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Physics Learning E-Module Integrated with Practicing Pancasila Values on Momentum and Impulse: Is it Effective to Improve Students' Critical Thinking Skill and Hard Work Character?

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ABSTRACT
The use of independent instructional materials and the integration of Pancasila values need to improve students' cognitive and affective abilities. This study aims to determine the effectiveness of the integrated physics learning e-module integrated with practicing Pancasila values in momentum and impulse to improve students' critical thinking skills and hard work character. The independent variable is the use of integrated physics learning e-module integrated with practicing Pancasila values and textbook, while the dependent variable is the critical thinking skill and hard work character. The type of this research is Quasi Experiment with a Pretest-Posttest Control-Group Design. The sampling technique used was cluster random sampling involving 70 students of the 10th-grade science class of a State Islamic High School in Yogyakarta. The instruments used were essay questions of critical thinking skills and a hard work character questionnaire. The data were then analyzed using MANOVA statistical test. The results showed that the physics learning e-module integrated with practicing Pancasila values in momentum and impulse effectively improved the students' critical thinking skills and hard work character on momentum and impulse. This shows that the use of independent instructional material such as e-modules has a good impact on improving cognitive and affective abilities, not only because students learn content in e-modules, but also because they can monitor their learning process, realize their mistakes, and plan the learning process according to their abilities.

INTRODUCTION

Education is inseparable from the human life process. The primary purpose of education is to improve abilities, build character, and develop the potential of each individual [1]. One of the essential skills

required by each individual in facing global challenges is critical thinking. This skill is important in analyzing, considering, and making decisions on information logically. A few experts mention several indicators of critical thinking skills. Ennis stated five critical thinking indicators, especially: Basic Clarification; Basis for Decision Making; Conclude; Advanced Clarification; and Rhetoric in Formulating Strategy [2]. Facione stated six indicators of critical thinking skills, namely: Interpretation; Analysis; Conclude; Evaluation; Explanation; and Self-Regulation [3]. Dwyer et al. stated four indicators of critical thinking, that is: Analysis; Evaluation; Conclude; and Reflective Assessment [4]. Based on some of these opinions, a synthesis of indicators of critical thinking skills can be taken, namely: Analyzing Facts; Formulating the Main Problem; Defending, Selecting, Clarifying and Evaluating Logical Arguments; and Drawing Conclusions.

Critical thinking help students face social problems and scientific problems in the learning process [5]. It also encourages students to be active in understanding problems, gathering information, reasoning and developing ideas to make decisions and make conclusions [6] [7]. Students need to have critical thinking skills, particularly in physics subject matter. They are required to analyze and think logically about physics concepts related to everyday phenomena, such as momentum and impulse.

However, students' critical thinking skills in studying momentum and impulse are still low [6] [8]. Malik et al., in their study, show that students can only achieve 30 points of the total score of critical thinking skills on momentum and impulse [6]. In addition, Permata et al. show that the average percentage of students' critical thinking skills in all aspects is 35.41% [8]. This is because students have difficulty in understanding concepts, providing arguments, and making decisions. Critical thinking skills significantly contribute to developing ideas and conclusions [7]. The process of developing ideas affects the skill to argue and the skill to conclude affects decision-making efforts. Therefore, the low skill of students in providing arguments and making decisions indicates a low skill to think critically.

In addition to cognitive problems, Demkanin stated that there needs to be in-depth research on the goals and objectives of physics education related to social problems [9]. According to him, Physics Education Theory will follow the development of research related to the humanities. Therefore, the development of physics learning cannot be separated from efforts to build students' social skills. The 21st-century physics learning curriculum needs to include dimensions of human activity that depend on history, culture, place, and time, so the cultivation of ethics, open-mindedness, and pro-social values are important [10]. Based on this, learning physics in Indonesia should not be separated from the social framework, especially in student character development. It is important in shaping the complete Indonesian people.

The characters possessed by students will support the success of their learning process, one of which is the character of hard work. Hard work character is needed to achieve higher learning achievement and attitudes [11] [12] [13] [14]. Students who have hard work character always try to solve the problems they face and complete assignments on time.

Some experts mention several indicators of the character of hard work. Kesuma stated that there are four indicators of hard work character, especially: Feeling worried if the work has not been completed to completion; Checking/examining what must be done/what are their responsibilities in a position/position; Able to manage their time; and Able to organize existing resources to complete their duties and responsibilities [15]. De Cooman et al. stated that there are three indicators of hard work is: Direction; Intensity; and Persistence [16]. Mustari stated three indicators of hard work character, namely: Showing sincerity in carrying out tasks; Persist in the assigned task even in the face of difficulties; and Trying to find solutions to problems [17]. Marzuki has three indicators of hard work, namely: Enthusiasm at work; Passion for learning; and Not laziness [18]. Based on these opinions, a synthesis of indicators of hard work character can be drawn, especially: Doing tasks well and on time; Not easily discouraged when faced with difficulties; and Able to manage existing resources to complete tasks.

However, students' hard work character is still in the low category [19] [20] [21] [22] [23]. A study conducted by Munfarikhatin et al. showed that some students' hard work character are only scored 40 [22]. Besides, Atika & Junaidi in their research show, that 80% of students' hard work character has not been embedded [23]. Students have not been serious about learning and doing assignments. Furthermore, they also give up easily if they face learning difficulties. This is because learning is not interesting and they do not really understand the importance of applying the content in the real-life situation [22].

The conceptual understanding and character education should be taught and applied in physics learning [24]. Physics learning integrated with character education will provide numerous benefits, especially to achieve cognitive goals and, at the same time forming a noble character [25]. As an Indonesian, the character in the nation is a crystallization of Pancasila values. Therefore, the inculcation of Pancasila values as the nations's ideology can strengthen students' character [26].

The practice of Pancasila values can be integrated into various subjects in schools [27]. This provides an opportunity to integrate the practice of Pancasila values with physics subject matter. Physics concepts can be explored deeper to obtain life lessons following the values of Pancasila. Moreover, physics content can be packaged in stories of everyday life following the practice of Pancasila values.

Efforts to improve critical thinking skills and hard work character need to be facilitated with appropriate instructional materials. Hadi, Susanti, & Agustini state that the skill to think critically is synonymous with independent learning styles [28]. This independent learning style can be facilitated with independent instructional materials, especially modules [29]. The module as an independent instructional material has advantage that students can find out how far their skill is to absorb learning content.

The use of module also encourages students to cultivate hard work character. This is because the module is independent and encourages students to do their best to understand the content provided in the module. Also, the inculcation of Pancasila values in the module provides students the behavior guidelines to strengthen their character. The module can be packaged into a software application operated using a device, or commonly known as an e-module. This electronic module (e-module) has several advantages including being able to display videos, animations, and interactive tests, making it easier for students to understand the content [30] [31] [32].

This makes the e-module a practical, interactive, and flexible independent instructional material to be used anytime and anywhere [33] [34]. The features in this e-module make the momentum and impulse easier for students to understand. Based on the description above, this study aims to determine the effectiveness of a physics learning e-module integrated with practicing Pancasila values in momentum and impulse to improve students' critical thinking skills and hard work character.

METHOD

The type of this research is a quasi-experiment using a pretest-posttest control-group design. This study involved one experimental class and one control class. The research design is shown in Table 1 below.

Table 1. Research Design

Class	Pretest	Treatment	Posttest
Experiment	O_1	X	O_2
Control	O_1	Y	O_2

Information :
O_1 : Pretest critical thinking skills and hard work character

O_2 : Posttest critical thinking skills and hard work character
X_1 : The use of an integrated e-module in the practice of Pancasila values
X_2 : The use of textbooks

The research was conducted at one of the State Islamic Senior High School in Yogyakarta in the 2019/2020 Academic Year. The physics learning e-module integrated with practicing Pancasila values on momentum and impulse used in the experimental class is a product developed by Himawan & Ariswan [35], while the textbook used in the control class is a textbook commonly used by teachers in that school. The sampling technique used was cluster random sampling involving 70 science students of the 10th grade. 34 students of science class 1 were plotted as the control class, and 36 students of science class 4 were as the experimental class. The data collection techniques used were test techniques and non-test techniques. The instruments used were 10 critical thinking skills essays questions and hard work character questionnaire consisting of 29 statements. The indicators of critical thinking skills and hard work character used in this study are a synthesis of several expert opinions, as explained in the introduction section. The indicators of critical thinking skills, namely: 1) analyzing facts; 2) formulating the main problem; 3) defending, selecting, clarifying and evaluating logical arguments; and 4) drawing conclusions. The indicator of hard work character, especially: 1) doing tasks well and on time; 2) not easily discouraged when faced with difficulties; and 3) able to manage existing resources to complete tasks. MANOVA statistical test was used in the data analysis to test the effectiveness of e-module in improving critical thinking skills and hard work character with the following: 1) the analysis of differences in critical thinking skills and hard work character is based on the sig. value. Hotelling's Trace; 2) the analysis of the improvement of critical thinking skills and hard work character is based on the mean difference; 3) the analysis of the effective contribution of treatment is based on the partial eta square value. Before the MANOVA statistical test was carried out, the prerequisite analysis test was conducted in the form of a normality test and a homogeneity test.

RESULTS AND DISCUSSIONS

Normality Test
The Shapiro-Wilk normality test was carried out on the pretest-posttest data on critical thinking skills and hard work character in the experimental class and the control class. The normality test result in the experimental class and control class are shown in Table 2 and Table 3. The pretest-posttest score of critical thinking skills and hard work character in the experimental and control classes has a sig. value which is more than 0.05, indicating that H_o is rejected. This shows that the pretest-posttest data on critical thinking skills and hard work character in the experimental class and control class have a multivariate normal distribution.

Table 2. Results of the Experimental Class Normality Test

Variable	Test	Shapiro-Wilk		
		Statistic	df	Sig.
Critical Thinking Skill	Pretest	.979	36	.708
	Posttest	.981	36	.768
Hard Work Character	Pretest	.971	36	.446
	Posttest	.969	36	.391

Table 3. Control Class Normality Test Results

Variable	Test	Shapiro-Wilk		
		Statistic	df	Sig.
Critical Thinking Skill	Pretest	.969	34	.426
	Posttest	.977	34	.665
Hard Work Character	Pretest	.982	34	.838
	Posttest	.953	34	.153

Homogeneity Test

Table 4 shows the homogeneity test result at the output Box 'M. has sig. value 0.978, more than 0.05 and indicating that H_0 is rejected. This means that the dependent variable variance-covariance matrix in the experimental class and control class is homogeneous.

Table 4. Homogeneity Test Results

Box's M	F	df1	df2	Sig.
.204	.066	3	933697.455	.978

The Difference Between Critical Thinking skill and Hard Work Character

The analysis results of the differences in critical thinking skills and hard work character are shown in Table 5. The sig. value obtained of the Hotelling's Trace test is 0.00, which is less than 0.05 and indicating that H_0 is rejected. This means there are critical thinking skill and hard work character differences of the experimental class students treated using the physics learning e-module integrated with practicing Pancasila values and the control class students treated using textbooks.

Table 5. Test Results of Differences in Critical Thinking Skill and Hard Work Character

Effect	Value	F	Hypothesis df	Error df	Sig.
Hotelling's Trace	.734	24.593b	2.000	67.000	.000

Improved Critical Thinking Skill

Table 6 shows the results of pairwise comparisons of critical thinking abilities in the experimental class and the control class. The mean difference in critical thinking skills in the experimental class and control class shows the sig. value of 0.00, which is less than 0.05. Therefore, H_0 is rejected. This indicates an improvement in the score of critical thinking skills in both classes.

Table 6. Result of Pairwise Comparison of Critical Thinking Skill

Class	(I) Test	(J) Test	Mean Difference (I-J)	Std. Error	Sig.
Experiment	Pretest	Posttest	-38,542	2,083	.000
Control	Pretest	Posttest	-13,676	2,143	.000

Figure 1 shows the pretest-posttest scores of critical thinking skills in the experimental class and the control class. It can be seen that the pretest scores of both classes are relatively not much different. However, the posttest score of the experimental class was higher than the posttest score of the control class. Therefore, using the physics learning e-module integrated with practicing Pancasila values on momentum and impulse is more effective in improving the students' critical thinking skills than textbooks.

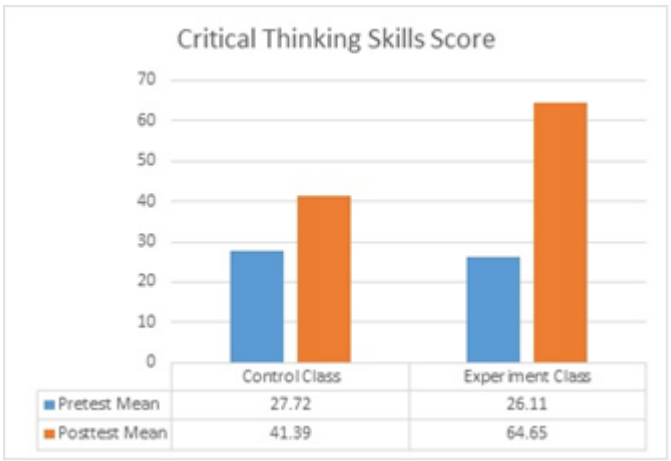

***Fig 1**. Critical Thinking Skills Score*

Improved Hard Work Character

The improvement in hard work character is known by looking at the Pairwise Comparison output. Table 7 displays the improvement in the pretest-posttest hard work character in the experimental and control classes shown by sig. value of 0.00. It is less than 0.05, which means that H_0 is rejected. Therefore, it can be interpreted that there is improvement in the score of the hard work character in both classes.

Table 7. Result of Pairwise Comparison of Hard Work Characters

Class	(I) Test	(J) Test	Mean Difference (I-J)	Std. Error	Sig.
Experiment	Pretest	Posttest	-20,455	1,581	.000
Control	Pretest	Posttest	-13,825	1,627	.000

Figure 2 shows the pretest-posttest scores of hard work characters in the experimental class and the control class. The posttest score of the experimental class is higher than the posttest score of the control class. Therefore, Therefore, using the physics learning e-module integrated with practicing Pancasila values on momentum and impulse is more effective in improving the students' hard work character than textbooks.

***Fig 2**. Hard Work Character Score*

Contribution of the Effective Treatments

Table 8 shows the amount of effective contribution in each class. The effective contribution of the treatment in the experimental class and control class is known from the partial eta squared value. Using the physics learning e-module integrated with practicing Pancasila values in the experimental class effectively contributes 83% to improving critical thinking skills and 71% to improving students' hard work character. Using physics learning textbooks in the control class effectively contributes 37% to improving critical thinking skills and 51% to improving the students' hard work character. Based on these results, it is known that using the physics learning e-module integrated with practicing Pancasila values on momentum and impulse is more effective in improving students' critical thinking skills and hard work character than textbooks.

Table 8. Contribution of Effective Treatments

Variable	Class	Test	F	Sig.	Partial Eta Squared
Critical Thinking Skill	Experiment	Hotelling's trace	342.407a	.000	.83
	Control	Hotelling's trace	40.720a	.000	.37
Hard Work Character	Experiment	Hotelling's trace	167.439a	.000	.71
	Control	Hotelling's trace	72.240a	.000	.51

The findings above have shown that e-modules have advantages over textbooks in improving students' critical thinking skills and hard work character. The use of e-modules makes learning more focused because those modules are designed for independent learning. This is different from the use of textbooks that are not based on a particular learning design. This claim is supported by the study conducted by Rofidah, Junus, & Hakim, showing that physics textbooks in general have deficiencies in the learning presentation component [36]. Besides, e-modules as independent instructional materials have been adapted to the characteristics of students. The independent instructional materials are arranged according to the learning environment, learning abilities, and learning speed [37]. This differs from textbooks that are generally not designed based on students' characteristics.

E-modules as independent instructional materials encourage students to reflect and monitor their thinking processes and learning achievement. Ghanizadeh states that this self-monitoring process affects critical thinking skills [38]. This is confirmed by Dwyer et al., who said that the skill to think critically is a metacognitive process for self-assessment or reflection [4]. When receiving this feedback, students can diagnose the error [39].

Self-assessment in the independent learning process makes students aware of the extent of their abilities in absorbing the subject matter. Independent learning with e-modules makes students accustomed to self-reflection, so that their critical thinking skills can be built [28]. This is supported by Lorencova, Jarosova, Avgitidou, & Dimitriadou stated that most studies on empowering critical thinking skills use independent learning [40].

The module's presentation in electronic form accessed via smartphone makes it easy for students to understand momentum and impulse. This is because the e-module is designed to be interactive. It contains images, audio, video, and animation presented in an integrated manner to visualize an active, effective, and efficient learning context [41] [42]. This is increases student motivation. This motivation will increase their understanding of reading the content [43] [44]. Also, using technology in e-modules greatly supports the independent learning process. Significant developments in learning technology are marked by the emergence of Bring Your Own Device (BYOD). It refers to the condition where students use their own devices, such as smartphones, to support a more autonomous learning process [45].

The presentation of content and examples of problem-solving in e-modules adjusted to the indicators of critical thinking skills makes students accustomed to carrying out logical and coherent thinking processes to process information and make decisions. Momentum and impulse packaged contextually through stories about facts of daily life also develop students' critical thinking skills. Thinking critically can develop because the students relate the knowledge they have acquired to their daily experiences [46].

The content presented in the e-module consists of four parts that facilitate four indicators of critical thinking skills. The first part is "The Facts" which aims to facilitate the indicators to analyze facts. This section presents various facts in everyday life related to momentum and impulse. The second part is "Let's Ask" which aims to facilitate the indicators in formulating problems. This section presents questions related to facts. The third part is "Let's Analyze" which is to facilitate the indicators to analyze arguments. This section describes the content that can guide students in developing arguments to answer the questions in "Let's Ask" part. The fourth part is "Let's Conclude" which is to facilitate the indicators to make conclusions. This section encourages students to draw conclusions answers to the questions in the "Let's Ask" part, with arguments made after studying the "Let's Analyze" part.

The process of building knowledge itself is essential in learning physics. Students will only truly understand and have competence in physics if they actively study, manage, digest, and formulate in their minds [47]. Student-centered learning also helps in assimilating the practice of disciplined character, providing valuable and meaningful learning, and following constructivist learning theory [48]. Therefore, learning physics independently and centering on students demands activeness from

these students.

E-module as an independent instructional material encourages students to try to understand the content so that their hard work character can grow. Furthermore, integrating the practice of Pancasila values in momentum and impulse provides an overview to students about the practice of implementing Pancasila in daily life as a source of forming the hard work character. This is follows Indra & Budimansyah's statement that the cultivation of Pancasila values can strengthen character [26]. There is an old debate on whether students sufficiently capture that value through role models or it needs to be taught directly. Lovat argues that students can catch value from a role model or environment, but the teachers' involvement in teaching values is essential [49]. That means the value does not only come from observing good examples in their environment, but the value needs to be taught by the teacher. One way is to present the practice of Pancasila values following the momentum and impulses textually through e-modules. This is follows the opinion of Fatkhurrohman & Kusuma that the value of the Pancasila character which is integrated with the subject matter makes students learn the content and learn related character values [50].

Pancasila is inseparable in the process of building Indonesia in a better direction. This is because Pancasila is used as a source of values and guidelines in living in this nation The practice of Pancasila values becomes a practical example in everyday life and becomes a direction for developing Indonesian people to achieve the noble ideals of the nation. Therefore, the values of Pancasila are considered exclusively to be practiced by Indonesian citizens in this context.

Mariana et al. stated that subject matter has intrinsic value. The intrinsic value is the value of life that can be integrated with the value of Pancasila [27]. Based on this, physics concepts are explored deeper to obtain the value of life following the practice of Pancasila values. For example, the momentum of an object can be defined as a measure of the difficulty of stopping the object. The greater the momentum of an object, the harder it is to stop the object. The lessons learned in the concept of momentum teach the importance of determination or enthusiasm in working hard. If someone has a strong determination or enthusiasm to work hard, then that person will be difficult to stop by the obstacles that are in the way. This is follows the practice of the 5^{th} point of the Pancasila precepts, which is working hard.

Another integration carried out is by combining the application of contextual physics concepts with the practice of Pancasila values. Himawan & Wilujeng stated that physics content can be packaged in the stories of everyday life and inserted with the appropriate implementation of Pancasila values [51]. Integrating physics with Pancasila values is not limited to presenting the content, but can be done on questions [52]. The questions are shown in story questions related to the practice of Pancasila values.

For example, the content in the news about Indonesian Army contenders winning international shooting competitions using domestically produced rifles. The shooting incident with a rifle is an application example of the law of conservation of momentum. The use of domestically produced rifles by TNI AD (Indonesian National Army) contenders provides a lesson that Indonesian people must be proud of their work which turns out to be able to lead the contingent to win the international shooting competition. This is following the practice of the 3rd precept, the 4th point, which is to be proud of being the Indonesian nation by glorifying its potential and its work. The hard work of the TNI AD contingent to win the competition can be integrated with the practice of the 5th precept, the 5th point, which is like working hard.

Students' hard work will improve their chances of future life [53]. The long-term goal of cultivating the character of hard work is that students are ready to face future challenges and short-term goals so that students do not give up easily when facing obstacles in the physics learning process. Students who have hard work character always try to solve the problems faced and can complete the physics subject assignments on time.

Based on the explanation above, know that the e-module integrated with practicing Pancasila values

on momentum and impulse effectively improves the students' critical thinking skills and hard work character. However, this study has limitations, including a pretest-posttest research design using essay questions and questionnaires. Further research would be better if added with an observation sheet to observe the development of the character of students' hard work in each learning activity. In addition, the use of e-modules as independent teaching materials is more suitable to be applied to a student-centered learning model. These learning activities emphasize discussion, tutoring, mentoring, coaching, and scaffolding activities [54]. This activity will encourage students to be able to build their knowledge.

CONCLUSION AND SUGGESTION

The results showed differences in critical thinking skills and hard work character between the experimental class and the control class based on Hotelling's Trace test. The mean difference in critical thinking skills and hard work character in the experimental class is higher than in the control class. Besides, the partial eta square value of the experimental class shows the effective contribution of the treatment is higher than the control class. Based on these results, it can be concluded that the physics learning e-module integrated with practicing Pancasila values on momentum and impulse effectively improves students' critical thinking skills and hard work character. The recommendations based on this research are that students need to be given knowledge about independent learning first so that there are no difficulties when carrying out the learning process using independent instructional materials. In addition, further research will be better if it is added with observation sheets to observe the development of the character of students' hard work in each learning activity.

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