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[Research Article]

INTEGRATING SCIENCE PROCESS SKILLS IN COOPERATIVE SETTINGS USING MODULES TO IMPROVE COGNITIVE LEARNING OUTCOMES ON THE SOLID ELASTICITY TOPIC

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ABSTRACT

This study aims to combine science process skills and students' cognitive abilities and improve students' cognitive learning outcomes by implementing the physics learning module in a cooperative setting. This research was conducted at SMA Negeri 3 Ambon, and this type is quantitative descriptive research. The design used in this study is the One-Group Pretest-Posttest Design. The sample in this study was class X MIA_3, totaling 33 people, and it was taken using a purposive sampling technique. The instruments used in this study were test instruments, Student Activity Sheets, and non-test instrument rubrics. The research data shows that students' average initial cognitive ability is very low, achieving 28.78. In contrast, the final cognitive ability of students increases with achievement of 83.39. Student's cognitive ability through student worksheets has an average achievement of 85.51, while the average percentage of concept mastery with student worksheets is above 80%. Science process skills (SPS) with the highest average achievement are in conducting observations, namely 91.67, while the skill with the lowest is in planning experiments, namely 80.52. The difficulty level and complexity of the skills developed influence the high and low average SPS achievements. The results of the research data calculation obtained an increase in the achievement of learning outcomes of the N-gain value of 0.78, which indicates an increase in learning outcomes with a high category. The results of this study suggest that integrating SPS through learning modules in a cooperative setting can improve the physics learning outcomes on the solids elasticity concept.

Keywords: science process skills, cooperative learning, module, solid elasticity, cognitive learning outcomes

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1. INTRODUCTION

Physics is one of the branches of science. It was born and developed through observation, discussion of problems, formulation of hypotheses, testing hypotheses through experiments, drawing conclusions, and discovering theories and concepts. The essence of physics is a science that studies natural phenomena through a series of scientific processes built based on scientific attitudes, and the results manifest as scientific products (Trianto, 2012; Noufal et al., 2020; Assem et al., 2023). Physics science learning is a branch of science that emphasizes providing direct experience related to everyday life because it is the basis for the development of science. Physics can direct students to improve process skills to produce good cognitive (Astalini et al., 2023; S. H. Siombone & Niwele, 2023)

Hungerford, Volk, and Ramsey (Wenno, 2011) stated that science contains two elements, namely scientific process and scientific products, that complement each other in the progress and development of science. Science as a process is a series of scientific activities or results of observations of natural phenomena that produce scientific knowledge called scientific products. Scientific products include facts, concepts, principles, postulates, theories and laws, and models expressed in several ways. The success of education in schools is one of the keys to the success of teachers in presenting subjects that can facilitate students to achieve the expected competencies (Rakhshand & Dafiyah, 2024). In each applicable curriculum, teachers are expected to be able to develop learning models based on field conditions, such as intake (differentiating power or average ability level of students in schools) and the completeness of learning media (Devi & Kadir, 2017).

The low quality of education today indicates the need for professional teachers. Teachers in the current era of technology and communication are not just teaching (transfer of knowledge) but must be learning managers. In other words, every teacher is expected to be able to create learning conditions that challenge students' creativity and activities, motivate students, and use multimedia, multi-methods, and multi-sources to achieve the expected learning goals (Rusman, 2012; Batra et al., 2023). On the other hand, quality education has several aspects, such as learning resources, technology, peer support, teaching methodology, qualifications, performance awards, co-curricular activities, teaching and learning resources, opinions of education stakeholders, and assessment of education (Batra et al., 2023).

The main problem of learning at the formal education level (school) today is the low absorption of students towards teaching materials. It can be seen from the average student learning outcomes, which are always concerning. The study's results also showed that participants' general problem-solving ability in physics was low. Item-by-item analysis revealed statistically significant differences in students' answers from urban and rural schools in problem-solving, connections, and understanding of physics topics (Tanti et al., 2020; Assem et al., 2023). This achievement is undoubtedly the result of learning conditions that are still conventional and have not touched on the students' dimensions. This aligns with Wenno's opinion (2011) that science learning has been dominated by the old paradigm, namely knowledge as a collection of facts that must be memorized. Learning in the classroom is still dominated by teachers (teacher-centered) as a source of knowledge; the lecture method is the teacher's choice of learning strategies, and students are rarely allowed to find out for themselves through experiments in the laboratory.

According to the author's observation results at SMA Negeri 3 Ambon, the conditions obtained show that physics learning in class is still oriented towards teacher-centered learning. This condition is evident from the lack of cooperation or interaction between students (teamwork) in the learning process; students who are ignored in learning activities become too lazy to know the tasks given by the teacher, and students are not given enough opportunities to process the basic science skills they have. Students can only learn theories, calculations, and problem-solving the teacher presents without proof of existing theories. This situation only made the students not fundamentally understand the teacher's physics concepts.

During the physics learning in the observed class, the physics teacher taught using teaching materials (teaching module) made by the teacher. This teaching module provides convenience, including concise material. The concept is easy for students to understand, but the examples of questions and practice questions presented are relatively complex and challenging. Besides that, it is not equipped with worksheet experiments, which are none other than to hold scientific activities, namely the learning process involving scientific processes or work skills. The impact is seen in that learning occurs seriously when the teacher monitors an assignment, so when separated from the teacher's direction, students sometimes lose motivation to read or answer the practice questions in the module. On the other hand, a lack of student motivation in learning leads to the achievement of student learning outcomes, and scientific creativity possessed by students is almost non-existent. This achievement can be shown by the data on the results of daily tests on solids elasticity; most of the student's test scores only range from 20 to 60, and only a small portion reaches the KKM (Minimum Completion Criteria) score. This condition shows that physics learning objectives in class have not been achieved. The demands of the curriculum in schools indicate that in learning physics in schools, each individual (student) is expected to reach at least the KKM, which is 75.

According to the results of the author's interview with the physics subject teacher in class X MIA (Natural Science Mathematics), it was said that physics teaching and learning activities should be more focused on how to activate students with the introduction of physics demonstration tools/practical tools and their use according to the material being studied by students. So that the material taught can be proven by students, where students can become more understanding and confident in the material they are learning, but this has not been fully realized due to the lack of opportunities for teachers to divide their time and management of physics laboratory managers that are not well accommodated.

Since the researcher conducted observation, monitoring, and research activities at SMA Negeri 3 Ambon, the 2013 Curriculum has been implemented in all grades X. The 2013 Curriculum emphasizes learning with a scientific approach, namely learning that encourages students to be more capable of observing, asking, trying/collecting data, associating/reasoning, and communicating. The scientific approach can be applied through science process skills in science learning (Putri & Nasrudin, 2018). Science process skills are skills used by scientists in conducting scientific explanations. Science process skills are intellectual skills that can be practiced, learned, and developed by children through the learning process and make students more able to face the challenges of the 21st century (Ikbal & Hasanah, 2022). Process skills need to be developed through direct experiences as learning experiences. Through direct experience, a person can better appreciate the process or activity (Koomson et al., 2024).

The science teaching and learning process emphasizes the process approach so that students can find facts and build concepts, theories, and scientific attitudes of the students themselves, which can ultimately positively affect the quality of the education process and educational products (Trianto, 2018). In addition, the process skills approach set in group learning (cooperative learning) allows students to be active and express something they think to friends, which will help them see things more clearly and even see the inconsistencies of their views. Through cooperative learning, several findings were obtained, including teachers managing to learn quite well, increasing teacher and student activities during learning, teachers training students' process skills well, and changing teacher-centered learning into student-centered learning (Odja & Mursalin, 2019; Wola et al., 2023)

One alternative to overcome problems in physics learning is to improve the physics learning system using open materials in physics modules. The provision of modules is expected to benefit the physics learning process for teachers and students (Himmah, 2021). According to (Puspitasari, 2019), no technology is most appropriate for achieving all learning objectives. However, it is adjusted to the creator's needs so that even though high technological capabilities are now an option, students still want and need non-electronic print media, one of which is a module. In addition, the learning module that is set explicitly through the integration of science process skills in a cooperative setting is expected to be able to foster a spirit of the process through science process skills, which are ultimately expected to be able to improve the cognitive learning outcomes of students at SMA Negeri 3 Ambon.

Based on the background above, this study aims to present a physics learning module by integrating science process skills in a cooperative learning setting to monitor students' science process skill activities, students' cognitive abilities during the learning process with Worksheets in the learning module, and improve students' cognitive learning outcomes. In addition, the research conducted with the implementation scheme of the learning module by integrating science process skills in cooperative learning helps spur student activity during the learning process in scientific activities through the developed process skills. Learning that is set through cooperative learning helps make students become organized in their learning in stages of cooperative learning that are sequential and systematically structured so that the process skills developed can be more focused, which will later be able to improve the activity of the science process skills and cognitive learning outcomes of students of SMA Negeri 3 Ambon.

2. METHOD

This study is included in quantitative descriptive research that aims to collect information about the status of an existing symptom, namely the condition of the symptom according to what it was at the time the study was conducted (Arikunto, 2018). The design used in this study is the One-Group Pretest-Posttest Design. Through this research design, the treatment results can be known more accurately because they can be compared with the conditions before and after treatment (Sugiono, 2013). This research was conducted at SMA Negeri 3 Ambon. This research was conducted in February 2021. The population in this study was class X MIA (Natural Science Mathematics), with a total of 132 people. The sample in this study was class X MIA_3 students, totaling 33 people with the lowest average Mid-Semester Exam score, namely 64.50. The sample was taken using a purposive sampling technique. The instruments used in this study were test instruments (for pre-test and post-test), Student Worksheets in the Learning module, and non-test instrument rubrics for students' science process skills performance during the learning process.
The prepared test instrument consisted of 15 Multiple-choice and 5 Essay questions. The test questions that were developed contained all topics of solid elasticity, which included the following sub-concepts: (1) Elastic and Plastic Objects, (2) Young's Modulus, (3) Hooke's Law, and (4) Application of Hooke's Law Principles. The test instrument will be used during the pre-test and post-test to measure the improvement of students' cognitive learning outcomes. Meanwhile, practice questions are inserted on each student worksheet in the learning module to measure students' cognitive abilities. Competency achievement indicators on the solids elasticity topic are shown in Table 1. On the other hand, students' science process skills use rubric performance, which is used to observe and monitor students' science process skills during the learning process on each student worksheet (WS) in the learning module. The science process skills developed in this study consist of six aspects, namely: (1) Making Observations, (2)

Interpreting Observation Results, (3) Making Hypotheses, (4) Planning Experiments, (5) Conducting Experiments, and (6) Communicating Results. The qualifications for the achievement categories of cognitive competencies and science process skills in the physics learning process on the elasticity of solid objects for students at SMA Negeri 3 Ambon are based on Table 2.

Table 1. Indicators of cognitive competence in the solids elasticity topic.

Solid Elasticity Topic			
Subconcept	**Num. Meeting**	**Indicator**	**Substance of Indicator**
Elastic objects and plastic objects	Meeting 1 (WS 1)	Competency achievement indicators: 1, 2	○ Identification of elastic and plastic objects. ○ Characteristics of elastic and plastic objects.
Young's modulus	Meeting 2 (WS 2)	Competency achievement indicators: 3, 4, and 5	○ Calculate stress, strain, and Young's modulus from some elasticity objects. ○ Differences in elastic modulus between several types of materials.
Hooke's Law	Meeting 3 (WS 3)	Competency achievement indicators: 6 and 7	○ Relationship between force and increase in length. ○ The spring constant value for a similar spring.
Application of Hooke's Law Principle	Meeting 4 (WS 4)	Competency achievement indicators: 8 and 9	○ Calculate the replacement spring constant value for series and parallel arrangements. ○ Stating the difference in magnitude of the replacement spring constant value for series and parallel arrangements.

Table 2. Criteria of Cognitive and KPS Achievement Qualification.

Mastery Level	Qualification
91-100	Very good
81-90	Good
75-80	Sufficient
< 75	Failed

Sumber: SMA Negeri 3 Ambon.

Table 3. Validation Criteria for Learning Module

Criteria	Validity Value (%)
Very Valid	81 – 100
Valid	61 – 80
Quite Valid	41 – 60
Invalid	21 – 40
Totally Invalid	0 – 20

Source: Amaliyah et al. (2023)

The learning physics module used as teaching material for applying science process skills in a cooperative setting is first validated through the walkthrough technique before being used in the learning process. The Walkthrough technique is a technique where the learning module developed before being applied in the learning process must first be validated by some experts considered capable in their field. The instrument used in this validation is a validator response questionnaire to the learning module being developed. The module validation reference refers to the validation value criteria in Table 3. There are three aspects of the validation material in this module: the content aspect, the language aspect, and the physical aspect. The content aspect is related to the suitability of the module content (matter substance) with the curriculum and its usefulness. The language aspect is related to the use of communicative language. At the same time, the physical aspect is related to the design of images, layout, and organization of the module content.

The data analysis technique in this study uses descriptive analysis by utilizing the Classical Test Theory Approach. This descriptive data analysis technique is applied by describing the data obtained from the results of the initial and final physics ability tests of students as they are without concluding. Meanwhile, this classical theory approach uses the N-gain test. The N-Gain test is commonly used to measure the effectiveness of learning or intervention in improving student learning outcomes. The N-Gain approach measures the relative change between the level of student understanding before and after learning. By making this comparison, the N-Gain analysis provides teachers with in-depth insight into the effectiveness of the application of a particular teaching method or model so that the results can quantitatively describe the extent to which students have mastered the subject matter being taught (Sukarelawan et al, 2024). The N-gain score ranges from -1 to 1. Positive values indicate an increase in student learning outcomes after learning, while negative values indicate a decrease in student learning outcomes (Siombone et al, 2024). The equation for calculating the N-gain score can be determined by the following equation (Hake, 1998; Meltzer, 2002):

$$\text{N-gain} = \frac{\text{Posttest Score} - \text{Pretest Score}}{\text{Ideal Score} - \text{Pretest Score}} \qquad (1)$$

To see the category of the magnitude of the increase in the N-gain score, you can refer to the Normalized Gain criteria in Table 4. Meanwhile, to determine the level of effectiveness of the implementation of the intervention, you can refer to Table 5.

Table 4. Normalized Gain Criteria

N-gain Value	Interpretation
$0{,}70 \leq g \leq 1{,}00$	High
$0{,}30 \leq g < 0{,}70$	Medium
$0{,}00 < g < 0{,}30$	Low
$g = 1{,}00$	No increase
$-1{,}00 \leq g < 0{,}00$	Decrease

* N-gain = Normalized Gain.

Table 5. Criteria of the effectiveness level

Percentage (%)	Interpretation
>76	Effective
56 – 75	Quite Effective
40 – 55	Less Effective
< 40	Not Effective

Source: Sukarelawa et al. (2024)

3. RESULT AND DISCUSSION

The research results obtained will be discussed in several subsections, namely: Results of validation of the physics learning module, results of student initial ability ini pre-tests, results of student cognitive learning on each worksheet (WS) of the learning module, Profile of students' science process skills (SPS), results of student finial ability in formative test (post-tests), and improvement in achievement of students' cognitive learning outcomes during the learning process using the physics learning module on the solids elasticity. Each part of the subsection will be discussed to explain the student's cognitive ability

3.1 Validation results of physics learning modules

The physics learning modules used, before being applied in the learning process in the study, must first be validated by the validator through the walkthrough technique. Three aspects indicate the validation of the learning module: the content, language, and physical aspects. The module validation process was carried out by four experts, including three lecturers from the Physics Education study program at Pattimura University and one teacher from SMA Negeri 3 Ambon. Each validator provided some input and suggestions for improving the teaching materials developed in addition to providing an assessment of the questionnaire. The appearance of the learning module is shown in Figure 1, while the results of the module validation by each validator are shown in Figure 2.

Figure 1. Display the module, each learning activity, and the student worksheet.

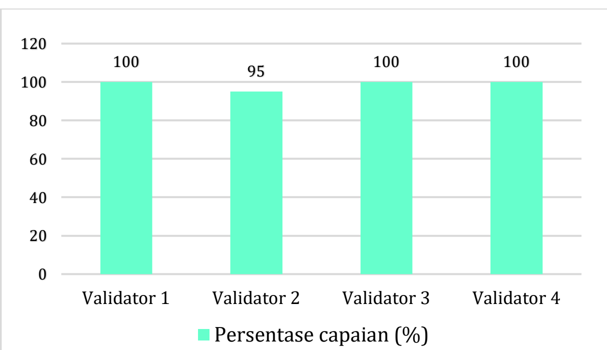


Figure 2. Percentage of achievement of module learning from each validator.

Based on Figure 2, each expert has a validation value, with a percentage ranging from 95% to 100%, and the average of the module validation results from the four experts (validators) is 98.75%. If we refer to the module validation criteria in Table 1, then the learning module used is in the very valid category. In addition to validation, this module also goes through a revision stage, such as suggestions and input from each expert on the learning module being developed.

3.2 Students' initial cognitive abilities.

Before participating in the teaching and learning process in class X MIA–3 through applying the science process skills approach in a cooperative setting using a learning module on the of elasticity solids topic, students' initial abilities were first measured using an initial test (pre-test). This pre-test tests students' initial abilities before treatment is carried out. The qualifications of students' achievement in the initial test and the percentage of students' achievement in each sub-concept of elasticity topic in this initial test are listed in Table 6.

Table 6. Qualification of students' initial cognitive ability achievement and the percentage of students' mastery in each sub-concept of elasticity topic.

Mastery Level	Frequency	Percentage Achievement (%)	Qualific.		Sub-concept	Students' initial mastery Percentage (%)
91-100	–	–	Very good	Sub-concept of solid elasticity topic	Elastic objects and plastic objects	49,36
81-90	1	3,03	Good		Young's modulus	26,67
75-80	–	–	Sufficient		Hooke's Law	40,84
< 75	32	96,97	Failed		Application of Hooke's Law Principle	33,16
Total	33	100				
The average value of the student's pre-test = 28,78						

Table 5a shows the qualification of students' initial abilities classically based on the pre-test results. The pre-test results show that students' initial cognitive abilities towards the material on elasticity of solids classically are in the fail category, namely 28.78. Further descriptions of the initial cognitive abilities of students of SMA Negeri 3 Ambon related to mastery of the solid elasticity topic are shown in Figure 3. Meanwhile, Figure 4 shows the percentage of students with initial abilities who mastered the sub-concepts in the material on the solid elasticity topic.

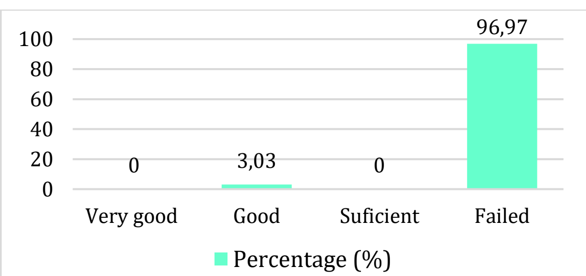


Figure 3. Students' initial ability achievement classically of the solid elasticity topic.

The graph in Figure 3 shows that personally, students' mastery of the elasticity of solids material before implementing the science process skills learning module in a cooperative setting was only 3.03% in the good category, while 96.97% were in the failed category. Classically, students' initial abilities in the elasticity material were in the failed category, with an average cognitive achievement of 28.78. These low initial test results indicate that the mastery of the solids elasticity topic is very low, so treatment is needed through the implementation of a physics learning module based on science process skills.

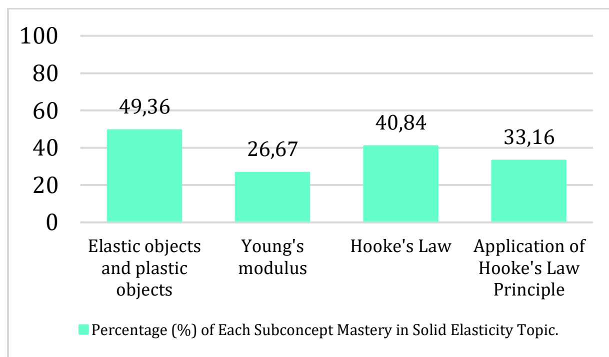


Figure 4. Percentage of students' initial mastery of each sub-concept on the solids elasticity topic.

Based on the graph in Figure 4 shows the total percentage of student's initial abilities in the various elasticity sub-materials, where the highest rate of achievement is in the elastic and plastic objects sub-materials, which is 49.36%, while the lowest is in Young's modulus sub-material, which is 26.67. The achievement of mastery of each sub-concept in students' initial abilities is, on average, below 50%, which shows that mastery of concepts on the topic of elasticity of solids is very low, so treatment is needed in the form of progressive and meaningful learning implementation to improve learning outcomes.

3.3 Results of student cognitive learning on each worksheet.

Data on students' cognitive abilities for the material on the elasticity of solids during the teaching and learning process as well as the treatment by implementing the integration of science process skills in a cooperative setting using learning modules, can be seen in the table of qualifications for achieving students' cognitive abilities and the percentage of students' mastery of concepts in each WS module listed in Table 7.

Table 7. Qualification of students' cognitive abilities achievement during the learning process with the WS module and the percentage of subconcept mastery in each WS learning module.

Mastery Level	Frequency	Percentage (%)	Qualific.		Worksheet of the module	Percentage (%) of sub-concepts mastery.
91-100	5	15,15	Very good	Student mastery classically in each WS	WS 1 (Elastic objects and plastic objects)	81,03
81-90	18	54,54	Good		WS 2 (Young's modulus)	83,93
75-80	9	27,27	Sufficient		WS 3 (Hooke's Law)	89,18
< 75	1	3,03	Failed		WS 4 (Application of Hooke's Law Principle)	87,63
Total	33	100				
The average value of cognitive achievement classical = 85,51						

Based on Table 7, implementing learning with the integration of science process skills in a cooperative setting using learning modules positively influences the achievement of student's cognitive abilities, which are in the good category, namely 85.51. In addition, the implementation of science process skills in learning with modules provides a positive contribution, where the mastery of each sub-concept on the topic of elasticity of substances becomes better, namely with the highest achievement in WS 3 with a percentage of 89.18% while the lowest is in WS 1 with a percentage of achievement of 81.03%. The percentage of achievement of mastery of each sub-concept in this elasticity topic, when viewed from the level of mastery of sub-concepts classically, is in the good category. The achievement of cognitive abilities and mastery of sub-concepts on the topic of elasticity of substances cannot be separated from the advantages presented in cooperative learning, namely that cooperative learning can direct and teach students to compete to achieve the best in learning. According to Odja & Mursalin (2018), Through the implementation of cooperative learning, students are trained to have 21st-century life skills, especially in terms of collaboration and communication between groups about science. Scientific activities that implement continuous cooperative learning make it easy for students to re-communicate things that have been done both verbally and in writing. Through oral discussion activities, students verbally communicate the results of experiments in front of their friends so that mastery of the material from each sub-concept increases and positively impacts the achievement of students' cognitive learning outcomes. Figure 5 will display the profile of students' cognitive ability qualifications during the learning process using student worksheets (WS). In contrast, Figure 6 will display the percentage of students' concept mastery on each worksheet in the module representing each sub-concept in the material on the elasticity of solids.

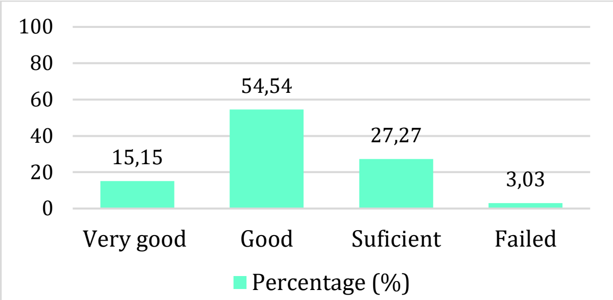


Figure 5. Qualification of students' cognitive abilities achievement in worksheet module.

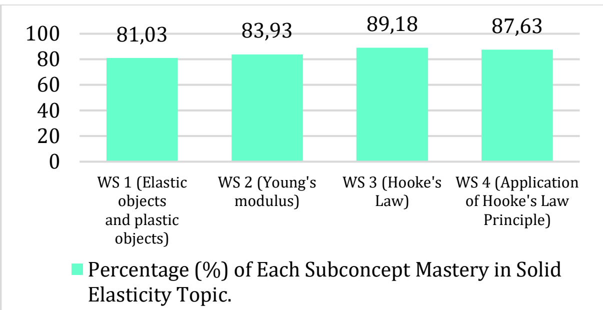


Figure 6. Percentage of subconcept mastery in each WS learning module.

The graph in Figure 5 shows the qualification of students' cognitive ability achievement during the learning process with student worksheets (WS) in the learning module, where the most significant percentage of student achievement is in the good category, which is 54.45%, while very good achievement is only around 15.15%, while the achievement of the sufficient category is 27.27, the percentage of students who fail is only 3.03%. On the other hand, the graph in Figure 6 shows that the level of student concept mastery on each worksheet (WS) in the module is classified as good because the average is above 80%. The highest concept mastery of the module worksheet is on Student WS 3, with an achievement of 89.18%, followed by WS 4, with 87.63%, followed by WS 2, with an achievement of 83.93. The lowest mastery is on WS 1, achieving 81.03%. High student achievement on each Student Worksheet in this learning module is supported by learning about science process skills in a cooperative setting. Learning with science process skills emphasizes students more on the process approach to improve their science skills (Wulan et al, 2024). During cooperative learning, the science process skills developed become more focused on following the syntax of the cooperative learning model (Putri & Nasrudin, 2018; Unayah et al., 2025). This result aligns with a study by Wulan et al (2024), which stated that cooperative learning could positively improve learning cognitive outcomes and build student motivation. At the same time, the learning module used functions to help students facilitate the teaching and learning process (Himmah, 2021; Ikbal et al., 2020). The student worksheets in the module help direct the student learning process to gain knowledge through the science process skills developed.

3.4 Profile of students' science process skills.

Science process skills consist of basic and integrated skills (Yunita & Makiyah, 2021; Koomson et al., 2024). In this study, the process skills developed combine basic process skills and several integrated process skills. The science process skills developed in the classroom learning process in this study are (1) observation, (2) observation results interpretation, (3) hypothesis formulation, (4) research planning, (5) research implementation, and (6) research results communication. Observation skills in this study are basic process skills, while the other five process skills, ranging from interpretation to results communication skills, are integrated. The relationship between these two process skills is also explained in the research of (Koomson et al., 2024), which states that Basic science process skills are also known as the basis for acquiring and developing integrated science process skills.

These developed science process skills are poured into the syntax of the cooperative learning model, namely at the group work stage to the evaluation stage of the learning process. These science process skills are presented in the task structure in the worksheet of the learning module. Presenting learning with these developed science process skills is to help achieve and improve students' cognitive learning outcomes at SMA Negeri 3 Ambon. Table 8 presents the achievement of students' science process skills ability during the learning process in a cooperative learning model atmosphere using learning modules. Meanwhile, Figure 7 shows the profile of students' process skills ability achievement during the learning process on each module worksheet.

Table 8. Achievement ability in each aspect of science process skills developed for students.

No	Process Skills developed	SPS achievement in each WS Module				Average Achievement of Each Science Process Skill (SPS)
		WS 1	WS 2	WS 3	WS 4	
1	Conducting an Observations	88,90	91,67	92,93	93,43	91,67
2	Interpretation of Observation Result	84,65	88,99	91,92	93,94	88,99
3	Making Hypothesis	85,30	89,54	92,93	93,94	89,54
4	Experimental Planning	79,74	80,52	92,42	89,99	80,52
5	Conducting an Experiment	90,91	90,15	92,93	93,43	90,15
6	Result Communication	85,86	87,46	85,19	92,42	87,46

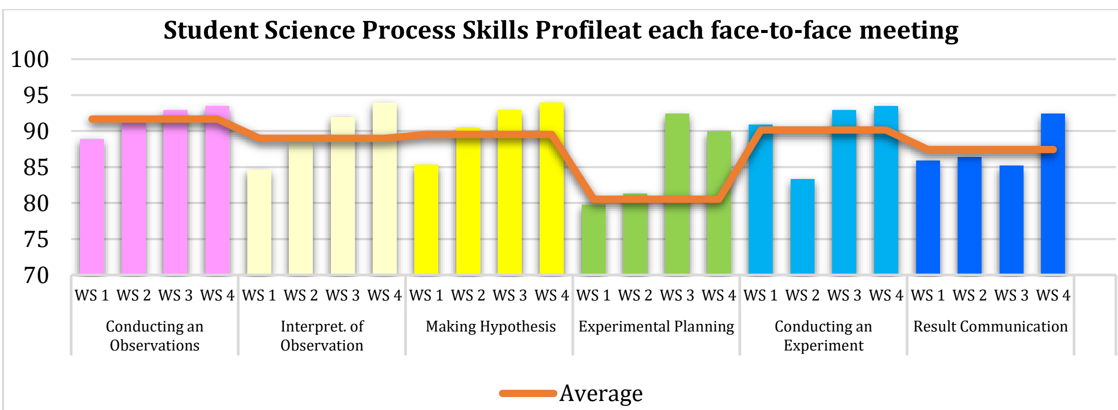


Figure 7. Profile of students' achievement ability in science process skills during four meetings.

Based on Table 8, six science process skills were developed, and a list of students' classical science process skills abilities was made, starting from the first worksheet (solid elasticity) to the fifth worksheet (Application of Hooke's law principle). Meanwhile, Figure 7 shows the visualization results of the trend of science process skill achievement for each module Worksheet and the average achievement of students' classical science process skill abilities from the four worksheets in the learning module. The benchmark for the qualification category of science process skill achievement refers to Table 2. Based on Table 8 and Figure 7, it appears that the science process skill with the highest average achievement is in the Conducting an Observations skill with an ability achievement of 91.67, which is in the very good category, then followed by the Conducting an Experiment skill ability with an achievement of 90.15 which is in the good category. The next skills with good achievements are hypothesis-making, interpretation of observation, and result communication skills, with successive ability achievements of 89.54, 88.99, and 87.45. The science process skill with the lowest achievement is Experimental Planning, with an average ability achievement of 80.52, which is in the good category.

As shown in Figure 7, of the six process skills developed in the physics learning of the solid elasticity concept, observation skills are the skills with the highest achievement, and the achievement track always increases from the meeting on worksheet 1 (WS 1) to worksheet 4 (WS 4). This skill also contributes to the highest average achievement compared to other science process skills with a value of 91,67, and this is because this process skill is a basic process skill, the operational actions of which are still relatively easy. These results align with the research of (Mufidah et al., 2023), where the process skill with the highest achievement was observation skills, with a success rate of 85%, which is in the very good category. In addition, Wulan, et al (2024) research showed an increase in the achievement of observation skills with an N-gain value of 0.79, which is in the high category; this illustrates that observation skills are skills with the best achievement improvement. The second science process skill developed is the skill of interpreting observation results. Interpreting observation results is one of the skills with mastery and achievement ability in the good category, with an increase in almost every worksheet in the learning module, starting from WS 1 to WS 2. This process skill also contributed a pretty good average achievement, which was 88.99, but not as high as the average achievement in observation skills; this is because this skill is part of an integrated skill whose operational level is slightly more complicated. This result aligns with research by Wulan, et al (2024), which found that the ability to interpret skills increased with an n-gain value of 0.56, which is in the moderate category. These results can be interpreted as students' abilities in interpreting skills being in the middle category, so getting good results requires sufficient effort. After interpreting observation results, there is the skill of making a hypothesis. Making a hypothesis is one of the skills that students must develop by making assumptions according to the formulation of the problem while still referring to the results of observations as described in the material in the module. The achievement of mastery in making a hypothesis is relatively high, namely 89.54. This result is in line with (Kirana et al., 2018) research, where the Process Skill Indicator was obtained in the post-test with an achievement of 80.43 and an N-gain value of 0.72, which showed an increase in the high category. The same results are supported by (Wulan, 2024) research, where the ability to submit a Hypothesis skill increased with an N-gain value of 0.80 in the high category. Based on the results of this study and its relevance to previous studies, it shows that making a hypothesis is one of the skills considered to have the appeal and opportunity to be done well by all students. The student's performance in this skill is certainly also supported by the goodness of the cooperative learning scenario, which provides space for students to discuss and work together.

Science process skills after making a hypothesis are experimental Planning. Experimental planning skills contain instructions, namely (1) Arranging the steps for implementing research correctly and precisely and (2) Assembling Tools correctly and precisely. Experimental Planning is a skill with the lowest ability achievement, namely 80.52, compared to the achievements of other developed process skills. Lower the ability of this skill because the process that must be carried out is quite complex, where a mature understanding and mastery of concepts are needed, and students' scientific analysis skills are quite capable in order to support the implementation and execution of this skill. Previous research conducted by (Wahyuni et al, 2020) showed that student achievement in Experiment Design skills was 33%, which was very poor. These results align with Wulan et al (2024) research, where the increase in experimental planning skills was relatively low, with an N-gain value of 0.44. The low criteria is because students do not yet have adequate skills in determining the tools and materials needed to conduct experiments in their activities. Hence, their ability to perform experimental Planning still needs to be improved. After planning the experiment well, the next stage is that students are faced with the next science process skill, namely Conducting an experiment skill. This process skill requires students to set up the equipment to carry out measurement activities and collect data around elasticity. The research data shows that the achievement of students' process skills during the learning process with the learning module worksheets has increased from worksheet 1 to worksheet 4. In addition, the average achievement of science process skills in conducting experiments contributed a value of 90.15, which is in the good category. This experiment skill is categorized as good because the cooperative learning scheme or stages are beneficial and support students in compactly discussing and working together in scientific groups.

Communicating results is the last skill that must be possessed from a series of developed process skills. There are several aspects that students must do while carrying out this skill, namely: (1) Being able to convey an idea obtained according to research results both verbally and in writing, and (2) Explaining the results of data analysis based on objects or events. Based on the research results obtained, the achievement of the ability to communicate research results is classified as fluctuating from each worksheet in the module. Still, classically, the average achievement is 87.46, classified as being in the good category. The results of previous research by Mufidah et al. (2023) found that the achievement of communication skills was 84.44%, which was in the good category. These results align with the research by Wulan, et al (2024), which showed an increase in communication skills with an n-Gain of 0.83, which is in the high category. In this communication process, a high increase in skill ability was obtained because, in this activity, students communicated data by reading tables from the results of interpretation activities through group presentation activities. This student activity is in line with the syntax of the cooperative method stage 5, namely the evaluation, where students are expected to be able to present the results of observations, classifications, and interpretations of data that have been carried out. The existence of this group presentation activity makes students actively participate in presenting the results of observations that have been made so that it will increase the communication indicator. This study is in line with the research of Fitriani et al., (2021) that communication skills can be improved through group presentation activitie

Table 9. Qualification of students' final cognitive ability achievement and the percentage of students' mastery in each sub-concept of elasticity topic.

Mastery Level	Frequency	Percentage Achievement (%)	Qualific.		Sub-concept	Students' final mastery Percentage (%)
91-100	7	21,21	Very good	Sub-concept of solid elasticity topic	Elastic objects and plastic objects	85,86
81-90	10	30,30	Good		Young's modulus	69,47
75-80	13	39,39	Sufficient		Hooke's Law	90, 94
< 75	3	9,09	Failed		Application of Hooke's Law Principle	77,65
Total	33	100				
Average value of student's pos-test (formative test)= 83,39						

3.5 Student final cognitive abilities

Students' final ability to master the material of solids elasticity is obtained after students take a final exam in the form of a post-test. The final exam is conducted after students have carried out learning process activities for four meetings, as required by the Student Worksheet in the learning module. Table 9 shows the students' final ability achievement results classically on the solids elasticity topic and the percentage of students' concept mastery level on each sub-concept. Table 9 shows that the average classical student learning achievement is 83.39. If we refer to the minimum completion criteria in Table 2, the student learning achievement has met the completion criteria. At the same time, Figure 8 shows the profile of students' final ability achievement. In contrast, Figure 9 displays the percentage of students' concept mastery on each sub-concept on the solid elasticity topic.

Based on Figure 8, the final results of student learning have increased. Students who are 21.21% in the very good category, the good category is 30.30%, the sufficient category is 39.39%, and those who fail are 9.09%. If totaled, 90.9% of students are in the complete category. Based on these results, implementing the science process skills learning module in a cooperative setting can lead students to success in learning the topic of solids elasticity.

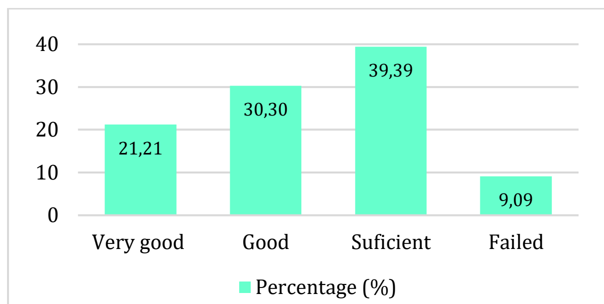


Figure 8. Students' final ability achievement is classically of the solid elasticity topic.

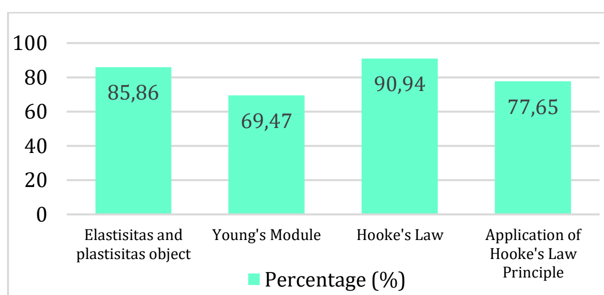


Figure 9. Percentage of students' final mastery of each sub-concept on the solids elasticity topic.

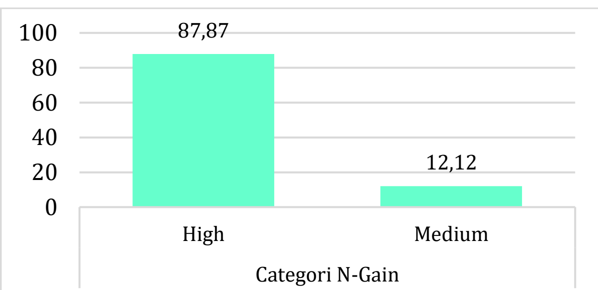
Based on Figure 9, the highest level of student concept mastery is in Hooke's Law sub-concept, with a percentage of 90.94%. This is followed by the Elasticity and Plasticity of Objects sub-concept, with a percentage of 85.86%, and then by the Application of Hooke's Law Principle sub-concept, with a percentage of 77.65%. The sub-concept with the lowest mastery is in the Young's Module sub-concept. Based on these results, student mastery of each sub-concept is classified as good because it is more than 60%.

3.6 Improvement in achievement of students' cognitive learning outcomes

Data on student learning outcomes in the form of average pre-test scores (initial ability), average post-test scores (final ability), and N-gain values that have been classified based on three groups of ability improvement, along with the average N-gain of students classically after the implementation of physics learning through the integration of science process skills in a cooperative setting using learning modules are presented in Table 10. Next, Figure 10 will show how to classify the level of improvement in student learning outcomes through classical N-gain values for the implementation of learning treatment.

Table 10. The average student achievement in pre-test and post-test, and N-gain value of improved cognitive Learning Outcomes on the Solid Elasticity Topic.

Pre-test average	Post-test average	N-gain value Class	Number of student	Percentage (%)	Interpret.	N-gain Average	Classical Interpret.
28.78	83.39	$g \geq 0.7$	29	87.88	High	0.78	High
		$0.3 \leq g < 0.7$	4	12.12	Medium		
		$g < 0.3$	0	0	Low		



Gambar 10. Category graph of student learning outcomes improvement classically.

Table 10 shows that there is an increase in student learning outcomes on the concept of elasticity of solids after the implementation of the science process skills module in a cooperative setting, as there is an increase in results from an average pre-test of 28.78 to 83.39 on the average post-test. In addition, Table 10 and Figure 10 show an increase in student learning outcomes with an N-gain value ≥ 0.7 (high category), having a very high percentage of 87.88% of students, while students with an N-gain value in the medium category are only 12.12%. Referring to Table 5, the learning treatment through implementing science process skills in a cooperative setting using modules is effective because classically, as many as 90.9% (>76%) of students have achieved learning outcomes. In addition, based on Table 10, the N-gain Average value is 0.78, which shows that classically, there is a relatively high increase in physics learning outcomes for the concept of elasticity of solids in class X MIA3 students of SMA Negeri 3 Ambon. The results of this study are in line with previous research conducted by Mindawati & Nana (2020), where there was an increase in students' science process skills in the very good category and an increase in learning outcomes in the moderate category after the STAD type cooperative learning model was implemented. Based on the results obtained and relevant previous research, it can be said that integrating science process skills in a cooperative setting using learning modules positively contributes to improving students' physics learning outcomes.

4. CONCLUSION

Based on the research data and discussion results, implementing science process skills in a cooperative setting using learning modules positively contributes to the cognitive learning outcomes of class X_3 MIA students of SMA Negeri 3 Ambon. The average cognitive achievement of students during learning with module worksheets is 85.51, with mastery of concepts in each LKS above 80%. Implementing science process skills also improves skills in the six aspects of skills developed, from conducting and observation skills to communication skills at each meeting, with an average achievement above 80. Implementing science process skills improves learning outcomes from an average initial ability of 28.78 to 83.39 at the final ability. In addition, the average value of N-gain classically is 0.78, which is in the high category with a very effective level of implementation of learning outcomes and a successful presentation of 90.9% (> 76%). Based on the presentation of research results and existing discussions, implementing science process skills in a cooperative setting using learning modules can effectively improve students' physics learning outcomes on the solids elasticity concept.

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