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The Effect of Multi-Stage Discussion with Google Classroom and WhatsApp in Learning Physics on Problem Solving Ability

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Abstract

This research describes the effect of applying multi-stage discussion with Google Classroom and WhatsApp in learning physics on students' problem-solving abilities. Google Classroom media was used for large group discussions and WhatsApp for small group discussions. The design in this research used a pre-experimental design in the form of a one-group pretest-posttest design with a purposive sampling technique for three meetings on Newton's Law of Motion with experimented classes with a total sample of 60 students. Data were analyzed using paired sample t-test. The results showed a difference in the average students' problem-solving abilities before and after treatment with a Sig. (2-tailed) value of 0.000. After implementing learning multi-stage discussion with Google Classroom and WhatsApp, students' problem-solving ability in the experimental class increased from the very low to moderate category with an average N-gain of 0.66. The highest increase occurred in the indicators of physics approach and mathematical procedure with an average N-gain of 0.71 and the lowest increase in the helpful indicator description with an average of 0.63. This increase shows that the application of learning multi-stage discussion with Google Classroom and WhatsApp on Newton's Laws of Motion has a moderate effect on students' problem-solving abilities.

Keywords: Google Classroom; Multi-Stage Discussion; Problem-Solving Ability; WhatsApp

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INTRODUCTION

The outbreak of the coronavirus disease that has hit many countries in the world since December 2019 presents challenges in education. The Indonesian government has made a policy to replace face-to-face learning activities in schools with distance learning carried out online from their homes. According to Law Number 20 of 2003 concerning the National Education System Clause 1, distance learning requires students to be separated from educators and learn using various sources through communication technology, information, and other media.

Combining information and communication technology in the classroom can significantly improve 21st-century skills, such as problem-

solving skills (Phreeraphan, 2013). Problem-solving ability is one of the components of higher-order thinking that is very important to be mastered by students in science, especially physics. However, students still find it difficult, especially in making physical sketches of the given phenomenon, determining the equations that can be used, and performing calculations according to mathematical procedures to find the correct answer. Based on the survey results at Negeri 1 Bangunrejo senior high school, it was found that when solving physics problems, 54.7% of students did not understand the questions, and 45.3% of students did not master the concepts. This fact aligns with Azizah's (2015) research, which shows that high school students have difficulty solving physics problems.

The results of several previous studies show that the problem-solving ability of students is still low and challenging. Low problem-solving ability can be influenced by three factors, namely cognitive, affective, and metacognitive factors (Thersia et al., 2019). According to Masdukiyanto et al. (2016), Newton's Law of Motion is the physics material considered challenging to solve. Students find it difficult to identify the forces interacting with objects and correctly use Newton's Laws of Motion's concepts and equations. It is influenced by the learning process experienced by students who are less effective at improving student learning outcomes and students' ability to solve problems, so it is necessary to apply a learning method, such as the discussion method. The discussion method provides opportunities for students to exchange information or ideas and work together to find solutions to problems given by the teacher.

Discussions conducted in groups can help students reflect on the problem-solving process and obtain higher learning outcomes scores (Yen & Lee, 2011). The level of problems presented in the group discussion should be higher than usual. The higher the level of the problem, the more often students ask questions to their friends. Hence, there will be an interaction between students to improve their understanding of each. Students are actively involved in the learning process to find their concepts and principles from the problems presented. Learning that emphasizes the importance of interaction between students and discovery of concepts is based on the constructivism philosophy of Vygotsky and combined with Bruner's learning theory (Widjajanti, 2008).

Swartika et al. (2014)suggested that Bruner's learning theory supports the group discussion method. Bruner's learning theory emphasizes the importance of students being actively involved in rediscovering concepts and principles through phenomena that students encounter in their lives. Students have many opportunities for self-study and solving problems in group discussions. The research results conducted by Waminton (2011) show that applying Bruner's learning theory into group discussions is very good and can improve problem-solving abilities.

According to Mahuda (2017), students' problem-solving abilities improve after small group discussions and applied intergroup discussions. Small and large group discussions in learning that are carried out in stages with tiered discussion topics are called multi-stage discussion techniques (Northover, 2015). The discussion process in the multi-stage discussion conducted online learning begins with posting the initial assignment to the class forum then analyzed and responded to by classmates; the responses given can be used to find solutions to the problem topics being discussed. Students can also compare the knowledge or information obtained from other groups against the

views and understandings of the students themselves.

The discussions in several stages can make students more focused on analyzing the physics problems presented in stages to formulate solutions. A similar study conducted by Puspitasari et al. (2018) also found that multi-stage discussion activities can improve students' problem-solving abilities. The results of this study were supported by Ibrahim et al. (2017), which revealed that the diversity of answers that students had through group work and class discussions made students able to find their answers to problems. It would have a positive effect on improving students' problem-solving abilities. In addition, the results of research conducted by Hamman et al. (2014) also found that student's interest in learning in discussions was gradually higher compared to regular online learning.

Problem-solving ability is the highest level and is more complex than learning because it requires skills to process and organize information obtained to solve a problem (Syafii & Yasin, 2013). According to Hidayat et al. (2017), the problem-solving ability is an action or process that utilizes the mathematics and science it has in solving a problem through the stages of problem-solving. Docktor & Heller (2009) divided the problem-solving process into five stages: useful description (organizing information from the problem statement into an appropriate and useful representation), physics approach (choosing the appropriate physics concepts and principles to use), specific application of physics (applying more specific concepts and principles of physics), mathematical procedures (selecting and using mathematical procedures appropriately), and logical progression (the overall communication of organized reasoning patterns).

Multi-stage discussion in online learning can be done with the help of Google Classroom and WhatsApp media. A survey conducted at SMA Negeri 1 Bangunrejo showed that 99.35% of respondents had used Google Classroom for learning purposes, and 95% of respondents often accessed WhatsApp. The results of research conducted by Kurniawati (2020) also found an influence on understanding the concepts of students who used Google Classroom compared to students who took conventional learning. Understanding students' concepts are needed in solving physics problems given by the teacher.

Bagarukayo et al. (2019) also found that WhatsApp has great potential to support students in developing higher-order thinking skills, namely solving problems. The use of WhatsApp in learning Newton's Law affects higher-order thinking skills (Sholihatin et al., 2019). Higher-order thinking skills, including critical thinking skills and students' ability to find solutions to contextual problems. Likewise, the results of research data analysis conducted by Anggraini et al. (2020) show that WhatsApp significantly affects students' learning motivation and problem-solving abilities.

Besides being easy to access and not requiring many quotas, the advantages of the Google Classroom and WhatsApp discussion features are suitable when used as a multi-stage discussion medium. However, so far, there are still few relevant studies that use a combination of Google Classroom and WhatsApp as a medium for multi-stage online learning discussions to improve students' problem-solving skills, especially in Newton's Laws of Motion. Therefore, this research aims to describe the effect of multi-stage discussion using Google Classroom and WhatsApp in Newton's Law of Motion on students' problem-solving abilities.

METHOD

The type of research is experimental research using a pre-experimental design method. The design in this research is a one-group pretest-posttest design, where the experimental class will be given treatment in the form of application of multi-stage discussion using Google Classroom and WhatsApp by following the stages of a scientific approach to Newton's Laws of Motion. The population in this research was all students of class X MIPA Negeri 1 Bangunrejo senior high school, Central Lampung Regency, for the 2020/2021 academic year, consisting of 5 (five) classes. The sample in this experimental research is class X MIPA 1 and X MIPA 3, with a total sample of 60 students. The determination of the sample class used a purposive sampling technique, namely the determination of the sample with specific considerations. The two classes' determination in this study was based on recommendations from the teacher by considering the stability of the students' internet connections.

The implementation of research with multi-stage discussion learning using Google Classroom and WhatsApp by following the stage of scientific approach can be seen in Figure 1.

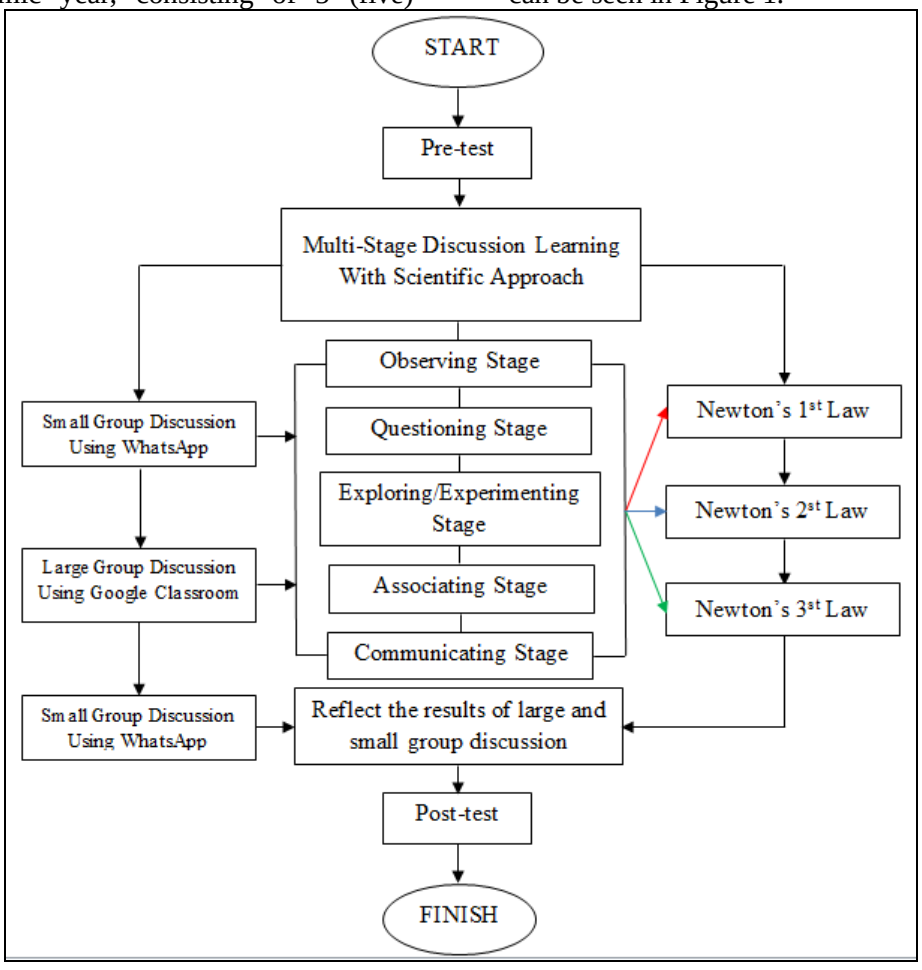

Figure 1 Research Implementation Flowchart

The instrument in this research was a problem-solving ability test question consisting of seven items describing higher-order thinking skills developed by Solekhah et al. (2018). The instrument has been tested valid with a value Pearson correlation > 0.349 and a sig. (2-tailed) < 0.05 and very reliable with

Cronbach's Alpha value of 0.908. This study's measurement of problem-solving ability was carried out using the rubric for assessing student problem-solving abilities developed by Docktor & Heller (2009), namely the Minnesota Rubric, which was used to measure five problem-solving indicators, including, 1) useful description, 2) physics approach, 3) specific application of physics, 4) mathematical procedures, and 5) logical progression.

The quantitative data in this research were the pre-test and post-test scores of students in the experimental class. Data collection techniques in this research used a technical written test in the form of pre-test and post-test. The quantitative data obtained were tested for normality first with the help of SPSS version 25.0. To find out the data comes from a population that is normally distributed or not. Data from samples from normally distributed populations were analyzed using the Paired Sample T-Test statistical test. The N-gain test was conducted to determine the improvement of students' problem-solving abilities by comparing the normalized gain between the pre-test and post-test.

The hypotheses tested in this research are:

H_0: There is no difference in the average problem-solving ability of students before and after learning by implementing multi-stage discussion using Google Classroom and WhatsApp.

H_1: There is a difference in the average problem-solving ability of students before and after learning by implementing multi-stage discussion using Google Classroom and WhatsApp.

RESULT AND DISCUSSION

This research applies multi-stage discussion learning with five stages adapting the five stages of the scientific approach by Mahmudi (2015). Students observed the phenomena presented in the first stage to identify things they wanted to know to take the next step. Second, students created and asked questions, discussed not understood and additional information they wanted to know, or clarification. Third, they read other sources, textbooks, and the internet, observing phenomena or conducting experiments to collect information relevant to the question. Fourth, they processed data/information that has been collected to answer questions/draw conclusions. Finally, they presented reports/conclusions in charts, diagrams, or graphs; and written reports. All learning activities were online using Google Classroom for large group discussions and WhatsApp for small group discussions. Pre-test and post-test scores were used to measure students' problem-solving abilities.

Based on the research that has been done, quantitative data on students' problem-solving abilities were obtained in the form of scores pre-test (before being treated) and scores post-test (after being treated), which can be seen in Table 1.

Table 1 Average Pre-test and Post-test Scores

Value	Min.	Max.	Mean	Std. Deviation
Pre-test	5.71	42.14	19.46	7.87
Post-test	60.00	92.86	76.61	8.78

Based on Table 1, it can be seen that the average post-test score is greater than the average pre-test score. Furthermore, the quantitative data normality test was carried out from the pre-test and post-test results, whether they came from a normally distributed population or not. The results of the data normality test showed that the data pre-test and post-test had values sig. (2-tailed) > 0.05. The test decision is based on the significant value of the data pre-test-test and post > 0.05. It can be concluded that all the

data tested are normally distributed so that hypothesis testing can be carried out using the Paired Sample T-Test test.

The Paired Sample T-Test test was conducted to determine the difference in the average results of students' problem-solving abilities before and after treatment. Based on the results of the Paired Sample T-Test as a significance value of 0.000. The decision-making criteria in the Paired Sample T-Test test gained the value of sig. < 0.05, then it rejected H_0 and accepted H_1, which means that there is a significant difference in average problem-solving abilities of students before and after the learning as the average post-test was more significant than the average value of the pre-test.

The Paired Sample T-Test results on each problem-solving per indicator showed that among the five problem-solving ability indicators, only one indicator had a significance value > 0.05. The specific application of physics was obtained at a significance value of 0.070, so H_1 was rejected, and H_0 was accepted. There was no significant difference in the average specific application of physics before and after the treatment.

Furthermore, the N-gain test was used to determine the improvement of students' problem-solving abilities before and after being given treatment. The results of the N-gain test can be seen in Table 2.

Table 2 Average N-gain Result Test

N-gain Max.	N-gain Min.	Average N-gain	Interpretation
0.88	0.47	0.66	Moderate

Table 3 N-gain Test Results for each Problem Solving Indicator

Indicator	Experiment Class		
	N-gain	N-gain (%)	Category
Usefull description	0.63	63	Moderate
Physics approach	0.71	71	High
Specific application of physics	0.69	69	Moderate
Mathematical procedure	0.71	71	High
Logical progression	0.70	70	High

The graph of students' problem-solving ability as a whole and on each problem-solving indicator based on the pre-test, post-test, and the N-gain value can be seen in Figure 2.

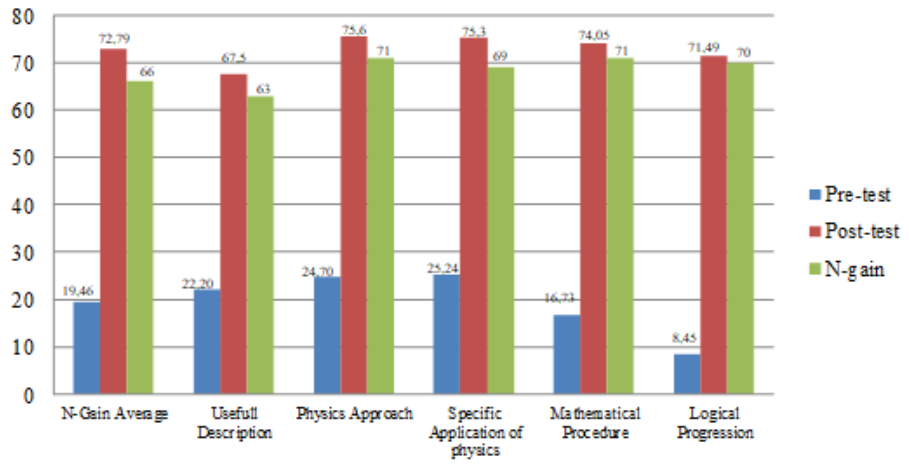

Figure 2 Graph of Student Problem Solving Ability

Based on Table 2, it can be seen that the average student experienced an increase in problem-solving ability in the moderate category with an average N-gain value of 0.66. In Figure 2, it can be seen that the average pre-test is 19.46, and the average post-test is 72.74. So, the difference in the increase in value is 53.28, with a percentage increase in N-gain of 66%. If we look at each problem-solving indicator, it can be seen that students' problem-solving abilities have the highest percentage increase in the indicators of physics approach and mathematical procedure with a percentage N-gain of 71% in the high category. Meanwhile, the lowest increase is in the helpful indicator description with an increase in N-gain 63%percentage in the moderate category.

This increase can occur because students were oriented to solve the problems presented during the multi-stage discussion process. Students tended to find out in advance from various sources such as the internet, scientific articles, and books when arguing. These activities enriched the knowledge possessed by students and improved students' thinking skills so that students could think more logically, critically, and creatively. The ability to think logically, critically, and creatively is needed in the problem-solving process. The results of this research are in line with what was stated by Syafii & Yasin (2013) that having the ability to solve problems means that students can think critically, logically, and creatively.

Before conducting a multi-stage discussion, the teacher first presented a video of the phenomenon related to the topic to be discussed. Furthermore, students discussed tiered questions from easy categories to more complex levels, from identifying phenomena to collecting experimental data to prove answers. Students were actively involved in group discussions to rediscover concepts and principles to solve problems through this activity. In line with Bruner's learning theory principles, students can find their concepts from the material being studied through an active and meaningful discussion process to solve problems more easily, quickly, and independently (Waminton, 2011).

Learning that applies multi-stage discussion in small and large groups also trains students to be more skilled in problem-solving. It can be seen at the stage of small group discussions using WhatsApp; students were trained to describe each problem in pictures and diagrams of styles. Next was a large group discussion in Google Classroom; each group was required to respond to rebuttals, criticisms, or suggestions for other groups' answers. Students were also free to provide factual follow-up questions so that students' problem-solving skills in the physics approach and skills in choosing the right approach in physics concepts were enhanced.

Responses and follow-up questions given by other groups were beneficial in correcting answers between groups and strengthening students' reasoning to choose the right physics approach and concept. It is reinforced by the results of research showing that students' problem-solving abilities on the physics approach indicator had the highest increase with an average N-gain of 0.71. The results of this research are also in line with those expressed by Anggraini et al. (2020) that mastery of physics concepts and reasoning is needed during the problem-solving process.

Based on the results of the Paired Sample T-Test on each indicator, it was found that the student's problem-solving ability on the specific application of physics indicator did not have a significant average difference after being given treatment. When learning conventionally, students tended to memorize formulas in solving problems so that students were already superior to this indicator. The achievement of

indicators after being given treatment has the highest percentage, which is 76.50%.

Students at a superior level in choosing a physics approach would also combine previous knowledge with physical reasoning. Students' answers tended to vary in choosing appropriate mathematical procedures and following mathematical rules to get problem-solving results. It can be seen from the average increase in students' problem-solving abilities on the mathematical procedure indicator, which also experienced the highest increase with an average increase in N-gain of 0.71. The results of this research are reinforced by those proposed by Anggraini et al. (2020) that students who were at a higher level in the physics approach stage tended to have diverse answers so that students could think creatively. Creative thinking tends to make students able to draw logical conclusions from all written answers. It can be seen from the results of the N-gain test on the logical progression indicator of 0.70 in the high category. The results of this research were supported by Ibrahim et al. (2017), which revealed that the diversity of answers that students had through group work and class discussions made students able to find their answers to problems. It would have a positive effect on improving students' problem-solving abilities.

Students' creative thinking positively impacts problem-solving abilities, clearly seen in the increase in the average N-gain indicator of problem-solving abilities. However, some indicators have increased in the Medium category, namely the useful description indicator with an average N-gain of 0.63 and a specific application of physics. It is due to the previous conventional learning in which students were used to memorizing theories and rigid formulas in books. Therefore, when given real problems slightly different from those in books, students still feel confused and are not accustomed to first describing the problems presented in pictures or diagrams of styles. Most students are still not sure about the concepts used.

Based on the research that has been done, students looked more active and enthusiastic when participating in discussions in WhatsApp groups compared to Google Classroom. It can be seen from the faster and more responsive student responses when participating in small group discussions in the WhatsApp group. Discussions using WhatsApp have many potentials supporting discussion media. However, they had some drawbacks, such as students tended to relax and joke a lot so that sometimes they got out of the topic being discussed. Therefore, the use of Google Classroom is more helpful for large group discussions. In large group discussions using Google Classroom, students tended to use formal language when discussing so that students would be more severe and not play around. This situation created a conducive, focused, focused, and not long-winded discussion so that students were more leveraged in discussions that impacted understanding concepts.

In line with the research conducted by Kurniawati (2020), which found an influence on understanding student concepts using Google Classroom, even though it is adequate for discussion media, the comments column in Google Classroom is arranged in parallel when students responded to their friends' comments. This display mode makes the discussion less effective because students have to read the entire comment in order. These obstacles can be minimized with the mentioned feature on the Google Classroom discussion forum. Apart from the shortcomings of the two applications, the combination of Google Classroom and WhatsApp as a discussion medium in multi-stage discussions is suitable for obtaining more information to improve problem-solving skills.

The relevant research is related to implementing multi-stage discussion on problem-solving abilities. However, on different materials, namely temperature and heat, that has been carried out by Puspitasari et al. (2018). The results showed that the average pre-test score was 7.67, and the post-test average was 69.12. From the pre-test and post-test scores, the N-gain value of 0.6 is in the Medium category, so it can be concluded that students' problem-solving abilities can be improved through learning by applying multi-stage discussions. Ibrahim et al. (2017) also conducted similar research, but on dynamic electrical materials. Based on the analysis that has been carried out, the average increase in problem-solving ability lies in the medium category with an average N-gain of 0.59. The results of the Paired Sample T-Test obtained in this research also have a Sig value. (2-tailed) of 0.000 <0.05, thus H_0 is rejected, and H_1 is accepted, meaning that there is a significant effect, where the average difference in students' problem-solving abilities is significant before and after learning.

CONCLUSION

Based on the research results, theoretical studies, and relevant research, it can be concluded that there is an effect of applying multi-stage discussion using Google Classroom and WhatsApp on students' problem-solving abilities, with a significance value of 0.000. The problem-solving ability of students has increased with an average N-gain of 0.66 in the medium category. The highest increase occurred in the physical approach and mathematical procedure indicators with an average N-gain of 0.71 and the lowest increase in the useful description indicator with an average of 0.63.

The results of this study can be consideration and input for education practitioners to improve the quality of education, especially in improving students' problem-solving abilities. The results of research on the application of multi-stage discussion using Google Classroom and WhatsApp positively affect students' problem-solving abilities. However, this study uses a pre-experimental research design, so many external variables still affect the results study. Therefore, further research is needed to test the validity of the research results but with a research design more accurate, and broader scope and samples

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