JPPIPA 8(2) (2022)

Jurnal Penelitian Pendidikan IPA

Journal of Research in Science Education

http://jppipa.unram.ac.id/index.php/jppipa/index

Symbolic Communication Ability of Prospective Physics Teacher Students

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DOI: 10.29303/jppipa.v8i2.1429

Article Info
Received: February 28, 2022
Revised: March 23, 2022
Accepted: April 21, 2022
Published: April 30, 2022

Abstract: Research in the field of physics education, only focuses on verbal communication such as the ability to ask questions. While communication skills are not only limited to the ability to ask questions. But there is an equally important symbolic communication. The indicators of symbolic communication in question: state the ideas of physics in the form of pictures, interpreting images into physical models, explain physical phenomena into problem solving procedures. The population in this study were all students majoring in Physics Education in the fifth semester of class 2019 and third semester of 2020, and the sample consisted of 38 students. The symbolic communication abilities of prospective physics teacher students at Samudra University are as follows: The indicator states physics ideas in the form of pictures, 24 people or 63.16% of students can state physics ideas in the form of pictures correctly and completely, The indicator interprets the picture into the physics model, only 1 person or 2.63% of students can connect the picture into the physics model correctly and completely, Indicators explain physical phenomena into problem solving procedures, there are 17 people or 44.74% of students who can explain solving procedures correctly and completely.

Keywords: Communication ability; Symbolic; Prospective physics teacher

Citation: Wahyuni, W., Husna, N., Evendi, E., Safitri, R., & Pratiwi, S.H. (2022). Symbolic Communication Ability of Prospective Physics Teacher Students. *Jurnal Penelitian Pendidikan IPA*, *8*(2), 751–758. https://doi.org/10.29303/jppipa.v8i2.1429

Introduction

Social cognitive theory has a central role in cognitive processes, representation, self-reference, and self-reflection. The ability to symbolize becomes a powerful tool for humans to understand, manage, and create their social environment. Cognitive factors become the determining factor in choosing which event to observe, what meaning should be given, does it have a lasting effect? What emotional impact or motivational power will it have? And how will the information conveyed be managed for future use? (Bandura, 2001). The answer is through symbols. With symbols, you can process and transform temporary experiences into cognitive models that serve as instruments for making judgments and actions. Through symbols, people give meaning, form, and continuity to their experiences (Wahyuni et al., 2021).

Knowledge can be acquired through symbolic operations derived from various information on personal and representative experiences. Through symbols, people can communicate with other people at any distance in space and time. As a prospective physics teacher, communication skills are important (BİLİR et al., 2021; Khan et al., 2017; Momchilova & Ilchev, 2016; Ustun et al., 2017). Through symbolic communication, a person can generate solutions to problems, evaluate the possible outcomes they get, and choose the appropriate options in solving problems more easily. The ability to communicate is a person's ability to express their ideas, describe, and discuss concepts that are in their minds coherently and clearly (Lomibao et al., 2016). Then

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communication skills are useful for explaining and justifying actions in procedures and processes both orally and in writing (Dimmel & Herbst, 2017; Moore-Russo et al., 2013; Schermerhorn & Thompson, 2019; Smith, 1979; Teledahl, 2015).

However, research in the field of physics education only focuses on verbal or verbal communication research such as the ability to ask questions (Ayunda et al., 2021; Nurjannah et al., 2020). Meanwhile, communication skills are not only limited to the ability to ask questions. But there is an equally important symbolic communication. There are four written communication skills in the research of Nurhayati, et al, namely describing problem situations and stating problem solutions using pictures, charts, tables and algebraically, explaining ideas, situations, and physical relations in writing. Using the language of physics, symbols and thinking schemes appropriately, can restate or draw conclusions in writing using language (Nurhayati et al., 2019). The indicators used by Nurhayati, et al are not specific, this is because there are no questions that explain these indicators. If we look at the indicators used, at least to answer the first indicator four questions are needed: (1) describing the problem situation and stating the solution to the problem using pictures; (2) describe the problem situation and state the solution to the problem using a chart; (3) describe the problem situation and state the solution to the problem using a table; (4) describe the problem situation and state the problem solution algebraically. Likewise for other indicators. Research conducted by Raamadina and Rosdiana discusses written communication in general, they did not mention the written communication indicators they assessed (Ramadina & Rosdiana, 2021).

Thus, this study will describe the symbolic communication skills of prospective physics teacher students. Ansari, et al divide the indicators of symbolic communication into two (1) Connecting real objects, images into mathematical ideas; (2) explaining ideas by constructing conceptual models such as pictures, or algebraic forms, expressing everyday events in mathematical language or symbols (making models) (Ramadhani et al., 2021). Meanwhile, Ika divides written communication indicators into three, namely (1) being able to make tables and interpret them; (2) able to analyze data; (3) can make conclusions (Nurhayati et al., 2019). The indicators of symbolic communication in this research are (1) expressing physics ideas in the form of pictures; (2) interpreting images into physical models; (3) explain physical phenomena into problem solving procedures.

Communication is more comprehensive than just language and speech. Through communication people can influence each other. So that communication must be done with full awareness of the sender to the recipient (Smith 1979). This study aims to describe the symbolic communication skills possessed by prospective Physics teachers. Because a teacher must have the ability to communicate that can influence students and improve their students' communication skills, whether reduced to writing or in other forms of communication such as symbolic communication in this study.

Method

This research is a qualitative descriptive. The first step is to collect data and prepare data for analysis. For more details, consider the following Figure 1:

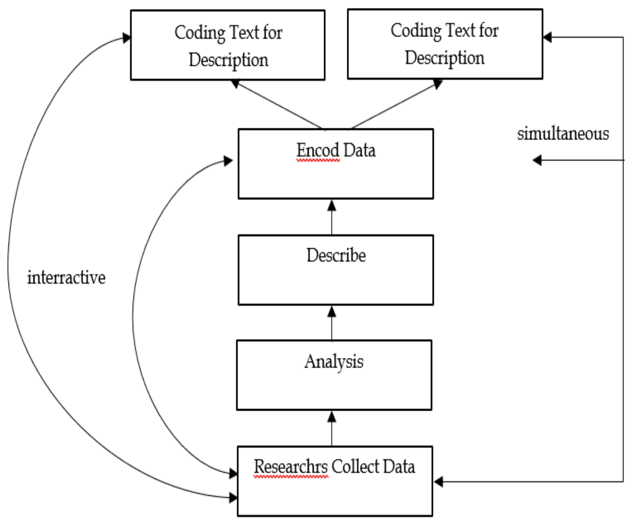

Figure 1. Research Methodology Analysis

The population in this study were all students majoring in Physics Education in the fifth semester of class 2019 and third semester of 2020, Faculty of Teacher Training and Education, Samudra University, one of the universities in Langsa City. The sampling technique used was purposeful sampling, so that the number of samples in this study amounted to 38 students. The data collection technique is through test questions which consist of three questions. Before being implemented, the questions are tested first and analyzed for validity, reliability, discriminatory power, and level of difficulty. The following table shows the symbolic communication ability test scoring table.

Table 1. Symbolic Communication Ability Score

Communication Indicator	Assessment	Score
Expressing physics ideas in the form of pictures	1. Students do not answer at all	0
	2. Students cannot express physics ideas in the form of pictures	1
	3. Students can only state a small part of physics ideas without pictures	2
	4. Students can express physics ideas in the form of inaccurate pictures	3
	5. Students can express physics ideas in the form of correct and complete pictures.	4
	Maximum Score	4
Interpreting images into physical models	1. Students cannot answer at all	0
	2. Students cannot connect pictures into physics models	1
	3. Only a small number of students can connect images into physics models	2
	4. Students can connect the picture into the physics model but it is not correct	3
	5. Students connect the pictures into the physics model correctly and completely	4
	Maximum Score	4
Explaining physical phenomena into problem solving procedures	1. Students cannot answer at all	0
	2. Students cannot explain the completion procedure	1
	3. Only a small part of students can explain the completion procedure	2
	4. Students can explain the procedure but it is not correct	3
	5. Students can explain the completion procedure correctly and completely	4
	Maximum Score	4

The data were analyzed by data reduction, data display, and conclusion drawing/verification. Categorization of the ability level is divided into three categories, namely**:**

Table 2. Ability Level Grouping

Criteria	Category
$80 \leq x \leq 100$	Tall
$70 \leq x \leq 79$	Currently
≤ 60	Low

Result and Discussion

The data from the symbolic communication ability test were analyzed to get an idea of how much students mastered the symbolic communication skills in geometrical geometry optics. The following is a description of the results of the symbolic communication ability test of prospective physics teacher students from each indicator:

a. Expressing physics ideas in the form of pictures

The results of the analysis of indicators that express physical ideas in the form of images in number one can be seen as follows. Based on Figure 2, it can be seen that the first indicator of symbolic communication ability is stating physics ideas in the form of pictures as many as 24 people or 63.16% of students can state physics ideas in the form of pictures correctly and completely, as many as 13 people or 34.21% of students who can express physics ideas in the form of a wrong picture, as many as 1 person or 2.63% of students who can only state a small part of physics ideas without pictures

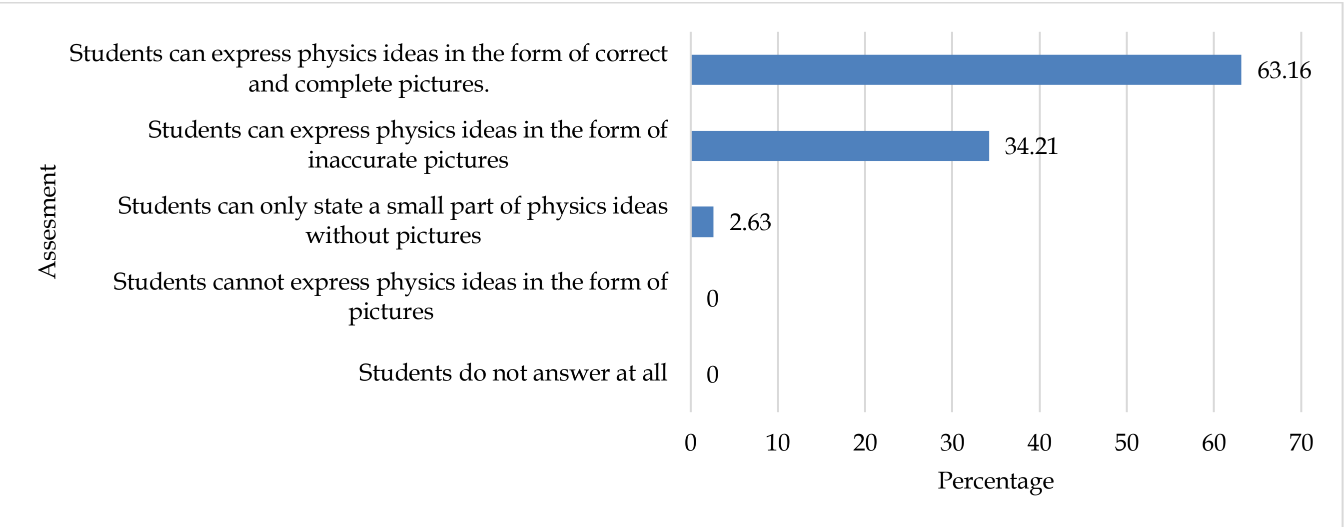

Figure 2. Description of the Indicators Expressing the ideas of physics in the form of pictures

Interviews were conducted to confirm the results of the answers that have been done by students. Some students make mistakes because of their inaccuracy in solving problems. But when the interview process and asked to provide answers to the same question the answers they gave were better, as well as when other questions with the same form were given. However, 13 people who made mistakes in expressing their physics ideas in the form of pictures made mistakes due to their misunderstanding of concepts such as the Figure 3.

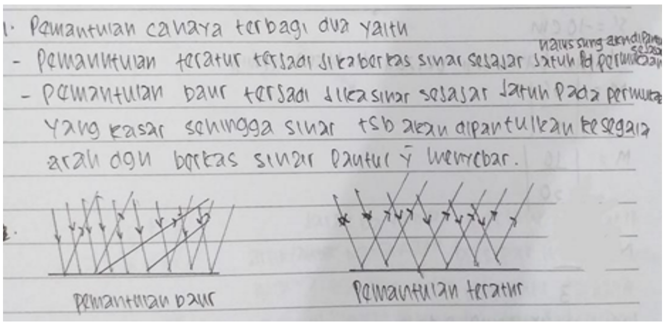

Figure 3. Answer A10

Physics teacher candidate with initials A10 can express physics ideas in the form of a wrong picture. It can be seen from Figure 3 above that A10 wrote that the reflection of light was divided into two, namely: regular reflection and diffuse reflection, but A10 had not been able to express physics ideas in the form of pictures correctly. The error made by A10 was on the surface of the light reflection. In addition, students are only able to express physics ideas without pictures. A person is said to have an understanding of a concept correctly, if he can represent what he understands in another form of representation (eg the representation is in the form of an image) so that it can be understood by others (Randita et al., 2018).

The results of this study indicate that even though a person has good comprehension skills, he may not necessarily be able to represent what he understands in the form of images. As the results of Firdiani et al's research which stated that there were still difficulties in expressing situations in the form of pictures or mathematical models, analyzing and evaluating mathematical ideas in other forms (Firdiani et al., 2020). Conceptual aspects play an important role. So, students must be able to integrate the conceptual aspects of symbolic forms to describe what features of the problem to be solved (Schermerhorn & Thompson, 2019).

b. Interpreting images into physical models

The results of the analysis of indicators interpreting the image into the physics model in question number two can be seen in the figure below

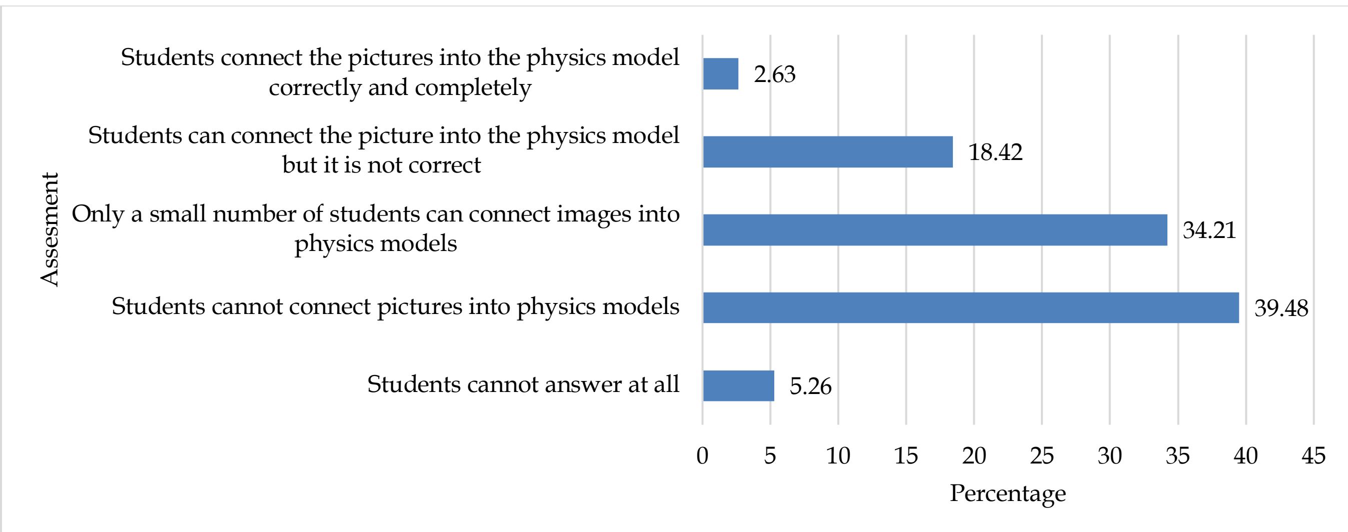

Figure 4. Description of the Indicators Interpreting images into physical models

Based on Figure 4 above, we can see that the second indicator of symbolic communication ability is to interpret images into a physics model, there are as many as 1 person or 2,63% of students can connect images into a physics model correctly and completely, as many as 7 people or 18.42 % of students who can connect pictures to the physics model but are wrong, as many as 13 people or 34.21% of students who only a small part can connect pictures to the physics model, there are as many as 15 people or 39.48% of students who can't connect pictures to the model physics, and there were as many as 2 people or 5.26% of students who could not answer at all.

Many factors cause a person to be unable to interpret images into a physical model which is the second indicator of symbolic communication skills in this study. Check out the Figure 5.

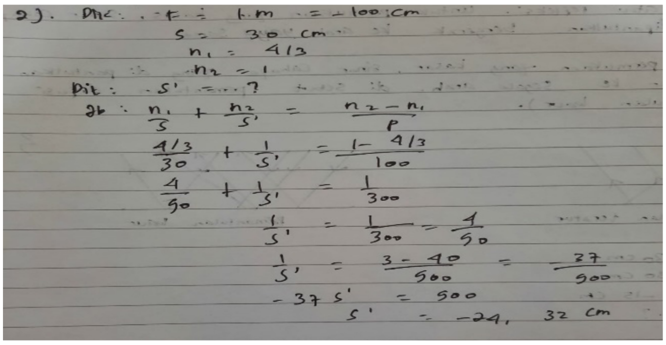

Figure 5. Answer A9

Figure 5 shows that student A9 was unable to connect the images into the physics model. Student A9 can only model the refractive index of air with $n_1 = 1$; the index of water with $n_2 = \frac{4}{3}$. Student A9 does not make information about what is asked of the question. So that A9 students cannot solve the questions given. The researcher conducted an interview with student A9 by asking why he could not answer the questions given? Student A9 said that he was confused about where to start, when answering questions, he had to focus on the pictures or information contained in the questions.

The inability of prospective physics teacher students in interpreting images into physics models is a task that must be completed. This skill is one of the key factors in studying physics material (Kukliansky, 2016; Purwana et al., 2020; Yustiandi & Saepuzaman, 2017). Because the ability to connect images into physical models is a fluency that must be possessed in carrying out various representation translations which are the basic abilities that prospective teachers need to have in building concepts and thinking skills (Kirana & Kusairi, 2019; Sabirin, 2014; Subali et al., 2015).

c. Explaining Physical Phenomena into Solving Procedures

The results of the indicator analysis explaining the physical phenomena into the problem-solving procedure in question number three can be seen in Figure 6.

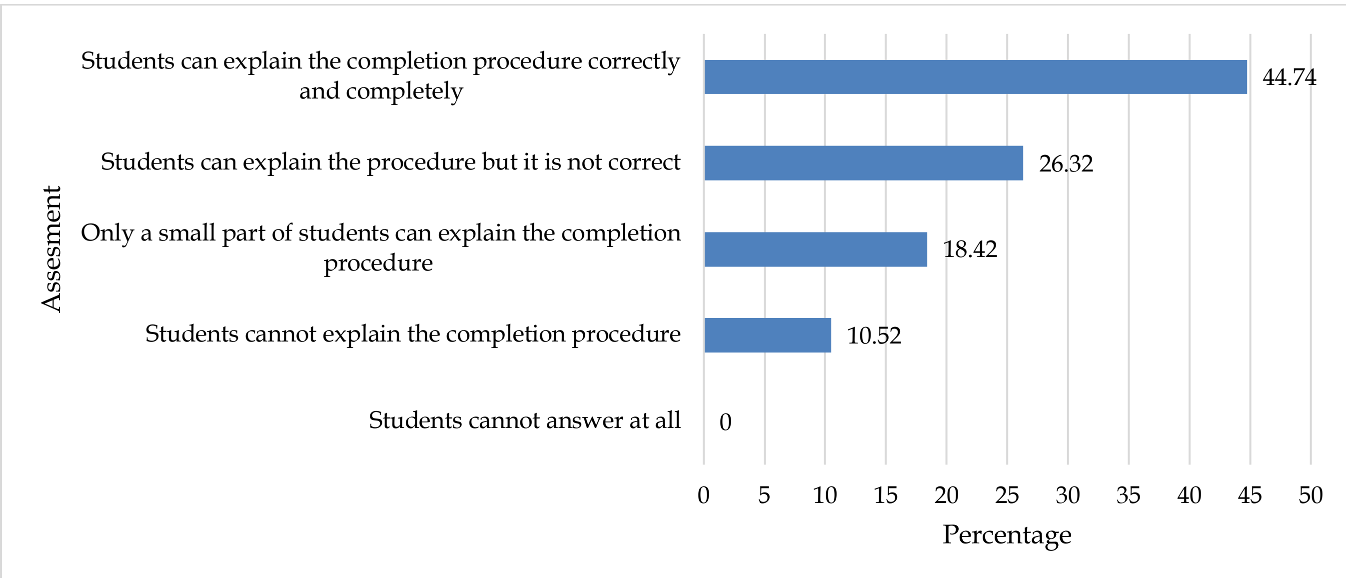

Figure 6. Description of the Indicators Explaining Physical Phenomena into Solving Procedures

Based on Figure 6 above, we can see that the third indicator of symbolic communication ability is to explain physical phenomena into the completion procedure, there are 17 people or 44.74% of students who can explain the completion procedure correctly and completely, as many as 10 people or 26.32% of students. who can explain the settlement procedure but are wrong, as many as 7 people or 18.42% of students who only a small part can explain the settlement procedure, there are as many as 4 people or 10.52% of students who cannot explain the completion procedure.

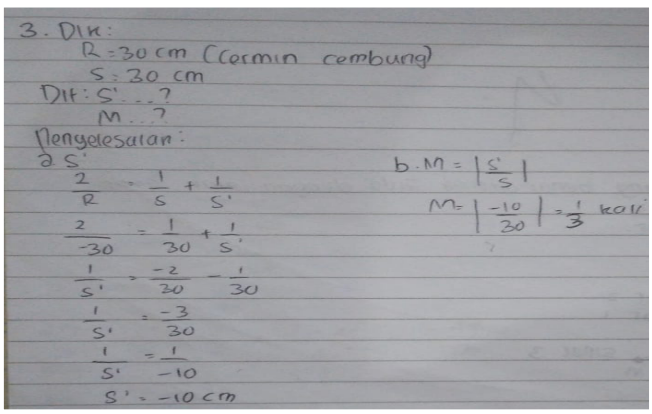

Figure 7. Answer A29

Figure 7 above shows that student A29 has been able to explain the completion procedure correctly and completely. Student A29 writes Dik : $R = 30\ cm$ (convex mirror); $s = 30\ cm$, Dit : $s^1 \ldots ?$; $M \ldots ?$ This is shown by the ability of student A29 to understand the given problem by writing down what is known and asked as shown in the picture above. Next, student A29 explains the completion procedure by writing a. s', he also plans the solution by writing the formula to use $\frac{2}{R} = \frac{1}{s} + \frac{1}{s'}$. Next, student A29 substitutes the known value in the formula he made $\frac{2}{-30} = \frac{1}{30} + \frac{1}{s'}$. Student A29 performs the following operation $\frac{1}{s'} = -\frac{2}{30} - \frac{1}{30}$ so that the result is $\frac{1}{s'} = -\frac{3}{30}$ and simplifying $\frac{1}{s'} = -\frac{1}{10}$ then student A29 gets the value of $s' = -10\ cm$. To determine the magnification of the image, student A29 plans the solution by writing $M = \left|\frac{s'}{s}\right|$ then substitute the values of s' and s into the equation $M = \left|\frac{-10}{30}\right| = \frac{1}{3}$ times.

Only 17 students out of 38 students could explain the procedure. This figure is too small for a prospective physics teacher who must master all concepts. A prospective teacher must have communication skills in explaining completion procedures. The inability to communicate on this indicator causes prospective physics teachers to lose their confidence in solving problems (Andriani et al., 2018; Kukliansky, 2016; Purba, J., Maimunah., Roza, 2020). Based on interviews with prospective physics teachers at Samudra University, they are constrained in planning or determining a formula to solve a problem. As well as in the settlement process, errors that often occur and repeat are errors in calculating. Arithmetic calculation errors are the biggest mistakes, especially if you don't use tools (Sudarmo et al., 2018). Arithmetic calculation errors can be minimized by re-checking the calculation process and results through the process of comparing the answers or by drawing conclusions (Rohmah et al., 2018; Trianggono, 2017; Wahyuni, 2019). Unfortunately, in the process of drawing conclusions, students tend to only make finished words, or make a sign line from the end of the answer, without checking again.

Based on the total value of the symbolic communication test for the candidate for physics teacher at Samudra University, it can be seen in Table 3.

Table 3. of Percentage Level of Symbolic Communication Ability of Samudra University Students

Category	Freq	Percentage (%)
Tall	13	34.21
Currently	13	34.21
Low	12	31.57

Based on the table and description above, the results show that the prospective physics teacher students at Samudra University who are included in the high category are 13 students with a percentage of 34.21%, the medium category is 13 students with a percentage of 34.21%, and the low category is 12 students with a percentage of 34.21%. 31.57%. This shows that the physics education students at Samudra University have low symbolic communication skills of physics on geometrical optical materials. Ideally a teacher candidate should have high symbolic communication skills (Khan et al., 2017).

Conclusion

The symbolic communication skills of prospective physics teacher students at Samudra University are as follows: The indicator states physics ideas in the form of pictures, as many as 24 people or 63.16% of students can state physics ideas in the form of pictures correctly and completely, the indicator interprets the image into the physics model, there are only 1 person or 2,63% of students who can connect the image into the physics model correctly and completely, Indicators explain physical phenomena into problem solving procedures, there are as many as 17 people or 44.74% of students who can explain completion procedures correctly and completely. This shows that the physics education students at Samudra University have low symbolic communication skills of physics on geometrical optical materials.

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