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Analysis of High School Students' Physics Literacy Ability Towards the Phenomenon of Elasticity Based on the Natural of Science Literacy Test Instrument

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Abstract

The advancement of science and technology requires students to possess strong scientific literacy, particularly in understanding physical phenomena such as elasticity. However, students often demonstrate a low conceptual understanding of elasticity in real-life contexts, posing a challenge in physics education. This study aims to analyze students' physics literacy skills using the Nature of Science Literacy Test (NOSLiT) instrument. This research employed a descriptive quantitative approach with a sample of 30 students from classes A, B, and C. Data were collected through a written test based on the NOSLiT framework, which consists of six scientific literacy indicators, and analyzed quantitatively using achievement categories. The findings revealed that students' overall scientific literacy achievement was categorized as low (43.2%). The highest achievement was on the scientific evidence rule indicator (58.8%, moderate category), while the lowest was on science process skills (24.3%, very low category). These results suggest the need for more interactive and experiment-based instructional strategies to enhance students' conceptual understanding. Students' responses were mostly descriptive and lacked evidence-based reasoning, with misconceptions about relationships among physics variables still apparent. These findings emphasize the importance of incorporating scientific practices—such as experimentation, evidence utilization, and contextual problem-solving—into teaching. This study was limited to a single school and instrument, which restricts the generalizability of the results. Future research should include a broader sample and adopt a mixed-method approach to obtain more comprehensive insights. Moreover, the development of inquiry-based learning models is crucial to support the advancement of students' scientific literacy.

Keywords: Scientific literacy, elasticity, NOSLiT

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INTRODUCTION

The rapid progress of science and technology in the 21st century has brought both positive and negative impacts, including in the field of education. Easy access to information can improve the quality of life, but it also presents challenges related to ethics, morality, and environmental sustainability (Andriani et al., 2018). In this context, strengthening students' scientific literacy is essential to help them understand natural phenomena and develop solutions to global and local problems. Scientific literacy involves the ability to read, write, calculate, and think critically within scientific contexts. One relevant phenomenon to support physics literacy development is elasticity, which is fundamental to understanding the behavior of materials in various contexts, such as the stretching of springs, bridge designs, or shock absorbers. Elasticity integrates abstract mathematical relationships with real-world phenomena, yet it remains underrepresented in literacy-based instruction. Physics learning associated with elasticity allows students to contextualize physical concepts in their daily lives (Budiyanto et al., 2018). However, several studies show that students still struggle to conceptualize and apply elasticity in real contexts.

A major challenge in teaching elasticity is students' low understanding of its real-life relevance, which limits their ability to identify the variables influencing material elasticity (Ahzari & Asrizal, 2023). This issue is exacerbated by the lack of contextual and experimental learning tools. Empirical data from 90 students at SMAN revealed that only 40% could accurately explain stress and strain, and only 30% were able to relate elasticity to practical applications like vehicle suspensions or architectural design. Additionally, more than 60% struggled to perform simple experiments such as determining spring constants through Hooke's Law (Simatupang et al., 2023). These findings highlight the need for interactive, experiment-based approaches to improve students' conceptual understanding.

Beyond classroom observations, national and international assessments also indicate weak scientific literacy among Indonesian students. The PISA results and the Ministry of Education and Culture's 2019 report show that 60% of high school students have not reached the basic competency level in physics. This reflects a superficial understanding of physics concepts, including elasticity, with minimal connection to scientific processes or real-world applications. A study by Oktaviana & Sugiyarto (2021) found that only 35% of students were able to explain the concept of elasticity conceptually and in context. Furthermore, scientific literacy in physics has often been measured using instruments that do not fully capture students' understanding of the Nature of Science (NoS). In recent years, studies have attempted to fill this gap by employing the Nature of Science Literacy Test (NOSLiT) instrument. For example, Agustin et al. (2023) and Isti et al. (2020) found that NOSLiT-based assessments revealed average student performance below 50%, with significant misconceptions and limited reasoning skills. However, few studies have focused specifically on elasticity as the context for investigating scientific literacy using NOSLiT. In physics education, the integration of guided inquiry and project-based learning (PjBL) methods has shown promise in developing students' ability to link theory to practice (Rohim et al., 2020). Such methods enable students to observe, question, and test elasticity-related phenomena, improving both content mastery and scientific thinking. Yet, instructional practices and assessment tools remain underdeveloped in capturing these competencies in elasticity topics.

This study aims to analyze the scientific literacy abilities of high school students regarding the concept of elasticity using the NOSLiT instrument, which evaluates six indicators of scientific literacy: (1) recognition of scientific questions, (2) explanation of phenomena scientifically, (3) use of scientific evidence, (4) interpretation of data and evidence, (5) understanding of scientific investigation, and (6) evaluation of scientific information. The results are expected to inform the development of more relevant instructional strategies and assessment tools that bridge abstract physics content with meaningful, real-world applications.

METHOD

This study uses a descriptive quantitative approach that aims to analyze the physics literacy skills of high school students towards the phenomenon of elasticity. The data collection technique was carried out through a written test (paper and pencil test) using the Nature of Science Literacy Test (NOSLiT) instrument, which consists of three fill-in-the-blank questions. Each question is designed to measure six indicators of science literacy based on NOSLiT, namely: (1) Scientific Naming, (2) Process Skills Ability, (3) Scientific Evidence Rules, (4) Scientific Postulates, (5) Scientific Dispositions, and (6) Main Misconceptions about Science

(Takda et al., 2023). The data obtained were analyzed descriptively to see the distribution and tendencies of students' abilities in each literacy indicator.

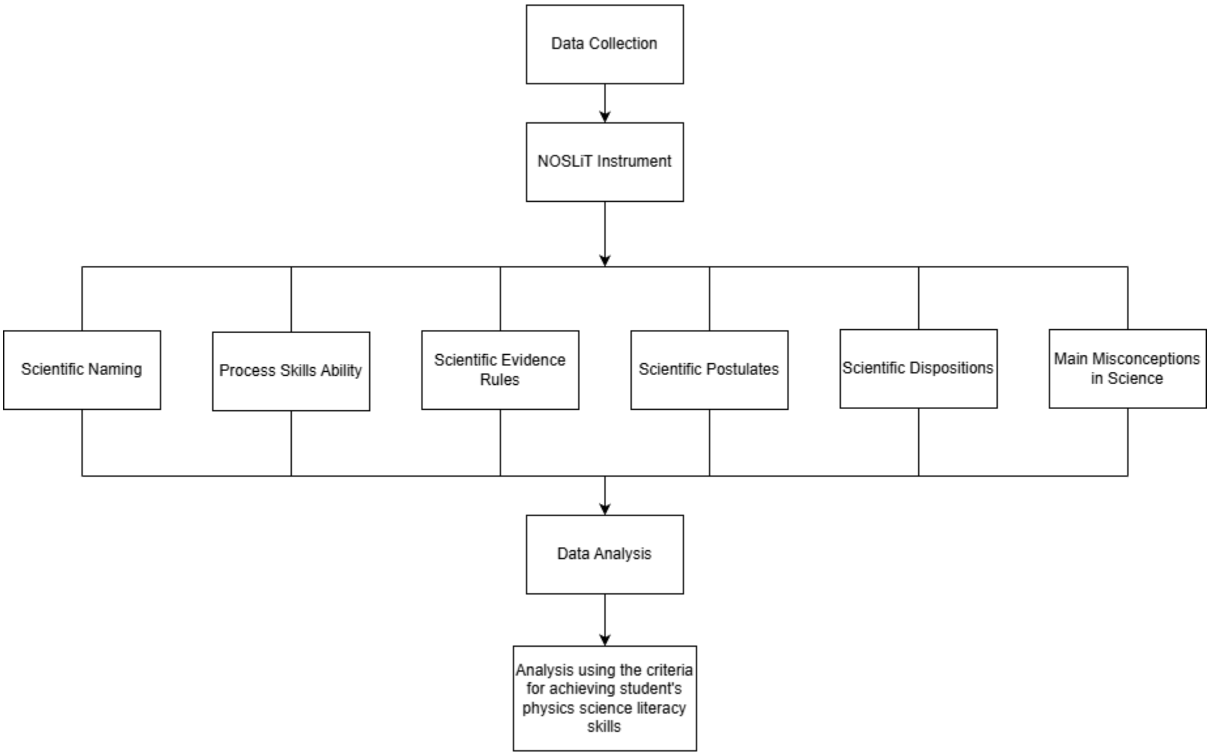


Figure 1. Research flowchart

The subjects of this study were high school students in class A, class B, and class C. The sample for each class consisted of 30 students. The data analysis technique for the results of the instrument answers was scored using the answer key. Correct answers are given a score of 1 and incorrect answers are given a score of 0. Each Instrument question was scored based on accuracy and reasoning quality, as follows,

- Score 1: Correct answer with scientifically valid reasoning.
- Score 0.5: Correct answer but with partial or flawed reasoning.
- Score 0: Incorrect answer or reasoning based on misconceptions.

Tabel 1. The rubric for each indicator

Indicator	Example of Correct Response	Common Misconceptions
Scientific Naming	Identifies "elastic limit" correctly in context	Confuses with "maximum force"
Process Skills Ability	Interprets Hooke's Law graph correctly	Reads axes incorrectly
Scientific Evidence Rules	Justifies response using empirical data	Relies on intuition only
Scientific Postulates	States that elasticity varies with material	Assumes all materials behave the same
Scientific Dispositions	Acknowledges uncertainty and variability	Seeks one fixed answer
Misconceptions	Rejects belief that thicker springs always stretch more	Maintains intuitive but incorrect belief

Data are analyzed descriptively on the results of students' answers in the form of averages, percentages and categories of each indicator of physics science literacy (Murti et al., 2018). Achievement scores are expressed in percentages, then categorized based on the criteria of Very High (ST), High, Low and Very Low based on the rules of (Arikunto, 2006) as in Table 2.

Table 2. Criteria for Students' Physics Science Literacy Achievement

Achievement Interval (%)	**Category**
$86 \leq x \leq 100$	Very high
$71 \leq x \leq 85$	High
$56 \leq x \leq 70$	Medium
$41 \leq x \leq 55$	Low
$x \leq 40$	Very low

The data is also presented in the form of tables and bar graphs. The data in the form of tables presents the average value of each indicator, the percentage value on each science literacy test, and the category, while the bar graph only presents the percentage value of the achievement of each science literacy indicator.

RESULTS AND DISCUSSION

Data collection was carried out at SMAN using the NoSLiT science literacy test instrument, obtained data on students' physics literacy abilities which were analyzed based on six main indicators. The NoSLiT instrument developed by Wenning (2006) measures students' abilities in the following aspects: (1) scientific naming, (2) process skills, (3) scientific evidence rules, (4) scientific postulates, (5) scientific dispositions, and (6) main misconceptions about science (Syarifuddin et al., 2023).

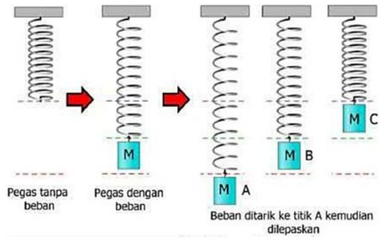
The results of the analysis of students' answers showed that the average percentage of achievement of science literacy abilities at SMAN was in the low category with a value of 43.2%. Referring to Arikunto's criteria (2006), achievement with a range of 41-55% is included in the low ability category, while achievement below 40% is classified as very low. When examined per indicator, the percentage of students who answered correctly on the scientific evidence rule indicator reached 58.8% (medium category) which is the highest achievement. Meanwhile, the scientific disposition indicator reached 46.3%, scientific postulates 43.9%, scientific naming 43.0%, and major misconceptions about science 42.8%, all of which are included in the low category. The lowest achievement was in the process skills ability indicator with a percentage of only 24.3%, which is included in the very low category. This is shown in Table 3.

Table 3. Percentage of Students' Science Literacy Ability Achievement

Literacy Indicators	Class A (%)	Class B (%)	Class C (%)	Average (%)	Category
Scientific Naming	45.2	42.8	41	43	Low
Process Skills Ability	25	23	23	24	Very low
Scientific Evidence Rules	61	58	58	59	Medium
Scientific Postulates	46	43	43	44	Low
Scientific Disposition	48	45	44	44	Low
Main Misconceptions	44	42	42	43	Low
Average	**45.4**	**42.4**	**41.7**	**43.2**	**Low**

The questions and responses of students in the test instrument using NOSLiT are presents in Figure 2.

Cermati teks informasi berikut!



Sebuah pegas yang digantung vertikal ke bawah lalu vertikal ke bawah lalu diberi beban diberi beban m pegas akan meregang dan membentuk kesetimbangan setelah posisinya diam. Jika setelah posisinya diam. Jika beban ditarik dengan simpangan tertentu lalu dilepaskan maka pegas akan bergerak naik turun membentuk sebuah getaran dengan titik keseimbangan berada di titik B. Pegas melakukan satu kali getaran ketika bergerak menempuh lintasan A-B-C-B-A. Waktu untuk menempuh satu kali getaran disebut dengan periode(T), sedangkan jumlah getaran tiap detik disebut dengan frekuensi (f). Periode getaran pegas (T) dengan konstanta pegas (k) yang diberi beban (m) ditentukan dengan persamaan,

$$T = 2\pi\sqrt{\frac{m}{k}} \text{ dan } f = \frac{1}{T}$$

Nilai konstanta pegas tergantung pada jenis pegasnya. Pegas yang kaku memiliki nilai konstanta pegas lebih besar konstanta pegas lebih besar dibandingkan pegas yang dibandingkan pegas yang lentur/elastis. lentur/elastis.

Figure 2. Question number one

In Figure 2, the material in the picture reflects several relevant indicators of scientific literacy. The Scientific Naming indicator can be seen from the use of scientific terms such as "spring constant", "vibration period", and "vibration frequency", which indicate an understanding of the correct physics concept. In addition, the Process Skills Ability indicator is also met, because the material explains how the spring system works by analyzing the relationship between mass, spring constant, and vibration period. Furthermore, this material follows the Scientific Evidence Principle, which is evidenced by the use of periods derived from the laws of physics that have been tested experimentally. In addition, the concepts explained in the picture also reflect Scientific Postulates, because the principles used, such as Hooke's law and simple harmonic motion dynamics, are widely accepted in physics. Meanwhile, the Scientific Disposition and Major Misconception indicators are less relevant in this context, because the material is descriptive and does not contain significant conceptual errors (see Figure 3).

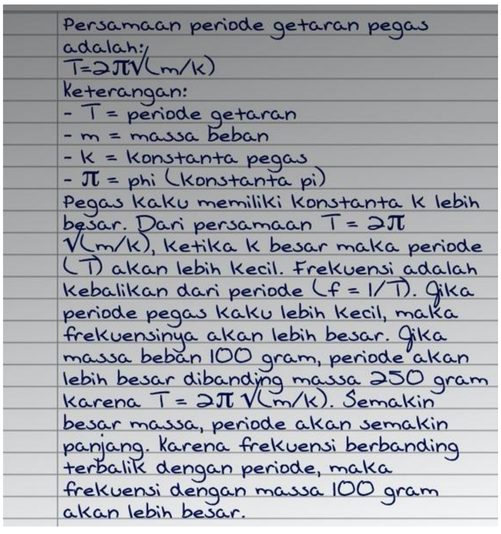

Persamaan periode getaran pegas adalah:
T=2πV(m/k)
Keterangan:
- T = periode getaran
- m = massa beban
- k = konstanta pegas
- π = phi (konstanta pi)
Pegas kaku memiliki konstanta k lebih besar. Dari persamaan T = 2π V(m/k), ketika k besar maka periode (T) akan lebih kecil. Frekuensi adalah kebalikan dari periode (f = 1/T). Jika periode pegas kaku lebih kecil, maka frekuensinya akan lebih besar. Jika massa beban 100 gram, periode akan lebih besar dibanding massa 250 gram karena T = 2π V(m/k). Semakin besar massa, periode akan semakin panjang. Karena frekuensi berbanding terbalik dengan periode, maka frekuensi dengan massa 100 gram akan lebih besar.

Figure 3. Students' answers to question number one

Figure 3 shows that students' answers have included the equation for the spring vibration period correctly. The concept explained regarding the relationship between spring constant (k), mass (mm), period (T), and frequency (f) is in accordance with the theory. The understanding that a stiffer spring has a larger kk value, resulting in a smaller period, is also correct. In addition, the relationship between period and frequency as inversely proportional quantities is also stated correctly. In terms of scientific literacy, students have demonstrated the ability to use scientific naming using appropriate physics terms, such as vibration period, load mass, spring constant, and frequency. However, in terms of process skills, the answers still lack numerical calculations or examples of numbers that can strengthen conceptual understanding. In terms of scientific evidence rules, the presentation of concepts is based on scientific formulas and variable relations, but has not been supported by experiments or real evidence. The basic principles of elasticity and simple harmonic motion have been explained well, demonstrating an understanding of scientific postulates. In scientific disposition, students are able to explain the relationship between variables with correct logic, although deeper analysis or criticism of the concept is still lacking. There were no major misconceptions in the answers, so overall the answers were quite good, although they could still be improved by adding numerical examples and experimental evidence.

(sumber: https://images.app.goo.gl/fzZ34fJrHSwcb1RE7)

Roni adalah seorang insinyur mekanik yang bekerja di perusahaan manufaktur. Perusahaan tersebut memproduksi mesin-mesin yang menggunakan sistem pegas untuk menopang dan meredam beban. Salah satu mesin yang sedang dikembangkan membutuhkan tiga pegas dengan karakteristik tertentu agar dapat berfungsi dengan baik. Pada awal pengembangan, Roni menyusun tiga pegas dengan konstanta yang berbeda-beda, lalu menggantungkan beban pada pegas-pegas tersebut. Hal ini dilakukan untuk mempelajari perilaku sistem pegas dan memastikan bahwa perubahan panjang pada ketiga pegas adalah sama. Namun, setelah itu Roni mengganti salah satu pegas dengan konstanta yang lebih tinggi, yaitu dari 100 N/m menjadi 300 N/m. Perubahan ini akan memengaruhi perilaku sistem pegas secara keseluruhan. Pertanyaannya adalah, apa langkah yang perlu dilakukan Roni agar perubahan panjang pada ketiga pegas tetap sama setelah penggantian pegas?

Figure 4. Question number two

In Figure 4, this question tests several aspects of scientific literacy, especially in the phenomena of elasticity and spring systems. Indicators that correspond to this question include several important aspects. Scientific naming can be seen from the use of appropriate physics terms, such as spring constant, spring system, and change in length, which students must understand. Process skill abilities are needed to analyze how changes in spring constants affect the system and determine the right solution so that the length of the spring remains the same. The rules of scientific evidence are also involved, because students must use an understanding of Hooke's law and spring systems, both in series and parallel arrangements, as the basis for analysis. In addition, scientific postulates are important indicators because the correct answer must be based on the principle of elasticity and the concept of force balance in a spring system. Scientific disposition is also tested, because this question requires critical thinking in choosing the right steps to keep the length of the spring the same after one of the spring constants is changed. Finally, major misconceptions can arise when students misunderstand the relationship between spring constant, force, and deformation in a spring system. Thus, this question covers almost all indicators of scientific literacy, with a primary focus on process skills, scientific evidence rules, and scientific postulates.

In Figure 5, the scientific naming indicator, the answers already use appropriate terms such as elastic force, spring constant, and changes in spring length. However, in the ability of process skills, students have not shown the correct analysis in determining how changes in spring constants affect the system as a whole. The answers given are still less precise in explaining how adjustments to the load or spring configuration should be made. In addition, in the rules of scientific evidence, the answers do not show mathematical calculations that support the results presented.

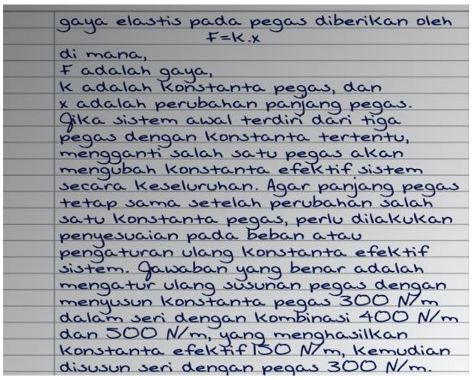
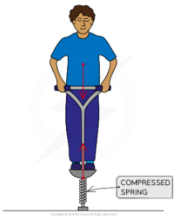

gaya elastis pada pegas diberikan oleh
F=k.x
di mana,
F adalah gaya,
k adalah konstanta pegas, dan
x adalah perubahan panjang pegas.
Jika sistem awal terdiri dari tiga
pegas dengan konstanta tertentu,
mengganti salah satu pegas akan
mengubah konstanta efektif sistem
secara keseluruhan. Agar panjang pegas
tetap sama setelah perubahan salah
satu konstanta pegas, perlu dilakukan
penyesuaian pada beban atau
pengaturan ulang konstanta efektif
sistem. Jawaban yang benar adalah
mengatur ulang susunan pegas dengan
menyusun konstanta pegas 300 N/m
dalam seri dengan kombinasi 400 N/m
dan 500 N/m, yang menghasilkan
konstanta efektif 150 N/m, kemudian
disusun seri dengan pegas 300 N/m.

Figure 5. Answers Students' answers to question number two

Although mentioning the combination of spring constants, students do not systematically explain how the effective constant value is calculated and how it affects the length of the spring. In the scientific postulate, students understand that changes in one of the constants will change the system, but do not provide the correct solution according to the principle of elasticity and Hooke's law. As for the scientific disposition, students show critical thinking efforts, but there are still errors in the application of concepts. Finally, in the main misconception, students seem to be wrong in determining how the combination of springs affects the effective constant of the system, so that the solution given is not right to maintain the same spring length. Therefore, this answer still needs to be improved to be more in line with the correct concept of elasticity.

Pegas pada Permainan Pogo

Dalam sebuah taman bermain, sekelompok anak menggunakan permainan pogo stick. Pogo stick bekerja dengan menggunakan pegas yang memungkinkan pengguna melompat-lompat. Seorang anak merasa senang karena ia dapat melompat lebih tinggi dibandingkan temannya. Ia memperhatikan bahwa ketinggian lompatan bergantung pada tekanan yang diberikan pada pegas dan berat badan pengguna. Namun, setelah beberapa kali lompatan, ia merasa pegas mulai terasa kurang elastis dan tidak menghasilkan lompatan setinggi sebelumnya. Pegas pada pogo stick dirancang untuk menyerap energi saat ditekan dan melepaskannya kembali dalam bentuk gerakan ke atas. Akan tetapi, pegas juga bisa kehilangan elastisitas jika digunakan secara berlebihan atau tidak dirawat dengan baik.



Mengapa tekanan yang diberikan pada pegas memengaruhi ketinggian lompatan?

Figure 6. Question number three

The question about the pogo stick game includes several indicators of scientific literacy that are relevant to the concept of elasticity and energy in the spring system. From the aspect of scientific naming, the question already uses the correct physics terms, such as spring, elasticity, pressure, and energy, which must be understood by students. In terms of process skills, students are expected to be able to analyze how pressure on the spring affects the height of the jump, and relate it to the concepts of elastic potential energy and kinetic energy. In addition, in the rules of scientific evidence, students must understand how the relationship between the force applied to the spring and the energy stored in the spring affects the height of the jump. They also need to be aware that springs can lose elasticity if used excessively, which is an important factor in real physics systems. In scientific postulates, students need to understand the basic principles of elasticity and how the elastic potential energy stored in the spring is converted into kinetic energy when jumping. From the aspect of scientific disposition, this question encourages students to think critically about the relationship between force, energy, and elasticity in everyday life. As for the main misconception, students may have a misunderstanding, for example by assuming that greater pressure on the spring always results in a higher jump without considering the elastic limit of the spring. Therefore, this question covers various aspects of scientific literacy, with a main focus on process skills, scientific evidence principles, and scientific postulates.

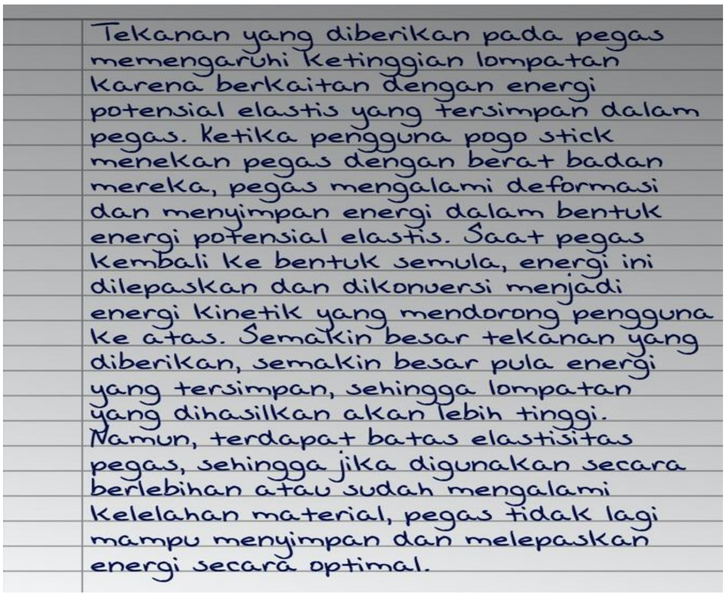

Tekanan yang diberikan pada pegas memengaruhi ketinggian lompatan karena berkaitan dengan energi potensial elastis yang tersimpan dalam pegas. Ketika pengguna pogo stick menekan pegas dengan berat badan mereka, pegas mengalami deformasi dan menyimpan energi dalam bentuk energi potensial elastis. Saat pegas kembali ke bentuk semula, energi ini dilepaskan dan dikonversi menjadi energi kinetik yang mendorong pengguna ke atas. Semakin besar tekanan yang diberikan, semakin besar pula energi yang tersimpan, sehingga lompatan yang dihasilkan akan lebih tinggi. Namun, terdapat batas elastisitas pegas, sehingga jika digunakan secara berlebihan atau sudah mengalami kelelahan material, pegas tidak lagi mampu menyimpan dan melepaskan energi secara optimal.

Figure 7. Answers Students' answers to question number three

In Figure 7, the student's answer still does not fully meet the literacy and numeracy indicators in the phenomenon of elasticity. In terms of scientific naming, the answer already uses terms such as elastic potential energy, kinetic energy, and elasticity, but does not explicitly explain the basic principles that support the concept. In terms of process skills, students have understood that the pressure on the spring affects the height of the jump, but the explanation is still descriptive without any in-depth analysis of other factors that play a role, such as the weight of the user or the properties of the spring material. From the aspect of scientific evidence rules, although it is explained that the greater the pressure, the greater the energy stored, there is no discussion of how this relationship can be measured or compared with real data. In the scientific postulate, students understand the basic principles of elasticity but have not explained the limits of elasticity in more detail, for example how material fatigue can reduce the effectiveness of springs in storing and releasing energy. In terms of scientific disposition, this answer does not show a critical attitude in considering other variables that can affect the results, such as differences in pogo stick design or spring conditions after repeated use. In addition, there is a major misconception, namely the assumption that greater pressure will always produce a higher jump without considering that springs have a certain elasticity limit. If this limit is exceeded, the spring will lose its ability to return to its original shape perfectly, so that the resulting jump can be lower.

This study has a number of advantages that make a significant contribution to the development of physics literacy studies, especially in the context of using the Nature of Science Literacy Test (NOSLiT) instrument. One of the main advantages lies in the comprehensive approach in examining six indicators of science literacy, namely scientific naming, process skills, scientific evidence rules, scientific postulates, scientific dispositions, and major misconceptions about science. Previous research generally only focuses on analyzing one or two indicators of science literacy without linking them comprehensively in an integrated framework. This study also presents detailed descriptive quantitative data based on class and indicators, which allows for more specific identification of student weaknesses. For example, in the process skills indicator, student achievement is very low, with an average of only 24%, indicating the need to strengthen scientific process-based learning.

In addition, this research approach places the phenomenon of elasticity as a learning context, which is an important topic but is still relatively rarely used as a background in measuring NOSLiT-based scientific literacy. Thus, this study not only evaluates theoretical mastery of concepts, but also examines how students think scientifically and understand physical phenomena in everyday life. This provides a more holistic understanding of students' scientific literacy abilities. The findings on the scientific evidence rule indicator, which obtained an average achievement of 59% or a moderate category, indicate potential that can be developed through an empirical evidence-based approach.

The results of the scientific literacy achievements of grade XI high school students show that their abilities in the three main indicators, namely interpreting data, drawing conclusions, and understanding the concept of elasticity, are still very low. In the data interpretation indicator, students only achieved a percentage of correct answers of 38% and 33%, which indicates their difficulty in reading and analyzing data in the form of graphs or tables. This difficulty is likely caused by a lack of practice in interpreting relationships between variables and a lack of problem-solving-based learning that allows students to develop their analytical skills. In the context of the Nature of Science Literacy Test (NOSLiT), data interpretation skills are essential because science is based on the analysis of empirical evidence. Therefore, a more contextual learning approach, such as the use of real experimental data and graphs based on everyday life phenomena, can help improve these skills (Ictte & Uns, 2015).

In the indicator of drawing conclusions, the percentage of student achievement is also still relatively low, namely 42% and 38%. This shows that they still have difficulty in drawing conclusions based on data or experimental results. Possible causes are a lack of understanding of basic statistical concepts, such as data relationship patterns and trends, and minimal experience in conducting direct experiments. According to NOSLiT, the ability to draw conclusions in science must be based on empirical evidence, not just memorizing theories without in-depth understanding. Therefore, an experimental or case study-based learning approach is needed to train students to get used to connecting experimental results with the concepts they have learned (Rahayu et al., 2018).

Meanwhile, in understanding the concept of elasticity, many students still experience misconceptions about the relationship between force, spring constant, and deformation. This error can occur because the teaching method focuses too much on mathematical calculations without explaining the physical concept in depth. In the NOSLiT approach, understanding science concepts should be linked to real phenomena, such as how the principle of elasticity works on a trampoline or vehicle suspension. To improve this understanding, teachers can use demonstration-based learning methods or interactive simulations so that students can more easily understand the concept by seeing its application in everyday life.

The achievement of scientific literacy of grade XI SMAN students is still very low in the three indicators. Some of the main factors that cause this low achievement include lack of practice in reading and analyzing graphs, minimal experimental approaches in learning, and teaching methods that still focus on lectures and mathematical formulas without explaining concepts in an applicative manner (Rebecca, 2023). To overcome this problem, a more interactive learning approach is needed, such as inquiry-based experiments, the use of technology in learning, and case study-based discussions. In this way, students can understand science not only as a collection of theories and formulas, but also as an evidence-based investigation process, in accordance with the concept of scientific literacy in NOSLiT. It is recommended to incorporate evidence-based pedagogical strategies to enhance students' understanding of physics concepts such as the spring constant. Recent studies (Wieman et al., 2025) demonstrate that interactive simulations like PhET can improve conceptual comprehension by up to 30% compared to traditional teaching methods, allowing students to visualize and experiment with phenomena virtually. Additionally, problem-based learning (PBL) using simple tools like rubber bands or springs has been shown (Hmelo-Silver, 2025) to foster critical thinking and problem-solving by engaging students with real-world challenges, connecting theory to practice. Moreover, strengthening scientific argumentation through discussions and reflections on real phenomena enhances critical thinking and communication skills vital for science learning (Osborne et al., 2025). Integrating these approaches makes teaching the spring constant more effective, interactive, and supportive of deeper conceptual understanding.

CONCLUSION

The results of the analysis using the NoSLiT instrument show that the level of scientific literacy of students in SMAN is still low, with an average achievement of 43.2%. The highest indicator is in the rules of scientific evidence (58.8%), while process skills are the lowest (24.3%). Although students understand scientific terms and basic concepts of physics, they have difficulty in applying process skills and numerical analysis. The answers given tend to be descriptive without strong evidence support, and misconceptions about the relationship between physics variables are still found.

RECOMMENDATION

The findings indicate the need for learning that emphasizes scientific practices such as experiments, use of evidence, and contextual problem solving. This study was limited to one school and one instrument, so the results cannot be generalized. Therefore, it is recommended that further research involve more schools and use a combined quantitative and qualitative approach to obtain a more comprehensive understanding. In addition, the development of an inquiry-based learning model is also important to support the improvement of scientific literacy.

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