The Effectiveness of Stop Motion Video Assisted Discovery Learning Model on Mathematics Problem Solving Ability in Elementary School Students

Noviani Try Ardhiati✉, Kartono Kartono, Rochamd Rochmad

Universitas Negeri Semarang, Indonesia

Abstract

The purpose of this study was to determine the effectiveness of the Stop Motion Video Assisted Discovery Learning model on mathematical problem solving abilities. The research method used in this study is a quasi-experimental quantitative method with nonequivalent control group design. The population in this study was the Prince Diponegoro cluster, Pecalungan District, Batang Regency. Sampling was done by using simple random sampling. The data collection technique used a mathematical problem solving ability test, observation, and documentation. This study was analyzed using t-test. The results showed that (1) the ability to solve mathematical problems with the effectiveness of the Video Stop Motion Assisted Discovery Learning model had reached 75% classical completeness, (2) the average mathematical problem solving ability with the effectiveness of the Video Stop Motion Assisted Discovery Learning model was better than average. -flat. students' mathematical problem solving abilities using the expository learning model, (3) the proportion of students' mathematical problem solving abilities using the effectiveness of the Stop Motion Video Assisted Discovery Learning model is greater than the proportion of students' mathematical problem solving abilities using the expository learning model.

INTRODUCTION

The development of science and technology is now increasingly advanced and modern. Many things from various fields take advantage of the existence of technology. Its presence has had a considerable impact on human life in various aspects. One of the fields that can be influenced by the development of science and technology is education.

The world of advanced education can be realized by a learning process that makes students actively develop their potential, a teacher can take advantage of advances in science and technology to create an effective learning process. In addition, in the learning process teachers must master teaching and learning strategies so that students can learn effectively and efficiently. The learning strategy in this case is the teacher's mastery of models, methods and learning media. Along with the development of technology, many models, methods, and learning media are growing.

Technology in education is the integration of various information and communication technologies to increase the capacity of a smoother learning environment (Azzam, 2020). The system listens to the teacher's explanation in front of the class and carries out assignments if the teacher gives practice questions to students. In addition, the impact of the corona virus disease 2019 (Covid-19) outbreak cannot be separated from the world of education, including in the world of basic education. It is the obligation of teachers who must continue to teach under any conditions, so the online model is one solution (Lange & Costley, 2020).

Ansari & Khan (2020) stated that education does not occur in the space between the teacher's mouth and the pupil's ear, but education occurs in the space in each other's brain. This means that learning can be done anywhere, anytime and by anyone. One of the lessons that can be done with the current conditions is the model in the network (online). According to Adhe (2018), the purpose of online learning is to provide quality online learning services that are massive and open to reach more and wider

enthusiasts. Of course, this impact is a positive thing for teachers to keep up with the times.

Teachers must be able to master the various uses of these models, methods, and learning media, so that later they can determine appropriate learning strategies that are in accordance with the subject matter and student characteristics. With teachers mastering appropriate learning strategies, they can create an effective and efficient learning process so that learning objectives will be achieved.

But in reality, the implementation of learning in schools has not been effective and efficient. Teachers still pay less attention to the achievement of student competencies. Students only listen and listen to the information or knowledge provided by the teacher. This makes conditions disproportionate so that students only become objects and do not develop their potential.

The learning process in elementary school contains various subjects. One of the subjects is mathematics. The purpose of learning mathematics is to understand mathematical concepts, use reasoning, solve problems, communicate ideas with symbols, tables, diagrams, or other media to clarify situations or problems, and have an attitude of appreciating the usefulness of mathematics in life.

There are many abilities that students develop in learning Mathematics. One of them is problem solving ability. Learning materials for elementary school students' mathematical problem solving skills use story questions a lot. This is very important in the daily life of students, because these questions put forward real problems that are in accordance with everyday life. Story questions as a form of evaluating students' abilities to the basic concepts of mathematics that have been studied in the form of problems applying formulas. A person can be said to have mathematical ability if he is skilled in correctly solving mathematical problems (Retna, et al. 2013: 75).

Mathematical problem solving skills as one of the 21st century learning skills are also very important for students to have (Zahroh, Parno, & Mufti, 2018). These skills can help students to

cope with rapid societal changes that are supported by technological advances (Azizah, 2018). One of the advantages of solving mathematical problems, namely: connecting teaching with everyday life, can stimulate students' intellectual abilities and thinking power (Kurino, 2018).

However, mathematics is still considered a very difficult subject to learn, less useful for everyday life and one of the scary subjects. This opinion arises because most teachers only ask students to work on practice questions continuously without being balanced with the correct mathematical problem solving ability in delivering subject matter. Several studies conducted in Indonesia yielded information that the ability to solve mathematical problems was still relatively low.

The results of research conducted by Wiguna, Widiana & Sudana (2016) concluded that learning outcomes using mathematical problem solving skills were not satisfactory, which was around 30.67% of the ideal score. Fitriani, Milama & Irwandi (2017) research results using a small test on mathematical problem solving abilities, there are 18 students out of 40 students who still experience similar difficulties. Research by Prabawa & Zaenuri (2017) mathematical problem solving abilities in the Wates area have not met expectations, students are less able to master mathematical notation concepts and classify ideas to perform mathematical problem solving skills.

Setiyadi, Zaenuri & Mulyono (2018) state that mathematical problem-solving skills can be honed through a mathematics learning process followed by students and this process will certainly present a context in the form of mathematical problems. Geni & Hidayah (2017) state that mathematical problem solving ability is a situation where students use mathematical knowledge and reasoning to solve problems. Murniati, Mulyono & Kharis (2017) state that problem-based learning is active, integrated, and interrelated in problem-based learning, students work in small groups and share responsibility for learning together.

Setiyadi, Zaenuri, & Mulyono (2018) Polya describes in detail the four steps of solving mathematical problem solving including: 1) understanding the problem, 2) making a problem plan, 3) implementing a problem-solving plan, 4) seeing (checking) again. This does not rule out the possibility that learning models can be used to improve students' mathematical problem solving abilities.

According to Amalia, Widodo & Ami (2018) mathematics is a branch of science that has close ties in life in the environment around students, besides that there are many objects that can be associated with learning mathematics that can be used as examples to be applied in the classroom. According to Noor & Mulyono (2017) mathematics is a tool to develop a way of thinking, is abstract, the reasoning is deductive and related to structured ideas whose relationships are arranged logically.

Mathematics is still considered a very difficult subject to learn, less useful for everyday life and one of the scary subjects. This opinion arises because most teachers only ask students to work on practice questions continuously without being balanced with the correct problem-solving ability in delivering the subject matter.

Various ways can be used in conveying mathematics material, one of which is the culture that is in the student's own environment. Learning from a problem that exists in the surrounding environment will make students better understand the solutions used to overcome these problems. This is related to mathematics which is based on a culture called ethnomathematics.

The school's location is in the hamlet of Rt 02 Rw 03, Gemuh, Pecalungan District, Batang Regency, Central Java which is filled with modern life, making students live well. Modern life has eroded several aspects of culture in the Batang City area. One of them is official offices such as the Central Java Provincial Education and Culture Office, the Batang Regency Education and Culture Office, and the Central Java Language Center Office. And for the nearest activity center (Cultural Institute). One of them is the Liyangan Site cultural heritage, the Kailasa

Dieng Museum, the Pokmas Mandala Kolaka Traditional Village, the Central Java Province Cultural Park, and the Sekar Shanty Art Studio. The following are Figures 1, 2 of the official office buildings and Figures 3, 4, 5, 6 of the activity centers (Cultural Institutions).

Figure 1. Office of the Education and Culture Office of Central Java Province

Figure 2. The Office of the Education and Culture Office of Batang Regency

Figure 3. Central Java Language Center

Figure 4. Liyangan Site Cultural Heritage

Figure 5. Kailasa Dieng Museum

Figure 6. Central Java Cultural Park

Based on observations at SD Negeri Gemuh 02 that in grade IV, the results of interviews and the results of the solving ability scores obtained by students in learning Mathematics, especially in solving story problems on geometrical geometry are still low, the scores obtained are below the Minimum Completeness Criteria (KKM) set by the school. ie From 28 students 20 students have not reached the KKM and 8 students have reached the KKM which is 75. This can be caused by several factors. One of them, the mastery that the teacher has in designing a teaching and learning strategy is not

right or there are several obstacles experienced by students in solving the story problems. Constraints experienced by students include not being able to change the information provided into mathematical expressions, not paying close attention to what is known in the problem, misconceptions in interpreting math problems. This shows that the problem solving ability on story questions is still very low.

Therefore, the role of the teacher is needed so that students better master the material being studied. One way is to design teaching and learning strategies that make learning more interesting. Interesting learning is by applying a learning model and selecting the right learning media.

The selection of learning models and learning media carried out by teachers must be careful and adapted to the material to be delivered, so that students can understand the material clearly. The existence of good interactions in the learning process, students will become more interested in learning so that they are able to make the learning process more optimal and achieve learning objectives.

In selecting the learning model, it must be adjusted to the existing learning theory. One of the most influential cognitive instructional models is the model of Jerome Bruner, known as Discovery Learning (Buto, 2010:58). Bruner considers that discovery learning corresponds to the active search for knowledge by humans, and by itself gives the best results. Try yourself to find a solution to the problem and the knowledge that accompanies it, so as to produce more meaningful knowledge.

In addition to the learning model, the strategy to make the learning process effective is learning media (Hadi, 2017: 97). The learning process is a communication process and takes place in a system, so the learning media occupies an important position as one of the components in the learning process. Learning media is very important because it can facilitate teachers and students in the teaching and learning process. In choosing learning media, it needs to be adjusted to the needs, situations and conditions of each class (Hadi, 2017: 97). The use of this learning media depends on the teacher how to develop it properly, seen from the subject matter, message explanations and student characteristics. Especially at the elementary school level where students are still in the stage of developing concrete operations.

The development of the times is directly proportional to the development of technology. The development of science and technology can be used to create a learning media. One of the technologies that can be used in the manufacture of learning media is multimedia technology. Multimedia is the use of computers to create and combine text, graphics, audio, moving images (video and animation) by combining links and tools that allow users to navigate, interact, be creative and communicate (Daryanto, 2016).

Based on the advantages of multimedia technology, students not only hear (involving the sense of hearing) but also seeing (involving the sense of sight). The more senses that are used to receive and process information, the more likely the information is understood and can be retained in memory (Prihantana, et al, 2014: 5). Experts agree that there is a significant difference between the acquisition of learning outcomes through the sense of sight and the sense of hearing.

Computer research and publishing institute, namely Computer Technology Research (CTR), states that people are only able to remember 20% of what is seen and 30% of what is heard. But people can remember 50% of what is seen and heard and 80% of what is seen, heard and done all at once. Therefore multimedia is very effective. Multimedia is a powerful tool for teaching and education (Prihantana, et al, 2014: 5).

One of the media that can be made using multimedia is stop-motion animation video. Stop-motion video animation is an animation technique for making physically manipulated objects appear to move on their own. Objects can move because they have many frames that are executed sequentially.

The purpose of this study was to analyze the effectiveness of discovery learning assisted by video stop motion on the achievement of fourth

grade elementary school students' mathematical problem solving abilities.

The benefit of this research is that the results of this research become a scientific study to develop theories and concepts related to the effectiveness of discovery learning assisted by video stop motion on the achievement of mathematical problem solving abilities of fourth grade elementary school students.

METHODS

The type of research used in quantitative analysis is a quasi-experimental type of nonequivalent control group design. This study is conducted in Gugus. The experimental and control class are determined by using Simple Random Sampling. The research subjects are fourth-grade students at the SD Negeri Gemuh 01 and SD N Gemuh 02, Pecalungan, in the 2021/2022 academic year.

The chosen design is the pretest-posttest control design. There are two groups selected randomly, which are presented in Tabel 1. Research design

Table 1. Research design

Kelas		Perlakuan	
Eksperimen Class	T1	Learning with *discovery learning* models assisted by video stop motion T2	T2
Control Class	T1	Learning with discovery learning learning model	T2

T1 : Problem Solving Ability Pretest.
T2 : Problem Solving Ability Posttest
The next stage, namely the results of the prerequisite test can be seen in Table 2.

Table 2. Prerequisite Test

Prerequisite Test	Skor	Sig.	Ket
Normality test	0,168	0,05	Data is normally distributed
Homogeneity Test	0,200	0,05	Data Homogeneous
Average Similarity Test	0,601	0,05	Population has the same ability

Data collection techniques were carried out using tests, observations, and documentation. The data collection instrument used was a mathematical problem solving ability test sheet and an interview sheet. The indicators of mathematical problem solving ability in this study are (1) understanding the problem, (2) making a problem solving plan, (3) implementing a problem solving design, (4) checking the results again.

RESULTS AND DISCUSSION

The data analysis in this study used an independent sample t-test with the prerequisites for normality, homogeneity, and average similarity tests as shown in Table 1.

Table 3. Prerequisite Test Results

Tes Prasyarat	Nilai	Sig.	Kesimpulan
Normality	0,283	0,05	Normal Distribution
Homogeneity	0,651	0,05	Homogeneous data
Average Similarity	0,419	0,05	Both classes have the same ability

The results of the effectiveness of using the Stop Motion Video Assisted Discovery Learning model on problem solving abilities are discussed further as follows. Analysis of individual mastery of students' mathematical problem solving ability tests with the Video Stop Motion Assisted Discovery Learning model using a one-way test with a significance level of 5%, the value of tcount = 8,561 is greater than ttable = 2,055 so that H0 is accepted, it is concluded that the average ability test mathematical problem solving experimental class students achieved success indicators of 65. The results of classical completeness analysis

with success indicators of 65 obtained 26 students who completed 96.30%. The results of testing the proportion of one party with a significant level of 5% obtained Zvalue = 2.11, while Ztable = Z (0.5-0.05) = Z (0.45) = 1.64, then Zvalue > Ztable so that H0 is accepted. Based on these results, it can be concluded that the results of students' mathematical problem solving abilities in the Video Stop Motion Assisted Discovery Learning model which reached 65 degrees had exceeded 75%. The achievement of classical completeness can be seen in Figure 7 below.
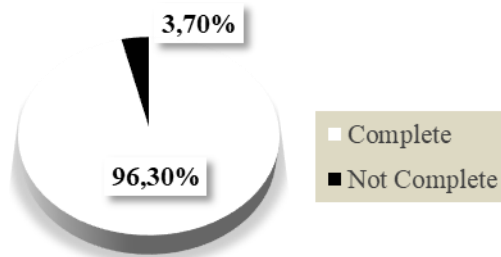
Figure 7. Classical Mastery of Ability

The effectiveness of the discovery learning learning model in improving mathematical problem solving skills, students in solving problems not only answer the problem, but also re-check what students have answered so that they get the right answer based on the correct concept. Murniati, Mulyono & Kharis (2017) stated that the approach to mathematical problem solving abilities, students are required to identify mathematical problems, be able to analyze a problem contained in the problem solving process, and in the end students are able to apply the concepts that have been obtained to other cases or examples, including when completing practice questions.

Based on the observation sheet, the teacher has carried out learning according to the steps of the discovery learning learning model assisted by video stop motion. Learning begins with a pretest on the scale material.

Implementation is done slowly because the stimulation of problem solving skills has never been done in the classroom. Students still feel awkward, because the teaching materials used are different and require adaptation to understand them. Ardian, Hasanah & Rana (2020) one of the obstacles faced when learning online is that students are not able to use applications used by teachers to provide learning materials online.

At this stage students understand problem solving in discovery learning with the material understanding of fractions. Students are introduced to stop motion videos in the form of images such as fruit images, and food images. This makes students interested because the stop motion video used is easy to use and students are enthusiastic in learning the material.

Various difficulties arise such as students' unpreparedness in counting fractions, such as students having difficulty imagining problems into mathematical sentences, and students having difficulty checking whether their answers are correct or not. The alternative that the teacher does is by providing opportunities for students to ask their parents or siblings or by asking the teacher in this case the researcher through google classroom.

The material presented is calculating the distance with a scale. Before students do activity 3, students are given the opportunity to understand the video about Lawang Sewu for 15 minutes. The purpose of understanding the video about the fractional image is to motivate students in doing learning. Sudarmoyo (2018) states by adding text, images, documents, videos, charts, or other types of content, and sways will make it look good with a few easy steps. Activity 3 is given to each group by containing the problem of calculating fractions.

Students are getting used to the problem solving steps, there are some students who are correct in applying the fourth step of mathematical problem solving abilities. The average learning score also increased from the second meeting so that the third meeting the students were easier to accept the concept of the material because the researcher gave a stop motion video in the form of

pictures or videos that are packaged in the discovery learning model that will be used in the material. Activity 4 and work on problem solving problems according to Polya's steps. In the last 30 minutes, a posttest was conducted to measure the success of the discovery learning learning model assisted by stop motion video.

The effectiveness of the discovery learning learning model assisted by stop motion video in improving problem solving skills, students in solving problems not only answer problems, but also re-check what students have answered so that they get the right answer based on the correct concept. This needs to be done to ensure that the answers written are correct, and students can understand and solve problems faced in everyday life.

Shanti & Agus (2016) state that the problem-solving ability approach requires students to identify mathematical problems, be able to analyze a problem contained in the problem-solving process, and in the end students are able to apply the concepts that have been obtained to other cases or examples, including when solving problems. exercises. The PBL-ethnomathematics online learning process is important because students will learn with problems that they encounter every day, namely several stop motion videos in the form of images or videos packaged

in the discovery learning model that will be used in the material.

The analysis of the results of mathematical problem solving abilities based on the level of mathematical problem solving abilities can be seen in Figure 8 below.
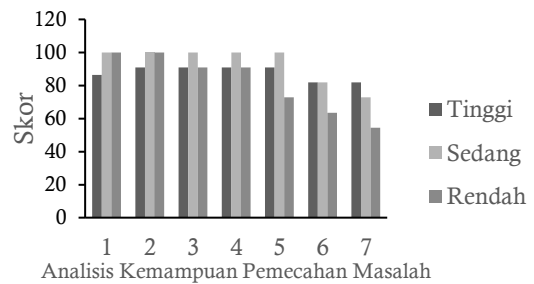
Figure 8. Level of Mathematical Problem Solving Ability

Based on Figure 2, it can be seen that on average students with high mathematical problem solving abilities can complete well, with an average score of 90.9 with very good criteria. For moderate mathematical problem solving abilities, the average score on question numbers 1-5 got 100, while for item numbers 6 and 7 the scores were only 81.8 and 72.2 with very good and good criteria. At low math problem solving skills, the number 1 and 2 got a score of 100 with very good criteria, for question numbers 3 and 4 the score was 90.9 with very good criteria as well. In questions number 5 to number 7, there was a decrease, namely the lowest score obtained at number 7, namely 54.4 with low criteria. Therefore, an encouragement is needed so that students can manage their time in solving problems well.

This is one of the results of the student's mathematical problem solving ability test which shows that the Stop Motion Video Assisted Discovery Learning model is effective in increasing the achievement of indicators. The results of the

problem-solving ability test in solving problems are presented in the following figure.
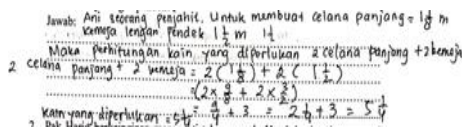

Figure 9. Understanding the Problem

Figure 9. Indicators of Understanding the Problem Based on Figure 9 it can be seen that students are able to write down the information contained in the questions well.
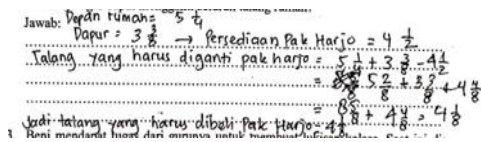

Figure 10. Make a problem-solving plan

Figure 10. Problem Solving Design Based on Figure 10, it shows that students can design problem solving well, according to the concept of adding fractions.
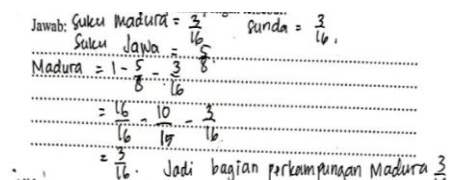

Figure 11. Implement a Problem Solving Plan

Based on Figure 11, it shows that students are able to carry out problem-solving plans that have been made correctly. The steps in the problem solving process are appropriate, in accordance with the concept of subtracting fractions.
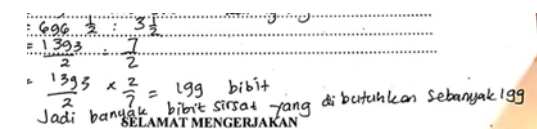

Figure 12. Checking Back

Based on Figure 12, it shows that students check the answers by giving conclusions at the end of the problem solving process correctly.

Dewi, Khoiri & Kaltsum (2017) state that the process of solving mathematical problems helps students integrate the knowledge they previously acquired with the problems or information obtained to be able to offer various alternative solutions. Different conditions experienced by the control class. Teacher assistance in providing stimulation to explore student knowledge is very important, so teachers need appropriate techniques in exploring student knowledge.

In the different test results, the average mathematical problem solving ability of the two classes was obtained t_count = 2.03 and t_table = 2.01. Because $t\_hitung > t\_{((1-\alpha),(dk))}$ then H_0 is rejected. This means that students' mathematical problem solving abilities in discovery learning assisted by video stop motion are more than students' mathematical problem solving abilities in expository learning models.

The analysis of proportional difference test results was used to compare the proportion of students' mathematical problem solving abilities in the Video Stop Motion Assisted Discovery Learning model with the proportion of students' mathematical problem solving abilities in the expository learning model class. The number of students who achieved individual mastery in the Video Stop Motion Assisted Discovery Learning model class was 26 students, while the number of students who achieved individual mastery in the expository learning model class were 22 students. The calculation results obtained Zcount = 1.732 and Ztable = 1.645. Because the value of Zcount > Ztable so that H0 is accepted, it can be concluded that the proportion of students' mathematical problem solving ability completeness on the Video Stop Motion Assisted Discovery Learning model is greater than the proportion of students' mastery in the expository learning model.

The effectiveness of a learning is a benchmark in determining the success of a learning. One of the benchmarks is showing student success in achieving KKM. The success of students is not only seen from the achievement of KKM, but there are other factors that

determine the effectiveness of a learning, namely the teacher applies a new innovation in discovery learning assisted by video stop motion. According to Hosnan (2014) and Marwazi (2019) "The Discovery Learning model is discovery-based learning. Through discovery learning, students will find their own concepts so that students can understand the available concepts and think analytically in solving the problems they face.

Based on the results of the effectiveness test and observations, it was found that students' mathematical problem solving abilities in discovery learning assisted by video stop motion were able to train students in understanding the problems presented. Students can construct their knowledge according to Piaget's opinion. Discovery learning assisted by video stop motion requires students to read and understand what has been read, then discuss it with other friends. The results of student understanding are expected that students can find their own concepts. This learning model, directs students to understand the problems that have been read, by utilizing previous knowledge students can solve the problem with their own concepts.

In addition, stop motion video media is an additional supplement in the learning process. This supplement directs students to increase student activity in learning, by giving students space to understand the questions presented in the form of videos. Supplements make students do not experience misconceptions about understanding the questions. According to Sumardi and Wardono (2019), stop motion animation media is able to reconstruct one thing into something more alive. The results of his research show that stop motion animation is effective in learning history in the era of the industrial revolution 4.0 with very good qualifications. According to Qamariah (2017) states that stop motion animation is appropriate to be used as a learning medium in the sub-material of the role of plants in the economy. So, it can be concluded that this media has a positive influence on learning.

The effectiveness of discovery learning assisted by video stop motion in this study is supported by the findings of previous studies. Some experts also state that discovery learning assisted by video stop motion is effective. This is stated by Widianingsih (2021) that animated videos of the musculoskeletal system (skeltoon) are quite effective in implementing learning biology in improving student learning outcomes. Meanwhile, with the results of previous research, according to Ulfa (2017) the guided discovery learning model for video learning is better than conventional learning on problem solving abilities and mathematical problem solving abilities of students who use guided discovery learning models for video learning to achieve classical completion, which is said to be complete if at least 85% of students complete learning individually from the number of students in one class, while individually completing the mathematical problem solving ability of students reaches an average of more than 75.

Based on the results of previous relevant research and research, it shows that discovery learning assisted by video stop motion can improve students' mathematical problem solving abilities during the learning process.

CONCLUSION

The conclusion of this research is that discovery learning assisted by stop motion video is effective towards the achievement of students' mathematical problem solving abilities which are shown as follows (1) students' mathematical problem solving abilities in stop motion assisted video discovery learning exceeds the KKM; (2) the proportion of students' completeness given in discovery learning assisted by video stop motion reaches or is more than 75%; (3) students' mathematical problem solving abilities in discovery learning assisted by video stop motion are better than students' mathematical problem solving abilities in expository learning; and (4) the proportion of students' complete mathematical problem solving ability in discovery learning assisted by video stop motion is better than the proportion of students' mathematical problem solving skills completeness in expository learning.

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