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Students' Communication Skills and Scientific Literacy Ability in Biology through Guided Inquiry Learning

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Abstract

The guided inquiry learning model, often called guided discovery learning, is an educational approach that emphasizes student engagement and active learning through exploration and problem-solving under the guidance of a teacher as an instructor. Through guided inquiry learning, this research aimed to examine the correlation between students' communication skills and scientific literacy ability on the environmental pollution sub-concept. The method used in this research was correlational. The participants in this study were the 10th-grade students of a Senior High School in Serang, Banten. The communication students ' communication skills and scientific literacy abilities were measured by observation sheets and essay questions, respectively. The result showed that the communication skills (oral and written) of the students were categorized as good, with a mean value of 82.27. Meanwhile, students' scientific literacy was categorized as moderate, with a mean value of 82.71. Pearson Product Moment correlation analysis showed that there was a very strong correlation between both values, with a correlation coefficient of 0.890. The linear regression test result showed that communication skills contributed to the student's scientific literacy by as much as 79.2%. It is suggested that applying the guided inquiry model could develop communication skills and students' scientific literacy.

Keywords: Communication Skills, Guided Inquiry Learning, Scientific Literacy

INTRODUCTION

In the fast-evolving 21st Century, people must possess various abilities related to problem-solving, complex communication, and other interpersonal, intrapersonal, and technical skills to thrive and adapt. Incorporating 21st-century skills into broader evaluations of academic and subject-specific knowledge and abilities is necessary. They can be incorporated into curriculum assessments, particularly in cases where deliberate education in 21st-century skills has been put into practice (Geisinger, 2016).

Wicaksono and Susilo (2019) state that current science education prepares generations to use their scientific knowledge to respond to socio-scientific issues. The education should provide experience in discovering scientific concepts through the scientific process, connecting science to technological advances, and examining their impact on the environment and society. Regarding science content, students need to understand "the meaning of science," including aspects of scientific research. Students can be "a scientist for a day" through hands-on activities in the laboratory classroom.

Science education ought to emphasize how students discover information on their own. As a facilitator, the teacher needs to implement a learning model that is in accordance with the

learning objectives and attracts students' interest so that students understand the essence of the material presented. Teachers should focus on the content and science process dimensions, which is the reference for scientific literacy assessment (Lukman et al., 2015). The learning process is expected to promote and encourage students to engage critically with scientific issues from an analytical perspective and to learn how to acquire, understand, and evaluate scientific knowledge.

According to data from the Organization for Economic Co-operation and Development (OECD) PISA (Programme for International Student Assessment) 2018, students in Indonesia scored lower than the global average (OECD, 2020). PISA examines what students know in reading, mathematics, and science and what they can do with what they know. The results from the PISA indicate that the average Indonesian student needs to improve literacy skills. In this context, scientific literacy is defined as the capacity to apply scientific knowledge, formulate questions, and reach conclusions based on evidence to comprehend and make decisions about nature and changes brought about by human activity.

In line with the OECD PISA result, the interview conducted with the 10^{th}-grade biology teachers at the participating school in this study showed that most students need to be proficient in asking questions, especially in the sub-concept of 'Environmental Pollution.' Furthermore, students still need help to express their ideas in writing when the teacher gives them the assignment to conclude the learning exercises. Students also need help to relate the problems of environmental pollution and human activities and to develop environmental conservation plans in light of the research. Unfortunately, during the learning process, teachers usually fail to assess students' communication skills, which leaves students with undeveloped and unknown skills.

One student-centered learning model involving scientific processes is guided inquiry or guided discovery learning. The application of the guided inquiry learning model involves mental processes with activities including asking questions, formulating hypotheses, collecting data, analyzing data, and making conclusions. Through this learning process, students are facilitated to validate the content being learned and develop their science process skills. Unlike direct instruction models, guided inquiry is a highly appropriate substitute for science learning, particularly when helping students develop their scientific literacy and comprehend concepts.

Communication skills correlate with students' scientific literacy. Applying the guided inquiry model is expected to develop communication skills and students' scientific literacy. Through guided inquiry learning, this study aimed to examine the correlation between students' communication skills and scientific literacy ability on the environmental pollution sub-concept.

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METHOD

The research method used in this study is correlational. This study aims to determine the relationship between communication skills and students' scientific literacy through learning with a guided inquiry model. The participants in this study were 10th-grade students of a senior high school in Serang, Indonesia. Sampling was done by simple random or convenience sampling because all characteristics of grade X in the school were homogeneous.

The data collection techniques used in this study were test and non-test techniques. The test technique is a description test to measure students' scientific literacy skills, while the non-test technique is observations to assess students' oral communication skills using an observation sheet and their written communication skills using a report assessment rubric. An observation sheet was used to analyze the implementation of the guided inquiry model in learning.

The data analysis technique used in this research is parametric statistical analysis because the results of the prerequisite test state that the data of the two variables studied are normally distributed and linear, so the Pearson product-moment correlation test can be carried out using SPSS version 16 software. The coefficient of determination can be measured by the linear regression test using SPSS version 16 software to determine the magnitude of the contribution of variable X to Y.

RESULTS AND DISCUSSION

Communication skills

Students' oral communication skills were measured using an observation sheet based on seven assessment aspects. The average score of students' oral communication skills was 81.21, which is categorized as good. Figure 1 shows that most students (44%) have excellent oral communication skills, and 26% and 11% have good and fair communication skills, respectively. Still, 19% of students must improve oral communication using the guided inquiry model during the learning process.

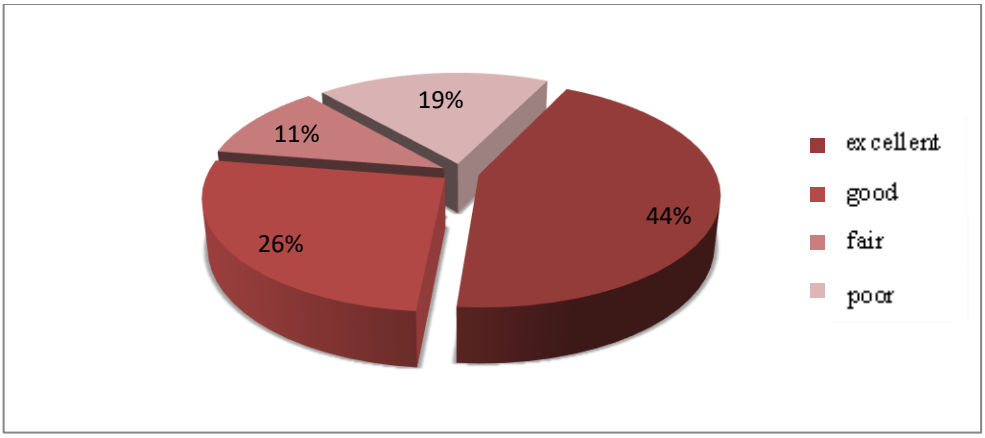

Figure 1. Student's oral communication skills in guided inquiry learning

The result of this study indicates that as many as 70% of students have actively communicated during the learning process, both with the teacher and friends. During the experiment, students asked the teacher about things they did not know. In addition, when presenting the data, the students could communicate it to their classmates. When students explained and communicated their ideas, other students paid attention and responded to what their friends presented. When discussing, students also exchanged ideas so that information delivery and communication between students could be well established.

Inquiry-based learning is an approach that encourages students to generate and test their hypotheses and allows the use of the scientific method. It stimulates students' curiosity and interest. In addition, it can lead to significant improvements in students' cognitive, affective, and skills dimensions. Communication skills, one of the 21st-century skills that are becoming increasingly important with the advent of technology, should be developed in environments where students are active, able to express themselves, and take responsibility for their learning. This is where teachers have a significant role to play, and students need practical guidance to develop these skills (Ormancı, 2020).

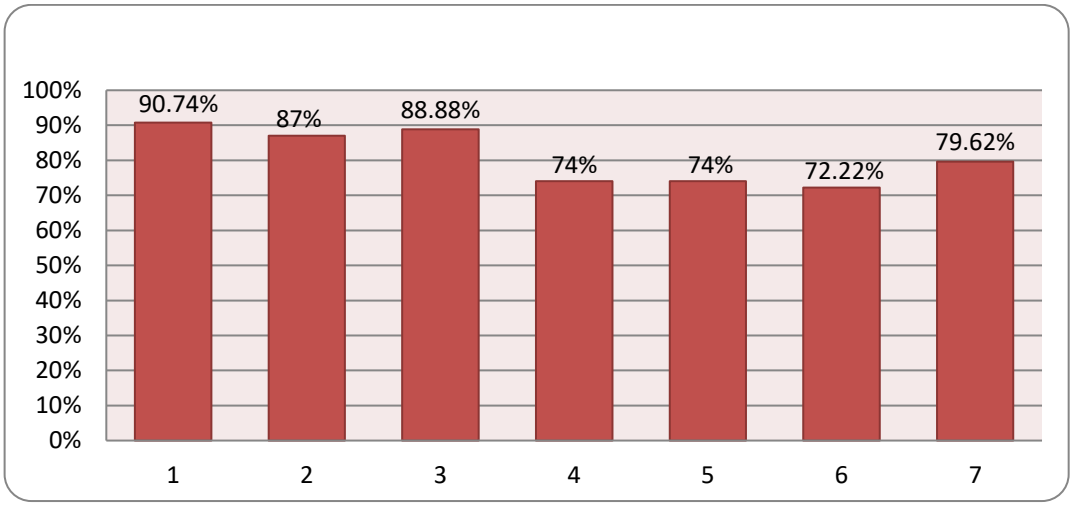

Figure 2. The percentage of students' oral communication skills in each aspect through learning with the Guided Inquiry Model

Description: 1. conveying information; 2. giving opinions/ideas; 3. asking questions; 4. language skills; 5. listening to teachers and friends in discussions; 6. submitting arguments to respond to criticism or input from friends; 7. attitude in discussions.

The best score for student's oral communication skills (90.74%) was in the aspect of conveying information based on facts or literature (Figure 2). Most students were able to convey the information they had obtained from the results of the lab, as well as from the existing literature. At the stage of conducting experiments, students get information based on the facts of the experiment results. Then, students build concepts based on these facts and the literature

they read so that they can convey them during discussions. At the presentation stage, students get more information when other students respond and provide input.

As seen in Figure 2, the lowest value of students' oral communication skills is in the aspect of students' ability to convey arguments related to criticism or input. In delivering criticism and suggestions, students cannot build strong arguments. Argumentation is a statement (claim) not merely uttered without basis. Argumentation must always be orientated to data, facts, or objective evidence to be accepted as valid. Therefore, to argue, a person will do analysis and critical thinking activities (Besnard & Hunter, 2008). Govier (2018) defines an actual argument as only a speech or piece of writing in which a speaker attempts to persuade listeners—or even the speaker themselves—of the veracity of a claim by providing evidence to support it.

In this study, the student's communication skills in listening to the teacher's explanation and friends during the discussion are categorized as moderate (74%). This condition could happen because some students lack motivation and interest in learning. According to Cook and Artino (2016), starting and maintaining goal-directed actions is known as motivation. The self-determination theory proposes that internalized extrinsic values or intrinsic interests provide the finest reasons for action.

Another aspect that scored moderately (74%) was language skills. According to Pringgawidagda (2002), the linguistic aspects are words, sentences, and paragraphs, considering intonation, tone, rhythm, stress, and tempo in spoken language. Practice is needed so students are accustomed to conveying their ideas by paying attention to good linguistic aspects, namely by frequently applying learning models that provide opportunities for students to communicate.

Students' practicum reports were the basis for assessing their written communication skills. Each student completes the report independently to improve and advance their written communication abilities. Every student in the sample under study has written communication skills that researchers can measure. The assessment criteria for practicum reports were used to gauge the students' written communication proficiency. Based on the observation sheet, the average score for students' written communication skills was 83.33, categorized as good. Figure 3 displays the percentage of students’ written communication.

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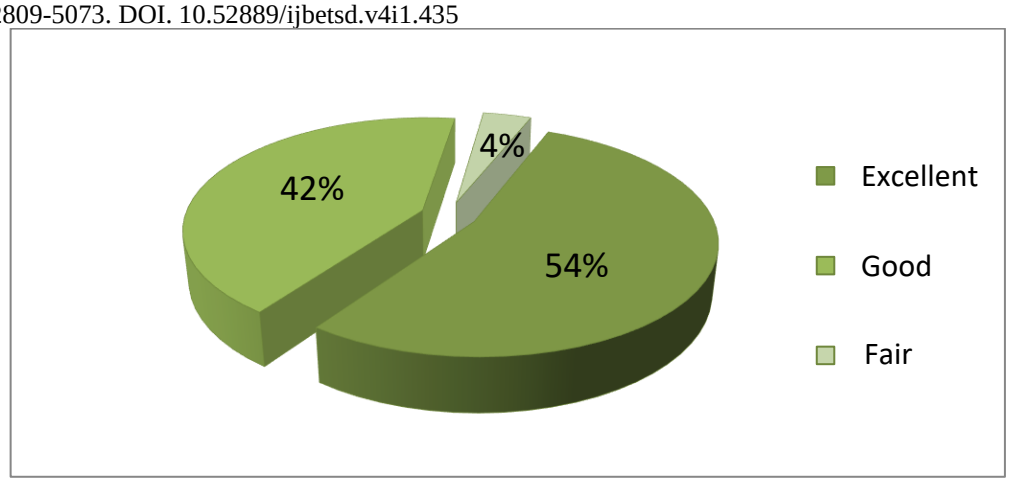

Figure 3. Students' written communication in learning using a guided inquiry model

Figure 3 shows that out of the sampling students, 56% have excellent skills, 42% have good skills, and 4% have fair skills in written communication. It means that most students (96%) could communicate the whole set of activities carried out in the pollution experiment using a written report. The high value of students' written communication is closely associated with prior learning experiences, specifically when students completed the LKS as a preliminary report for an experiment. Students actively questioned the teacher about topics they did not understand and discussed their experiments with their group members. Students share many thoughts and seek advice from friends throughout the stage of presenting the experimental results through presentations, which improves the amount of knowledge learned. Writing reports is relatively simple for students when they comprehend their completed experiments.

Figure 4 shows the measurement of students' written communication skills when presenting reports on the results of environmental pollution experiments based on their aspects.

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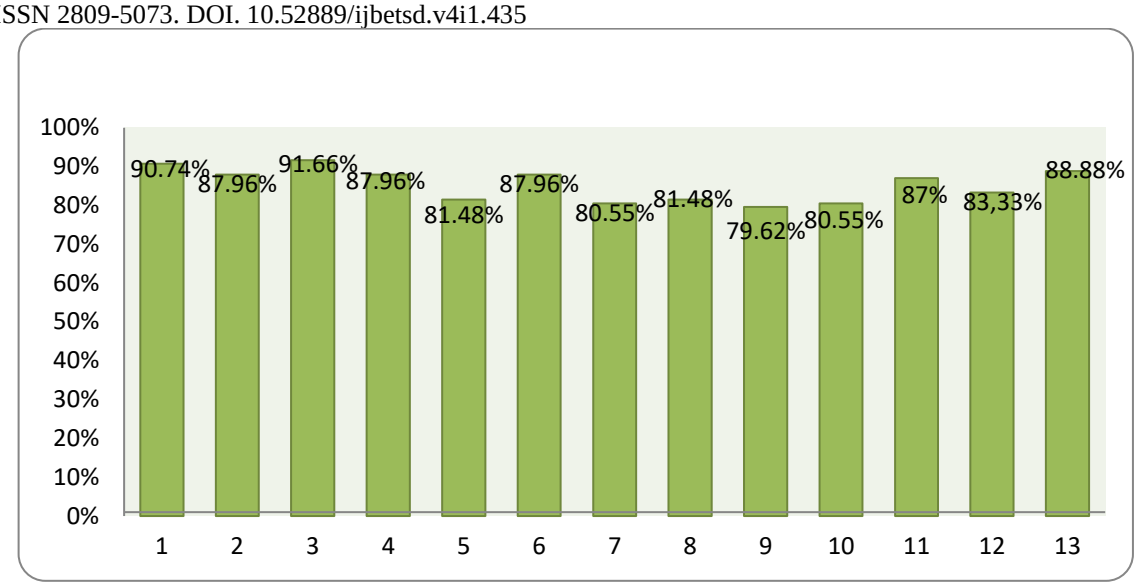

Figure 4. Percentage of Students' Written Communication Skills Through Writing Experiment Report Based on Each Aspect

Description: 1. Formulate a title; 2. Formulate learning objectives; 3. Formulate a problem; 4. Formulate a hypothesis; 5. Write down the theoretical basis; 6. Write down tools and materials; 7. Write down how to work; 8. Write down the results of observations; 9. Make a discussion; 10. Write down the answer to the question; 11. Conclude; 12. Write down the bibliography; 13. completeness of components.

Students' written communication skills through writing experiment reports have good scores. As represented in Figure 4, most students have been able to formulate problems and hypotheses according to the topic of practicum well and specifically. However, the lowest ability of students is in discussing the experimental results. Students' ability to interpret data from tabular/graphic form to description form is considered low, so the information from the table/graph cannot be conveyed properly.

According to study results conducted by Larasati (2015), several factors influence students in writing reports, including high motivation and discipline, which are needed in writing scientific works such as experimental reports because motivation is an influence from within the writer to encourage themselves always to produce written work. Another factor that influences report writing is the ability of students to process data so that a result can be concluded. Students must also be able to think logically and integrate because scientific papers that discuss a problem must be solved logically and scientifically as well as whole or integrated, not eliminating certain parts. Language skills are also essential because scientific papers require the use of standardized language that is systematic and effective.

In this study, the assessment of students' scientific literacy skills in the science process aspect is carried out individually and measured using a description test at the end of learning activities (post-test). The process dimension of students' scientific literacy measured includes

three indicators, i.e., student's ability to identify scientific problems, explain scientific phenomena, and use scientific evidence in making decisions / drawing conclusions.

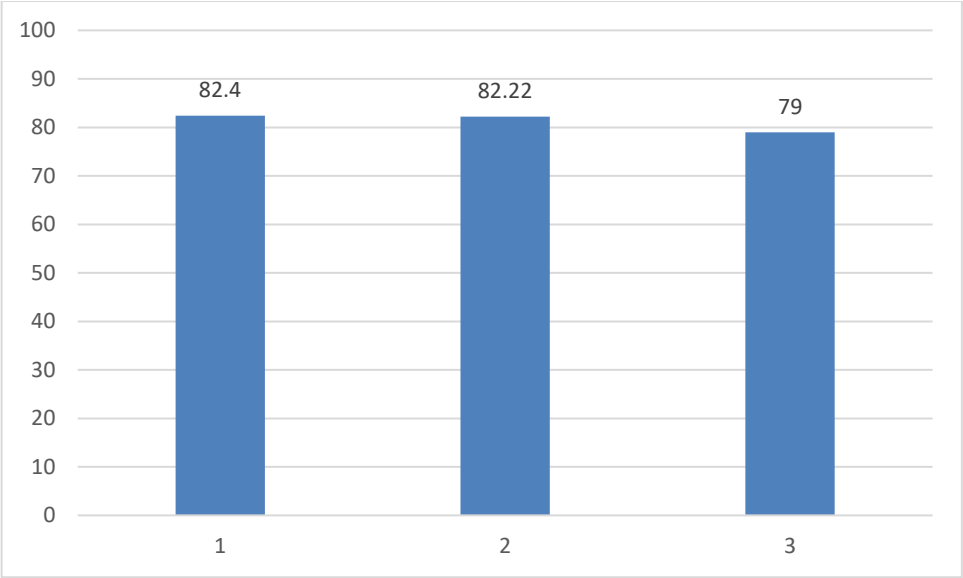

Figure 5. Students' ability in Scientific literacy based on the Science Process Dimension Indicator

Description: 1. Identify scientific problems; 2. Explain scientific phenomena; 3. Use scientific evidence

Figure 5 describes students' ability in Scientific literacy based on three indicators of the science process dimension (the value is the mean score of all students). The result shows that the indicator for identifying scientific problems has a higher average score than the other competencies. Students go through a series of guided inquiry learning stages that help them identify scientific problems. For example, students are brought into real-life conditions and identify existing environmental problems with their group members. Students also conduct a series of environmental pollution experiments to obtain information on how to solve environmental problems. In addition, when finding the information they need, students need to be able to identify keywords so that the information they use meets the need to solve problems. Therefore, when answering questions, students are used to identifying keywords to get information that will later be used to solve a problem.

Student's scores on the indicators for explaining phenomena scientifically, such as explaining evidence and decisions with words, diagrams, or other forms of representation, describing phenomena, predicting scientific changes, and applying scientific knowledge to given situations, are higher than the indicators for using scientific evidence. It is because, in learning, students conduct a series of activities through direct experimentation to prove the truth of the existing theory. In writing answers, students can explain scientific phenomena based on information obtained from the experiment's results.

The problems given to students are also environmental problems that are very close to students' lives so that students can apply the science knowledge they get from learning to the given situation. However, students' scores on the indicator of explaining scientific phenomena are not higher than the indicator of identifying scientific problems because, when answering questions, some students still need help in making graphs and interpreting them in sentence form.

Students' scores on the indicator of using scientific evidence, such as describing clear and logical relationships between evidence and conclusions or decisions, are lower than the other two indicators because describing the relationship between the evidence found and the conclusion requires analytical skills and critical thinking. Therefore, teachers need to habitually give exercises on scientific literacy questions in learning so that students can hone their critical thinking skills.

Based on the calculation results, the average value of students' scientific literacy is 82.71, categorized as moderate. This means that the average student has been able to use the knowledge they have gained to solve problems through learning activities with the guided inquiry model. These students have answered questions about environmental pollution well. The high score obtained by students is inseparable from the process carried out during learning, namely by carrying out a series of stages of inquiry activities.

In guided inquiry learning, students conduct experiments to prove the truth of existing theories. In addition, students solve problems based on the results of their analyses. After that, through discussion, students communicate actively. Thus, students get more information and better understand the concept. A study conducted by Anggriani *et al*. (2020) revealed that there were significant differences in the mean score of scientific literacy competencies before and after the guided discovery model. Aiman *et al*. (2020) also found that the Process Oriented Guided Inquiry Learning (POGIL) Model can improve the scientific literacy of primary school students.

In this study, communication skills and students' scientific literacy were correlated. The prerequisite test results show that the data is usually distributed and linear. The Pearson Product Moment correlation test was then conducted based on the prerequisite test results. The correlation coefficient between communication skills and scientific literacy skills is 0.890 (Table 1), at a firm relationship level in the interval 0.80-1.00 with a positive direction. It shows that students' communication skills are robustly correlated with their scientific literacy skills. It means that an increase in the value of variable X is always followed by an increase in the value

of variable Y and vice versa; a decrease will always follow a decrease in the value of variable X in the value of variable Y.

Table 1. Correlation Test between Communication Skills and Students' Scientific literacy

coeficient correlation	Category	Probability score 0.05 >Probability Score *Sig.*	Information
0.890	Very Strong	0.05 > 0.000	Significance

The recapitulation data of students' communication skills scores and scientific literacy scores show that most students who have excellent communication skills scores than their scientific literacy scores are in the high category; on the other hand, students whose scientific literacy skills are in the low category, then their communication skills are also classified as sufficient. Students with good communication skills will be able to convey their ideas better. It makes it easier for students to solve a problem or make decisions based on evidence of experimental results. In contrast, if students' communication skills are low, it will make it difficult for them to discuss in learning, so students get less information, which impacts their scientific literacy skills.

Students' communication skills contribute to their scientific literacy when they can convey information based on facts/literature well. It is easier for students to explain scientific phenomena, which is one of the indicators of scientific literacy. When students actively ask questions during learning, they will get much information to identify keywords used to solve an environmental problem. Experiment reports written by students are also able to facilitate students in remembering information obtained from the results of the experiment, which makes it easier for students to use scientific evidence to draw conclusions or make decisions when solving problems.

A linear regression analysis was conducted to determine students' communication skills' contribution to scientific literacy skills. Based on the calculation, the R Square value (coefficient of determination) is 0.792 or 79.2%. It shows that students' communication skills contribute 79.2% to students' scientific literacy skills at the participating school, while the other 20.8% is influenced by other factors not examined by the researcher.

CONCLUSION

Based on the results of a study conducted on 10th-grade students of a senior high school in Kota Serang on the sub-concept of environmental pollution through guided inquiry learning, it can be concluded that students' communication skills are categorized as good category, with an average score of 82.27. Students' scientific literacy skills are in the medium category, with an average score of 82.71. Based on the correlation test analysis results, the correlation coefficient value is 0.890. It means a strong relationship exists between students'

communication skills and scientific literacy abilities. The results of the linear regression test showed that communication skills contribute to students' scientific literacy skills, as much as 79.2%.

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