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## Improving the Ability to Observe, Identify and Define Variables Through Comic-Assisted Inquiry Learning Model

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**Abstract.** This research is motivated by students' science process skills which are still in the low category. Based on the initial observations made there were students who still had difficulty in conducting experiments. This research aims to determine the increase in the ability to observe, identify and define variables through the comic-assisted inquiry learning model. This research was conducted on class XI MIPA 2 students at SMAN 2 Banda Aceh involving 32 students. The research design used in this study is *isone grup pretest-posttest design*. Data collection techniques through tests (pretest and posttest) and student response. The pretest and posttest questions in this research were prepared referring to three indicators of science process skills, namely, observing, identifying and defining variables. After the data is collected, the data is analyzed using the gain test. The results of the research showed that there was an increase in students' science process skills in the aspect of observing by 0.54 in the medium category, identifying by 0.68 in the medium category and defining variables by 0.72 in the high category. Based on the results of this research, it can be concluded that the ability to observe, identify and define variables can be improved through comic-assisted inquiry learning.

**Keywords:** Observing, Identifying and Defining Variables, Inquiry, Comics

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## Introduction

Education is an important element in creating quality human resources. Quality education is really needed by a country to continue to maintain its existence. Thus, to create a quality education system, it is necessary to equip students with skills in the learning process so that they can easily understand quickly the material taught by the teacher. Science education that applies in schools must include two important components, namely science products and science processes. Science products are produced through a process of scientific investigation that involves scientific attitudes and scientific processes. Meanwhile, science as a process includes the skills and attitudes possessed by scientists when investigating natural phenomena to produce scientific products (Sanjaya, 2012).

One of the science education taught in schools is physics which is also known as a part of Natural Sciences (IPA) subjects, by studying physics students can not only learn

about natural laws in the form of concepts or principles, but also an activity of scientific investigation and observation carried out directly. An understanding of scientific evidence and ways to collect scientific evidence can be obtained through practicum activities and one of the places where practicum is carried out is the laboratory (Damopolii et al., 2015). Practicum activities can train students' science process skills. Science process skills are an adaptation of the skills used by scientist to develop a concept, investigate a problem and make conclusions about the problem (Mulyani et al., 2017).

Based on observations and the results of initial interviews with a physics teacher at SMAN 2 Banda Aceh, it is known that the curriculum currently used is K-13 with KKM physics learning of 70 and the practicum that takes place is still verification because it only proves the concepts or principles that have been learned. previously. Based on data from case studies, students' science process skills were obtained with an average percentage of 48.4%. Low science process skills because students still cannot identify variables, do not know the use of practicum tools and how to operate them. So in this study three indicators of science process skills were focused, namely observing, identifying and defining variables. These three indicators are included in the aspect of planning the experiment. After students fulfill these three indicators, it will make it easier for students to carry out an experiment.

One learning model that can be applied based on these problems is to apply an inquiry learning strategy. Inquiry learning is applied so that students are free to develop the concepts they learn, not just material that is recorded and then memorized (Yulianingsih & Hadisaputro, 2013; Vieira et al., 2021; Dani et al., 2021; Putri, 2021). Setiawan and Sucahyo (2019) in their research stated that the Inquiry learning model is a learning model that aims to develop students' attitudes and skills through scientific proof activities, so that they can be independent in solving their own problems. Inquiry applied in the learning process can improve students' ability to make observations and put forward answers to a problem through interpreting data until a conclusion is reached (Dewi, 2016). Based on the level of complexity, inquiry learning is divided into three levels (Trowbridge, 1990). The first is discovery learning. The second is guided inquiry learning. The most complex level is open inquiry learning. What these three levels of inquiry have in common is that they involve scientific process skills and basic scientific work abilities. In this research, the inquiry learning applied is uided inquiry. This learning model was chosen because each learning step in this learning model provides opportunities for students to make observations, ask questions, propose hypotheses, collect data, conduct experiments and draw conclusions. It is hoped that it will make students learn more understanding, and students will be able to explain knowledge based on evidence from the experimental processes they carry out. In addition, the inquiry learning strategy can improve conceptual understanding and learning motivation because students are actively involved in conducting investigations. This investigation has learning stages that can be used to train science process skills (Wulanningsih et al., 2012).

Students' science process skills can be trained using the investigative stages of inquiry learning. Science process skills are the physical and mental skills possessed by scientists to acquire and develop knowledge (Rahmawati et al., 2014). In addition, science process skills also involve intellectual, manual, and social skills that students use in the learning process (Rustaman et al., 2005). Science process skills are said to be process skills in conducting scientific investigations. Optimal science process skills are the goal of the learning process (Wulaningsih et al., 2022). Science process skills can be improved with the help of comic media. Pictures can help students to know how the procedure for using a tool or how to do an instructed step (Carney & Levin, 2002). Therefore, a combination of text and images is needed in work instructions so that students can better understand and easily visualize the practicum steps that must be carried out. One form of combination of text and images is comics. Comics are simple, clear, easy, and personal (Rohani, 1997). Educational comics can be useful for teaching science and are a good

vehicle for conveying concepts about science in an interesting way (Tatalovic, 2009). Therefore, comics were chosen as the format in the practicum implementation instructions. This is in accordance with research conducted by Asmi et al (2018) which concluded that there was an increase in students' science process skills taught using worksheets that looked comic.

Practicing students' science process skills can be used in the investigative stages of inquiry learning. Like several previous studies conducted by Irmu et al (2019) it shows that the application of inquiry learning can improve students' science process skills. Sulistiyono et al (2020) showed that students' science process skills increased through the application of inquiry learning. Then research researched by Wu et al (2018) in his research shows that curiosity related to inquiry can be expressed in school laboratories as student involvement which characterizes aspects of scientific inquiry and can facilitate the development of student inquiry. In addition, previous research conducted by Rahmawati (2020) shows that through the application of inquiry learning it can have a positive influence on students' science process skills. Other research conducted by Vieira et al (2021) shows that inquiry-based learning models can encourage teacher preparation to make changes when learning is implemented in schools. Then research conducted by Ekici & Erdem (2020) explains developing science process skills such as making hypotheses, determining variables, and being able to carry out controlled experiments through inquiry learning. Research conducted by Mutlu (2020) Through inquiry learning, students can develop their ability to understand learning by using scientific images which can help students understand learning.

Although the various recent studies that have been conducted show positive results, there has been no similar research that discusses in more detail the three aspects of science process skills, namely observing, identifying, defining variables through inquiry learning designed with a combination of text and images. Therefore, researchers are interested in conducting research on three aspects of students' science process skills through comic-assisted inquiry learning.

## Methods

This research used a quantitative and qualitative approaches. The research design used in this study is *one grup pretest-posttest design*. This research was conducted at SMAN 2 Banda Aceh with 34 students in class XI MIPA 2. The sampling technique used was purposive sampling with consideration of classes that had not yet studied the material to be conducted research. Data collection techniques through tests (pretest and posttest) and student response questionnaires to learning. The flow of research stages is carried out with initial observations as initial problem determination, then problem solving is determined using the comic-assisted inquiry learning model, then providing *pretest* before implementing comic-assisted inquiry learning, after implementing comic-assisted inquiry learning, it was carried out *posttest* to see the increase in students' science process skills before and after treatment. The pretest and posttest questions in this study were prepared referring to three indicators of science process skills, namely, observing, identifying and defining variables. After the data is collected, the data is analyzed using the gain test using the following categories.

**Table 1.** Gain Index

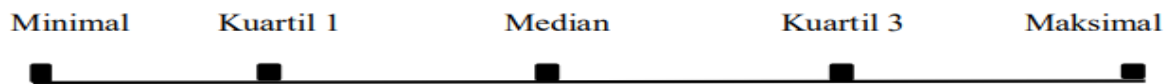
Score gain	Category
$g \geq 0.70$	Height
$0.30 \leq g < 0.70$	Currently
$g < 0.30$	Low

(Meltzer, 2002)

The flow of research stages carried out with initial observations as a determination of initial problems, then determining problem solving with the use of comic-assisted inquiry learning models, then giving a pretest before applying comic-assisted inquiry learning, after applying comic-assisted inquiry learning, a posttest is carried out to see the improvement of students' science process skills before and after treatment.

Next, the student response questionnaire regarding the application of the comic-assisted inquiry learning model was prepared with four alternative answers, namely strongly agree, agree, disagree and strongly disagree. The response questionnaire uses a likert scale with four answer choices, namely strongly agree (score 4), agree (score 3), disagree (score 2) and strongly disagree (score 1). The level of student and teacher response questionnaires is calculated in the following way:

1. Looking for the minimum score = minimum number x number of respondents
2. Looking for the maximum score = maximum number x number of respondents
3. Determining the median value =  $Skor\ maks + Skor\ min / 2$
4. Determine the value of quartile 1 =  $Skor\ min + median / 2$
5. Determining the value of quartile 3 =  $Skor\ maks + median / 2$
6. Create a scale that describes the minimum score, 1st quartile value, median, 3rd quartile and maximum score



The collected student response questionnaire data can then be seen with interpretation in Table 2.

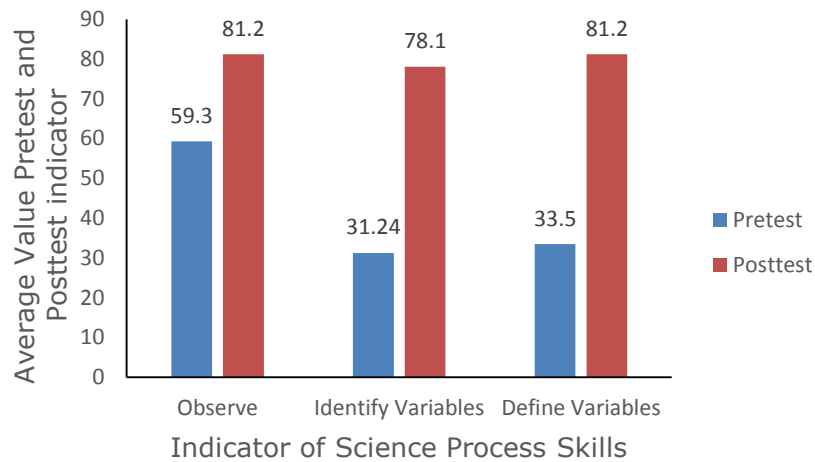
**Table 2.** Interpretations of Student Responses

Category	Index
Very Positive	81.25 – 100
Positive	62.5 – 81.24
Negative	43.75 – 62.4
Very Negative	25 – 43.74

(Yusrizal, 2016)

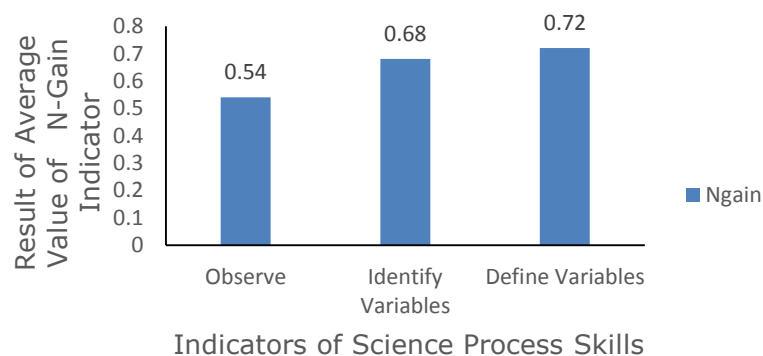
## Results and Discussion

Students' science process skills are assessed using pretest-posttest questions about traveling waves and stationary waves. The pretest-posttest data obtained then analyzed with the aim of knowing the increase in observing, identifying and defining variables through inquiry learning. If reviewed based on the average value pretest and posttest each indicator can be seen in the following Figure 1.



**Figure 1.** Average Value *Pretest* and *Posttest* indicator

Based on Figure 1, it can be seen that the three aspects have increased after applying the inquiry learning model. This can be seen from the students' posttest results. Analysis of pretest and posttest data was also carried out based on N-gain per indicator. This is done to find out more clearly the difference in the value of student improvement in each indicator. As for when reviewed based on the N-gain of the three indicators can be seen in the following Figure 2.



**Figure 2.** Average Value of N-Gain Indicators

Based on Figure 2 regarding the N-Gain value of science process skills from the three aspects namely observing, identifying and defining variables obtained by students in each indicator can be described as follows:

## 1) Observe

The first aspect is observing, where students are expected to define what is meant by observation. During the learning process the teacher has accustomed students to observing the problems presented. So that students are used to making observations about problems and understand what is meant by observation. Observing activities aim to train accuracy and accuracy in thinking. The ability to observe can be trained with a critical nature in all things. In this case, students are required to be careful and develop their thinking skills in making observations so they can solve the puzzle (Shophia et al, 2017).

The average obtained by students in the observing aspect is 0.54 which is the medium category. In this aspect, students use their five senses in making careful and structured observations through worksheets that are designed to look comic. As said by Nurkamilah et al (2020) that practicum guides are designed in the form of comics which are a combination of text and pictures in work instructions can make students understand better. During the learning process, students are trained to be actively involved in the learning process so that they can develop their skills. This is in line with research conducted by Negoro (2019) the challenge that occurs in inquiry learning is how to motivate students to engage in inquiry-based learning. Through the stages of inquiry learning, students are given the opportunity to experience firsthand how scientists discover concepts. Starting from observing the problems given by the teacher before conducting the experiment then questions arise. From these questions, hypotheses or temporary answers emerge that need to be proven experimentally.

The importance of science process skills as an indicator of observing in the teaching and learning process is that students will be easily active, in this aspect students will use all their five senses. This is in accordance with Nurhasannah (2016) that the indicator of observing is a basic scientific skill and observing students must be able to use all their five senses including seeing, hearing, feeling, tasting and smelling. In learning activities, students will be required to interact directly with real objects or events, so that it is easier for students to observe or observe an object

As stated by Ramadhan (2021) and Mutlu (2020) in their research that the Inquiry learning model is an approach in the teaching-learning process that aims to develop students' attitudes and skills through scientific evidence activities, so that students can become more independent in overcoming challenges and problems independently. Through inquiry learning students are required to solve problems given by the teacher through real data resulting from their own observations or observations (Febriana et al, 2018; Jufrida et al, 2021; Purwita et al, 2020; Yasin et al, 2019). To obtain data in inquiry learning is usually done by experimenting in the laboratory (Brinson, 2015).

## 2. Identifying Variables

Furthermore, in the aspect of identifying variables, students are expected to be able to identify control variables, response variables, and manipulation variables. This aspect gains an increase of 0.68 in the moderate category. During the learning process that takes place using inquiry learning, students are actively involved in planning experiments when using comic-looking LKPD so that students are trained in science process skills in identifying variables, even though during learning there are some students who are still confused in identifying variables. After making further observations on this aspect, students are trained to be able to find out the differences in the use of each experimental tool used during the experiment. So that in this aspect students can easily determine what variables are measured, variables whose values change, and variables that are maintained during the experiment. In training variable identification skills require quite a long time at the first meeting because these skills are very new for students who have never been taught before.

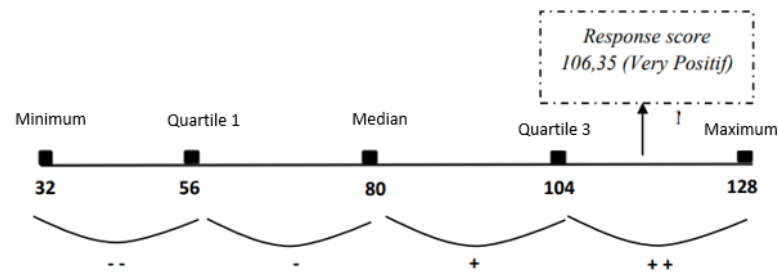
However, after being given training through activities experiment which requires students to identify variables, students can already be identify variables. In accordance with Ping et al (2020) opinion, experiments involve a number of steps who gives student a hands-on, collaborative and reflective learning experience help them for fully learn new skills and knowledge. In other words, someone must experience or do it themselves to gain knowledge. This is in line with research conducted by Juhji (2016) that using the inquiry learning model makes it easier for students to know the usefulness of each experimental tool used. In accordance with Sudibyo et al (2018) that the hypothesis is an assumption about the influence exerted by the manipulation variable on the response variable. Meanwhile, to know the variables control, students can identify based on experimental steps. Therefore, it can be said that the inquiry learning can be used as an alternative that can make students more active in learning activities and pay attention to a comfortable and pleasant atmosphere and is closely related to the development of students' science process skills. Through the inquiry learning, it can help teachers relate science material to students' real world situations, and encourage students to make connections between the knowledge they have and its application in their daily lives, both as members of the family and society, with this concept the expected learning outcomes more interesting for students, and can improve students' science process skills well (Bonney et al, 2016; Imran, 2016).

### 3. Defining Variables

The last aspect is defining variables, students are expected to be able to define operational variables after identifying variables. During the learning process, after students can identify variables, the next step that needs to be done is to define variables from the response variables, manipulation, and control variables that have been identified. In this aspect, the increase value is higher than the other aspects, which is 0.72 in the high category. This is because when students can identify variables, it will then make it easier for students to define variables operationally and also because students use comic-assisted LKPD, where educational comics can be useful for teaching science and are a good tool for conveying concepts about science in an interesting way (Tatalovic, 2009). After these 3 aspects are met by students, then students will be easy to carry out an investigation to prove the hypothesis or conjecture that has been formulated previously. Through inquiry learning students are trained in making hypotheses to carry out investigations like a scientist (Sakdiah et al., 2018; Prasetyo and Rosi, 2021; Nur'Azizah et al., 2016; Kadarisma et al., 2022).

Aspects of identifying and defining variables are carried out when conducting experiments. Students are required to be able to know the tools and materials and design work procedures for conducting experiments. After students can carry out experiments, students can easily identify and define variables. Through guided inquiry learning, students are encouraged to determine their own experimental activities to be carried out, where the teacher only guides and facilitates the students. Science process skills can trained with method students gain direct experience during the learning process (Widodo et al, 2014). Science process skills involve cognitive or intellectual, manual and social skills. Cognitive skills or intellectual with perform process skills students use their minds, manual skills are involved in the use of tools and materials, measuring, preparing or assembling tools, social skills are meant that with student process skills interact with each other in carrying out teaching and learning activities (Makransky et al, 2019; Rustaman, 2005).

The results of the student response questionnaire evaluation can be seen as follows:



**Figure 3.** Result of Student Response

Based on the results of the analysis that has been carried out, students give a very positive attitude towards the comic-assisted inquiry learning model. This is shown by the student response questionnaire score which shows 106.35 and is in the very positive category. This shows that studying physics on traveling waves and stationary waves using the comic-assisted inquiry learning model for students can improve science process skills. This can also be seen during the learning process, students can determine and define variables and are very enthusiastic in carrying out practicums to discover concepts in traveling wave and stationary wave material using LKPD based on comic-assisted inquiry learning models. This was also conveyed by Tatalovic (2009) who said that educational comics can be useful for teaching science and are a good means of conveying concepts about science in an interesting way. So it can be said that LKPD based on the comic-assisted inquiry learning model is effective for application in learning. Science process skills can be improved with the help of comic media. This is in accordance with research conducted by Asmi et al (2018) which concluded that there were differences in the science process skills of students who were taught using worksheets with comic displays and students who were taught using worksheets without comic displays. Media in the form of comics can make it easier for students to remember and analyze learning compared to using reading texts. Setiawan (2022) believes that the meaning of komik in general is a picture story which is usually found in magazines, newspapers, or in the form of, in general, comic stories that are easy to digest and funny. Comics are also a medium that can be used to improve and develop children's personalities. Media in the form of comics can make it easier for students to remember and analyze learning compared to using reading texts. This learning process can make some passive students become active, because from start to finish all students will solve problems.

The use of practical guides in the form of comics in practical activities has advantages and disadvantages. The combination of images and text in the practical guide can help students visualize the work steps that must be carried out. This is in accordance with the results of the student questionnaire where almost all students stated that they agreed that the practical guide in the form of a comic guided the practical implementation and provided knowledge about how to carry out work steps correctly. Apart from that, students easily understand the practical guide in the form of comics and prefer to use the practical guide in the form of comics. The disadvantage of this comic-shaped practical guide is that it takes quite a long time and costs a lot to make. This is certainly less efficient if it is used in schools that have a relatively large number of students. With the practicum guide format in the form of a comic which is a recipe book format, it will hinder the emergence of students' creativity to try new things because students are fixated on the work steps that have been provided. In fact, high school students are required to be able to carry out an inquiry process, finding out for themselves what work steps must be carried out. However, this comic-shaped practicum guide can be developed as a tool to foster students' analytical, inference and critical thinking skills.



Based on the explanation above, it can be said that the comic-assisted inquiry learning model can make students more actively involved during the learning process. So that through this comic-assisted inquiry learning students are expected to be able to develop their abilities to be better such as improving students' science process skills in observing, identifying and defining variables. In accordance with the theory which states that improving science process skills using a guided inquiry model assisted by comics provides opportunities for students to be directly involved in learning activities, so that students are more active in learning activities (Damayanti, 2020). The inquiry process involves all scientific activities to obtain information such as hypothesizing, predicting, reading, planning and carrying out experiments and collaborating with other scientists. Carrying out activities related to science is usually called science process skills. The achievement of science process skills for students who studied using the guided inquiry learning model provided more optimal results than students who studied using the direct learning model. The inquiry approach is an approach that is able to create more effective learning than conventional approaches. In the inquiry approach, students carry out more activities in learning than in the conventional approach and are able to improve basic science process skills. Inquiry activities provide a brilliant opportunity to build knowledge through discovery.

When learning activities take place, students deepen everything they learn during the experimental process so that they can easily understand the material of traveling waves and stationary waves based on the concepts they discover in experimental activities, so that their science process skills will also increase. This is in accordance with the statement given by Kumala & Admoko (2017) that inquiry learning can be used to improve students' science process skills through experiments carried out to build and develop concepts in physics learning so that they can improve the learning outcomes obtained by students. This statement is also supported by the results of research conducted by Sakdiah et al (2018) which states that learning using the inquiry model can attract attention and increase students' curiosity so that students are interested in searching for and finding their own answers to a problem that they will solve. This statement is also supported by research conducted by Muliyani (2017) which states that the inquiry learning model encourages students to build a deep understanding of target concepts almost entirely through their own experiences and reasoning.

As students design and conduct scientific investigations, students are able to develop skills such as: systematic observation, taking careful measurements, and identifying and controlling variables. Interpretation skills are visible when students carry out observational investigations on experimental objects. Students will explain based on what they observe, and as they develop cognitive skills, they will be able to differentiate explanation and research and be able to construct relationships based on evidence and logical arguments.

This is in accordance with the research conducted by Walil et al (2021) which resulted in the applied inquiry learning process obtaining increased indicators of students' science process skills. Then research conducted by Ekici & Erdem (2020) states that through inquiry learning develops science process skills such as making hypotheses, determining variables, and being able to carry out controlled experiments. This is similar to the results of research conducted by Owolade et al (2022) which show that inquiry learning places an advantage on students' ability to think like a scientist and is a mode of instruction in which students study concepts, existing problems, investigate and question them freely.

During the learning process, researchers used Vygotsky's learning theory. Inquiry learning includes constructivist-based learning based on Vygotsky's theory. According to Sapu et al (2020), Vygotsky's constructivist theory explains that in constructivist learning, students are given the opportunity to experiment or inquire and interact with friends to

improve their development. According to Mialisa et al (2017), the concept of learning according to constructivism theory is learning that conditions students to carry out an active process of building new concepts, new knowledge based on data and the teacher acts as a facilitator and media. According to Vygotsky, development cannot only be seen from facts or skills, but more than that, a person's development passes through two levels. Social level and psychological level. Where the social level is seen from the place where a person's social environment is formed and the psychological level is from within the person concerned.

Vygotsky's theory underlies the existence of social skills in this learning process. During the learning process, the teacher guides students in developing their social skills among friends, so that students can easily solve problems easily and can fulfill the three aspects discussed in this research. The limitation in this research is that it has not used in-depth interview techniques among students to find out more about the implementation of inquiry learning on students' ability to observe, identify and define variables. In addition, this research was only conducted in one school, perhaps it can produce a more comprehensive result if it is conducted in several schools.

## Conclusion

Based on research resultsshow that practical guides in the form of comics can help and guide students to carry out practical work independently at school. Practical guides in the form of comics received positive responses from students. Furthermore,The three aspects of science process skills, namely observing, identifying and defining variables applied through comic-assisted inquiry learning, have improved each aspect. This can also be seen during the learning process, students are actively involved in fulfilling these three aspects and students learn to work together well and have good communication with their friends, help each other among group members, and play an active role in each group so that problems in the learning process can be resolved. solved well. The model used needs to be redesigned and studied further so that it can be applied to various types of material, especially in physics subjects.

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