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Application of The Ethno-STEM Based Discovery Learning Model to Improve Student's Science Literacy

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Abstract. Science literacy among students is fundamental to the development of the competencies and qualities needed in the 21st century. Therefore, teachers play an important role in helping students improve these skills through appropriate learning strategies. This study aims to describe students' science literacy integrated with Ethno-STEM, where the ethnoscience introduced is Sidoarjo's signature shrimp paste, using a pre-experimental design in a one-group pretest-posttest design. The research sample consisted of 31 ninth-grade students from class IX-B at one of Sidoarjo's public junior high schools. The instruments used were pretest and posttest sheets. Data collection techniques were conducted through tests, while data analysis techniques involved paired t-tests and N-Gain analysis. The t-test results showed a significant difference in the average science literacy scores before and after the implementation of the Etno-STEM-based Discovery Learning model. Additionally, the N-Gain analysis yielded a value of 0.8, which falls into the high category. Based on these findings, it can be concluded that the implementation of the discovery learning model based on Etno-STEM in science education on biotechnology is effective in improving students' science literacy.
Keywords: Discovery Learning, Ethno-STEM, Science Literacy

Introduction

Science education plays a fundamental role in preparing students to face global challenges in the 21st century knowledge era. Critical thinking, problem-solving, and decision-making skills based on scientific evidence are prerequisites for participatory and adaptive citizens (Utami et al., 2022). Therefore, one of the main objectives of science education is to develop scientific literacy in students. Scientific literacy is defined as the ability to use scientific knowledge, identify questions, and draw conclusions based on evidence in order to understand and make decisions about the universe and the changes occurring within it (OECD, 2019).

Education in the modern era requires students to possess various essential competencies, one of which is scientific literacy. Scientific literacy does not only refer to mastery of scientific concepts, but also the ability to use scientific knowledge, identify questions, and draw conclusions based on evidence, in order to understand and make decisions related to nature and changes occurring in nature due to human activities (OECD, 2018). These skills are crucial in facing global challenges and making decisions based on accurate information. Unfortunately, the science literacy achievements of students in Indonesia are still a concern. International studies such as the Programme for International

Student Assessment (PISA) consistently show that the science literacy skills of Indonesian students rank below those of other countries (OECD, 2023).

To address this issue, an innovative and relevant learning approach is needed. The discovery learning model is one such learner-centered approach, where students are encouraged to discover concepts on their own through a series of investigative and exploratory activities (Bruner, 1961). In this model, teachers act as facilitators, while students actively seek, analyze, and draw conclusions from information. Discovery learning not only enhances conceptual understanding but also develops critical thinking skills (CTS), problem-solving abilities, and other scientific skills because students are directly involved in the process of constructing their own knowledge. As a result, students can also develop their science literacy skills, such as explaining scientific phenomena, evaluating and designing scientific investigations, and interpreting scientific data and evidence.

In this study, to further enhance the relevance and contextuality of science education, the ethno-STEM approach (science, technology, engineering, and mathematics integrated with ethnoscience or local wisdom) can be an effective solution (Prasetyo & Sukarmin, 2020). Ethnoscience is knowledge and practices developed by local communities based on their experiences and observations of their environment. By integrating ethnoscience into STEM learning, students can understand that science is not only the domain of Western civilization but also grows and develops within their own culture. This can enhance learning interest, the relevance of the material, and a deeper, more meaningful understanding of scientific concepts (Ahsani et al., 2024).

The integration of ethno-STEM in science education using the discovery learning model is an innovative approach aimed at making science more contextual and meaningful for students (Suryani, 2024). In this model, local knowledge, cultural practices, or traditional wisdom (ethnoscience) found in the students' surroundings serve as the starting point or initial stimulus for scientific inquiry. Students do not merely receive information but actively discover relevant science concepts and STEM principles through exploring these cultural phenomena (Khairiyah, 2019). For example, in the context of shrimp paste, students are encouraged to observe and formulate questions about why shrimp paste has unique characteristics, a process involving fermentation biotechnology. Through data collection (e.g., organoleptic tests and pH tests of shrimp paste), data processing, and verification, students are encouraged to understand how science (microorganism biology, pH change chemistry), technology (the production of shrimp paste as a process), engineering (optimization of the fermentation process), and mathematics (pH measurement, data comparison) are inherently integrated into this cultural practice. This approach enables students to develop a deeper understanding of science concepts while appreciating their cultural heritage, as well as cultivating 21st-century skills such as critical thinking, problem-solving, and collaboration (Halimah & Sasmita, 2025). As a result, learning becomes more relevant, engaging, and encourages students to view science as an integral part of their lives and cultural heritage.

Sidoarjo is a regency in East Java with a wealth of local wisdom that has great potential to be integrated into science education, particularly in the field of marine product processing (Shofiyah et al., 2020). One of Sidoarjo's well-known products is shrimp paste. The process of making shrimp paste is a concrete example of the application of scientific concepts, including biology (fermentation, the role of microorganisms such as bacteria), chemistry (pH changes, chemical composition of raw materials), and technology (processing techniques, drying, packaging) (Aprilia et al., 2021). Shrimp fermentation, which is the core of shrimp paste production, is a traditional biotechnology process that has been practiced for generations. This process involves the activity of microorganisms that transform the shrimp raw materials, producing a unique aroma and taste and increasing the product's shelf life (Setiarto, 2020).

Integrating the local wisdom of Sidoarjo shrimp paste into an Ethno-STEM-based discovery learning model has great potential to significantly improve students' science literacy skills (Sumarni, 2023). Through direct exploration and investigation of the shrimp paste production process, students can independently discover and understand relevant scientific concepts in a contextual manner. For example, they can observe the physical and chemical changes that occur during fermentation, study the role of bacteria in the process, or even design simple experiments to test the factors that influence the quality of shrimp paste. This approach not only enriches their understanding of scientific concepts but also fosters appreciation for local wisdom and cultural heritage (Widyaningrum et al., 2022).

Preliminary research results at one of the public junior high schools in Sidoarjo in Class IX-B tested three indicators of science literacy, namely 1) explaining scientific Phenomena 41.25%, 2) evaluating and designing scientific investigations 31.25%, and 3) interpreting scientific data and evidence 25%. This indicates low science literacy skills among students in all three indicators, necessitating improvements in science literacy indicators among students.

Interviews with science teachers at one of the public junior high schools in Sidoarjo revealed that students primarily come from the surrounding area, and 80% of teaching methods remain conventional. Implicitly, teachers have integrated science concepts with daily life to provide concrete examples to students, such as the Lapindo mudflow phenomenon in Sidoarjo, which is related to science learning on the topic of the Earth's core layers and environmental pollution. However, learning based on local wisdom has not been optimally implemented, as events occurring in the surrounding environment are merely used as illustrations of the scientific concepts being taught, without further exploration of relevant local values. This condition indicates a gap between the curriculum objectives and the reality of classroom learning, which is often still dominated by conventional methods that are rote-based and irrelevant to the daily lives of students (Rusnawati et al., 2021).

Several studies have examined the effectiveness of discovery learning and local wisdom-based learning separately or in combination, but these studies are still limited to specific contexts and focuses of local wisdom. For example, Nurmiyati and Lestari (2023) showed that local wisdom-based discovery learning can improve science learning outcomes. However, research specifically examining the application of Ethno-STEM-based discovery learning with ethnoscience or the local wisdom of Sidoarjo shrimp paste and its direct impact on improving students' science literacy skills, particularly in the Sidoarjo region, is still scarce.

Therefore, this research is relevant and urgent to conduct. Through this study, the effectiveness of applying the discovery learning model integrated with Sidoarjo shrimp paste-based ethno-STEM in enhancing students' science literacy skills will be empirically analyzed. The results of this study are expected to provide significant contributions to the development of innovative, contextual, and relevant science learning models tailored to the students' environment, as well as serve as an alternative solution to address the low levels of science literacy in Indonesia, particularly in the Sidoarjo region.

Methods

This type of research is an experiment with a pre-experimental design, using a one-group pretest-posttest research design. This study was conducted over two sessions or 4JP (4 × 40 minutes) in June 2025 at one of the public junior high schools in Sidoarjo with 31 ninth-grade students in class IX-B as the research subjects. This study applied the discovery learning model based on Ethno-STEM to improve students' science literacy skills. The research instruments used were pretest and posttest sheets that had been validated by expert lecturers and science teachers at the research location school. The tests consisted of 10 multiple-choice questions aligned with science literacy skill indicators, focusing on the topic of biotechnology.

This study used paired t-test data analysis techniques to examine differences in the average science literacy skills of students before and after the implementation of the ethno-STEM-based discovery learning model. The analysis was conducted using IBM SPSS Statistics 27 software. Before the t-test was performed, a normality test was conducted as a prerequisite. If the data was normally distributed, the t-test was applied. However, if the data was not normally distributed, nonparametric statistical analysis using the Wilcoxon test was used.

The data obtained were the students' test results, which were then analyzed using N-Gain analysis to measure the effectiveness of learning by comparing the increase in pretest and posttest scores. The N-Gain score was calculated by subtracting the posttest score from the pretest score, then comparing it with the difference between the maximum score and the pretest score, according to the N-Gain calculation classification by Hake (2002).

Results and Discussion

This section focuses on presenting the results and discussion of research on the application of the discovery learning model based on Etno-STEM to improve students' science literacy. The research process used pretest and posttest instruments that had been validated by expert lecturers and teachers at the research location and through a revision stage, resulting in a validity score of 3.5, which is categorized as good and ready for use in research.

The data obtained from this research are science literacy skill data. The data obtained were then analyzed in accordance with the research objectives. The research objectives include describing students' science literacy skills after participating in the learning process. The following are the research results and their discussion.

Science Literacy Skills

Improvements in science literacy skills were obtained after comparing pretest and posttest scores. The pretest and posttest consisted of 10 multiple-choice questions covering three indicators of science literacy according to the OECD (2023), namely explaining scientific phenomena, evaluating and designing scientific investigations, and interpreting scientific data and evidence. The pretest and posttest questions were given to 31 students in class IX-B. The results and scores of each student were grouped and averaged according to the number of students who obtained scores in the categories of very good, good, fair, poor, and very poor. This can be seen in Table 1.

Table 1. Average pretest and posttest scores for each indicator

Science Literacy Indicators	Average Pretest Scores	Pretest Category	Average Posttest Scores	Posttest Category	N-Gain Score	N-Gain Category
Explaining Scientific Phenomena	62.9	Good	95.1	Very Good	0.86	High
Evaluating and Designing Scientific Investigations	76.3	Good	92.4	Very Good	0.67	Medium
Interpreting Scientific Data and Evidence	64.5	Good	93.5	Very Good	0.81	High

Table 1 shows that each science literacy indicator also improved. For the indicator of explaining scientific phenomena, the pretest average score was 62.9, categorized as good, and increased to 95.1 on the posttest, categorized as very good. For the indicator of evaluating and designing scientific investigations, the pretest average score was 76.3, categorized as good, and increased to 92.4 on the posttest, categorized as very good. For the indicator of interpreting scientific data and evidence, the pretest average score was 64.5, categorized as good, and increased to a posttest score of 93.5, categorized as very good. The following is a bar chart showing the increase in pretest and posttest scores for each indicator.

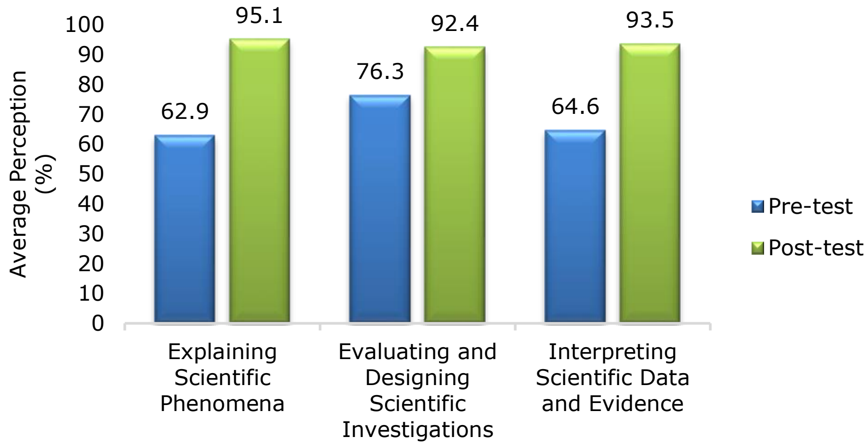

Figure 1. Results of avarage pretest and posttest scores for each indicator

The results of the study indicate that all students in class IX-B experienced an improvement in their science literacy skills. During the learning process, students were presented with a local product unique to their region, Sidoarjo, in the form of shrimp paste. Students utilized their science literacy skills to understand, identify, and analyze problems, enabling them to formulate appropriate hypotheses based on their analysis. Science literacy facilitates the analysis of phenomena from various perspectives, including the importance of thinking and acting with a scientific approach, as well as the ability to think critically when addressing social issues (Limiansih, 2016).

The indicator shows that the natural phenomenon experienced an increase in value from 62.9 in the pretest to 95.1 in the posttest, with an N-Gain score of 0.86, which is in the high category. In this indicator, students are trained to explain natural phenomena and technology using scientific knowledge, recognize descriptions, explanations, and scientific predictions, and propose explanations for specific phenomena (Hayati et al., 2024) through the discovery learning model based on ethno-STEM. This aligns with the syntax of the discovery learning model at the stimulation stage. In this indicator, students are presented with interesting phenomena or problems such as "why does shrimp paste have a distinctive aroma?" Students are encouraged to ask questions and seek scientific explanations independently through observation and exploration. The results of training scientific literacy skills in the indicator of explaining natural phenomena successfully increased from an average score of 62.9 with a good criterion to 95.1 with an excellent criterion.

The improvement in students' science literacy in the indicator of explaining scientific phenomena was the highest among the other categories. This occurred because the indicator focused on the ability to explain natural and technological phenomena using scientific knowledge, recognize scientific descriptions, explanations, and predictions, and propose explanations for specific phenomena (Astria et al., 2022). This aligns with the research by Choi (2018), which states that students tend to understand natural phenomena more easily when they are connected to experiences or events around them.

In the study conducted by the authors, this was linked to the local wisdom of Sidoarjo's signature shrimp paste, which is a distinctive product of the students' local environment.

On the indicator "evaluating and designing scientific investigations," there was an increase in the average score from 76.3 on the pretest to 92.4 on the posttest, with an N-Gain score of 0.67, which is in the moderate category. In this indicator, students were trained to describe and evaluate scientific investigations, as well as propose ways to answer scientific questions using the discovery learning model based on etno-STEM (Kenny, 2025). This involves understanding what constitutes a scientifically investigable question and how data can be collected and analyzed to answer that question (Mijaya et al., 2019). In this indicator, students apply their knowledge in decision-making and problem-solving, which not all individuals possess, resulting in outcomes that are not as favorable as the other two indicators (Astuti, 2018).

This is in line with the syntax of the discovery learning model at the problem statement and data collecting stages. In this indicator, students are encouraged to design simple experiments to test their hypotheses. Students learn to identify variables, determine procedures, and select appropriate tools to use in their experiments or observations. The results show that the skills in scientific literacy, particularly in evaluating and designing scientific investigations, have improved significantly, with the average score increasing from 76.3 (good) to 92.4 (very good).

In the indicator of interpreting data and scientific evidence, there was an increase in the average score from 64.5 in the pretest to 93.5 in the posttest, with an N-Gain score of 0.81, which is in the high category. In this indicator, students were trained to analyze and evaluate data, claims, and scientific arguments in various representations (graphs, tables, texts), and draw conclusions based on scientific evidence (Zulaiha & Kusuma, 2023) using the discovery learning model based on ethno-STEM. This aligns with the syntax of the discovery learning model at the data processing, verification, and generalization stages. In this indicator, students are trained to interpret the data they collect, identify patterns, and draw conclusions from the evidence. Class discussions in the form of presentations and question-and-answer sessions from each group's discussions are crucial for sharpening interpretation skills (Maisarah et al., 2025). The results of training scientific literacy skills in the indicator of interpreting data and scientific evidence successfully increased from an average score of 64.5 (good criteria) to 93.5 (very good criteria).

Based on the research conducted, it can be stated that students' science literacy skills improved after the discovery learning model was implemented, because each stage of the discovery learning model trains students' science literacy skills in all syntaxes. This aligns with the research by Fauzi & Irwandani (2020), which showed that the implementation of discovery learning can significantly improve students' understanding of science concepts and science literacy skills because students are actively involved in discovering these concepts in middle school science lessons. In this study, the N-Gain category was moderate and not yet in the high category.

The results of this study are in line with research conducted by Rahayu (2022), which shows that this model is effective in improving students' CTS, which is one of the important dimensions of science literacy. The relationship between critical thinking and science literacy is very close and mutually supportive. Science literacy is not merely about understanding scientific concepts but also involves the ability to apply that knowledge in decision-making and problem-solving, as reflected in the indicators of science literacy, such as evaluating and designing scientific investigations, interpreting data, and scientific evidence (Kusumastuti et al., 2019). This study emphasizes that the discovery learning model creates a learning environment that enables students to construct their own knowledge rather than merely receiving information, thereby positively impacting understanding and higher-order thinking skills (Dayelma et al., 2019).

Descriptive Statistics Test

After the implementation of the pretest and posttest, the results of descriptive statistical analysis are presented in Table 2.

Table 2. Descriptive statistics of learning outcomes

Test Type	Minimum	Maximum	Mean	Standard Deviation
Pre-test	30	90	66.7	15.997
Post-test	70	100	93.87	7.606

Descriptive statistical analysis shows a significant increase in students' science literacy skills after the implementation of the etno-STEM-based discovery Learning model. In the pretest phase, the average student score was 66.7 with a standard deviation of 15.997, indicating considerable variation in ability among students. However, after the learning intervention, the average score on the posttest increased dramatically to 93.87, while the standard deviation narrowed significantly to 7.606. This indicates that this learning model not only succeeded in improving the average skills of students but also made the distribution of students' abilities more even. This improvement is in line with research by Prawoto & Setyawati (2022), which states that a learning model based on social-scientific issues can improve science literacy. The local cultural context highlighted in the ethno-STEM approach has proven to facilitate students in connecting scientific concepts with their daily lives, making the discovery process they undertake more meaningful and effective in enhancing science literacy.

Statistical Prerequisite Test

This normality test aims to determine whether the research data is normally distributed or not. The normality test was conducted using the Shapiro-Wilk test assisted by IBM SPSS statistics 27, which is presented in Table 3.

Table 3. Normality test results

Test Type	Shapiro-Wilk Statistics	Significance Value
Pre-test	0.931	0.046
Post-test	0.744	0.001

Based on Table 3, data can be considered normally distributed if it has a significance value greater than 0.05. Based on Table 3, the pre-test and post-test values are not normally distributed with significance values of 0.046 and 0.001, respectively. The next step to determine whether there is a significant difference and improvement in the pre-test to post-test results can be done by hypothesis testing using the Wilcoxon test.

The pretest and posttest results obtained from the students were then subjected to a normality test to determine whether the data were normally distributed or not, thereby determining the hypothesis testing method to be used. After it was determined that the data was not normally distributed, the pretest and posttest data were analyzed using a nonparametric test, namely the Wilcoxon test. Based on the Wilcoxon test using IBM SPSS statistics 27, the results in Table 4 show that the significance value is $0.001 < 0.05$. These results indicate that H0 is rejected and H1 is accepted. This means that there is a significant difference in the application of the discovery learning model based on etno-STEM to improve the science literacy skills of ninth-grade students at SMP Negeri Sidoarjo before and after implementation. Thus, it can be stated that the application of the discovery learning model based on etno-STEM is capable of improving students' science literacy skills. If the probability of the sig value (2-tailed) ≤ 0.05, then H1 is accepted and H0 is rejected, meaning there is a significant difference between the pretest and posttest scores (Istiningsih, 2023).

Implementation of learning

All phases of the lesson were carried out, including the introduction, core activities divided into six syntaxes, and the conclusion. In the introductory activities, the teacher began with a prayer, classroom preparation, perception, motivation, presentation of learning objectives and urgency, and then assessed the students' abilities by giving them a pretest. The core activity consists of six discovery learning syntaxes. In phase 1, stimulation, the teacher displays images of Sidoarjo's signature shrimp paste product and ask students questions about it as one of Sidoarjo's signature local products. This phase aims to stimulate students' curiosity about the learning process (Rahmawati, 2022). According to Nurhaeni (2020), stimulation at this stage serves to provide learning interaction conditions that can develop and encourage students to explore.

In phase 2, the problem statement, the students were grouped and given worksheets in each group. In this phase, the students began discussing to formulate research questions based on the ethnoscience study of Sidoarjo's signature shrimp paste presented in the worksheets. This phase aims to build the students' understanding so they become accustomed to identifying problems (Nurhaeni, 2020). In phase 3, data collection, students collect data to answer their research questions by preparing experiments, conducting experiments in the form of organoleptic tests and pH tests on three types of Sidoarjo shrimp paste products, observing the experimental results, and writing down the experimental results. This stage serves to answer questions or test the acceptance or rejection of hypotheses, by providing students with the opportunity to collect various relevant information, read literature, observe objects, conduct experiments, and so on (Nurhaeni, 2020).

Students show their observation results through the observation table provided in the LKPD. The results show that the color of the shrimp paste is brown in product A, earth brown in product B, and dark brown in product C. Then, the texture of the shrimp paste is fine grains in product A, smooth in product B, and coarse grains in product C. The taste of the shrimp paste was observed to be dominant shrimp flavor in product A, a bitter taste in product B, and a salty taste in product C. The aroma of the shrimp paste was observed to have a mild shrimp odor in product A, a fishy odor in product B, and a strong shrimp odor in product C. The pH observation yielded data showing that product A has a pH of 7, product B has a pH of 6, and product C has a pH of 7.

In phase 4, data processing, students were asked to analyze the data obtained from observations and experiments by answering questions in the worksheet and then analyzing the process to relate it to the STEM approach. This stage serves to form concepts and generalizations (Rusli, 2021). Students conducted a STEM approach analysis of the ongoing activity, which was written in the LKPD activity 5 under syntax 5 Verification (proof). The analysis results showed that, on average, students answered the integration of science, which is knowledge related to the process of making shrimp paste through fermentation involving the role of microorganisms. Technology integration involves the use of a pH meter to measure acidity. Engineering integration involves knowledge of the various methods of making shrimp paste and the proportions used in its production, which affect the final product. Mathematics integration involves the systematic recording and interpretation of observation data.

In the 5th verification phase, students verify whether their observations align with existing hypotheses or theories. Students present their analysis and observation data in front of their teachers and peers. This verification stage aims to ensure that the learning process proceeds effectively and creatively if teachers provide students with opportunities to discover concepts, theories, rules, or understandings through examples encountered in real-life situations (Afiesta et al., 2022). In phase 6 (generalization), the teacher guides students to summarize the results of their observations and learning and then connect the activity to the ethno-STEM approach. In this phase, the teacher also reinforces the biotechnology material studied to all students (Mustikawati & Nurita, 2021).

The closing activity consisted of reflecting on the learning outcomes and appreciating the students' work in the learning process, followed by a prayer. The students were very enthusiastic and active in the learning process. Efforts to create optimal conditions in the classroom were made by conditioning the students in the learning process (Hidayat et al., 2020).

During the first session, the students were very enthusiastic during the observation activity. The teacher was less effective in managing the classroom due to the students' enthusiasm for conducting organoleptic tests and pH tests, as these were new concepts for the students. However, the learning process proceeded smoothly and within the allotted time. Students were also active in asking questions about new things they did not know or understand, such as how to use a pH indicator, and they also asked about the meaning of STEM.

In the process of linking observation activities with the STEM approach, the teacher first explained and demonstrated the understanding of the STEM concept so that students could maximize their learning process, especially in the data processing phase where students were asked to analyze and link their observations with the STEM approach. The students also did not yet understand the meaning of the word "ethnoscience," so the teacher provided an explanation of the term 'ethnoscience' using the term "local wisdom," and the students immediately understood the meaning of ethnoscience. All students were already familiar with the local wisdom of their region, Sidoarjo. Students can also provide examples of local wisdom specific to Sidoarjo. Students are also very familiar with the shrimp paste product specific to Sidoarjo because it is widely available in their immediate environment, especially its usage.

Students fundamentally possess varying information absorption skills. This is evidenced by the N-Gain scores analyzed for each student, which show varying scores. This occurs because each individual has different intellectual abilities (Turhusna & Solatun, 2020). This statement emphasizes that intelligence plays a crucial role in students' academic achievements. Students with higher intelligence levels tend to have better abilities in thinking, understanding, and solving problems more quickly compared to those with lower intelligence levels (Fajar, 2017). This gives them an advantage in understanding lesson materials, absorbing information, and applying knowledge in various academic situations.

During the learning process, students actively engage in building their own knowledge alongside their peers through discussions to test hypotheses derived from research questions and studies presented. Through these activities, students gain new knowledge from observation and exploration to find the information they need. This is in line with Vygotsky's constructivist learning theory in Ardianti (2021), which states that education, according to Vygotsky's ideas, occurs through social interaction between students, educators, and peers with appropriate challenges, enabling new learning in the zone of proximal development. This ethno-STEM-based discovery learning model is in line with Bruner's discovery theory that students attempt to solve problems supported by existing knowledge and obtain meaningful knowledge outcomes (Inayati, 2021).

Based on the research conducted, it can be stated that students' science literacy skills improved after the discovery learning model was implemented, as each stage of the discovery learning model trains students' science literacy skills in all syntaxes. This is in line with the research by Fauzi & Irwandani (2020), which shows that the application of discovery learning can significantly improve students' understanding of science concepts and science literacy skills because students are actively involved in discovering these concepts in junior high school science subjects. In this study, the N-Gain category was moderate and not yet in the high category.

Conclusion

Based on data analysis, the implementation of the discovery learning model based on etno-STEM shows a significant positive impact on students' science literacy skills. This is clearly evident from the N-Gain score of 0.8, indicating a high level of improvement in science literacy skills following the educational intervention. This finding is supported by the results of the paired sample t-test, which yielded a significance value of 0.001 ($p < 0.05$). This significance value indicates that H_1 is accepted, thus concluding that the observed improvement in students' science literacy skills is statistically significant and not due to chance, thereby confirming the effectiveness of the ethno-STEM-based discovery learning model.

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