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Assessing the comprehension and numerical skills in physics: Challenges encountered by non-stem students in solving worded – problems

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Abstract: This descriptive study investigated the comprehension levels, numerical skills, learning behaviors, and difficulties of non-STEM senior high school students in solving physics word problems. The respondents were 100 non-STEM students from Dimaukom National High School who completed tests and survey questionnaires. Reading comprehension was assessed using the Philippine Informal Reading Inventory (PIRI) of the Department of Education, while numerical skills were measured through an adapted DepEd Numeracy Assessment Tool. Students' difficulties in physics problem-solving were identified using a test focusing on unit conversion, formula selection, and mathematical operations. Learning behaviors, attitudes, and interests toward physics were examined using Wrenn's Study Habit Inventory, Entwistle's Student Attitude Inventory, and the Guilford-Zimmerman Interest Inventory. Results showed that students were at the instructional level in reading comprehension and moderately numerate, suggesting the need for academic intervention. Survey findings indicated that students generally found physics unengaging, as reflected in their poor study habits, attitudes, and interest. Among the identified challenges, mathematical operations were the most difficult, followed by selecting appropriate formulas and converting units. Overall, non-STEM students were more comfortable with simple calculations than with complex, multi-step worded physics problems.
Keywords: *Attitude, Comprehension Level, Interest, Numerical Skill, Study Habit.*

1. Introduction

In physics, most concepts have mathematical applications. These topics need to be solved mathematically if accurate answers are to be obtained. However, once mathematical concepts are integrated into the field of science, students often encounter difficulties in learning. Many students face challenges in problem-solving situations that require numeracy skills.

Aside from the problems in numeracy among students studying physics concepts, the medium of instruction also poses a challenge. Word problems, such as calculating the speed of a car or determining the velocity of a free-falling object, often cause students difficulty in identifying which values are given and which are needed to find. These challenges contribute to students' poor performance in science subjects.

Research on physics education in the Philippines reveals several factors influencing student performance. Mathematics and English skills significantly affect physics test scores [1]. Higher-order thinking skills, particularly analysis, comparison, evaluation, and inference, also correlate with academic performance in physics, with some gender differences observed. To address learning challenges, innovative approaches have been explored.

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The use of electronic Strategic Intervention Material (e-SIM) has shown promise in improving both academic performance and motivation in physics [2].

Physics word problems present significant challenges for students, particularly those learning in a second language. Language complexity, including passive voice and homonyms, can hinder problem visualization and understanding for ESL students [3].

A startling 18 million high school graduates in the Philippines were discovered to be "functionally illiterate" in the most recent survey; lawmakers and education experts say this finding highlights structural issues in the nation's educational system that require immediate attention [4].

The foregoing statements prompted the researcher to conduct a study aimed at assessing the comprehension levels, numerical skills, and challenges faced by non-STEM students in solving word problems in physics.

2. Literature Review

2.1. Study Habits

Recent studies have found that study habits are significantly correlated with academic performance, with academic pressure negatively influencing and concentration positively impacting academic outcomes [5]. Furthermore, a significant relationship between study habits and students' academic performance in biology has been observed, emphasizing the importance of developing effective study habits for academic success [6]. These findings highlight the crucial role of effective study habits in enhancing students' academic performance across different subjects and educational contexts.

Study habits significantly impact academic performance among secondary and higher secondary students. Research shows a strong relationship between study habits and scholastic achievement [6]. Effective study habits include high motivation, avoiding distractions, proper time management, and the ability to concentrate and remember facts [7]. Students in private schools tend to perform better academically compared to those in government and government-aided schools [7]. To enhance academic performance, teachers and school counselors should guide students in developing effective study habits [6].

2.2. Students' Interest

Research consistently shows that students' interest in learning positively influences their academic performance. Chen [8] emphasizes the significance of learning interest in stimulating motivation and promoting student development. Wahyudi and Annurwanda [9] quantified this impact, reporting that learning interest accounts for 90.8% of students' performance in trigonometry. They also identified happiness as the most influential indicator of learning interest (48.4%). These findings underscore the critical role of fostering student interest to enhance academic achievement and suggest that educators should consider student interests and develop positive relationships to promote learning success.

Additionally, a study by Mappadang et al. [10] showed that academic curiosity has a significant impact on academic success. However, neither the student's attitude nor the quality of their learning affected their academic performance. Academic performance was positively correlated with students' levels of academic curiosity. Meanwhile, when students exhibit different attitudes and qualities of learning, their academic performance suffers.

Interest and enjoyment are crucial factors in determining students' approach to learning, with implications for educators aiming to promote deep learning approaches [11]. According to research, pupils' enthusiasm for science declines as they become older. These findings confirm the long-held understanding that students' situational interest and willingness to engage (behaviorally) in physics-related activities both within and outside the classroom are significantly influenced by the importance they assign to the topic. This study builds on earlier methods by demonstrating that enhancing students' preexisting individual leisure interests can positively affect their situational interest in physics.

2.3. Students' Attitudes

According to the findings of the Mamuda and Peni [12] study, students' perceptions of physics-focused professional disciplines are largely favorable. However, a lack of understanding, a lack of confidence, an inability to utilize the proper formulas to answer physics questions, and a failure to see the significance of physics in society are the main causes of students' poor performance in the subject. As a result, high-achieving students show an interest in physics lessons and adopt a constructive approach to tackling physics problems.

Research consistently shows that students' attitudes significantly influence their academic performance. A study in Uganda found strong positive correlations between student engagement, motivation, behavior, and academic achievement in secondary schools [13]. Similarly, research in Tanzania revealed a positive correlation between students' attitudes and mathematics performance, with enjoyment and attitude predicting academic outcomes [14].

2.4. Literacy and Comprehension

Research consistently demonstrates a strong link between reading comprehension and academic performance, particularly in science and mathematics. Students' beliefs about knowledge influence their comprehension abilities, while effective reading strategies are crucial for constructing meaningful representations of texts [15]. Studies show a correlation between reading comprehension results and success in math and science classes, with reading comprehension contributing both positively and negatively to performance in these subjects [16].

Furthermore, students who struggle with text comprehension often experience difficulties in their overall academic performance [17]. To enhance reading comprehension and, consequently, academic performance, educators should concentrate on teaching effective reading strategies and fostering positive beliefs about acquiring knowledge. These findings emphasize the importance of developing robust reading comprehension skills as a foundation for success across various academic disciplines.

According to research, physics students often have difficulty understanding scientific writings when reading them, especially in the field of physics [18, 19]. According to studies, students typically have poor reading comprehension skills for both scientific and physics literature. This emphasizes the necessity of integrating reading comprehension techniques into physics curricula and teacher preparation programs [18].

According to Handayani et al. [19], university students should be taught appropriate comprehension techniques for physics books. Furthermore, studies indicate a link between students' comprehension of ideas and their level of interest in physics, with a lack of interest perhaps resulting in mistakes [20]. In order to address these issues, it is recommended that physics instruction integrate reading comprehension strategies [18, 19] and that students' conceptual knowledge and interest in physics be evaluated using diagnostic tests such as the Four-Tier Diagnostic Test [20].

2.5. Mathematics and Science

There are several instances in which science and mathematics come together, particularly as new applications of mathematics are discovered. Certain parts of mathematics become indistinguishable from specific scientific and engineering disciplines as they develop. By helping students find connections between hypotheses and the information acquired, mathematics helps demonstrate what scientists have found. Data from experiments are used by scientists to confirm or deny their theories. It would be very challenging to demonstrate scientific theories without using mathematics in science [21].

Science for All Americans Project [22] states that the main language of science is mathematics. It has been demonstrated that the symbolic language of mathematics is especially helpful for clearly communicating scientific concepts. More than just stating that the force acting on an object and its mass affect its acceleration, the equation $a=F/m$ provides a clear explanation of the quantitative relationship between those variables. More significantly, mathematics provides the language of science, the set of guidelines for methodically analyzing scientific theories and data.

The study of mathematics necessitates the use of rigorous argumentation, abstract reasoning, and pattern recognition. It involves much more than just data analysis. It is similar to science in that it involves problem solving, experimentation, and the statement of physical principles and hypotheses. It could be time to explore the hidden aspects of math if you are interested in science but find it unappealing. Researching understudied mathematical ideas or learning how much fun it is to solve math puzzles for fun are good places to start [23].

3. Methodology

3.1. Research Design

This study employed a descriptive research design to examine the difficulties encountered by students in solving word problems in Physics. Specifically, it focused on identifying and describing challenges related to comprehension levels, numerical skills, study habits, attitudes, interests, and students' capabilities to solve word problems.

Descriptive research was deemed appropriate for this study because it enables the researcher to systematically observe, describe, and document aspects of a situation as they naturally occur, without manipulating any variables [24]. This design is particularly useful when the objective is to gain a detailed understanding of a population's current status regarding certain characteristics or conditions, in this case, the academic challenges faced by non-STEM students in Physics.

3.2. Data Collection and Analysis

Since this study involved several areas to be explored, the researcher used different research instruments, including the Philippine Informal Reading Inventory, Numeracy Assessment Tool, Wrenn's Study Habit Inventory, Entwistle Student Attitudes Inventory, Guilford–Zimmerman Interest Inventory, and a separate test questionnaire in evaluating the students' challenges in solving word problems in physics.

3.2.1. The Philippine Informal Reading Inventory

The test questionnaire for comprehension level was based on the Department of Education (DepEd) program's The Philippine Informal Reading Inventory (Phil-IRI). It was created to provide classroom teachers with a tool for measuring and describing reading performance. It is an assessment tool composed of graded passages designed to determine a student's reading and comprehension level [25].

3.2.2. Numeracy Assessment Tool

The numerical and algebraic skill levels of the students were tested using an examination based on the DepEd Numeracy Assessment Tool (NumAT). It is a standardized test designed to assess students' numeracy skills and their proficiency in the four fundamental mathematical operations [26].

3.2.3. Wrenn's Study Habit Inventory

The study habits were determined using Wrenn's Study Habit Inventory, adopted from Albert [27]. This is a list of statements regarding students' habits related to their use of study time. By understanding students' current study habits and identifying areas for improvement, a study inventory helps evaluate students' study behaviors and practices, thereby pinpointing areas where they can enhance their overall academic performance.

3.2.4. Entwistle Student Attitudes Inventory

The Entwistle Student Attitudes Inventory, adopted from Enwistle and Tait [28], was used to determine the attitudes of the students towards studying physics. It is composed of 10 statements pertaining to students' behavior towards understanding physics concepts. This student's attitude inventory can provide insight into how students approach their academic work and pinpoint possible areas for study habit improvement.

3.2.5. Guilford, Zimmerman Interest Inventory

The students' interest in understanding physics concepts was determined using the Guilford-Zimmerman Interest Inventory adopted from Guilford and Zimmerman [29], which provides a comprehensive picture of the students' interest patterns in physics. The statements in this inventory describe the students' eagerness and enthusiasm for understanding physics concepts.

3.2.6. Physics Test Questionnaire

This physics test was prepared by the researcher for the purpose of assessing students' abilities in solving word problems in physics. It consists of problems presented in sentences, where students analyze the given values, identify the relevant physics concepts, and determine the appropriate formulas and operations to use.

The exam was divided into three parts: conversion of units, appropriate formulas, and mathematical operations.

4. Results and Findings

4.1. Comprehension Level

The results of the comprehension level test for non-STEM Senior High School students are presented in Table 1.

Table 1.
Comprehension Level of Non-STEM Students.

No. of Students	Percentage	Mean Score	Percentage	Interpretation
22	22%	18.58	92.90%	Independent
47	47%	12.63	63.15%	Instructional
31	31%	7.68	38.40%	Frustration
N = 100				

Note: Legend:

Scores	**Percentage**	**Description**
16 – 20	80% - 100%	Independent
10 – 15	50% - 79%	Instructional
1 – 9	0 – 49%	Frustration

The comprehension levels of non-STEM students, as shown in Table 1, indicate that 22% of the students are at an independent level. This means they can understand and apply concepts with minimal assistance. They are likely capable of tackling new material confidently and demonstrating a solid grasp of the subject matter.

In addition, 47% are instructional, indicating that these students can understand some concepts but still require guidance and support. They may struggle with more complex ideas and benefit from additional instruction, practice, or clarification to fully grasp the material. On the other hand, 31% experience frustration. This suggests that they are having significant difficulty understanding the material, which may lead to feelings of discouragement. They likely need substantial help and intervention to improve their comprehension skills.

This distribution highlights varying degrees of comprehension among students, with a significant portion requiring instructional support.

4.2. Numerical Skills

The results of the numerical skill test for non-STEM senior high school students are presented in Table 2.

Table 2.
Numerical Skills of Non-STEM Students.

No. of Students	Percentage	Mean Score	Percentage	Interpretation
59	59%	17.79	88.95%	Highly Numerate
35	35%	13.02	65.10%	Moderately Numerate
6	6%	8.33	41.65%	Non - numerate
N = 100				

Note: Legend:

Scores	**Percentage**	**Description**
16 – 20	80% - 100%	Highly Numerate
10 – 15	50% - 79%	Moderately Numerate
1 – 9	0 – 49%	Non – numerate

The data in Table 2 demonstrates a strong proficiency in numerical skills among non-STEM students, with 59% being highly numerate. This is a positive indicator, suggesting that a significant majority of students possess a solid understanding of numerical concepts.

The majority of students, 59%, are classified as highly numerate. These students possess strong numerical skills and can effectively understand, interpret, and apply mathematical concepts. They are likely comfortable with complex calculations and problem-solving tasks, which suggests they can handle quantitative data and mathematical reasoning with confidence.

Approximately 35% of individuals are moderately numerate. They possess a basic understanding of numerical concepts but may encounter difficulties with more advanced applications. While they can perform some calculations and comprehend fundamental mathematical ideas, they might require additional support or practice to improve their skills and confidence in numerical tasks.

A small group of students, representing 9%, were classified as non-numerate, indicating significant difficulties with numerical concepts. These students may lack the foundational skills necessary to perform basic calculations or understand numerical information, which can hinder their academic performance and confidence in subjects that require quantitative reasoning.

Overall, the data on the numerical skills of non-STEM students indicates a strong proficiency in numerical understanding among the majority. However, it also highlights the need for targeted support for those who are moderately or non-numeric.

4.3. Correlation of Comprehension Level and Numerical Skills of Non-STEM Students

The table below indicates the correlation between the comprehension level test and the numerical skill test of non-STEM students. It consists of the mean, standard deviation, and the computed values of Pearson's r correlation.

Table 3.
The correlation of Comprehension level and numerical skills of non–STEM students.

	N	Mean	Std. Deviation	Correlation coefficient (r)	Level of Correlation	p-value	Interpretation
Comprehension Skills	100	13.39	4.20	0.321	**Weak Positive**	**0.001**	**Significant**
Numerical Skills	100	15.56	3.19				

Note: $p<0.01$, significant at $\alpha = 0.01$ level

Legend:

Range of Correlation	Level of Correlation
Coefficient Values	Very Strong Positive
0.80 – 1.00	Strong Positive
0.60 – 0.79	Moderate Positive
0.40 – 0.59	Weak Positive
0.20 – 0.39	Very Weak Positive
0.00 – 0.19	Very Strong Positive

The results show that the value of r = 0.321, indicating a positive correlation between the two variables. This suggests that comprehension skills are strongly correlated with numerical skills. In other words, if students' comprehension levels increase, their numerical skills tend to improve as well.

A p-value of 0.001 is significantly smaller than 0.01, indicating that the observed correlation is statistically significant at the 0.01 level. This suggests that the relationship between the two variables is unlikely to have occurred by chance. The statistical significance of a correlation, which reflects the likelihood that the observed relationship is not merely due to random variation, is determined through statistical tests and p-values.

Moreover, literacy skills, including vocabulary and comprehension, are closely related to mathematical achievement [30]. Children with strong language skills often find it easier to understand and solve mathematical problems, as word problems frequently require reading and interpretation.

Regression analysis conducted by Nahdi et al. [31] indicates a robust relationship between mathematics interest and reading comprehension, simultaneously affecting mathematical problem-solving abilities.

4.4. Study Habits

The results of non-STEM senior high school students' study habits towards physics, as measured by Wrenn's Study Habit Inventory, are presented in Table 4.

Table 4.
Non–STEM senior high school students' Study Habits toward physics.

Statements	Mean	Description
1. I would prefer to spend my free time engaging in physics work.	2.25	Disagree
2. I enjoy reading Physics books.	2.27	Disagree
3. I would prefer to conduct physics experiments rather than just read about them.	2.74	Agree
4. It is interesting to attend lectures, symposiums, or seminars about Physics.	2.67	Agree
5. Physics has not been a challenging subject for me.	1.78	Disagree
6. I take another look at my physics class notes days after they are taken.	1.80	Disagree
7. I don't get tired or distracted while studying physics for a long period of time.	1.96	Disagree
8. I spend time studying what I am learning in physics.	2.30	Disagree
9. I don't get lost in the details of learning physics and have trouble identifying the main ideas.	2.39	Disagree
10. I can organize my thoughts into a paper that makes sense.	2.43	Disagree
Grand Mean	2.25	Disagree

Note: Legend:

Rating	Description
1.00 – 1.74	Strongly Disagree
1.75 – 2.49	Disagree
2.50 – 3.24	Agree
3.25 – 4.00	Strongly Agree

The grand mean of 2.25 indicates a general disagreement with positive statements about Physics, suggesting that students do not find Physics particularly engaging or enjoyable.

Statements 1 and 2 indicate that students prefer engaging in Physics experiments rather than just reading about them. This suggests that hands-on experiences are more appealing to students than theoretical study, as evidenced by statement 3, which has a mean score of 2.74.

Statement 4, with a mean of 2.67, indicates that students find attending lectures, symposiums, or seminars about physics interesting, which may suggest that they appreciate learning from experts or engaging with the community.

Statement 5 shows a mean of 1.78, indicating that students do not find Physics challenging, which could imply a lack of engagement or motivation to tackle difficult concepts.

Several statements (6, 7, 8, 9, and 10) reflect poor study habits and a lack of effective learning strategies among students. The means for these statements are all below 2.5, indicating disagreement with positive study behaviors, such as reviewing notes, maintaining focus, and organizing thoughts.

The overall low scores across multiple statements suggest that students may not be fully engaged with the subject matter, which could impact their learning outcomes and their interest in pursuing further studies in physics.

Research indicates that students often have negative attitudes towards physics, which can negatively impact their academic performance. Studies in Ghana, the Philippines, Ethiopia, and Nigeria have found that many students perceive physics as difficult and unattractive [32-34]. This negative perception is particularly pronounced in secondary schools and can lead to low academic achievement [33, 34].

4.5. Attitudes

The results of non-STEM senior high school students' attitudes towards physics, as measured by the Entwistle Student Attitudes Inventory, are shown in Table 5.

Table 5.
Non–STEM senior high school students' Attitude toward physics.

Statements	Mean	Description
1. I appreciate what physics has done for man to live more comfortably.	2.55	Agree
2. Physics can help make the world a better place in the future.	2.65	Agree
3. I can always associate the things around me with Physics.	2.41	Disagree
4. Physics can provide solutions to our technological problems.	2.55	Agree
5. Laboratory work in Physics fascinates me.	2.58	Agree
6. I can see the relevance in most of the physics work we do.	2.35	Disagree
7. My Physics lecture notes are often easy to decipher afterwards.	2.30	Disagree
8. I don't give up easily if something is too difficult for me in learning physics.	2.66	Disagree
9. I don't need to be in the right mood before I can study physics effectively.	2.27	Disagree
10. I find it easy to keep awake and alive during physics lectures.	2.34	Disagree
Grand Mean	2.44	Disagree

Note: Legend:

Rating	Description
1.00 – 1.74	Strongly Disagree
1.75 – 2.49	Disagree
2.50 – 3.24	Agree
3.25 – 4.00	Strongly Agree

The overall grand mean rating of 2.44 indicates a general disagreement with the statements about Physics, suggesting that students may not have a strong positive perception of the subject.

Statements 1, 2, 4, and 5 received ratings that indicate agreement, with means ranging from 2.55 to 2.65. This suggests that students appreciate the contributions of Physics to comfort, believe in its potential for future improvements, recognize its problem-solving capabilities, and find laboratory work fascinating.

Statements 3, 6, 7, 8, 9, and 10 received lower mean ratings, indicating disagreement. This suggests that students struggle to connect physics with their everyday experiences, find their lecture notes difficult to understand, and face challenges staying engaged during lectures.

In summary, while students recognize the importance of physics in society and express interest in practical applications, they struggle with personal relevance, understanding, and engagement in the subject.

Performance in physics often remains low, possibly due to factors such as poor prior science grades [35] or the nature of a specific topic. Research indicates that students often have negative attitudes towards physics, perceiving it as difficult and unappealing [32, 33]. This negative perception is associated with low academic achievement in the subject [33].

4.6. Interest

The results of non-STEM senior high students' interest in physics, as measured by the Guilford-Zimmerman Interest Inventory, are shown in Table 6.

Table 6.
Non–STEM senior high school students' Interest in physics.

Statements	Mean	Description
1. I find Physics more thrilling and fascinating than other subjects.	2.45	Disagree
2. I wish the time we spend in Physics class would be extended.	2.24	Disagree
3. I would like to join the Physics club.	2.53	Agree
4. Physics is one of the interesting school subjects.	2.43	Disagree
5. I am always very eager to attend my Physics class.	2.32	Disagree
6. The thought of learning physics excites me.	2.41	Disagree
7. I take the lead in doing physics activities.	2.30	Disagree
8. I can listen to a physics lecture without feeling restless.	2.31	Disagree
9. I can generally be free from worry about physics challenges	2.40	Disagree
10. I often try to motivate others to get involved in learning physics.	2.50	Agree
Grand Mean	**2.38**	**Disagree**

Note: Legend:

Rating	Description
1.00 – 1.74	Strongly Disagree
1.75 – 2.49	Disagree
2.50 – 3.24	Agree
3.25 – 4.00	Strongly Agree

The grand mean rating of 2.38 suggests that students have a negative or indifferent attitude towards Physics, characterized by a lack of enthusiasm and engagement. While there are some positive indicators, such as interest in joining a club and motivating peers, these do not significantly alter the overall sentiment.

Statements 1, 2, 4, 5, 6, 7, and 8 all received mean scores below 2.5, indicating that students do not feel enthusiastic about Physics, do not desire additional class time, and do not actively attend or participate in Physics classes.

While students expressed a desire to join the Physics club (mean of 2.53) and sometimes try to motivate others (mean of 2.50), these scores are still relatively low, suggesting that, while there is some interest in participation, it is not strong.

The mean score of 2.40 for feeling free from worry about Physics challenges indicates that students may feel apprehensive or anxious about the subject, which could contribute to their overall disinterest.

In Ethiopia, grade 10 students prefer other science subjects over physics, citing subject difficulty and teaching approaches as the main deterrents [36]. Similarly, in Indonesia, a majority of high school students (58%) exhibit low interest in pursuing physics in college [37]. This trend extends to specialized schools, as evidenced by low interest and motivation in physics among sports excellence students in Indonesia [38].

4.7. Physics Unit/Conversion of Units

The test results in the conversion of units for non-STEM Senior High School students are shown in Table 7.

Table 7.
Understanding Physics: Unit/Conversion of Units

Item		Difficulty Index	Description
1	A student measures 12 inches of yarn. What is the conversion of 12 inches to centimeters?	0.57	Moderately Difficult
2	A school bus traveled a total distance of 750 meters. How far does the school bus travel if 750 meters are converted into kilometers (km)?	0.56	Moderately Difficult
3	Farhad has a mass of 75 kg. What will be his weight if he is on the Moon, which has a gravitational acceleration of 1.62 m/s^2?	0.17	Very Difficult
4	The normal human body temperature is 37°C. If it is converted into Fahrenheit, it will be approximately 98.6°F.	0.38	Difficult
5	Converting 45 minutes to an hour will be	0.77	Easy
6	The base unit for length in the metric system is	0.78	Easy
7	Express 0.000840 in scientific notation	0.59	Moderately Difficult
8	The conversion factor to change kilograms to pounds is	0.36	Difficult
9	Convert 3.25 mi to kilometers.	0.34	Difficult
10	65.0ºC is equivalent to	0.51	Moderately Difficult
Mean		0.50	Moderately Difficult

Note: Legend:

Difficulty Index	Level of Difficulty
0.00 – 0.19	Very Difficult
0.20 – 0.39	Difficult
0.40 – 0.60	Moderately Difficult
0.61 – 0.79	Easy
0.80 – 1.00	Very Easy

Table 7 outlines the difficulty index of various physics-related conversion problems, indicating how challenging students found each item. Overall, it has a difficulty index of 0.50, indicating that the respondents found the test moderately difficult.

Items 5 and 6 have difficulty indices of 0.77 and 0.78, respectively, categorizing them as "easy." These items involve straightforward conversions, such as minutes to hours and determining the base unit for length. The high difficulty indices suggest that students are comfortable with basic unit conversions and can easily apply their knowledge in these areas.

Items 1, 2, 7, and 10 fall into the "Moderately Difficult" category, with difficulty indices ranging from 0.51 to 0.59. These items involve conversions that require some understanding of measurement systems but are not overly complex.

Item 3 has a low difficulty index of 0.17, categorized as "Very Difficult." This indicates that students may struggle with applying gravitational concepts to calculate weight. In summary, while students find basic conversions relatively easy, they struggle with more complex problems, particularly those that require a deeper understanding of physics concepts.

4.8. Physics Formula

The test results for determining the appropriate formula for non-STEM senior high school students are shown in Table 8.

Table 8.
Appropriate Physics Formula

Item		Difficulty Index	Description
1	A car moves a total distance of 400 km to the right in 4 hours. What is the total velocity of the car?	0.49	Moderately Difficult
2	A body starts from rest and is uniformly accelerated for 1 minute, during which time it travels at 120 m/s. Find its acceleration.	0.48	Moderately Difficult
3	A ball is dropped from the top of a 100 m building. After how many seconds will it strike the ground below?	0.12	Very Difficult
4	How much force does a 1,000 kg car need to accelerate at 3 m/s^2 to the south?	0.47	Moderately Difficult
5	What is the velocity of a 2-kilogram object that has a momentum of 1,000 kg.m/s?	0.17	Very Difficult
6	A car travels at uniform velocity a distance of 100 m in 4 seconds	0.64	Easy
7	Cassie walked to her friend's house with an average speed of 1.40 m/s. The distance between the houses is 205 m. How long did the trip take her?	0.48	Moderately Difficult
8	Jerry pushes a 3.2kg box with 1.5N of force. What is the resultant acceleration?	0.14	Very Difficult
9	What is the momentum of a child and wagon if the total mass of the child and wagon is 22 kg and the velocity is 1.5 m/s?	0.38	Difficult
10	Compute the weight of a body on the moon if the mass is 60 kg. g is given as 1.625 m/s^2.	0.38	Difficult
Mean		**0.43**	Moderately Difficult

Note: Legend:

Difficulty Index	Level of Difficulty
0.00 – 0.19	Very Difficult
0.20 – 0.39	Difficult
0.40 – 0.60	Moderately Difficult
0.61 – 0.79	Easy
0.80 – 1.00	Very Easy

Table 8 presents the results of students' performance in selecting the appropriate formulas for each item. As shown in the table, the students achieved an overall average difficulty index of 0.43, which is classified as moderately difficult.

The easiest item was Item 4, which had a difficulty index of 0.64. This item required only the direct substitution of values into the velocity formula. In contrast, Items 3, 5, and 8 emerged as the most difficult, with the lowest difficulty indices of 0.12, 0.17, and 0.14, respectively. These items required transforming formulas and applying prior knowledge about gravitational acceleration and its units.

Items 1, 2, 4, and 7, with difficulty indices ranging from 0.47 to 0.49, were classified as moderately difficult. These questions were based on motion lessons. The presence of multiple formulas in motion, such as those for distance, velocity, and time, may have contributed to students' confusion in selecting the appropriate formula.

Items 9 and 10 were also considered difficult, both having difficulty indices of 0.38. Although these items involved the direct application of units, they required careful analysis, as similar formulas in motion may appear applicable but are not always appropriate.

Another contributing factor to the test results was the students' tendency to choose formulas based on familiar units rather than on conceptual accuracy. This suggests that, while students may recognize units, they may lack a deeper understanding of which formulas are contextually appropriate.

4.9. Mathematical Operations

The test results in the mathematical operation of non-STEM Senior High School students are shown in Table 9.

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Table 9.
Mathematical Operations.

Item		Difficulty Index	Description
1	A car is traveling at 13 m/s². After 30 seconds, it speeds up to 20 m/s². What is the acceleration of the car?	0.55	Moderately Difficult
2	A school bus drove at a velocity of 23.04m/s for 18 seconds. What distance did the bus travel?	0.43	Moderately Difficult
3	If a female student weighs 617 N, what is her mass?	0.15	Very Difficult
4	Which has greater momentum – a 70.0 kg soccer player running at a speed of 4.0 m/s or a 0.50 kg bullet fired at a speed of 500 m/s?	0.53	Moderately Difficult
5	A force of 15 N is applied to a box weighing 5 kg. If the force is applied for 10 seconds, what is its impulse?	0.17	Very Difficult
Mean		0.36	Difficult

Note: Legend:

Difficulty Index	Level of Difficulty
0.00 – 0.19	Very Difficult
0.20 – 0.39	Difficult
0.40 – 0.60	Moderately Difficult
0.61 – 0.79	Easy
0.80 – 1.00	Very Easy

The results in Table 9 show a difficulty index of 0.36 for students' ability to perform mathematical operations in solving word problems in physics. This indicates that students experience notable difficulty in executing such mathematical operations.

Items 3 and 5 had difficulty indices of 0.15 and 0.17, respectively, and were categorized as very difficult. The problem in Item 3 required students to apply the relationship between weight and mass, which involves understanding gravitational acceleration. The need to convert weight to mass may have confused some students. Meanwhile, Item 5 presented three units; however, only two, force and time, were relevant for calculating impulse. The inclusion of the unit for mass may have contributed to confusion, affecting the item's difficulty index. Items 1, 2, and 4, which had higher difficulty indices, were all classified as moderately difficult. These items required the direct application of formulas for acceleration, momentum, and impulse. However, students' performance suggests that difficulties arose from the order of operations and the selection of appropriate mathematical procedures.

Overall, the data suggest that students are generally capable of applying basic physics formulas when solving problems that require direct computation. However, items classified as very difficult reveal specific areas of weakness, particularly in applying conceptual understanding to problems involving distance, weight, and mass. These findings highlight the need for more focused instruction and practice on multi-step problem solving and conceptual clarity in physics.

5. Discussion

The results indicated that a significant number of students faced challenges with reading comprehension. Specifically, 47% of the students were classified at the instructional level, 31% at the frustration level, and only 22% were considered independent readers.

In contrast, students performed better in the numerical skills test. About 59% of the students were categorized as highly numerate, achieving an average of 89.95% correct answers. Meanwhile, 35% were moderately numerate, and only 6% were identified as non-numerate, with an average of 41.65% correct responses. A Pearson r correlation analysis revealed a weak positive but statistically significant relationship between comprehension and numerical skills, with a correlation coefficient of $r = 0.321$ and a p-value of 0.001, indicating significance at the 0.01 level.

The study also found that students generally disagreed with positive behaviors toward learning physics. This was evident in the mean scores for the survey on study habits (2.25), attitudes (2.44), and interest (2.38), suggesting an overall lack of engagement.

Regarding specific problem-solving challenges, students found mathematical operations the most difficult, with a difficulty index of 0.36, categorized as "difficult." Converting units and choosing appropriate formulas were also challenging, falling into the "moderately difficult" category with difficulty indices of 0.50 and 0.43, respectively.

6. Conclusion

Based on the findings of the study, it is concluded that the comprehension level correlates with the students' numerical skills. Although students perform better in the numerical skills test, it is still expected that they will have similar results in the comprehension level test.

Students do not find physics engaging, as evident in the results of the study habits, attitude, and interest survey. These results suggest that students may not have a strong positive perception of the subject. Among the difficulties in solving word problems in physics, mathematical operations were the most challenging, followed by choosing the appropriate formula and the moderately difficult conversion of units. These results were supported by the outcomes of the comprehension and numerical skill tests, as students were moderately numerate and instructional in comprehension.

Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

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