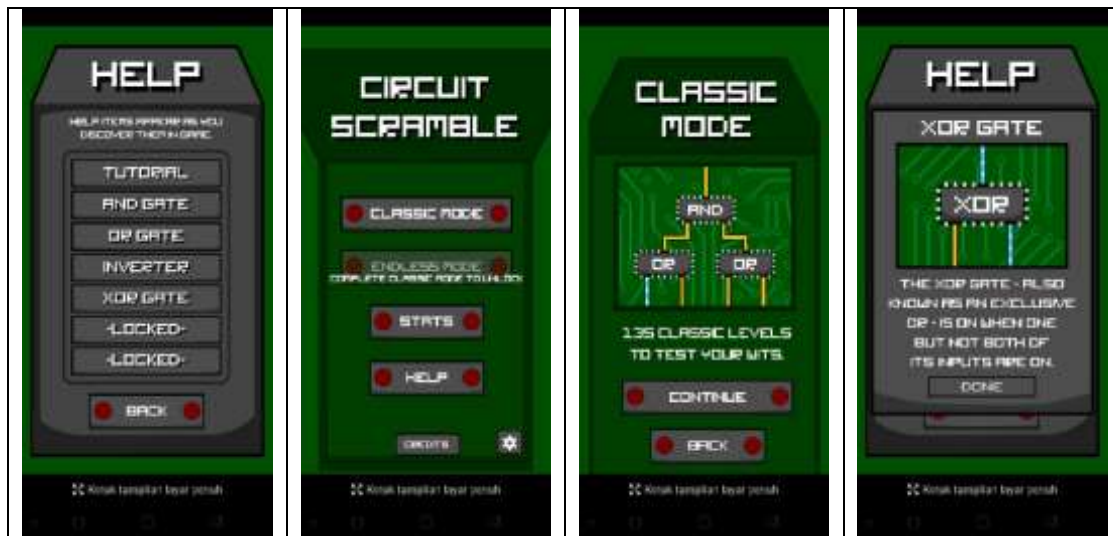


Figure 1. Display of the game scramble circuit

The application of game based learning is expected to provide an increase in student learning outcomes. Improved student learning outcomes can be seen from the results of student pretest and posttest. Improved student learning outcomes can be seen from the results of student pretest and posttest. The average pretest and posttest results can be seen in Figure 2.

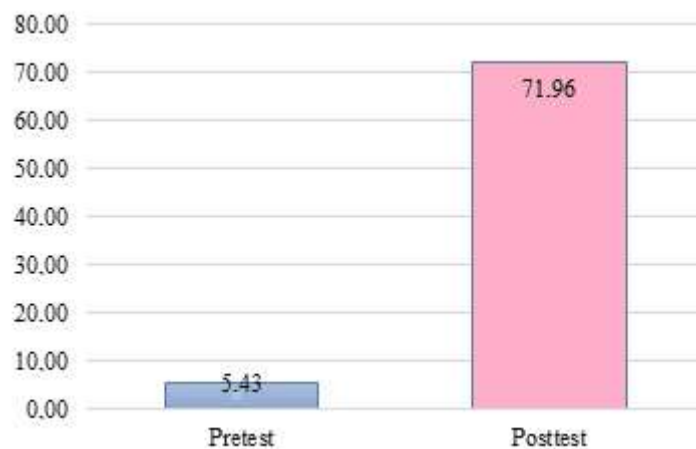


Figure 2. Result of pretest and posttest

N-gain test results show a value of $\langle g \rangle$ of 0.703. The category of effectiveness criteria is above 0.700 then it is categorized high [8]. Therefore, the effectiveness of the application of Game Based Learning on the Logic Gate Material to student learning outcomes is of high category. Thus, an increase in student learning outcomes after applying the effectiveness of the application of Game Based Learning on Logic Gate Material. This increase has occurred in accordance with previous research, [7,11,12] which states that Game Based Learning can improve learning outcomes.

The game used in learning is an educational game. Educational games have become learning media for the past few years [13]. Educational games are considered as a potential way of learning [14]. Games meet the needs and interests of students, and become the most popular computer activity and provide new modes of interaction [15]. Through games, students can discover and learn independently [16]. Thus, game based learning can make the learning process fun and arouse learning enthusiasm so that it can motivate students [6,17].

Game is one technique that can help students in understanding the material provided [6]. With the advancement of modern technology in line with the industrial revolution 4.0, and the need to involve students in the investigation of knowledge, the educational game is used as a cognitive tool to support science learning [18]. Educational games can make students experience learning methods that emphasize practice, supported by structures that lead to expertise, skills such as professionals, and innovative thinking [19].

Games are considered as a useful instrument for learning specific strategies and for gaining knowledge [18]. Games are a reflection of the real world, so it is useful for studying physics [20]. Previous studies revealed that the use of games in education is considered a useful tool for learning, because it allows teachers to engage students in educational experiences to achieve certain learning goals [21]. In the game world, students can experience concrete reality that is described by words and symbols. Through such experiences, students can understand complex concepts without losing the connection between abstract ideas and authentic problems that can be used to solve them [19].

The function of the educational game is so that the material delivered by educators can be well absorbed by students. Educational games are used to assist educators in delivering learning material so that the learning process of students is more effective and efficient [22]. Games are able to customize large numbers of individuals to match the challenges of learning activities with player skills as they develop. Educational games make students the center of learning, which makes the learning process easier, more interesting, and more effective [15]. In general, it seems that games can be very useful in generating deeper understanding of certain key principles of a given topic, especially when dealing with complex and diverse problems, which are difficult to understand through mere factual knowledge [23]. Games can motivate, to reduce affective barriers to learning [24]. Effective educational games are games that can compensate for the increased ability of students to facilitate continued learning in a game-based learning environment [25].

Educational games can be considered as entertainment media designed to bring cognitive changes to the players [13]. Game based learning needs to balance the need for complex and clear problems for students to solve [26]. In game based learning, students learn how to solve problems that start easily and then get harder as the player's skills develop. Players are motivated to learn, in part, because learning lies and takes place through a process of hypothesizing, probing, and reflecting a world that is simulated in a game [25]. It is very important to provide proper tutoring when using games in the learning process [14].

Game-based learning is a competitive activity where students set educational goals that are intended to enhance learning or the development of cognitive skills, or take the form of simulations that allow students to practice their skills in a virtual environment [13]. Education is also required to create situations that can bring students active learning in achieving good learning outcomes [22]. Although the environment might look like a game designed just for fun, there are serious results to be expected through the game, and serious content embedded in the environment they need to interact [27].

Game Based Learning apparently can increase student motivation and interest in learning [9]. Our previous findings in increasing student motivation were adopted in mobile games [28]. If in game based learning, rewards are given to students, the learning will motivate students more [29]. Broadly speaking, there are two roles that make game based learning an effective learning tool, namely as a motivator and simulator. As a motivator because with various advantages that can make someone more interested and enthusiastic in facing the learning process. As a simulator because games can facilitate things that are difficult to be modeled, done or simulated in the real world [6].

4. Conclusion

The conclusion from the results of this study is the application of effective game based learning implemented in order to improve student learning outcomes, with the category of effectiveness being high. Thus, in learning, instructors can use applying game-based learning in delivering lecture material. This is because the game "circuit scramble" can be used as an educational game that makes students motivated and active in learning so that the maximum in the learning process. Based on the results of

this study it is suggested that readers can try to apply game based learning in learning logic gates to improve student learning outcomes.

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