Studies in Learning and Teaching (SiLeT)
Homepage: https://scie-journal.com/index.php/SiLeT
Email: silet@scie-journal.com

p-ISSN: 2722-399X; e-ISSN: 2722-1857
SiLeT, Vol. 5, No. 3, December 2024
Page 770-790
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Analysis of Students' Physics Numeracy Literacy Ability and Its Learning Implementation: Case Study in Nganjuk City

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Article Info

Article history:

Received November 1, 2024
Revised December 13, 2024
Accepted December 26, 2024
Available Online December 30, 2024

Keywords:

Literacy;
Numeracy;
Student;
Teacher;

ABSTRACT

This study aims to identify high school students' numeracy literacy abilities and physics learning that trains numeracy literacy. The study involved 183 students from three high schools (SMAN A, B, and C) in Nganjuk district, along with 9 teachers. Research instruments included a Numeracy Literacy Test and Physics learning response questionnaire, both validated by experts. Results showed that students' literacy skills were high (81.5%), with interpretation and integration scoring highest (90.33%), followed by information finding (77.33%) and evaluation/reflection (77.13%). In numeracy abilities, understanding scored highest (88.47%), followed by application (72.37%) and reasoning (63.9%). The reliability analysis of the research instrument showed a Cronbach's Alpha value of 0.87, indicating very good internal consistency in measuring the literacy-numeracy skills of high school students in Nganjuk Regency. This high reliability value provides a strong level of confidence in the research findings, including the average literacy skills (81.5%) and numeracy (78.25%). The overall average numeracy ability was 74.91%, falling in the sufficient category. Common teaching approaches included explanation with example problems, practice questions, and practicals (55%), along with the 5M approach (observe-question-try-analyze-communicate) used often (44.4%) or always (33.3%). Popular learning models included Direct Instruction (55.5%), Cooperative Learning (44.4%), Inquiry (22.2%), Problem-Based Learning (33.3%), and Project-Based Learning (66.6%). Other models included Discovery learning, Cooperative game learning, and differentiated PjBL. In conclusion, students' numeracy literacy ability reached a sufficient level at 78.5%.

https://doi.org/10.46627/silet

INTRODUCTION

Literacy in general has a very broad scope, including the ability to read, write, understand, and process information in various areas of life. Literacy is not only limited to aspects of language or numeracy, but also includes the ability to think critically, solve problems, and make decisions based on available information (Apriandi et al., 2024). In the context of physics and natural phenomena, literacy is an important tool for understanding scientific concepts, analyzing data, and connecting theoretical knowledge with everyday life (Wulff, 2024). However, literacy also includes other dimensions such as social, cultural, and technological, all of which contribute to the development of a person's ability to actively participate in society. Thus, strengthening literacy not only supports the understanding of physics, but also builds holistic competencies that are relevant in various aspects of life (Tang & Chen, 2024).

In this modern era, students' literacy skills are closely related to their ability to understand physics concepts, especially in analyzing various natural phenomena analytically, critically, and reflectively (Sukarno & Widdah, 2020). In line with the implementation of the independent learning curriculum developed by the Ministry of Education and Culture, physics learning must be based on freedom of thought initiated by teachers and developed by students (Winarno et al., 2024). Numeracy literacy is one of the essential competencies that high school students must master in facing the challenges of the 21st century, including the ability to identify quantitative information, apply mathematical concepts, conduct data-based reasoning, and communicate analysis results effectively (Purwaningrum et al., 2024). Literacy skills and competencies play an important role in physics learning, because they support students to understand concepts, analyze phenomena, and solve problems scientifically (Rawlings & Cutting, 2024). Literacy allows students to read, interpret data, and draw conclusions based on evidence, thus becoming a strong foundation for maximizing the effectiveness of physics learning (Suryati et al., 2023). The learning process is still predominantly oriented towards students' ability to face exams, where teachers focus on understanding physics concepts and students on their ability to answer questions. The learning approach applied tends to be conventional (No Name Learning), where teachers only lecture, ask questions, and give assignments without specific learning strategies (Akingbola et al., 2024).

A student was asked to calculate the average speed of a car, but despite initial success, the student had difficulty solving follow-up questions about the additional distance covered, misunderstood the appropriate mathematical operations, and was confused about interpreting the term "average speed." This conformity is increasingly apparent in story problems, indicating low numeracy literacy that includes understanding concepts, data expertise skills with real contexts, and application of concepts to new situations. To overcome this, contextual-based learning, gradual problem practice, and the use of visual aids such as diagrams or graphs are needed to strengthen student understanding (Rohman et al., 2020).

This condition is reflected in PISA data which shows that the abilities of Indonesian students are still low, with reading scores of 359, mathematics 366, and science 383 (Emilia et al., 2022). The 2022 results are the lowest since the PISA measurement began, equivalent to the achievements in 2003 for reading and mathematics, and 2006 for science. This downward trend has been increasingly visible since 2015, although there was an increase previously (Emilia et al., 2022). Further analysis shows that during 2018-2022, the gap between high and low-achieving students narrowed in mathematics, but stagnated in reading and science. This phenomenon indicates a decline in the overall quality of learning, which placed Indonesia in the bottom 6 in 2022, down from the bottom 10 in 2018 (Azinar et al., 2020). Based on these conditions, efforts are needed to improve problem-solving skills to improve Indonesia's PISA achievements, considering that this assessment prioritizes critical thinking skills (Grey & Morris, 2024). The decline in the 2022 PISA score, which was exacerbated by the Covid-19 pandemic, has caused learning loss due to online learning, thus creating uncertainty in the development of student abilities. This situation requires serious attention and more effective learning strategies to improve the quality of education in Indonesia (Nusantara et al., 2020).

Previous studies have discussed scientific literacy in general, such as students' ability to read and analyze scientific data. However, these studies tend to ignore the integration of literacy with physics learning that focuses on concrete phenomena in everyday life. This study presents novelty by developing a literacy-based physics learning model that not only improves students' understanding of physics concepts but also their ability to apply these concepts in real contexts, making learning more relevant and meaningful (Wu & Hsieh, 2024). The interactive learning methods in question include various approaches such as project-based learning, collaborative discussions, and the use of digital media that involve active student participation (Ferdianty et al., 2024). Research results consistently show that the use of numeracy-based problem-solving methods can significantly improve students' ability to solve unstructured problems. This

https://doi.org/10.46627/silet.v5i3.537

improvement can be seen from students' ability to analyze problems, identify relevant information, formulate solution strategies, and evaluate the results obtained. However, the integration of literacy in numeracy learning still requires further development to achieve optimal results, especially in terms of developing learning materials that integrate both aspects in a balanced manner (Maulana et al., 2022; Sartika et al., 2023).

The importance of numeracy literacy in thematic learning in high schools has been proven through various studies that show significant improvements in student learning outcomes. This improvement is especially evident when learning is implemented with a curriculum that is specifically designed to support literacy development. The Kampus Mengajar Program is present as an innovative solution that integrates technology and modern pedagogical approaches to improve students' literacy and numeracy skills. This program prioritizes technology-based learning and interactive media, such as the use of digital learning applications, interactive simulations, and online learning platforms tailored to students' needs. The implementation of technology in learning has shown encouraging results, reflected in the increase in student learning outcomes in various aspects, including conceptual understanding, analytical skills, and problem-solving abilities (Dwi Noerbella, 2022).

Identifying the numeracy literacy profile of high school students is essential to understand their level of ability in using mathematical concepts to solve everyday problems, including in academic and non-academic contexts. The numeracy literacy profile helps teachers identify students' strengths and weaknesses, so they can design appropriate learning strategies to support the development of critical thinking, data analysis, and problem-solving skills (Purnomo et al., 2023). In addition, good numeracy literacy is an important foundation for students in understanding various disciplines, especially science, technology, and economics, which require quantitative understanding. By knowing the numeracy literacy profile, schools can take more effective steps to improve students' competencies, so that they are better prepared to face challenges in the world of work and everyday life (Sari et al., 2024).

The systematic integration of literacy and numeracy culture into curricular activities has shown significant positive impacts. This integration is carried out through various structured learning activities, such as thematic projects, problem-based learning, and exploration activities involving the application of numeracy concepts in real contexts. This has been proven to provide a positive contribution to improving students' abilities, especially in the context of the Minimum Competency Assessment (AKM) which is one of the indicators of learning success (Tunnicliffe et al., 2018). This finding further strengthens the relevance of the Campus Teaching Program approach which combines various interactive learning methods. This program is not only in line with the demands of the school curriculum but also creates a dynamic learning environment and supports the development of students' numeracy literacy skills comprehensively. The integration of various learning methods includes the use of digital technology, collaborative learning, and a project-based approach that allows students to develop their numeracy literacy skills in a context that is meaningful and relevant to everyday life.

The benefits of this study are to provide insight into students' numeracy literacy profiles, which can be used to design more effective learning strategies. The results of this study also help educators in identifying students' strengths and weaknesses, and support the development of relevant curriculum and education policies to improve students' numeracy literacy at the secondary education level. Thus, the purpose of this study was to analyze the Profile of numeracy literacy skills of students and Physics teachers from 3 high schools in Nganjuk City, in Senior Hight School Class A to C.

https://doi.org/10.46627/silet.v5i3.537

RESEARCH METHOD

This study uses a mixed method approach that combines both quantitative and qualitative research methods. The study employed an explanatory sequential design, where quantitative data were collected first, followed by qualitative data to provide deeper insights into the initial findings. The survey method was chosen due to its effectiveness in exploring and describing the research variables comprehensively. The following is a flow diagram of the research carried out,

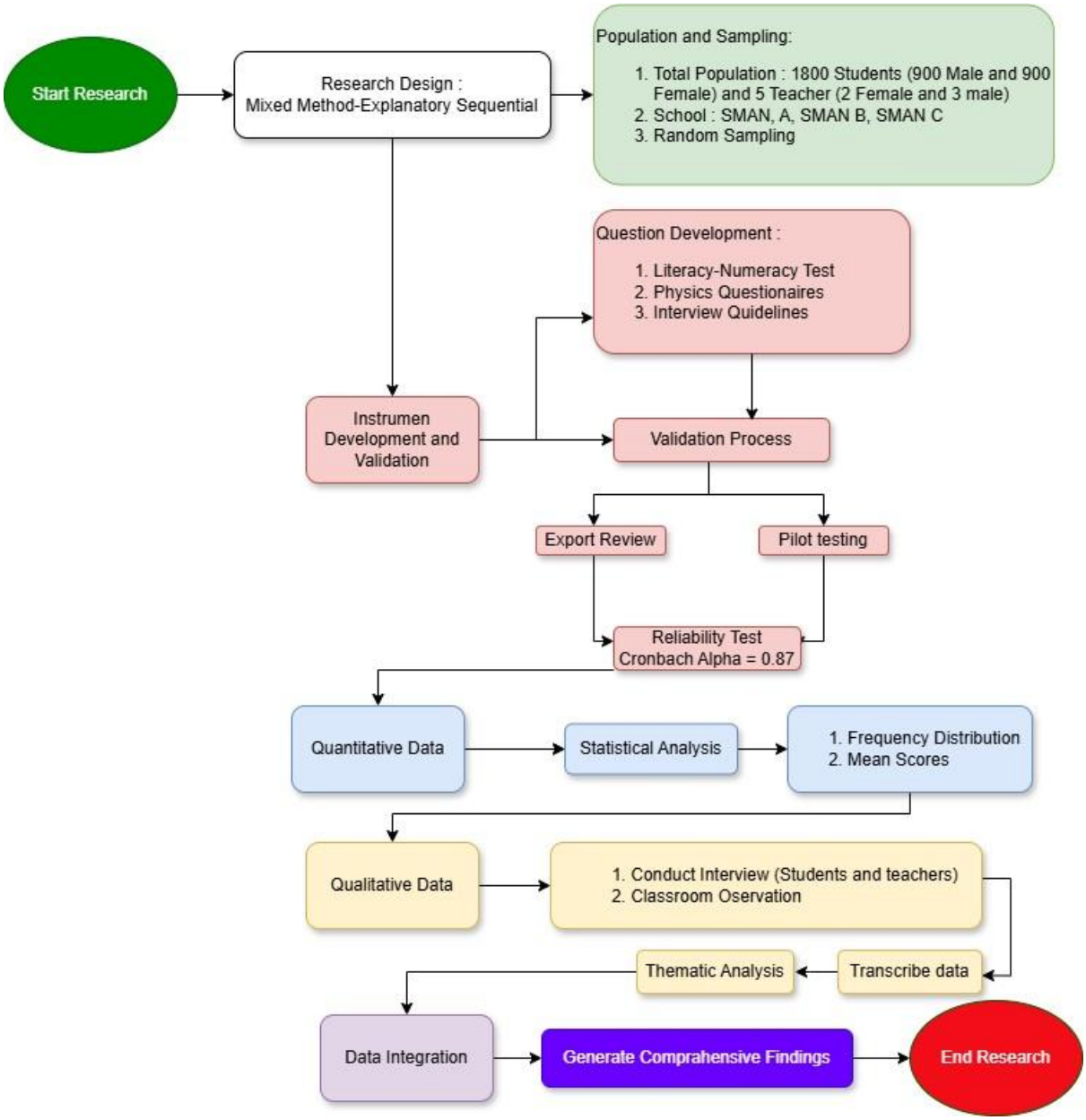


Figure 1. Flowchart research

The study population consisted of high school physics students and teachers in Nganjuk Regency, with a total of 1800 students and 5 physics teachers from three schools: SMAN A, SMAN B, and SMAN C. The demographic breakdown of the participants included 900 male students (50%) and 900 female students (50%), aged between 15 to 17 years. The sample of teachers consisted of 3 male and 2 female physics teachers, all with teaching experience ranging from 5 to 10 years. A random sampling technique was used to select participants.

Data collection involved several primary instruments: an essay-based literacy-numeracy test, physics learning questionnaires and assessments, and interview guidelines for teachers and

https://doi.org/10.46627/silet.v5i3.537

students. The literacy-numeracy test was designed to assess both reading literacy and numeracy skills. Reading literacy was included to evaluate students' ability to find, interpret, integrate, and evaluate information, which are crucial for understanding physics concepts and problem-solving. Numeracy was assessed based on aspects such as understanding, application, and reasoning in relation to physics learning. The physics material used for this study focused on the topic of Heat (Suprapto et al., 2023).

The research instruments were validated through expert reviews and pilot testing. The Cronbach's Alpha value for the literacy-numeracy test was found to be 0.87, indicating good reliability. The validity of the instruments was ensured through content validity checks conducted by subject-matter experts. The data analysis employed both quantitative and qualitative descriptive techniques. The quantitative analysis involved statistical calculations, such as frequency distributions and mean scores, to describe the literacy-numeracy abilities of students. For qualitative analysis, thematic analysis was conducted on interview transcripts and observation notes to explore the relationship between physics learning and literacy-numeracy skills. The results of both analyses were integrated to provide a comprehensive picture of the literacy-numeracy profiles of high school students in the context of physics learning. This study systematically analyzes the literacy-numeracy abilities of high school students and teachers, with a particular focus on how physics learning supports the development of these skills.

RESULTS AND DISCUSSION

Result

Numeracy Literacy Ability Data, Percentage of Correct Answers for literacy and Numeracy questions for each school and each indicator are presented in Figure 2.

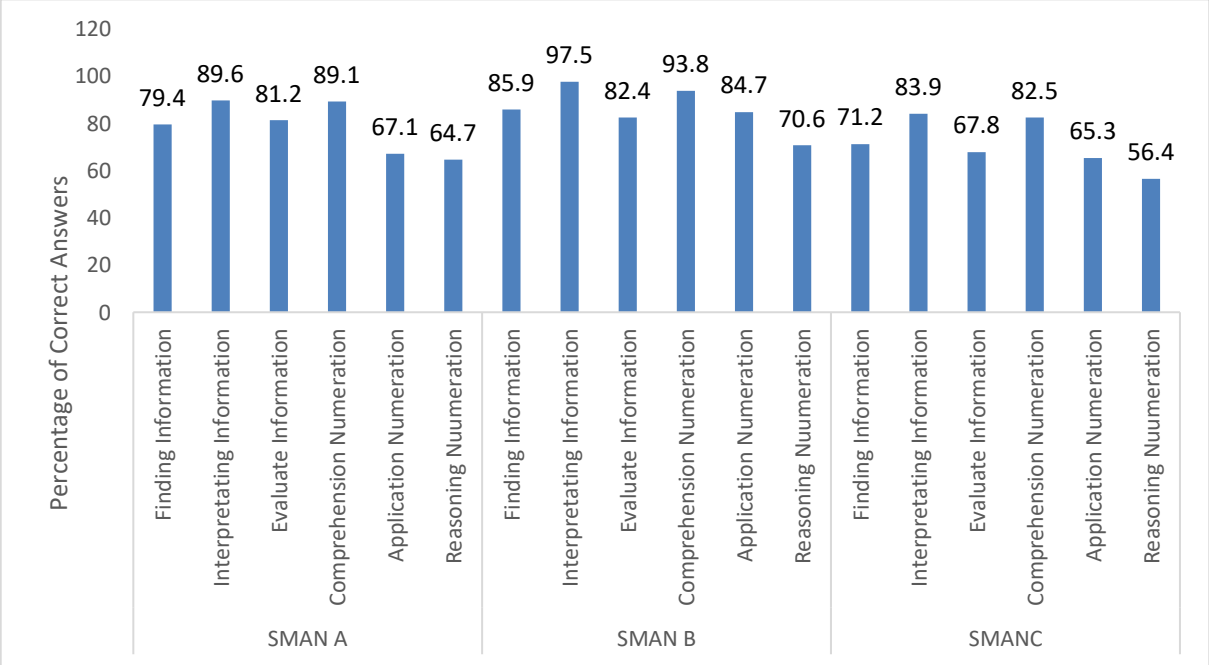


Figure 2. Graph of percentage of correct answers for students in each school

Ability to Find Information. The questions are related to identifying factors causing land and sea breezes from the information text presented.

1. Range of values from school data: 71.2% - 85.9%
2. The questions require the ability to identify information about factors causing land and sea breezes

https://doi.org/10.46627/silet.v5i3.537

The assessment criteria for the ability to find information are presented in Table 1.

Table 1. Information capability assessment criteria

Criteria	Description
Low ($0 \leq x \leq 70\%$)	• Students are only able to find 1 factor or are not precise in identifying and the answer does not use information from the text
Enough ($71 \leq x \leq 80\%$)	• Students are able to identify 2 general causal factors • The answer uses some information from the text but is incomplete
High ($81 \leq x \leq 90\%$)	• Students are able to identify 3 causal factors clearly • Answers use information from the text correctly • Able to explain the relationship between temperature and air pressure
Very High ($91 \leq x \leq 100\%$)	• Students are able to identify all causal factors very completely • Answers use information from the text comprehensively • Able to explain the relationship between temperature, air pressure, and heat transfer very well • Able to relate to relevant physics concepts

Based on figure 2, school data and data analysis obtained: SMAN C (71.2%) Sufficient Category, SMAN A (79.4%) Sufficient Category, SMAN C (85.9%) - High Category. The average ability for the whole is 77.3% with the Sufficient category. Based on the analysis of the ability to find information from the three schools, it can be explained that SMAN C which obtained a percentage of 71.2% (sufficient category) showed that students were able to find basic information about the difference in land and sea temperatures from the text presented. However, at this level students are still limited in identifying specific factors, such as the relationship between air pressure and temperature and the concept of heat transfer. Students tend to only identify general factors without explaining the details of the process. SMAN A with a percentage of 79.4% (sufficient category approaching high) showed a better ability to find specific information from the text. Students were able to identify the difference in temperature between land and sea and were able to explain the relationship between air pressure and wind transfer. However, the ability to explain the details of the physics process and link all concepts comprehensively still needs to be improved. Meanwhile, SMAN C achieved the highest percentage of 85.9% (high category) which shows very good ability in identifying detailed information from the text. Students are able to find the relationship between temperature and air pressure, relate the concept of heat transfer to wind movement, and understand the time patterns of land and sea breezes. They also demonstrate the ability to organize information systematically and connect various information from the text to explain the phenomena that occur.

Based on these results, SMAN C needs reinforcement in identifying detailed information and practice linking various information in the text. SMAN A needs to develop deeper information analysis skills and reinforcement in explaining the process in detail. Meanwhile, SMAN C needs to maintain the quality of learning that is already good by enriching more complex questions and developing the ability to apply concepts in different contexts (Siraj & Huang, 2024).

Interpreting Information

The assessment criteria for the ability to find information are presented in Table 2.

Table 2. Information capability assessment criteria

Criteria	Description
Low ($0 \leq x \leq 70\%$)	• Students only mention types of plants without looking at the table data • Unable to identify the relationship between calorific value and temperature decrease • The reasons given are not based on data
Enough	• Students can identify data from tables but are less precise in analysis

Criteria	Description
(71≤ x ≤80%)	• Able to compare calorific values between plants in a simple way • The reasons given are still incomplete
High (81≤ x ≤90%)	• Students are able to identify and compare specific heat values, heat capacity, and heat (Q) • Can provide reasons based on accurate data • Understand the relationship between heat value and the ability to lower temperature
Very High (91≤ x ≤100%)	• Students are able to analyze all data components in great detail • Provide comprehensive reasons by linking all values (specific heat, heat capacity, heat) • Can explain the process of decreasing temperature associated with the concept of heat transfer

criteria for the Literacy indicator (Information Interpretation) based on the questions and data provided:

1. Range of values from school data: 83.9% - 97.5%
2. Questions require the ability to identify information from tables and relate it to the concept of heat to lower body temperature

Based figure 2 on school data SMAN C (83.9%) - High Category; SMAN A (89.6%) - High Category; SMAN B (97.5%) - Very High Category. These results indicate that all schools have demonstrated good abilities in identifying and analyzing information from tables, with SMAN B showing very good performance in Information Interpretation literacy skills. Analysis of information interpretation skills in the three schools showed interesting variations in the quality of understanding and interpretation of data. SMAN C with a percentage of 83.9% (high category) showed a good basic understanding in interpreting the specific heat value and heat capacity of the two plants, as well as interpreting the relationship between heat value and temperature reduction. Students were also able to make simple conclusions from the available data. However, there are still some areas that need to be developed such as in-depth interpretation of the significant differences between the two plants, analysis of the implications of differences in calorific value on the effectiveness of temperature reduction, and interpretation of the cause-and-effect relationship between heat components. Based on table 2, SMAN A with a percentage of 89.6% (high category) showed more advanced abilities in interpreting the relationship between specific heat and heat capacity, and analyzing the differences in the effectiveness of the two plants based on data. Students showed excellence in connecting numerical data with practical applications, providing systematic explanations of the temperature reduction process, and interpreting the effect of calorific value on the rate of temperature reduction. Based on table 2, They were also able to make logical interpretations of the heat transfer process. Meanwhile, SMAN B achieved the highest percentage of 97.5% (very high category) which showed advanced interpretation abilities in comprehensively analyzing the relationship between heat variables. Students showed specific excellence in in-depth interpretation of the heat transfer mechanism, critical analysis of the relative effectiveness of the two plants, and the ability to connect theoretical concepts with practical applications. They were also very good at interpreting quantitative data into accurate qualitative explanations and making conclusions supported by strong evidence from the data.

Based on the results of the analysis table 2 and figure 2, several recommendations for development can be given. SMAN C needs to strengthen the ability to analyze in-depth relationships between variables, practice interpreting quantitative data into qualitative explanations, and develop the ability to make more comprehensive conclusions. SMAN A needs

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to improve the ability to interpret causal relationships, develop critical analysis of data, and strengthen the ability to explain the practical implications of data. Meanwhile, SMAN B needs to maintain high standards in data interpretation, develop analytical skills in more complex contexts, and strengthen the ability to make predictions based on data interpretation. Overall, all three schools showed good interpretation skills, with SMAN B showing excellence in analyzing and interpreting data comprehensively and in depth.

Evaluation Ability (Evaluate Information)

Criteria for the Literacy indicator (Evaluate Information) based on the data provided: The Assessment Criteria are presented in Table 3

Table 3. Evaluation ability assessment criteria

Criteria	Description
Low ($0 \leq x \leq 70\%$)	• Students are only able to evaluate the truth of 1-2 statements • Comparing data between months • Assessing the validity of statements about change trends • Analyzing relationships between variables (land and sea breezes) • Evaluations tend not to be supported by evidence from graphs
Enough ($71 \leq x \leq 80\%$)	• Students are able to evaluate the truth of 3 statements • Assess some changes in data over time • Compare values between months with sufficient accuracy • Evaluate simple statements about trends • Evaluation begins to be supported by data from graphs
High ($81 \leq x \leq 90\%$)	• Students are able to evaluate 4-5 statements correctly • Carefully assess the accuracy of statements • Compare complex data between variables • Analyze trends and patterns of change • Evaluate the validity of statements with strong evidence • Consistent evaluation supported by data from graphs
Very High ($91 \leq x \leq 100\%$)	• Students are able to evaluate all statements with great accuracy • Analyzing complex relationships between data • Assessing the validity of statements with great care • Making comprehensive evaluations with concrete evidence • Identifying discrepancies between statements and data

Based on table 3, Analysis of school scores shows that all schools are in the high category with little variation in literacy-numeracy skills. SMAN C, with a score of 81.2%, showed good ability in disseminating information from graphs, with consistent evidence support in their analysis. SMAN A, with the same score, also showed equal ability in disseminating information and analyzing the validity of statements, reflecting skills in assessing the credibility of information, which is an important aspect of reading literacy. Meanwhile, SMAN B, with a score of 82.4%, recorded the best performance in this analysis, with excellent ability in understanding, applying, and concluding numerical and text data. Overall, the third school showed very good achievement in literacy-numeracy skills, although there were small differences in areas such as interpreting graphs and critically evaluating information.

Slightly superior in evaluating information, showing more thorough and comprehensive analysis. The three schools showed very significant performance in the high category, indicating good ability in evaluating information from graphs, although there is still room for improvement towards the very high category. The results of the analysis of literacy skills (evaluate information) in the three schools showed performance in the high category with a very close range of values. SMAN B achieved the highest score of 82.4%, while SMAN C and SMAN A both obtained the

https://doi.org/10.46627/silet.v5i3.537

same score of 81.2%. This achievement indicates that students in the three schools have shown good ability in evaluating information from wind speed fluctuation graphs.

Specifically, students in all three schools were able to demonstrate skills in analyzing trends and patterns of data change, accurately comparing values across months, and evaluating the validity of statements with strong evidence from graphs. They were able to identify and analyze complex relationships between land and sea breeze speeds, and were able to carefully assess the accuracy of the statements given. Although in the high category, there is still room for improvement towards the very high category (91-100%). To achieve this, students need to develop deeper abilities in analyzing complex relationships between data, making more comprehensive evaluations with concrete evidence, and increasing their accuracy in identifying discrepancies between statements and data presented in graphs.

Comprehension Numeracy

Comprehension (Numeracy) assessment criteria and analyzing the results from the three schools. Comprehension Assessment Criteria are presented in Table 4.

Table 4. Comprehension ability assessment criteria

Criteria	Description
Low ($0 \leq x \leq 70\%$)	• Students only mention types of plants without data analysis • Unable to interpret the relationship between variables in the table • Unable to explain reasons based on numerical values • Conclusions are not supported by mathematical calculations
Enough ($71 \leq x \leq 80\%$)	• Students can choose the right plant • Can compare several simple numerical values • Provide basic reasons based on only one variable • Limited understanding of the relationship between numerical data
High ($81 \leq x \leq 90\%$)	• Students choose the right plant (Temulawak) • Analyze at least 2 numerical variables (specific heat and heat capacity) • Provide logical reasons based on data comparison • Demonstrate an understanding of the relationship between variables in the context of decreasing temperature
Very High ($91 \leq x \leq 100\%$)	• Students select plants very precisely with comprehensive analysis • Analyze all numerical variables in the table • Provide very strong reasons with mathematical calculations • Demonstrate a deep understanding of the relationship between heat and temperature drops • Able to relate numerical concepts to physiological contexts

Based on Table 4, an Analysis of school grades are SMAN B (93.8%) is a very high category. This shows a very good understanding of numeracy; Students are able to analyze data comprehensively and provide complete answers by considering all variables. SMAN A (89.1%) - High Category. This shows a good understanding of numeracy; students are able to analyze several important variables and provide logical reasons based on data. SMAN C (82.5%) high category Shows a fairly good understanding of numeracy; students can identify key variables and provide reasons based on simple data analysis. From these results, SMAN B shows excellence in numeracy skills with a very high category achievement, while the other two schools are in the high category with a good ability to analyze numerical data to solve the problems given.

Based on the analysis of Comprehension (Numeracy) abilities on questions related to the selection of herbal plants to lower body temperature, the three schools show different performances but all are in the high category and above. SMAN B has a very satisfying achievement of 93.8%, placing this school in the very high category. The students demonstrate

comprehensive numerical analysis skills in interpreting data from the table. They were able to deeply analyze the relationship between specific heat, heat capacity, and total calorific value to determine which plants are more effective in lowering body temperature. Students also succeeded in providing strong arguments by considering all available numerical variables and relating them to the physiological context of lowering body temperature. SMAN A achieved a score of 89.1%, which is in the high category. Students at this school showed a good understanding of analyzing numerical data from tables. They were able to identify and compare important values, such as specific heat and heat capacity, to determine which plants are more effective. Although they have not achieved a very comprehensive analysis like SMAN B, students could still provide logical arguments based on proper data interpretation. SMAN C, with a score of 82.5%, was also in the high category, although at the lower threshold of the category. Students demonstrated good basic skills in analyzing numerical data, were able to identify key variables in tables, and were able to provide reasons based on simple analysis of the available data. However, the analysis carried out tended to be less comprehensive than the other two schools. Overall, all three schools showed good abilities in understanding and analyzing numerical data to solve contextual problems. The main difference lies in the depth of analysis and the ability to relate various numeric variables to the physiological context of body temperature decrease. SMAN B excels in providing a more comprehensive and in-depth analysis, while SMAN A and SMAN C, although still in the high category, show room for improvement in terms of depth of analysis and interrelationships between variables.

Application Numeration

The Application Numeracy Assessment Criteria are presented in Table 5.

Table 5. Comprehension ability assessment criteria

Criteria	Description
Low ($0 \leq x \leq 70\%$)	• Students have difficulty applying the concept of calculating the temperature of a mixture • Limited in interpreting measurement data • Less precise in evaluating statements based on experimental results • Minimal in using numerical data to support analysis
Enough ($71 \leq x \leq 80\%$)	• Students can apply some basic calculation concepts • Able to interpret some measurement data correctly • Quite good at evaluating simple statements • Use some numerical data to support analysis
High ($81 \leq x \leq 90\%$)	• Students apply calculation concepts well • Interpret measurement data accurately • Evaluate statements appropriately and logically • Use numerical data effectively to support analysis
Very High ($91 \leq x \leq 100\%$)	• Students master the application of calculation concepts comprehensively • Very accurate in interpreting measurement data • Evaluate statements very precisely and deeply • Use numerical data comprehensively and systematically

Based on Table 5, the Analysis of Application (Numeracy) ability in the three schools showed quite significant variation in solving the water mixture temperature experiment problem. SMAN B showed the best performance with a score of 84.7%, which is included in the high category. Students in this school demonstrated good ability in applying numeracy concepts to analyze experimental data. They were able to understand and apply the concept of calculating the mixture temperature correctly, interpret measurement data correctly, and evaluate statements related to the results of the experiment accurately.

Meanwhile, SMAN A (67.1%) and SMAN C (65.3%) were in the low category with almost the same score. Both schools showed that students still had difficulty in applying numeracy concepts to solve the problems given. Although students could understand the basic procedures of the experiment, they had difficulty in analyzing numerical data and evaluating the truth of statements based on the results of the experiment.

These results indicate the need to strengthen numeracy application skills, especially in SMAN A and SMAN C. The focus of development should be directed at improving students' ability to apply calculation concepts, interpret measurement data, and evaluate statements based on experimental results more accurately and comprehensively.

Question Number 6 (Reasoning Numeracy)

The assessment criteria used are presented in Table 6.

Table 6. Reasoning assessment criteria

Low ($0 \leq x \leq 70\%$)	• Students have difficulty understanding the concept of expansion in railroad tracks • Unable to identify important variables (initial temperature, final temperature, initial length) • Difficulty interpreting data from images • Unable to relate temperature changes to changes in length • Minimum gap calculations are incorrect or incomplete
Enough ($71 \leq x \leq 80\%$)	• Students can understand the basic concept of expansion • Able to identify several important variables • Able to read data from images quite well • Understand the basic relationship between temperature changes and length • Minimum gap calculations still contain several errors
High ($81 \leq x \leq 90\%$)	• Good understanding of expansion concepts • Correct identification of all important variables • Accurate interpretation of data from drawings • Understanding of the complex relationship between temperature change and length • Accurate calculation of minimum gap with minimal error
Very High ($91 \leq x \leq 100\%$)	• Deep understanding of expansion concept • Identifying and analyzing all variables very precisely • Interpretation of data from drawings is very accurate and comprehensive • Understanding of complex relationships with consideration of safety factors • Minimum gap calculation is very precise and complete

Based on table 6, The results of the Comprehension (Numeracy) ability analysis on the question of calculating the minimum gap size of railroad tracks showed varying performance but tended to be in the low to sufficient category. SMAN B led with a score of 70.6% which was at the lower limit of the sufficient category, followed by SMAN A with 64.7% and SMAN C with 56.4% which were both in the low category. The data showed that SMAN B, although in the sufficient category, still had significant room for improvement. Students were able to understand the basic concept of expansion and identify several important variables, but still had difficulty in more complex calculations. SMAN A and SMAN C showed greater difficulty in understanding the concept of expansion and applying it in calculating the minimum gap. Both schools need reinforcement, especially in understanding the relationship between temperature changes and changes in length, as well as improving the ability to interpret data from images to perform accurate calculations.

Table 7. Average Numeracy literacy skills

	Percentage						
School	Finding Information	Interpretation	Evaluate	Comprehension	Application	Reasoning	Rate
SMAN A	79,4%	89,6%	81,2%	89,1%	67,1%	64,7%	77,77%
SMAN B	85,9%	97,5%	82,4%	93,8%	84,7%	70,6%	85,82%
SMAN C	71,2%	83,9%	67,8%	82,5%	65,3%	56,4%	71,18%
Rate	**77,33%**	**90,33%**	**77,13%**	**88,47%**	**72,37%**	**63,9%**	**78,25%**

Table 8. Average Numeracy literacy skills

	Percentage of Ability			
School	Finding Information	Interpretation	Evaluate	Rate
SMAN A	79,4%	89,6%	81,2%	83,4%
SMAN B	85,9%	97,5%	82,4%	88,6%
SMAN C	71,2%	83,9%	67,8%	74,3%
Rate	**77,33%**	**90,33%**	**77,13%**	**81,5%**

Table 9. Average Numeracy literacy skills

	Persentase			
School	Comprehension	Application	Reasoning	Rate
SMAN A	89,1%	67,1%	64,7%	73,63%
SMAN B	93,8%	84,7%	70,6%	83,03%
SMAN C	82,5%	65,3%	56,4%	74,91%
Rate	**88,47%**	**72,37%**	**63,9%**	**78,25%**

Based on Table 8. In terms of literacy skills, the highest average was achieved for the cognitive process of interpretation and integration with an achievement of 90.33%, then the ability to find information at 77.33% and finally evaluation and reflection at 77.13%. The average literacy ability of students at Nganjuk Regency State Senior High School was 81.5%, included in the high category, as visualized in Figure 2 below.

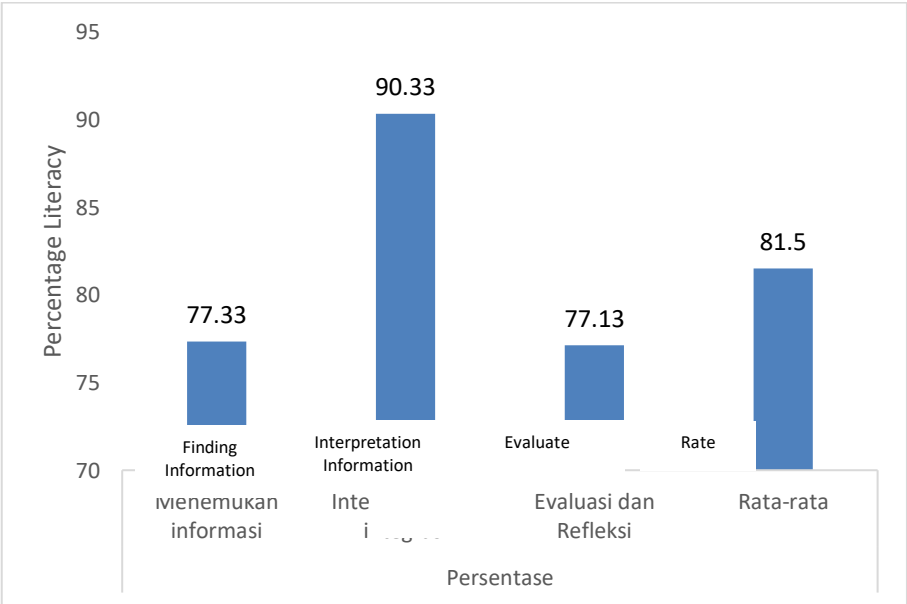


Figure 3. Literacy Skills of high school students in Nganjuk regency

https://doi.org/10.46627/silet.v5i3.537

Based on the data analysis displayed in the graph, there are several interesting findings related to students' literacy skills. Data variation shows significance in the four aspects measured, namely the ability to search for information (77.33%), interpretation of information (90.33%), evaluation (77.13%), and the overall average (81.5%). These results indicate that there is a fairly large gap between the ability to search for and interpret information, which logically seems unusual considering that interpretation of information should be supported by good information search skills.

Several factors that may be the cause of this phenomenon include the format of information presentation that is already very structured, the level of difficulty of interpretation questions that may be simpler than information search questions, and the possibility that students are more trained in interpreting than searching for information. This has implications for the need to strengthen learning, especially in the aspect of information search, without reducing the good achievements in existing interpretations. In addition, it is necessary to ensure that the evaluation of the assessment instrument is carried out to balance the level of difficulty between aspects.

Interestingly, the evaluation ability which is also relatively low (77.13%) shows that students are stronger in basic understanding but still need development in high-level abilities. This raises several important questions for further research, such as how the question format is for each aspect, whether there is a significant difference in the level of difficulty between aspects, what learning methods have been applied so far so that the interpretation is very high, and what is the right strategy to improve information search and evaluation skills without reducing the good interpretation skills.

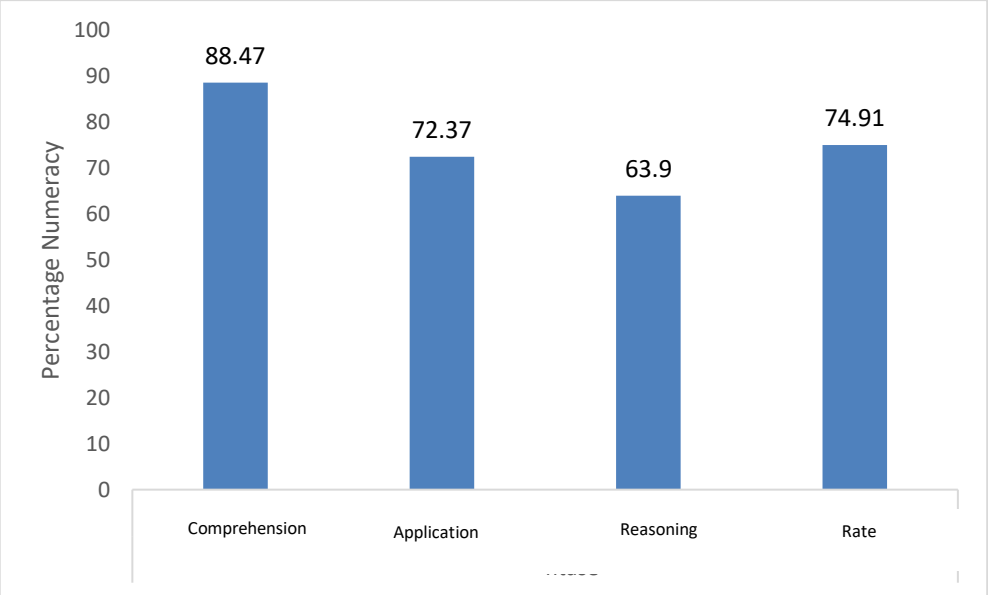


Figure 4. Numeracy ability of high school students in Nganjuk regency

Teacher questionnaire data

Learning approach

Based on teacher responses through the results of the questionnaire given to Physics subject teachers regarding the learning approach used is presented in Figure 5 below.

https://doi.org/10.46627/silet.v5i3.537

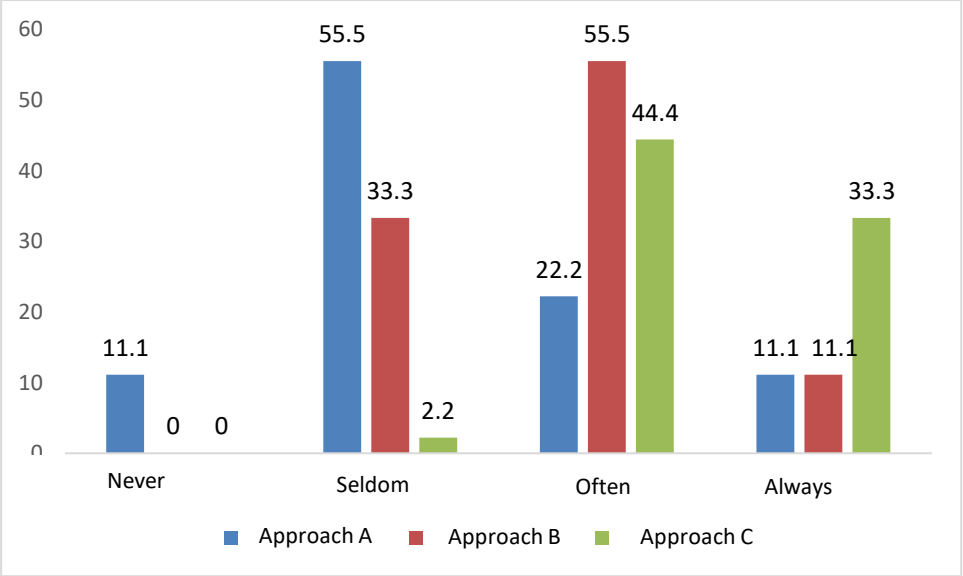


Figure 5. Learning approach

Description:
Approach A: Lecture (explaining-giving examples of questions-practice questions)
Approach B: Explaining-giving examples of questions-practice questions-practice
Approach C: Using a scientific approach (observing-asking-trying-analyzing-communicating)

Based on teacher responses about the learning approach that is often used is approach B (55.5%), which is explaining followed by giving examples of questions, practice questions and practicums. Furthermore, the one that is often (44.4%) and always (33.3%) used is approach C Using a scientific approach (observing - asking - trying - analyzing - communicating). This has a very good impact on training literacy-numeracy skills. Through this approach, students are trained to find information, interpret and evaluate. Likewise, by being given practice questions, students are trained in numeracy skills through physics problems.

Learning Model Used

Based on teacher responses, the learning model used in learning activities is presented in the bar diagram in the following Figure.

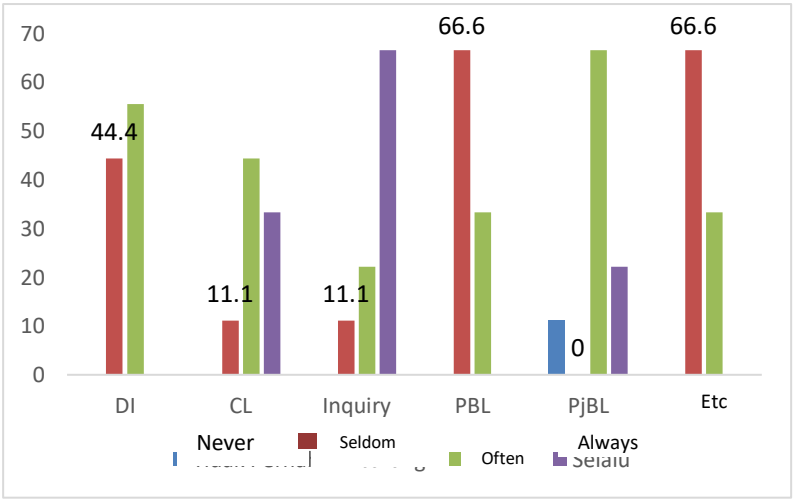


Figure 6. Learning model used

Based on the graph of the use of learning models, there are several important findings that need to be underlined. The Direct Instruction (DI) learning model is still often used (55.5%) although it is not the most dominant approach. Meanwhile, modern learning models such as Inquiry, Problem Based Learning (PBL), and Project Based Learning (PjBL) show a consistent pattern of use with a percentage of 'often' reaching 66.6%. This indicates a positive transition from traditional learning models to a more student-centered approach. Cooperative Learning (CL) has a lower level of use, with most teachers rarely using it (33.3%). This data shows that teachers have begun to adopt various innovative learning models, although there is still a balance with the use of direct teaching methods.

The reliability analysis of the research instrument showed a Cronbach's Alpha value of 0.87, indicating very good internal consistency in measuring the literacy-numeracy skills of high school students in Nganjuk Regency. This high reliability value provides a strong level of confidence in the research findings, including the average literacy skills (81.5%) and numeracy (78.25%), as well as differences in achievement between schools where SMAN B showed the highest performance (85.82%), followed by SMAN A (77.77%), and SMAN C (71.18%). These results also strengthen the validity of the findings related to the effectiveness of the applied learning approach, including the use of the Project Based Learning (PjBL) model by 66.6% of teachers. With this high reliability, development recommendations can be formulated with more confidence, especially for strengthening the reasoning aspect (63.9%) and numeracy application (72.37%), while maintaining high achievement in the interpretation aspect (90.33%).

The results of the study showed variations in literacy-numeracy skills in three state senior high schools in Nganjuk Regency, with an overall average reaching 78.25%. This finding shows a higher level compared to Jailani's et al (2020) study, which found that the average literacy-numeracy skills of high school students in East Java were 71.3%. Based on the results of an in-depth analysis, the literacy-numeracy skills aspect showed various achievements, starting from the ability to find information which reached an average of 77.33%, with variations between 71.2% and 85.9% (Jailani et al., 2020). The highest achievement was found at SMAN B (85.9%), which indicates the effectiveness of the learning approach applied. The ability to interpret information showed the highest achievement with an average of 90.33%, higher than previous research by Yuvita et al (2023), which recorded an average interpretation ability of high school students of 82.5% (Yuvita et al., 2023). At SMAN A this ability reached 97.5%, which surpassed the maximum achievement recorded by Hartono (2016) of 92.3%. For information evaluation ability, the average recorded was 77.13%, with a relatively narrow range of values between 81.2% and 82.4%, indicating uniformity in information evaluation teaching methods between schools (Oktiningrum & Hartono, 2016). Meanwhile, numeracy comprehension ability recorded an average of 88.47%, which was higher than Yuliana's (2021) study which recorded an average of 83.2%. SMAN C also showed excellence with a value of 93.8%, indicating the effectiveness of project-based learning. On the other hand, numeracy application ability showed an average of 72.37%, with significant variation between schools (65.3% to 84.7%), in line with Kusuma's (2022) findings regarding similar gaps between schools (Yuliana et al., 2021). The ability of numeracy reasoning was recorded as the lowest, at 63.9%, indicating the need to strengthen reasoning learning strategies, in accordance with Samad's (2023) findings on challenges in developing high school students' mathematical reasoning abilities (Samad et al., 2021).

In the context of the learning approach and models applied, the data shows a shift from conventional approaches to integrative learning, with 55% of teachers often using Approach B (explaining-examples-questions-practices) and 71% applying Approach C (scientific approach) (Suwahyu & Rahayu, 2023). The dominant learning model is Project-Based Learning (PjBL), which is used by 66.6% of teachers, followed by Direct Instruction (52%) and Cooperative Learning (44,23%). This shift reflects the increasing adoption of approaches that integrate theoretical understanding with practical application, fostering deeper learning experiences (Nafidiah et al., 2023).

One example of student work that demonstrates the effectiveness of the scientific approach and PjBL model is a project themed "Environmentally Friendly Transportation Solutions." In this project, students observed transportation patterns in their surroundings, collected data on the number of vehicles and estimated carbon emissions, analyzed the data using mathematical concepts such as percentages and diagrams, and developed numeracy-based recommendations to reduce carbon emissions through alternative transportation (Purnomo et al., 2023). The outcomes included an infographic comparing carbon emissions between conventional vehicles and environmentally friendly alternatives, a bar chart illustrating the potential reduction in emissions, and a proposal for implementing "Bike to School Day" with an estimated impact on reducing carbon footprints. This project exemplifies the application of the scientific approach through observing, asking, trying, analyzing, and communicating, while also demonstrating the ability of PjBL to train critical and analytical thinking skills. Furthermore, it highlights students' success in applying numeracy skills in real-world contexts, particularly in interpreting data and creating actionable, number-based solutions (Novitasari et al., 2023; Setiyani et al., 2024a).

Students' achievements in interpreting information (87.33%) and evaluating data demonstrate the effectiveness of integrated learning in enhancing information literacy. Moreover, evaluation and reasoning skills, trained with frequencies of 77% and 77.8%, respectively, emphasize the importance of contextual learning in fostering higher-order thinking skills (Ramadhani et al., 2024). The overall findings confirm that combining the scientific approach with the PjBL model significantly improves the quality of education, develops literacy and numeracy skills comprehensively, and provides students with meaningful and relevant real-life learning experiences (Purnomo et al., 2022).

In terms of learning approaches and models, the data show a shift from conventional approaches to integrative learning, with 55.5% of teachers often using approach B (explaining-examples-exercises-practice) and 77.7% using approach C (scientific approach). This finding supports Deda's (2024) research which shows the effectiveness of an integrative approach in improving numeracy literacy (Deda et al., 2024). The dominant learning model is Project Based Learning (PjBL), which is used by 66.6% of teachers, followed by Direct Instruction (55.5%) and Cooperative Learning (44.4%). The use of PjBL is reflected in the high performance of SMAN 1 Pace, which consistently applies this model, in line with the positive developments recorded in Marhami's (2022) research on the dominance of the previous conventional model (Marhami et al., 2022).

The findings of this study have several important implications. The success of SMAN 1 Pace in achieving the highest score (average 85.82%) shows the effectiveness of the combination of scientific approaches with the PjBL model, supporting the findings of Yeni (2024) who identified a positive correlation between project-based learning and increased literacy-numeracy (Yeni et al., 2024). The gap in application and reasoning abilities in numeracy indicates the need to strengthen contextual learning, in line with Selim's (2024) recommendation on the importance of real-world problem-based learning (Selim, 2024). The high performance in the aspect of information interpretation (90.33%) also shows the success of the implementation of integrative learning, supporting Sunarti's (2024) research which emphasizes the effectiveness of integrated learning in developing literacy (Sunarti et al., 2024).

This study used a mixed-method that combines quantitative and qualitative analysis to provide a more holistic understanding of the effectiveness of the learning approach. Quantitative data were obtained from the results of the evaluation of students' literacy and numeracy skills, which were analyzed using descriptive statistics, while qualitative data were collected through interviews with teachers and students, as well as direct observation during the learning process (Noguez et al., 2021). Qualitative analysis was carried out in several steps, including categorizing student responses to the learning approach, contextual descriptions of the results of interviews with teachers, and triangulation of data from classroom observations, interviews, and student work to ensure consistency of findings (Noguez et al., 2021). Observations showed that students

with high and very high ability categories were more active in discussions and were able to complete projects with a higher level of complexity. Meanwhile, students in the low category showed increased engagement when given more intensive guidance, although their understanding of the concept was still limited. Teachers mentioned that the scientific approach with Project-Based Learning (PjBL) helped create more meaningful learning, especially on topics that were relevant to students' lives (Setiyani et al., 2024b).

The total 90 students studied, the evaluation results showed the distribution of literacy and numeracy skills as follows: 22.2% of students were in the low category, 33.3% in the medium category, 27.8% in the high category, and 16.7% in the very high category. The majority of students were in the medium and high categories, while students with low abilities required a more intensive approach, such as problem-based contextual learning to facilitate basic understanding. Students in the very high category showed that a small number of them had been able to apply reasoning and evaluation at a complex level, supporting the effectiveness of PjBL (Shodikin et al., 2024).

The results of this study indicate the need to strengthen the implementation of PjBL by adopting best practices from SMAN B which have been proven effective. In addition, special programs need to be developed for students in the low category with a focus on improving reasoning and numeracy applications, such as the intervention model proposed by Kumari (2024). The intensity of contextual learning through practicums and real-world case studies also needs to be increased to connect theory with practical applications. In addition, the implementation of a periodic monitoring and evaluation system is very important to maintain student development and ensure consistency in the quality of learning. These findings emphasize the importance of an integrative and experience-based approach to improving literacy and numeracy comprehensively and sustainably (Handayani & Sutama, 2024).

CONCLUSION

Based on the results of the study, it can be concluded that the literacy-numeracy skills of students in three state senior high schools in Nganjuk Regency showed relatively high achievements. The average literacy skills of SMAN A, SMAN B, and SMAN C reached 81.55%, categorized as high. Meanwhile, the average numeracy skills of the three schools were 74.91%, categorized as sufficient. The overall average literacy-numeracy skills were 78.25%, also categorized as sufficient. The reliability analysis of the research instrument showed a Cronbach's Alpha value of 0.87, indicating very good internal consistency in measuring the literacy-numeracy skills of high school students in Nganjuk Regency. This high reliability value provides a strong level of confidence in the research findings, including the average literacy skills (81.5%) and numeracy (78.25%). Several aspects of literacy-numeracy, such as information interpretation and numeracy understanding, showed very good results, while the application and reasoning skills of numeracy still need to be strengthened. The learning approach used, especially the scientific approach and the Project Based Learning (PjBL) model, has proven effective in improving students' literacy-numeracy skills, as reflected in the superior performance of SMAN B. This finding also indicates the need to improve contextual learning and strengthen numeracy reasoning strategies to address existing gaps. Therefore, strengthening project-based learning, scientific approaches, and improving practicums and contextual learning are important steps that need to be taken to further enhance students' literacy-numeracy skills in the future.

ACKNOWLEDGEMENTS

I would like to thank all parties who have collaborated in supporting this research activity, especially teachers and students at SMAN in Nganjuk Regency, East Java Province.

REFERENCES

Akingbola, O. G., Abiodun, P. O., Owolabi, O. A., Efe, F., & Abedoh, H. (2024). Engaging university students in practical physics labs through motivational active learning. *ASEE Annual Conference and Exposition, Conference Proceedings*.

Apriandi, D., Murtafiah, W., Suprapto, E., Masfingatin, T., & Lusiana, R. (2024). The development of problem-based calculus E-modules to improve students' numeracy literacy skills. *AIP Conference Proceedings*, *3148*(1). https://doi.org/10.1063/5.0243257

Azinar, J. A., Munzir, S., & Bahrun. (2020). Students' logical-mathematical intelligence through the problem-solving approach. *Journal of Physics: Conference Series*, *1460*(1). https://doi.org/10.1088/1742-6596/1460/1/012024

Deda, Y. N., Disnawati, H., Tamur, M., & Rosa, M. (2024). Global trend of ethnomathematics studies of the last decade: a bibliometric analysis. *Infinity Journal*, *13*(1), 233–250. https://doi.org/10.22460/infinity.v13i1.p233-250

Dwi Noerbella. (2022). Implementasi program kampus mengajar angkatan 2 dalam meningkatkan kompetensi literasi dan numerasi peserta didik. *Jurnal Cakrawala Pendas*, *8*(2), 480–489. https://doi.org/10.31949/jcp.v8i2.2087

Emilia, E., Sujatna, E. T. S., & Kurniasih, N. (2022). Training teachers to teach PISA-like reading: A case in Indonesia. *Indonesian Journal of Applied Linguistics*, *12*(1), 58–78. https://doi.org/10.17509/ijal.v12i1.46534

Ferdianty, M. S., Setyansah, R. K., & Apriandi, D. (2024). The analysis of mathematical literacy skills of junior high school students in solving PISA problems in terms of learning styles in the new normal era. *AIP Conference Proceedings*, *3148*(1). https://doi.org/10.1063/5.0244675

Grey, S., & Morris, P. (2024). Capturing the spark: PISA, twenty-first century skills and the reconstruction of creativity. *Globalisation, Societies and Education*, *22*(2), 156–171. https://doi.org/10.1080/14767724.2022.2100981

Handayani, P. N., & Sutama. (2024). Numeracy literacy skills of socio-cultural contexts on geometry in junior high schools. *AIP Conference Proceedings*, *2926*(1). https://doi.org/10.1063/5.0182847

Jailani, J., Heri Retnawati, H. R., Wulandari, N. F., & Djidu, H. (2020). Mathematical literacy proficiency development based on content, context, and process. *Problems of Education in the 21st Century*, *78*(1), 80–101. https://doi.org/10.33225/pec/20.78.80

Marhami, M., Lukman, I. R., & Muliani, M. (2022). Scientific literacy and numeracy: How is it perception's pre-service science and mathematics teachers?. *AIP Conference Proceedings*, *2468*. https://doi.org/10.1063/5.0102484

Maulana, A., Puspita, A. J., Pangastuti, K. K., Daryati, D., & Arthur, R. (2022). The concept of literacy vocational-based e-module of technical mechanical subject. *Journal of Physics: Conference Series*, *2377*(1). https://doi.org/10.1088/1742-6596/2377/1/012068

Nafidiah, F. Z., Parno, P., Fitriyah, I. J., Fardhani, I., Nida, S., & Suprihatin, R. (2023). Development of digital game-based learning based pbl-stem to stimulate scientific literacy of junior high school students in climate change analyzing activities. *AIP Conference Proceedings*, *2569*. https://doi.org/10.1063/5.0112551

Noguez, J., Neri, L., Robledo-Rella, V., García-Castelán, R. M. G., Gonzalez-Nucamendi, A., Escobar-Castillejos, D., & Molina, A. (2021). Vis-hapt: A methodology proposal to develop visuo-haptic environments in education 4.0. *Future Internet*, *13*(10). https://doi.org/10.3390/fi13100255

Novitasari, Y. F., Purwanto, P., & Permadi, H. (2023). Students' mathematical literacy in solving pisa-like problems based on personality types. *AIP Conference Proceedings*, *2569*. https://doi.org/10.1063/5.0112314

Nusantara, D. S., Zulkardi, & Putri, R. I. I. (2020). Designing PISA-like mathematics problem in covid-19 pandemic (PISAComat). *Journal of Physics: Conference Series*, *1657*(1). https://doi.org/10.1088/1742-6596/1657/1/012057

Oktiningrum, W., & Hartono, Y. (2016). Developing pisa-like mathematics task with indonesia natural and cultural heritage as context to assess students mathematical literacy. *Journal on Mathematics Education*, *7*(1), 1–10.

Purnomo, H., Sa'dijah, C., Hidayanto, E., Sisworo, Permadi, H., & Anwar, L. (2022). Development of instrument numeracy skills test of minimum competency assessment (mca) in indonesia. *International Journal of Instruction*, *15*(3), 635–648. https://doi.org/10.29333/iji.2022.15335a

Purnomo, H., Sa'dijah, C., Permadi, H., Anwar, L., & Cahyowati, E. T. D. (2023). Mathematical creative processing abilities of junior high school students' in numeracy tasks. *AIP Conference Proceedings*, *2569*. https://doi.org/10.1063/5.0113667

Purwaningrum, J. P., Ahyani, L. N., Utomo, A. P., & Purwoko, R. Y. (2024). Designing a digital interactive module with Javanese culture nuances to improve the numeration literacy abilities of Dysculia students. *AIP Conference Proceedings*, *3148*(1). https://doi.org/10.1063/5.0242354

Ramadhani, S., Nurcahyo, A., Kasman, N., Hardianti, & Ahmad, J. (2024). Analysis of problem-solving skills with Polya's steps in solving numeracy problems in class VIII junior high school in terms of gender differences. *AIP Conference Proceedings*, *2926*(1). https://doi.org/10.1063/5.0183389

Rawlings, B. S., & Cutting, S. J. (2024). Linking disparate strands: A critical review of the relationship between creativity and education. *Educational Psychology Review*, *36*(4). https://doi.org/10.1007/s10648-024-09973-z

Rohman, F., Fauzan, A., & Yohandri. (2020). Project, technology and active (PROTECTIVE) learning model to develop digital literacy skills in the 21st century. *International Journal of Scientific and Technology Research*, *9*(1), 12–16.

Samad, F., Salasa, M., & Ramadali, W. O. R. L. O. (2021). Improving numeracy skill through leng kali leng traditional game in learning early math to young learners. *Journal of Physics: Conference Series*, *1832*(1). https://doi.org/10.1088/1742-6596/1832/1/012031

Sari, C. M., Ridwan, A., Sastrawijaya, Y., & Rahmawati, Y. (2024). Validity and reliability of the questionnaire learning environment of numeracy. *New Educational Review*, *75*, 152–163. https://doi.org/10.15804/tner.2024.75.1.12

Sartika, D., Nurlina, Mutmainna, Aris, N. A., & Musliana. (2023). The scientific literacy profile of senior high school student based on science competence dimension. *AIP Conference Proceedings*, *2619*. https://doi.org/10.1063/5.0122563

Selim, S. A. S. (2024). Mastering complex science content using a digital literacy strategy. *Education and Information Technologies*, *29*(11), 13551–13575. https://doi.org/10.1007/s10639-023-12337-9

Setiyani, Waluya, S. B., Sukestiyarno, Y. L., Cahyono, A. N., & Santi, D. P. D. (2024a). Assessing numeracy skills on flat shapes and scaffolding forms in junior high school. *International Journal of Evaluation and Research in Education*, *13*(1), 422–432. https://doi.org/10.11591/ijere.v13i1.25186

Setiyani, Waluya, S. B., Sukestiyarno, Y. L., Cahyono, A. N., & Santi, D. P. D. (2024b). Assessing numeracy skills on flat shapes and scaffolding forms in junior high school. *International Journal of Evaluation and Research in Education*, *13*(1), 422–432. https://doi.org/10.11591/ijere.v13i1.25186

Shodikin, A., Kohar, A. W., & Sumarno, W. K. (2024). Improving student bilingual numeracy: Developing teaching modules with a project-based learning approach. *AIP Conference Proceedings*, *3116*(1). https://doi.org/10.1063/5.0210433

Siraj, I., & Huang, R. (2024). Promoting teaching and learning through research-informed professional development: The leadership for learning programme in australia and china. *Education Sciences*, *14*(12). https://doi.org/10.3390/educsci14121299

Sukarno, & Widdah, M. E. (2020). The effect of students' metacognition and digital literacy in virtual lectures during the covid-19 pandemic on achievement in the "methods and strategies

on physics learning" course. *Jurnal Pendidikan IPA Indonesia*, *9*(4), 477–488. https://doi.org/10.15294/jpii.v9i4.25332

Sunarti, T., Suprapto, N., Prahani, B. K., Satriawan, M., & Rizki, I. A. (2024). Online problem-based learning and 3D digital books to improve pre-service teachers' scientific literacy. *International Journal of Evaluation and Research in Education*, *13*(5), 3139–3150. https://doi.org/10.11591/ijere.v13i5.29835

Suprapto, E., Suryani, N., Siswandari, & Mardiyana. (2023). Mathematical literacy profile of junior high school students in solving PISA questions. *AIP Conference Proceedings*, *2614*. https://doi.org/10.1063/5.0126666

Suryati, I., Hadiwijaya, S., & Septiana, T. (2023). Development of Google Sites-based blended learning media on linier program material mathematics subjects. *AIP Conference Proceedings*, *2727*. https://doi.org/10.1063/5.0141439

Suwahyu, F. A., & Rahayu, S. (2023). Development and utilization of instrument using PISA framework to improve chemistry literacy ability: A systematic review. *AIP Conference Proceedings*, *2569*. https://doi.org/10.1063/5.0113478

Tang, F., & Chen, F. (2024). The derivation and physical meaning of wave function on college physics course ideological and political integration. *Advances in Transdisciplinary Engineering*, *48*, 697–704. https://doi.org/10.3233/ATDE231384

Tunnicliffe, S. D., Gazey, R., & Gkouskou, E. (2018). Learning in physical science opportunities at natural history dioramas. In *Natural History Dioramas - Traditional Exhibits for Current Educational Themes: Science Educational Aspects*. https://doi.org/10.1007/978-3-030-00175-9_12

Winarno, Muchtarom, M., & Fauziyah, H. (2024). Readiness and efforts of civics teachers in developing literacy and numeracy skills. *Journal of Education and Learning*, *18*(4), 1209–1223. https://doi.org/10.11591/edulearn.v18i4.21425

Wu, Y. J., & Hsieh, F.-J. (2024). An investigation on the mathematical creativity of regular junior high school students in Taiwan. *Proceedings of the International Group for the Psychology of Mathematics Education*, *4*, 217–224.

Wulff, P. (2024). Physics language and language use in physics—What do we know and how AI might enhance language-related research and instruction. *European Journal of Physics*, *45*(2). https://doi.org/10.1088/1361-6404/ad0f9c

Yeni, S., Nijenhuis-Voogt, J., Saeli, M., Barendsen, E., & Hermans, F. (2024). Computational thinking integrated in school subjects – A cross-case analysis of students' experiences. *International Journal of Child-Computer Interaction*, *42*. https://doi.org/10.1016/j.ijcci.2024.100696

Yuliana, I., Cahyono, M. E., Widodo, W., & Irwanto, I. (2021). The effect of ethnoscience-themed picture books embedded within contextbased learning on students' scientific literacy. *Eurasian Journal of Educational Research*, *2021*(92), 317–334. https://doi.org/10.14689/ejer.2021.92.16

Yuvita, Y., Husain, A., Sulistyawati, A. E., Meiristiani, N., Fatimah, E., & Sunmud, S. (2023). Assessing the digital literacy competence of pre-service English teacher in Indonesia and Thailand. *Journal of Education and Learning*, *17*(4), 604–612. https://doi.org/10.11591/edulearn.v17i4.20910

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