The Effect of Character and Local Wisdom-Integrated *Causalitic* Model Learning on Problem-Solving Skills and the Development of Environmental Conservation Literacy

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Abstract *- The study aims to examine the effect of a causalitic learning model that integrates character and local wisdom on problem solving ability (*PSA*) physics and environmental conservation literacy (ECL) development of students. The type of research used was quasi-experimental with an untreated control group design with pretest-and posttest. The population is all class X students of SMAN 1 Terara, totaling 206 people. The research sample was taken using purposive sampling technique so that 31 students from X MIPA 6 class were selected as the experimental group and 31 students from X MIPA 3 class as the control group. The experimental group was treated in the form of a causalitic learning model integrated with character and local wisdom, while the control group was treated in the form of a conventional learning model. The* PSA *instrument consists of tests in the form of descriptive questions taking into account validity, reliability, level of difficulty of the questions, as well as the differential power of the questions and ECL development tests in the form of questionnaires. The average* PSA *value obtained in the experimental group was 79,87 and in the control group was 72,39. The average score for the development of ECL in the experimental group was 80,00 and that of the control group was 42,58. The data of both classes are homogeneous and normally distributed. Data on* PSA *and development of ECL were analyzed using t-test polled variance with a significant level of 5%. The results of the* PSA *analysis were obtained at 4,32 and the results of the ECL development analysis were obtained at 10,94. Thus, it can be concluded that there is an influence of the integrated causalitic learning model of character and local wisdom on* PSA *and the development of ECL.*

Keywords: *Causalitic; Character; Local wisdom; Problem solving ability; Environmental conservation literacy*

INTRODUCTION

In the 21st century, science and technology are rapidly advancing, demanding individuals to possess skills to cope with the swift developments in the world. According to Dewantara (2021), the education system in the 21st century expects both students and teachers to actively contribute to providing quality education. 21st-century education is required to prepare students for learning and innovation. The challenges of the 21st century is substantial due to the fast-paced and dynamic world development, making it essential for students to be equipped with abilities and skills.

Problem-solving skills (PSS) are among the 21st-century skills that students must possess. According to Venisari et al. (2015), problem-solving skills are high-level cognitive abilities. Aji et al. (2017) state that PSS is crucial in physics education because the goal is not only understanding concepts but also how students connect one concept to another. Physics provides students with the foundation to solve problems in their daily lives.

Physics education aims to develop students' knowledge, understanding, and analytical skills related to their environment. Students are expected to not only grasp physics concepts but also apply these concepts to solve physics problems.

However, physics education in the classroom often neglects students' problem-solving skills. According to Azizah et al. (2015), students' PSS in solving physics problems given by teachers is still relatively low. This occurs because students tend to directly use mathematical equations without prior analysis, memorizing provided formulas.

The application of physics concepts is frequently encountered in the surrounding environment. Learning about environmental conservation is crucial in education because environmental literacy is vital for students. Environment-related learning can instill an awareness in students to preserve the environment and provide more meaningful learning experiences. However, students' awareness of the importance of environmental conservation is still low and needs improvement. According to Haske & Wulan (2015), environmental literacy is an individual's knowledge and understanding of environmental aspects, principles occurring in the environment, and the ability to take action to preserve environmental quality. Anggraini & Nazip (2022) state that the cumulative level of environmental literacy among Indonesian students still needs improvement, indicating a low level of environmental concern within the average Indonesian society.

The results of observations at SMAN 1 Terara for the academic year 2022/2023 indicate that physics learning is still not highly favored by students. A majority of students perceive physics as a challenging subject that is not easily understood. According to student surveys, physics learning is seen as focusing solely on formulas, leading to low interest and poor problem-solving abilities.

Interviews with physics teachers and surveys of students' problem-solving skills (PSS) in physics learning show that students' PSS is still relatively low because they struggle to solve physics problems. This is attributed to teachers using instructional methods that are teacher-centered, limiting students' opportunities to process, construct, and define concepts on their own based on their existing knowledge. Students often solve physics problems by directly asking teachers for solutions, and they memorize formulas rather than analyzing the problems first. As a result, students' PSS is sidelined, with teachers focusing primarily on concept mastery. During the learning process, students tackle problems without analyzing the issues beforehand, leading to a decline in their PSS and affecting their physics learning outcomes.

Environmental conservation literacy (ECL) at SMAN 1 Terara, based on observations and teacher statements, indicates that students still lack environmental awareness. Students often dispose of waste improperly, and this lack of awareness stems from the insufficient integration of environmental education into the curriculum.

To address these issues, teachers need solutions to develop students' PSS and ECL. According to Tamami et al. (2017), to enhance problem-solving skills, there is a need for methods that encourage students to think broadly in solving problems with varied answers.

One effort is selecting an appropriate learning model. The *causalitic* learning model is one that can improve students' PSS in physics. According to Sari et al. (2020), the application of the *causalitic* learning model enhances students' PSS and trains them to solve *causalitic* problems. Rokhmat (2013) suggests that the *causalitic* thinking approach in learning provides students with *causalitic* and analytical thinking abilities. The *causalitic* learning model is designed to guide students in learning that emphasizes skill development, analyzing cause-and-effect elements in phenomena, and constructing arguments to explain the causes leading to specific effects (Rokhmat et al., 2020).

Environmental conservation literacy (ECL) can be developed by integrating character and local wisdom into the *causalitic* learning model. Hunaepi et al. (2018) state that integrating local wisdom into education makes students appreciate local culture, builds their character, stimulates curiosity, and fosters a desire to solve problems through critical thinking. Additionally, according to Lestari & Yuliana (2014), character education, especially environmental care, can make students more environmentally conscious and capable of preserving the environment. One of the functions of local wisdom is conservation and preservation of natural resources (Maridi, 2015).

Each learning model has its strengths and weaknesses. According to Anshori et al. (2019), the *causalitic* learning model has five advantages: 1) training students to analyze physics phenomena, 2) understanding concepts comprehensively, 3) critical and synthesis thinking, 4) divergent thinking, and 5) solving problems based on physics concepts. Sari et al. (2020) point out that obstacles to implementing the *causalitic* learning model include students' lack of familiarity with it and difficulty understanding the taught phenomena. Thus, real-world physics phenomena are needed to help students comprehend physics concepts. Integrating character and local wisdom into the *causalitic* learning model can facilitate students' understanding and utilization of existing culture, enhance their character, and develop their ECL.

Through the implementation of the *causalitic* learning model integrated with character and local wisdom, it is expected to enhance students' problem-solving abilities (PSA) and develop their environmental conservation literacy (ECL). Furthermore, physics learning is no longer perceived as solely focusing on formulas by students, as they can analyze physics phenomena in their environment. Students become more active in learning activities, and teachers can develop creativity by varying teaching models and methods.

Given the background issues outlined, this motivates the researcher to conduct a study on the impact of the *causalitic* learning model integrated with character and local wisdom. The aim is to identify whether this teaching model influences students' physics problem-solving abilities and the development of environmental conservation literacy among students.

RESEARCH METHODS

The research design employed in this study is quasi-experimental, specifically utilizing the untreated control group design with pretest and posttest measurements.

Group	***Pre-test***	**Treat**	***Post-test***
Experimental	O_1	√	O_2
Control	O_3		O_4

(Setyosari, 2013)

The experimental group received treatment with the *causalitic* learning model consisting of four phases: (1) Orientation Phase, (2) Exploration and Development of Causality Concepts, (3) Argumentation Compilation Phase, and (4) Evaluation Phase. Additionally, it included changes in character and local wisdom issues. The control group, on the other hand, received treatment with a conventional learning model.

The population for this research comprised all 10th-grade students at SMAN

1 Terara for the academic year 2022/2023. Sample selection was done using purposive sampling, resulting in Class X MIPA 6 as the experimental group and Class X MIPA 3 as the control group, with 31 students in each class.

Data collection techniques for Problem-Solving Abilities (PSA) included a written test with four open-ended questions, while Environmental Conservation Literacy (ECL) was assessed using a questionnaire with 10 items. The scores were obtained from the post-test, and the assessment technique involved accumulating the scores for each PSA indicator and ECL.

The Problem-Solving Abilities (PSA) indicators include:

1. **Understanding**: the ability to comprehend thoughts or ideas in the questions.
2. **Selecting**: the ability to choose causes and predict various possible effects related to the conditions or phenomena presented.
3. **Differentiating**: the ability to distinguish and select causes that can have specific effects or become factors in a particular effect.
4. **Determining**: the ability to define concepts, principles, theories, and laws of physics that can be used to identify some causes to produce a specific effect.
5. **Applying**: the ability to use concepts, theories, and laws of physics needed to identify causes to produce a specific effect.
6. **Identifying**: the ability to identify the conditions causing a specific effect.

The test and questionnaire instruments underwent validity testing, reliability testing, difficulty level assessment, and discrimination power assessment before being used in the study. Hypothesis testing in this research utilized the t-test with a significance level of 5%.

RESULTS AND DISCUSSION

Results of PSA

The homogeneity test used is the variance test or F-test (Sugiyono, 2013). The results of the homogeneity test for the experimental group and the control group can be seen in Table 1.

Table 1. The Result of homogeneity Test on PSA

Group	N	Variants	F_{count}	F_{table}	Ket
Experimental	31	42,12	1,11	1,84	Homogen
Control	31	51,65			

The normality test is conducted to determine whether the test data is normally distributed or not. The technique for testing the normality of the data is determined using the chi-square test (Sugiyono, 2017). The results of the normality test for the students' PSA can be seen in Table 2.

Table 2. The Results of Normality Test on PSA

Group	N	db	x^2_{table}	x^2_{count}	Exp
Experimental	31	5	11,070	9,7725	Normal
Control	31			9,0599	Normal

The hypothesis test used is a two-sided t-test at a 5% significance level, which is a hypothesis that does not indicate a specific direction with the alternative hypothesis using a parameter statistic, namely the t-test pooled variance (Sugiyono, 2013).

Table 3. The Results of hypothesis test on PSA

Group	N	Average Score	Variants	dk	t_{count}	t_{table}
Experimental	31	79,87	42,12	60	4,32	2,00
Control	31	72,39	51,65			

Results of Developing Environmental Conservation Literacy (ECL)

Homogeneity test for ECL in the experimental and control groupes can be seen in Table 4.

Table 4. The Result of homogeneity Test on ECL

Group	N	Variants	F_{count}	F_{table}	Ket
Experimental	31	186,66	1,04	1,84	Homogen
Control	31	179,78			

The normality test for students' Environmental Conservation Literacy (ECL) can be seen in Table 5.

Table 5. The Results of Normality Test on ECL

Group	N	db	x^2_{table}	x^2_{count}	Exp
Experimental	31	5	11,070	5,2654	Normal
Control	31			5,0900	Normal

The results of the hypothesis test for Environmental Conservation Literacy (ECL) at a significance level of 5%, using the working hypothesis with the parameter statistics, namely the t-test with pooled variances, can be seen in Table 6.

Tabel 6. The Results of hypothesis test on ECL

Group	N	Average Score	Variants	dk	t_{count}	t_{table}
Experimental	31	80,00	186,66	60	10,94	2,00
Control	31	42,58	179,78			

Discussion

Problem-Solving Abilities (PSA)

Based on the hypothesis test results, it is found that there is an influence of the integrated *causalitic* learning model with character and local wisdom on the Physics Problem Solving Ability (PSA) of students in class X MIPA 6 at SMAN 1 Terara. It is proven that the average score of the experimental group is higher than the average score of the control group after treatment in both classes. The average scores for the experimental and control groupes can be seen in Figure 1.

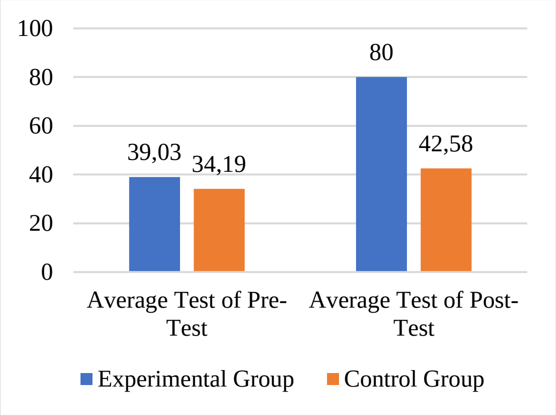

Figure 1. The Average Score of PSA

It can happen because the integrated *causalitic* learning model with character and local wisdom involves students actively and optimally in learning. Thus, students can actively identify the causes in the phenomena related to Newton's laws of motion and produce an effect. It can train students to solve physics problems. This aligns with previous research conducted by Sari et al. (2020), stating that the application of the *causalitic* learning model improves students' physics problem-solving abilities and trains them to solve *causalitic* problems.

Learning that demands student involvement can significantly help improve students' problem-solving abilities. The research results are consistent with previous studies, such as the one conducted by Wulandari (2019), which stated that the correct application of the *causalitic* learning model can significantly improve students' problem-solving abilities.

In the first orientation stage, the researcher reviewed and discussed preliminary tasks done by students before the learning process, given to help students find information independently. The problem-solving ability trained in this first stage is understanding because students will try to understand the questions provided by the researcher.

The second stage is exploration and the development of causal concept, where students are required to explore, investigate, and analyze various causes that may produce an effect in the phenomena provided in the form of worksheets integrated with character and local wisdom. The problem-solving ability trained in this second stage includes selecting, i.e., students' ability to choose causes and predict various possible effects that may arise in worksheets. The second indicator is differentiating, or the ability to distinguish and select causes that can cause specific effects or become factors of a particular effect.

The third stage is argumentation, where students are asked to compile arguments about problem-solving in the worksheets, explaining how each effect obtained can be related to each combination that becomes the cause by including concepts, principles, theories, and/or laws of physics related to Newton's laws of motion. Students are trained for determination and application in this stage, as they are trained to apply concepts, principles, theories, and/or laws of physics used to support the identification of causes that result in an effect on worksheets.

In this stage, students still have difficulty applying concepts, principles, theories, and/or laws of physics to associate them with the causes that result in an effect, making time allocation the most significant constraint felt by the researcher in conducting the learning. Students spent too much time compiling arguments, and this became less optimal in the implementation of the next stage due to time constraints.

The fourth stage is evaluation, where students are facilitated to align perceptions and revise incorrect perceptions of Newton's laws of motion. The problem-solving ability trained in this stage is identification, i.e., the ability to identify the conditions that cause a particular effect. From this stage, students are able to draw conclusions.

Based on the above discussion, the research results indicate that applying the integrated *causalitic* learning model with character and local wisdom can be an alternative in physics learning. Moreover, based on relevant research presented in the background and the data analysis, it is proven that applying the integrated *causalitic* learning model with character and local wisdom has a significant effect on students' physics problem-solving abilities in Newton's laws of motion.

Environmental Conservation Literacy ECL

The application of the *causalitic* learning model integrated with character education and local wisdom can help students improve their environmental conservation literacy (ECL). This is evidenced by an increase in ECL scores, especially in the experimental group that received treatment with the integrated *causalitic* learning model with character education and local wisdom. The average scores for the experimental group and the control group can be seen in Figure 2.

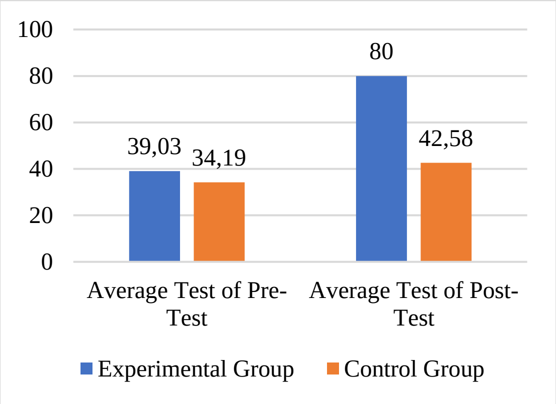

Figure 2. The Average Score of ECL

In the experimental group, the average scores of students experienced a very significant improvement because, in each session, students were consistently provided with lessons related to local wisdom and character education. For instance, in LKPD-1, the researcher integrated the local wisdom found at Selong Belanak Beach. It is known that Selong Belanak Beach is one of the famous beaches in Central Lombok known for its beauty. The researcher then posed questions and statements emphasizing the importance of preserving nature and marine ecosystems. In LKPD-1, there was also a character education aspect promoting mutual assistance. Good character involves knowledge of kindness and a desire to do good. By instilling good character and knowledge of local wisdom, students develop awareness of the environment and a desire to protect it.

In the control group, the average scores of students remained low with only slight improvement. The application of conventional learning models had less impact on the development of environmental conservation literacy (ECL) in students because the learning was not connected to local wisdom and character education.

Based on the hypothesis testing conducted, the results indicate that there is an influence of the integrated *causalitic* learning model with character and local wisdom on the development of ECL in the students of X MIPA 6 SMAN 1 Terara. This can occur because the integrated *causalitic* learning model with character and local wisdom provides direct examples of local wisdom and character education, enabling students to comprehend valuable information about the importance of environmental protection. According to Ilhami (2019), environmental literacy can be defined as awareness of the environment or activities based on environmental protection. From the post-test data in the experimental group, students already have awareness of the environment and a desire to preserve it, indicating that learning with the *causalitic* model integrated with character and local wisdom influences the development of ECL in students.

In conclusion, the research results show that the application of the *causalitic* learning model, especially when integrating character education and local wisdom, can be considered an alternative in physics education. Learning becomes more enjoyable by integrating character education and local wisdom known to the students. Thus, based on the data analysis, it is evident that the application of the integrated *causalitic* learning model with character and local wisdom significantly influences the development of students' environmental conservation literacy.

CONCLUSION

Based on the results of the research conducted at SMAN 1 Terara, data analysis, hypothesis testing at a significance level of 5%, and discussion, it can be concluded that there is an influence of the *causalitic* integrated character and local wisdom learning model on students' physics problem-solving abilities (PSA) and the development of environmental conservation literacy (ECL). The *causalitic* learning model, integrated with character and local wisdom, can be applied in physics learning, considering various aspects, including time allocation during learning. It is advisable to simulate this learning model to students before full implementation so that they can become familiar with it, creating an enjoyable learning experience.

Suggestion

Based on the research results, the researcher provides several recommendations as follows:

Firstly, clearly define time constraints during the argumentation phase to ensure that subsequent stages can be carried out optimally, leading to maximum results in both problem-solving skills and the development of environmental conservation literacy. Secondly, for future researchers, during the development of research instruments, it is recommended to establish connections between character, local wisdom, and physics concepts. This approach will enable the research to proceed smoothly in line with the intended goals. Thirdly, future researchers are encouraged to conduct simulations with the *causalitic* learning model for students before implementing the research. This step will contribute to a smoother implementation of the *causalitic* learning model and data collection, creating an enjoyable learning experience.

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