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Mathematical communications through project based learning based on android

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Abstract. The lack of multimedia applications in schools and the low mathematical communication ability of students, as an alternative to using Android. The purpose of this research is to improve students' mathematical communication ability through android based learning project. Using the quasi experimental method. This research conducted at Junior High School in Bandung with 55 students as samples, 29 students in class VIII C as an experimental class and 26 students in class VIII D as a control class. Mathematical communication ability test instrument. Data analysis: independent T test, two way ANOVA test. The findings: Improved communication of students who get learning on Android based learning projects was higher than students who get conventional learning. There were no difference in the achievement of mathematical communication between students who get an Android based learning project and conventional learning based on mathematical basic knowledge in the high, medium and low categories. There is the influence of the interaction between the type of project based learning with android applications and expository learning and prior knowledge mathematics category (high, medium, and low) on the ability of students' mathematical communication. Android based learning project facilitates inventions process, reflective, the material is easy to understanding so that students' mathematical communication skills increase.

1. Introduction

The demands of professional teachers in the era 4.0 industrial revolution actually skilfully applying information and communication technology, to enhance the competitiveness of the tight community. The role of mobile apps android is one of the prospective technologies in the future that have a high flexibility and portability as a medium interaction in the learning process especially in mathematics, with some abstract that requires a strong understanding and communication.

Empirical reality in the field one of the problems encountered, the poor quality of the students in solving mathematical communication that demands a lot of ways but the completion of a single solution, and an array of solutions but the algorithm logical reasoning problem-solving steps. In the process of learning mathematics teacher to experience difficult to understand abstract mathematical concepts, the students think math difficult and tedious lessons [1]. Teachers not provide non-routine exercises that bad structure on mathematical communication skills. On the other hand the students lack of confidence during the learning process, strategy or monotonous teaching model centered on the teacher, so that the mathematical power, including mathematical communication skills of students less than the maximum.

Based on the results of a preliminary study in a junior high school in Bandung, two questions were elaborated on the description of mathematical communication skills the results, only 11 students out of



34 students who were able to resolve the matter in accordance with the indicators of mathematical communication, such as (1) connecting real objects, drawings, and diagrams into mathematical ideas and (2) declare a daily occurrence in mathematical symbols. Students difficulty in reflecting the real object or image into a mathematical idea. Only 32.3% were able to resolve the problem properly. Most students did not complete his work properly because students are not accustomed to solve problems of high-level thinking and mathematical expression based on the reality of everyday life. Based on the test results of many students who still have not reached the minimum completeness criteria.

Results in depth the school almost all students could use android smartphone device for communication purposes and playing games on YouTube that students often spend time playing android smartphone [2], multimedia interaction android-based math still hard to find in schools, not many skilled teachers apply android in mathematics. Based on the survey results mobo market types of mobile apps are the most downloaded by smartphone users is a game that reached 43.71%. This indicates that the smartphone has not been widely used in the learning process of mathematics, it is used for entertainment purposes only.

Smartphone usage during the learning process has not been optimal impact on the quality of learning outcomes of students. Given the findings of Nikmah the impact of mobile phone use on student achievement shows that students would do better if it can minimize play games with mobile phones outside learning activities [3]. This confirmed that the smartphone students have not utilized during the learning process. One suitable material taught math using instructional media Android is a matter of Algebra and Geometry. Based on the results of research Hendikawati et al that a valid Android-based CAI can be used as a learning resource, flexible, and supports students' self-regulated learning [4]. Add clearer expression abstract algebra material requires the creativity of teachers to contextualize it geometry and matter involving many objects related spatial visualization and measurement of space insight into the characteristics of a flat plane area and a wake-up space [5].

The impact of the development of science and technology to the learning process becomes meaningful, due to android mobile apps as a representative application of learning media that can facilitate the repetition of material whenever and wherever students need it. Application android mobile apps as a learning medium multy will facilitate easy interaction for students achieve the learning objectives appropriate cognitive, affective, and psychomotor.

One of the cognitive aspects in mathematics learning process is the ability of mathematical communication. Mathematical communication ability as one of the NCTM process standards establishes the following indicators [6]: (a) connecting the real objects, pictures, graphics, and algebra (b) declare a daily occurrence in the language of mathematics, (c) listening, discussion, and writing about mathematics, (d) read with understanding a mathematical presentation writing, (e) develop mathematical questions that are relevant to the problem situation, (f) constructing a conjecture, develop argument, formulate, definition and generalization). The findings Rohid et al reveal that only 1 in 3 students can express mathematical ideas; understand, interpret and assess or respond to mathematical ideas; and use terms, notations, and symbols to present mathematical ideas [7]. This research implies that students' mathematical communication skills need to be developed. Mathematics teachers not only teach mathematics but also awaken students' mathematical communication skills through creative and innovative learning activities.

The alternative learning that is using android-based project based learning, its seen as learning that able to implement students' demands using their thinking skills when they faced with problem or situations that conflict with their cognitive structure, during the mathematics learning process. Project-based learning is an innovative learning model that organizes classes in a project. According to NYC Department of Education project-based learning is a teaching strategy in which students must build their own content knowledge and demonstrate new understanding through various forms of representation [8]. Research result Rahmazatullaili et al [9] that project based learning can improve students' creative thinking skills and problem solving [10]. The implementation of project based learning can improve outcomes and student motivation. In accordance with the results of the study Eliana et al that project-

based learning is effective for learners in using technology in junior high schools in the high, medium and low categories [11].

In addition to the empirical fact that has been mentioned above, there are other factors that can contribute to the ability of mathematical communications that initial knowledge of mathematics that are categorized into three levels: smart, enough, and low. Technical knowledge of early mathematical aims to determine the equivalence between the experimental group and a control group that each sample has a mathematical knowledge in the same initial conditions. This is confirmed by the opinion from Kadir and Masi that [12]: the cognitive process can go smoothly if students can understand and connect all of the information that has been learning. The learning process can take place well if the knowledge that supports all learning activities has been well owned by students.

Explicitly the purpose of the paper to analyze: (1) differences in the ability of mathematical communication between students carry out project based learning with the android app and learning expository based on the entire students (2) differences in the achievement of the ability of mathematical communication between students carry out project based learning with android application and Expository learning is based on prior knowledge mathematics in the high, medium, and low categories (3) the effect of the interaction between the type of project based learning with android applications and expository learning and prior knowledge mathematics category (high, medium, and low) on the ability of students' mathematical communication. Moreover, quasi-experimental method makes students' mathematical communication skills increased after learning based on Android-assisted projects. The results of the study Ummah et al show that project-based learning can increase creativity in the project of making manipulative mathematics learning media [13].

2. Methods

This research using Quasi experimental method and non-equivalent control group design. The population is all eighth grade students of junior high school in Bandung. Samples were taken through a random sample sampling technique or random numbers. The students selected from members of the population without regard to strata in the population. There are 39 students of class VIII A as an experimental class using android project based learning and 40 students class VIII B as control classes who using conventional learning. The independent variable is Android-based learning and the dependent variable is students' mathematical communication skills. There are controlling variables in prior knowledge mathematics of the high, medium and low categories. Retrieval of data through instrument test prior knowledge mathematics, and mathematics communication skills test. The analysis of Independent t test data after the assumption of normality and homogeneity tests are met, two-way ANOVA test.

3. Results and discussion

To see the difference in the ability of mathematical communication between groups of students who carry out the project based learning with android app and get expository, performed data processing test results communication ability mathematically derived from the value of pre-test and post-tests were then obtained the value of N-gain test the ability of the mathematical representation Students, the average N-gain test students' mathematical communication ability that implement the project based learning with android application with the acquisition value of 0.58 in the high category better than students who carry out expository with a value of 0.13 in medium category.

After going through a series of tests of mathematical communication ability test data were normally distributed and had homogeneous variance. Independent T-test is then performed. The results of the t test with SPSS, with the Sig. (2-tailed) is $0.000 < 0.05$, then H_0 is rejected, meaning that there are differences in the improvement of communication capabilities between students who carry out the mathematical project-based learning with android applications and expository.

To see the difference in the achievement of communication ability mathematical based on prior knowledge of mathematics among the classes that implement the project based learning with android applications and classroom learning expository, performed data processing test results communication

ability mathematic derived from the value of post-test who then obtained the value of n-gain test communication abilities past students mathematically differentiated based on the value of prior knowledge of mathematics category of high, medium, and low. After going through a series of tests of mathematical communication ability test data were normally distributed and had homogeneous variance.

Based on two-way test ANOVA calculation results are as follows: students have the sig value is $0.739 > 0.05$, then H_0 is accepted. This means that there are no significant differences regarding the achievement of students' mathematical communication skills by PMK categories based on high, medium and low. It shows that prior knowledge of mathematics influence on the development of thinking skills abstraction characteristics of the students prior to batch-process implementation of learning [14]. Given the findings Putra Low student's prior knowledge mathematics communication skills mathematics impact on students [15]. More clearly Hevriansyah and Megawanti found a significant difference between students' prior knowledge of mathematics to mathematics learning outcomes [16]. The Sig. $0,017 < 0.05$, then H_0 is rejected. This means that there are differences in the achievement of students' mathematical communication capabilities significantly between students who carry out the project based learning with android application and the class as a whole in terms of learning expository, this shows that learning factors have a significant influence on the improvement of students' mathematical communication skills. Learning has the Sig. $0.012 < 0.05$, then H_0 is rejected. That is, there is an interaction with the type of project based learning with android applications and expository learning with prior knowledge mathematics levels (high, medium, low) students on students' mathematical communication skills.

Research result from Maron that learning that is carried out in a social constructivist manner, creates, and develops knowledge through assignments, is not the result of receiving information from the instructor alone, even in modern conditions professionally cannot rely solely on self-acquired knowledge, the involvement of other teachers and students reconstructs the concept of learning material to overcome conflict and training in completing ongoing tasks are urgently needed, to meet the challenges of the problem [17]. In accordance with the results of research Timur Koparan and Bülent Güven [18], that a project-based learning approach increases the level of student statistical literacy for data representation. The findings Indrawan et al revealed that project-based learning as an instructional innovation. Students can work in a team effectively and able to plan, organize, negotiate, while make consensus about the task to be presented scientifically [19].

According to the results of research Susilawati et al that learning project based learning challenge-based learning multimedia-assisted help in articulating ideas that can bring cognitive conflict becomes lighter [20]. The findings Susilwati indicated that there an increased ability of mathematical representations of students with Android-based challenge-based learning than students in the control group [21]. In accordance with the results Debbie Marie et al that the application of technology offers a more interesting media and its designed to help students in understanding and developing proofs in theorem of geometry [22].

Research results from Basya et al show that mobile learning android apps already fit for use as a medium of learning mathematics based contextual approach to facilitate students' understanding of the concept [23]. Ease the students to understand the material supported by research Kim and Lee which states that the use of images, animations, and sounds can help students' understanding of complex material [24]. Learning media is good to be used to support interactive learning, because the software has more supreme ability compared with other software in displaying media, graphic combination, animation, sound, and has interactivity with the users. Android application on the matter of evaluating the space as follows:



Figure 1. Android screen geometry evaluation questions.

4. Conclusion

There are differences in mathematical communication skills between students who carry out project based learning with Android applications and expository learning based on overall students. There is no difference in the achievement of mathematical communication skills between students who carry out project-based learning with android applications and expository learning based on prior knowledge mathematics in high, medium, and low categories. There is the influence of the interaction between the type of project based learning with android applications and expository learning and prior knowledge mathematics category (high, medium, and low) on the ability of students' mathematical communication. Project based learning on android application facilitated the process of conflict, discovery, social interaction, and reflective processes of students so that the ability of mathematical communication is improved while the material Easily understood and exciting.

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