Improvement of student mathematics learning outcomes through Kahoot learning games application at elementary school

D Umboh*, D Tarusu, A Marini and M S Sumantri
Postgraduate Program Universitas Negeri Jakarta. Jl. Rawamangun Muka No. 1, Jakarta Timur, Indonesia

*deane.umboh@gmail.com

Abstract. The purpose of this research is to improve the student mathematics learning outcomes through Kahoot learning games application at elementary school. This classroom action research adopted from Kemmis and Mc Taggart Model was conducted in three cycles for the fourth grade as many as 22 students at 02 Public Elementary school in Tomohon, North Sulawesi, in Indonesia. The result of this study shows there is an improvement of students learning outcomes from cycle one to cycle three reaching 64, 72, and 81 from the maximum score of 100. Percentage of teacher and student activities increased from cycle one to cycle three achieving 77, 80, and 86 %. It can be concluded that application of Kahoot learning games can improve the student mathematics learning outcomes at 02 Public Elementary school in Tomohon, North Sulawesi, in Indonesia.

1. Introduction
The role of technology in the special learning process in schools greatly determines the success of learning. The use of technology in some of these periods after being a very important breakthrough in the learning process in elementary schools. Smartphone or Android-based technology is already being applied, given the current generation of students who have since been known to be familiar with the world of computers, cell phones, and the internet. As stated by Martins [1], namely the use of android in the learning process becomes normal and is proven with the assistance that can support the learning process. Learning mathematics in primary schools that rely solely on conventional media will not result in spending in the world of education today, because it cannot be denied. After all, the development of technology is crucial to the development of special education in mathematics learning in elementary schools, because basically, students are very familiar with the use of smartphones or Android in everyday life, for example in the activities of students playing online games, the use of other learning applications that are currently very easily obtained through Android or smartphones. Learning through applications that can be downloaded via smartphones or Android which has become a trend now, must be balanced with the creativity and innovation of teachers to be able to facilitate learning that is interesting and fun for students.

When teachers teach material about integer count operations, teachers can use online-based applications that use Smartphones or Android to stimulate student curiosity about the material provided. Because learning patterns play while learning can stimulate students to develop the ability to understand the basic concepts of learning integer operations. When teachers teach this material by applying
conventional based learning, many students are not interested in learning this material. Students feel bored and not motivated to learn, thus affecting student learning outcomes. Based on the results of formative tests obtained relating to the material of arithmetic operations of integers, it was found that out of 22 students, only 9 or 41% of students achieved mastery learning, with the specified KKM (Minimum completeness criteria) of 70. It means that there were still 16 or 59% of students who had not yet reached mastery learning. So, based on the findings above it is necessary to improve the learning process especially regarding integer count operations. Therefore, in this study using the application Kahoot game learning as an effort to improve mathematics learning outcomes, especially material arithmetic operations of integers in grade 4 students of 02 Public Elementary School in Tomohon.

Based on research conducted in Jordan, it was found that the use of mobile games in mathematics learning in 4th-grade elementary schools can significantly improve student learning outcomes [2]. Furthermore, research conducted in the Elementary School Kec. Pinoh regarding the importance of instructional media in learning integer counting operations [3]. Likewise, classroom action research conducted to improve student learning outcomes in learning mathematics using educational game applications in sixth-grade elementary school students [4]. In this study, researchers will research class using Kahoot learning games to improve mathematics learning outcomes material about integer count operations in grade 4 elementary school students of 02 Public Elementary School in Tomohon.

Integer count operations are generally taught by using the line number props [5], or negative-positive cards that are coloured differently. Simple technology as a teaching aid that is commonly used, is common and needs to be modified by utilizing internet-based technology, for example by utilizing a Kahoot learning game application. Kahoot learning game is an online-based application that can be downloaded for free and offers a platform that stimulates student responses to play while learning with easy use. Teachers can use Kahoot learning games to make game-based quizzes or discuss them. The integer counting operation quiz by utilizing the Kahoot application is designed by starting with the addition or subtraction operation of integers with simple numbers but challenges students to find the right answer within a predetermined time limit. The material for arithmetic operations of integers that are carefully designed and interesting will increase the motivation and activeness of students and increase the creativity of teachers in developing digital games [6].

Kahoot learning games are an excellent choice for teaching students with access to mobile devices supported by the availability of Wi-Fi or data packages. Kahoot learning games can support students in exploring concepts, making the learning atmosphere fun and easy to use. The use of the Kahoot application can also increase student engagement for fast and cooperative learning and increase healthy competition in friends [7].

Learning mathematics in elementary schools must get special attention from teachers. This is very important in efforts to improve student learning outcomes, especially regarding integer count operations [8]. Furthermore, teachers need to diagnose and solve problems that cause low learning outcomes of mathematics in primary school students, by considering methods of improving the quality of learning that can be adopted, designing interesting learning and by student characteristics, and facilitating students to learn in pleasant conditions. Learning mathematics is not only through practice and assignments. The teacher must help students to learn more effectively, attract students' attention, give instructions calmly and clearly, and solve complex problems to be simple, and devote sufficient time to respond to the opinions of each student [9].

In this study, researchers used the Kahoot learning games application that was designed by giving quizzes and discussions about integer arithmetic operations to improve students' understanding of concepts and skills in solving integer arithmetic operations in daily life. Therefore, the purpose of this study is to improve mathematics learning outcomes regarding integer count operations through the Kahoot learning games application in elementary schools.

2. Research method
The method of this research is Classroom Action Research which aims to improve mathematics learning outcomes through Kahoot learning game for 4th-grade students of 02 Public Elementary School in
Tomohon. This study adopted the Kemmis and Mc Taggart model with a cycle consisting of four stages, namely planning, implementing actions, observing and reflecting. The flow of research is as follows:

![Figure 1. Classroom action research using the Kemmis and Mc Taggart model [10].](image)

Action research is carried out as an effort to improve the learning process through giving actions in class in this case by using Kahoot learning game, which starts with planning learning materials and procedures regarding integer count operations, followed by classroom actions, namely the implementation of the plans that have been made, observations made along with the implementation of actions to monitor the activities of teachers and students during the use of Kahoot learning games in the learning process for further reflection related to the findings obtained from observations made, whether the learning process and learning outcomes are running following predetermined criteria or not maximally done. The results of the reflection will be a reference to plan the next cycle again [11].

Research subjects were grade 4 students, totalling 22 students of 02 Public Elementary School in Tomohon. The characteristics of students come from different work backgrounds of parents, different religions but generally come from the Minahasa tribe. But there are 2 (two) students who have difficulty learning, while other students can read, write and count according to their development. Especially in mathematics about integer arithmetic operations, it still shows the low achievement of students classically.

In this study the sampling technique used purposive sampling, because the researcher took samples intentionally, not randomly, and determined specific characteristics following the purpose of the study. Certain considerations are sought so that the data from the results of research conducted will be more representative. Purposive sampling technique is also a selective sampling or subjective sampling [12]. This shows that sampling relies on researchers' assessments of schools, especially classrooms and certain students who will be selected when conducting research, particularly concerning mathematics learning about integer arithmetic operations that show low learning outcomes.

The data consists of the results of the observation sheet describing the learning process related to teacher and student activities and student learning outcomes through tests conducted. Qualitative data processing taken through observation sheets when implementing actions and analyzed descriptively during reflection. While quantitative data processing of student mathematics learning outcomes is taken through tests and analyzed with simple statistics.

The data source in this study is monitoring the learning process data during the action carried out by using the Kahoot learning games application, and the research data in the form of integer count operation test results from grade 4 students of 02 Public Elementary School in Tomohon. In addition to these data, researchers also collected data from field notes describing learning activities, as well as photo and video documentation about the activities of teachers and students during the learning process in class. While other supporting data is the result of reflection that has been analyzed [13].
3. Results and discussion

3.1. Cycle 1
The action implementation using Kahoot learning games is done in 4-grade by dividing students into 4 (four) groups. Students have brought 4 smartphones or android using a data package prepared by the teacher. Students are directed to follow the teacher's instructions to enter the game and quiz about the concept of integer operations designed by the teacher through students' smartphones or androids. Students are arranged to play in groups for this game. The teacher guides students to ensure that students have accessed the Kahoot web address and enter the game pin provided by the teacher. In the learning process, students look very enthusiastic, but because this game is new to students, there are still many students who have difficulty following it. Students have difficulty at the beginning when accessing the Kahoot web address and are still confused about entering a pin. This takes up time, so the target for completing games and quizzes is not reached.

Based on the results of student learning obtained in cycle 1, it has not shown maximum results, namely only achieving an average score of 62 with a maximum score of 100 [14]. Besides, that based on observations obtained the achievement of teacher and student activities are 77%. This becomes the basis for continuing research in the second cycle by making improvements by an analysis of the deficiencies found in cycle 1.

3.2. Cycle 2
Based on the results of reflection and analysis of deficiencies and obstacles encountered in the implementation of cycle 1, the implementation of cycle 2 requires the addition of a smartphone or Android device. So that the group is reduced again its members and the class is divided into 7 groups consisting of 3-4 students, and 7 (seven) smartphones or android are needed in addition to those of the teacher. The teacher guides students to return to following the teacher's instructions to access Kahoot's web and start the game about integer concepts and complete the quiz given by the teacher. But there are occasional network constraints that are not good so that teachers and students experience interference to interact in games and quizzes. However, this obstacle is not too long, so the lessons can be continued again.

Students seem to begin to adjust to the instructions given by the teacher. Students are very enthusiastic and alternately in groups students are actively involved in the games and quizzes given. But there are still some students who don't get the chance to hold a smartphone or Android because their friends are more dominant. The teacher reminds students to share and give instructions to other friends who are still experiencing difficulties in playing and taking quizzes.

Following the results of the tests carried out at the end of cycle 2, the average student achievement score is 72. Although it has exceeded the KKM (Minimum completeness criteria) but only a slight increase. Furthermore, the results of the observation sheet of teacher and student activities also increased significantly to 80%. These findings become a reference to continue again in cycle 3 to obtain maximum results.

3.3. Cycle 3
The implementation of cycle 3 is almost the same as cycle 2. But the use of data packages that affect the quality of the internet network is further enhanced. The use of Kahoot learning games in cycle 3 shows a significant increase in teacher and student activities. The teacher gives clear instructions and gives good guidance to students. Likewise, students can already follow the teacher's instructions. The class atmosphere shows the active involvement of students with good collaboration between teachers and students, even between students and students.

Based on the results of tests conducted at the end of the cycle showed a significant increase. Student learning outcomes increased to 81 scores, while observations of teacher and student activities also increased to 86%. Therefore the research will not be continued in the next cycle because both the learning outcomes and observations have reached the set targets.
Overall student learning outcomes and observations in each cycle can be seen in the following picture:

![Graph showing student learning outcomes and observations from cycle 1 to cycle 3.](image)

**Figure 2.** Student learning outcomes and observations result from cycle 1, cycle 2 and cycle 3.

Based on the picture above, shows a significant increase in each cycle for learning outcomes and observations of teacher and student activities. Based on the picture above, shows a significant increase in each cycle for learning outcomes and observations of teacher and student activities. Following the characteristics of classroom action research, an increase in learning outcomes and observations have increased significantly since cycle 1 to a maximum in cycle 3 [15]. Student learning outcomes in cycle 1 with a score of 64 increased 8 scores to 72 in cycle 2 and increased 9 scores in cycle 3 to 81. While the percentage of observations of teacher and student activities from cycle 1 with a percentage of 77% increased 3% in cycles 2 to 80%, then increased significantly 6% to 86% in cycle 3. It was seen that the increase in learning outcomes in each cycle was directly proportional to the increase in the percentage of observations of teacher and student activities.

4. **Conclusion**

The use of the Kahoot learning game application can improve learning outcomes of integer count operations. Besides students are very enthusiastic and active in the learning process. Students also learn to develop the ability to interact by working together in groups. The use of the Kahoot learning game application also enhances the creativity and innovation of teachers to design technology-based mathematics learning using smartphones or Android.

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