International Journal of Contextual Science Education (IJCSE)
e-ISSN.
Vol. 2, No. 1, March 2025
pp. 30-38.

The Influence of Integrated Causalytic Learning Model of Local Wisdom on Mastery of Concepts and Environmental Literacy on Global Warming Material of Grade X Students

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Accepted: March 10th 2025, Approved: April 10th 2025, Published: April 22nd 2025

Abstract— The physics learning process is generally teacher-centered and provides less opportunity for students to think openly. This learning results in low mastery of concepts and environmental literacy of students. This study aims: (1) to examine the effect of causalytic learning model the integrated with local wisdom on the mastery of concepts on global warming material students class X, (2 to examine the effect of causalytic learning model the integrated with local wisdom on the environmental literacy on global warming material students class X, (3) to examine the effect of causalytic learning model the integrated with local wisdom on the mastery of concepts and environmental literacy on global warming material students class X. This study is a quantitative study with a quasi-experimental research type. The research design used is a pretest-posttest control group design. The population in this study were all class X students at SMAN 1 Lembar in the 2024/2025 academic year, totaling 229 students and divided into 7 classes. The sampling technique used random sampling so that class X-1 students were selected as the experimental class with a total of 28 students who were given treatment in the form of a causal learning model integrated with local wisdom and class X-3 students as the control class with a total of 27 students who were given treatment in the form of conventional learning. The data collection tool consisted of a concept mastery test in the form of descriptive questions and an environmental literacy questionnaire by considering the results of the validity, reliability, difficulty level, and discriminatory power tests, so that six descriptive questions and 20 questionnaire statement items were obtained. Before the hypothesis test was carried out, a hypothesis prerequisite test was first carried out, namely the normality test and the homogeneity test. Based on the data analysis, the average value of the final concept mastery test results in the experimental class (81.11) with the criteria "Good" and the control class (76.93) with the criteria "Good". The results of the environmental literacy data analysis showed that the average value of students in the experimental class (82.11) with the criteria "Good" and the control class (76.11) with the criteria "Good". The research hypothesis was analyzed using the MANOVA test, so that the results obtained H_{a1} were $0{,}039 \leq 0{,}05$: H_{a2} namely $0{,}008 \leq 0{,}05$, and H_{a3} namely $0{,}01 \leq 0{,}05$ then H_0 rejected and H_a accepted. Thus, it can be concluded that there is an influence of the integrated causal learning model of local wisdom on the mastery of environmental concepts and literacy in the global warming material of class X students.

Keywords— Local Wisdom, Environmental Literacy, Causal Learning Model, Concept Mastery, Global Warming.
How to Cite— Ummah, N. C., Rokhmat, J., Verawati, N. N. S. P., & Zuhdi, M. (2025). The Influence of Integrated Causalytic Learning Model of Local Wisdom on Mastery of Concepts and Environmental Literacy on Global Warming Material of Grade X Students. International Journal of Contextual Science Education, 2(1), 30–38. https://doi.org/10.29303/ijcse.v2i1.933

1. Introduction

Indonesian society in facing the 21st century must be able to keep up with the demands and challenges of the times so that life can develop, one of which is efforts in developing education (Angga *et al.*, 2022). 21st century learning has the basic principle that learning must be centered on students, collaborative, contextual, and integrated with society (Zubaidah, 2016). One aspect of assessment in learning is mastery of concepts. Students will find it easier to understand the concepts learned if learning activities are contextual, based on real examples seen or experienced by students themselves (Hikmawati *et al.*, 2022).

Verawati *et al.*, (2020) explained that mastery of concepts is an absolute requirement in achieving learning success, because it is a foundation for thinking and developing abilities and skills in learning. Mastery of concepts is not only limited to knowing concepts, but students must be able to connect one concept with other related concepts. In line with this, Nisrina *et al.*, (2016) stated that students who develop mastery of concepts will be faster at doing things related to procedural knowledge compared to students who only memorize and remember. In addition, Murtiyasa and Sari (2022) also stated that the success of students in achieving learning targets can be increased by the ability of students to understand concepts well.

According to Anderson and Krathwohl (2017), concept mastery is part of knowledge, where knowledge is the first dimension of educational outcomes and cognitive is the dimension of that knowledge. Bloom's taxonomy in the cognitive domain

consists of 6 parts commonly known as C1 to C6, namely: C1 *remembering*, C2 *understanding*, C3 applying , C4 analyzing , C5 evaluating , and C6 creating .

Fajri *et al.,* (2019) revealed that the application of physics concepts is often found in the surrounding environment. Learning about environmental care needs to be applied to learning because environmental literacy is very important for students to have. In line with the opinion expressed by Al-maraghi *et al.,* (2017), the environment can also be a place to find new inspiration and knowledge. Learning that is integrated with the environment can make learning more meaningful for students in receiving learning in the classroom.

According to Sari *et al.,* (2020) in 21st century learning, environmental literacy has an important role as a supporter in contextual learning for students. Furthermore, Suryanto (2022) stated that the knowledge possessed by students actually comes from knowledge that is naturally obtained through their interaction with the environment. As expressed by Haske and Wulan (2015) environmental literacy is an individual's knowledge and understanding of environmental aspects, principles that occur in the environment, and the ability to take action to maintain the quality of the environment that is applied in the environment. According to Kusumaningrum and Muslihasari (2020) the components of environmental literacy that need to be considered in learning are knowledge about the environment, attitudes towards the environment, cognitive skills, and behavior towards the environment.

Agustin *et al.,* (2018) in their research revealed that local wisdom can improve students' environmental literacy. In line with this, Munandar *et al.,* (2022) stated that students' ability to understand learning will be much more effective if it is linked to their culture. Local wisdom-based learning aims to increase students' interest and love for their culture. Furthermore, Manao *et al.,* (2023) stated that learning will be more meaningful if there is continuity between the subject matter and daily life activities in the student's residential environment which are used as learning facilities and resources. Local wisdom according to Sudarmin (2018) is interpreted as the foundation of community or ethnic knowledge obtained through a certain approach and following procedures that are part of the community's culture and can be proven scientifically. One of the subjects that can be integrated into local wisdom is physics, because physics learning studies natural phenomena that are often observed by students.

One of the learning models that teachers can use to improve students' mastery of concepts and environmental literacy is to implement student-centered learning . Learning that involves students can improve the quality of learning if students can actively participate in learning (Sari *et al.,* 2024). Therefore, innovation is needed in learning, especially in physics subjects. This innovation can be in the form of using the right learning model so that it can encourage students to play an active role in finding concepts during the learning process (Rerung *et al.,* 2017). A learning model is a conceptual framework that describes systematic steps in organizing learning experiences to achieve predetermined learning objectives (Rokhmat, 2023).

Based on the results of interviews conducted by researchers with physics teachers at SMAN 1 Lembar in the 2023/2024 academic year, it was found that teachers use the PBL *(problem based learning) learning model* in class. However, physics is still less popular with students. This is because students assume that physics is a difficult and challenging subject because of the many mathematical equations, resulting in low interest in learning physics among students and a lack of student ability in solving physics phenomena. The following presents data on the results of the Final Semester Assessment (PAS) of class X (ten) students in the 2023/2024 academic year in Table 1.

Table 1. Results of PAS Class X SMAN 1 Sheet Academic Year 2023/2024

Class	Number of Students	Average value	KKM
X-1	33	46	70
X-2	33	42	70
X-3	32	48	70
X-4	32	44	70
X-5	33	46	70
X-6	33	46	70

(Source: Academic Section of SMAN 1 Lembar)

Table 1 shows that the average value of the Final Semester Assessment (PAS) results in the physics subject of class X (ten) students has not yet reached the Minimum Completion Criteria (KKM). The KKM value set for the physics subject of class X (ten) at SMAN 1 Lembar is 70. This is because the mastery of physics concepts of students is still relatively low. Students who do not understand the concept from the beginning cause students to be left behind and unable to solve the phenomena presented. In line with the research of Aditya & Sutriyono (2018) which states that the aspect that causes students' errors in solving a phenomenon is that students do not understand the basic concept of a material.

The results of observations conducted by researchers at SMAN 1 Lembar show that the knowledge possessed by students regarding environmental literacy is still relatively low. This is due to the lack of integration of learning about the environment during learning. According to Mawarni and Miterianifa (2024), environmental awareness refers to an individual's understanding and recognition of the importance of protecting and preserving the environment. In the context of environmental literacy, literacy

refers to an individual's ability to understand, apply, and participate in issues that occur in the surrounding environment.

Based on these problems, a more effective learning model is needed to improve students' mastery of concepts and environmental literacy. According to Khairani (2024), Mahmudah (2022), Rokhmat (2023), the causal learning model is a learning model based on physics problems that rely on causal and analytical thinking skills. This model can facilitate learning activities that emphasize students' reasoning skills, so that students no longer consider physics to be a subject that focuses on formulas but rather emphasizes problem solving with scientific concepts rather than in the form of calculations.

Kurniati *et al.,* (2021) in their research revealed that during the causal thinking process, students will analyze a physics phenomenon. Meanwhile, in the analytical thinking process, students will rationalize several situations that cause a phenomenon to occur. According to Rokhmat (2023), the stages of learning activities in the causal learning model consist of 4 learning phases, namely: (1) Orientation phase, (2) Exploration and concept development phase, (3) Argument development phase, and (4) Evaluation phase. However, this causal learning model cannot run independently because it requires a context that is relevant to the lives of students. Therefore, this model is combined with local wisdom to make it easier to understand, apply, and have a real impact on learning. Local wisdom provides a cultural foundation and real experience in supporting the causal and analytical thinking process, so that students can connect phenomena with everyday life. Based on the description presented, the researcher is interested in conducting further research with the title "The Influence of the Integrated Causal Learning Model of Local Wisdom on the Mastery of Environmental Concepts and Literacy in Global Warming Material for Grade X Students".

2. Method

This research is a quantitative research with a *quasi-experimental research type* . The research design used in this study is *a pretest posttest control group design* involving two classes as samples, namely the experimental class and the control class. This study involves independent variables, namely the integrated causal learning model of local wisdom and two dependent variables, namely concept mastery and environmental literacy. The research design can be seen in Table 2. below.

Table 2. Research Design

Class	*Pretest*	Treatment	*Posttest*
Experiment	O_1	X	O_2
Control	O_3	–	O_4

(Setyosari, 2020)

The population in this study was all grade X students at SMAN 1 Lembar in the 2024/2025 academic year, totaling 229 students and divided into 7 classes. The sampling technique used *random sampling* so that class X-1 was selected as the experimental class with 28 students who were given treatment in the form of a causal learning model integrated with local wisdom and class X-3 as the control class with 27 students who were given treatment in the form of conventional learning. Both classes were given treatment for three meetings with a time allocation of 90 minutes for each meeting or 2 teaching hours with global warming material.

The test instrument used was in the form of questions given in the form of *pretest* and *posttest* . The data collection tool consisted of a concept mastery test in the form of descriptive questions and an environmental literacy questionnaire by considering the results of the validity, reliability, difficulty level, and discriminatory power tests, so that six descriptive questions and 20 questionnaire statement items were obtained. Before the hypothesis test was carried out, the hypothesis prerequisite test was first carried out, namely the normality test and the homogeneity test.

Hypothesis testing in this study uses MANOVA test assisted by SPSS *version* 21 *software* . Before conducting the MANOVA test, a prerequisite test is first carried out, namely the *Levene's test* to determine the homogeneity of the data and *the Box's M test* to determine the homogeneity of the variance-covariance matrix. If after carrying out the two steps, homogeneous data is obtained, the hypothesis test can be continued using the MANOVA test.

3. Result and Discussion

This study aims: (1) to examine the influence of the integrated causal learning model of local wisdom on the mastery of concepts in the global warming material of class X students, (2) to examine the influence of the integrated causal learning model of local wisdom on environmental literacy in the global warming material of class X students, (3) to examine the influence of the integrated causal learning model of local wisdom on the mastery of concepts and environmental literacy in the global warming material of class X students. This study was conducted at SMAN 1 Lembar using two research samples, namely class X-1 as an experimental class with 28 students and class X-3 as a control class with 27 students. Students in the experimental class were given treatment with the integrated causal learning model of local wisdom, while conventional learning was applied in the control class. Both classes were given treatment for three meetings with a time allocation of 90 minutes for each meeting (1 meeting = 2 x

45 minutes). The material taught in both classes was global warming material.

Based on the data from the instrument trial results conducted in class XI MIPA 2 at SMAN 1 Lembar, it was obtained that the six questions on concept mastery were said to be valid and reliable. The results of the test on the level of difficulty of the questions showed that question number 1 was included in the "Easy" criteria, while questions number 2, 3, 4, 5, and 6 showed the "Moderate" criteria. The results of the discriminatory power test showed that questions number 1, 2, 3, 4, and 5 were included in the "Enough" criteria, while question number 6 was included in the "Good" criteria, so that the six questions on concept mastery were acceptable and worthy of being used as the initial test *(pretest)* and final test *(posttest)* in the study. The same results were obtained in the environmental literacy questionnaire with 20 statement items said to be valid and reliable so that they could be used as *the pretest* and *posttest* of the study.

3.1 Concept Mastery

The results of the initial test *(pretest)* of students' concept mastery in the experimental class and the control class are included in the low category. This can be seen from the average value of the concept mastery test in each class, namely the experimental class (52.42) with the highest value (78) and the lowest value (39), while the control class obtained an average value (44.74) with the highest value (72) and the lowest value (34), so it can be concluded that the values obtained by students in both classes are included in the "Very Poor" criteria. The low average value of *the pretest of* students' concept mastery can be caused by several things, including students not having received global warming material according to their level and students not being used to thinking openly in solving a phenomenon. According to Rahmawati *et al.*, (2015) this shows that both classes before being given treatment using the learning model still have the same initial abilities and are not significantly different.

The final test *(posttest)* was given to students in the experimental class and control class after being given the treatment. The experimental class was given treatment using a causal learning model integrated with local wisdom, while the control class was given treatment using conventional learning. The application of the causal learning model integrated with local wisdom in the experimental class gave better results on students' concept mastery compared to the control class which applied conventional learning. This can be seen in Table 3. and Figure 1. where it can be seen that the results of the concept mastery test showed a higher increase in the final test *(posttest)* in the experimental class compared to the control class. Results of the final test analysis *(posttest)* mastery of the concept that has been carried out, namely obtaining an average value in the experimental class of 81.11 with the highest value (95) and the lowest value (73), and the average value of the control class of 76.93 with the highest value (94) and the lowest value (61). Both classes are included in the "Good" criteria .

Table 3. Data from *the Pretest* and *Posttest* Results of Students' Mastery of Concepts in the Experimental and Control Classes

Test	Class	Amount Student (n)	Max Value	Min Value	Average	Criteria
Pretest	Experiment	28	78	39	52.43	Very less
	Control	27	72	34	44.74	Very less
Posttest	Experiment	28	95	73	81.11	Good
	Control	27	94	61	76.93	Good

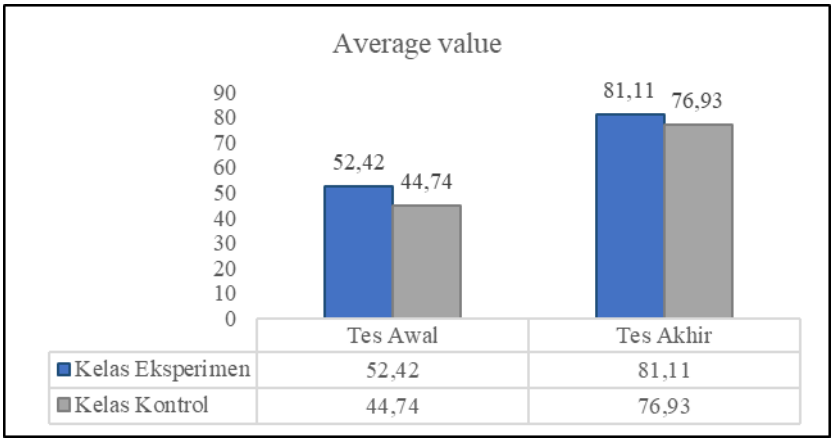

Figure 1. Average Value of Concept Mastery of Experimental Class and Control Class

Based on the results of the final test *(posttest)*, both classes experienced an increase when compared to the average score in the initial test *(pretest).* However, the experimental class obtained a higher average score than the control class. This can happen because the integrated causal learning model of local wisdom can involve students to be active and optimal in learning, so that

students can identify the causes of the phenomena in the global warming material and produce an effect and can train students to solve physics problems. This is supported by the opinion of Rokhmat (2023) who stated that the causal thinking process has five advantages, namely: 1) students will be trained to analyze physics phenomena, 2) understand concepts as a whole, 3) think critically and synthetically, 4) think divergently, and 5) answer problems based on physics concepts. The five advantages of the causal learning model above can facilitate the development of each indicator of concept mastery that is measured. The following is a percentage of *the pretest* and *posttest scores* for each indicator of concept mastery of students in the experimental and control classes in Table 4.

Table 4. Recapitulation of Percentage of *Pretest* and *Posttest* Scores for Each Level of Cognitive Concept Mastery of Students in the Experimental and Control Classes

Concept Mastery Indicator	***Pretest* Scores for Mastery of Concepts for Each Indicator**							
	Pretest				***Posttest***			
	Ex	**Criteria**	**K**	**Criteria**	**Ex**	**Criteria**	**K**	**Criteria**
C1	76.2	Good	74.1	Enough	100	Very good	98.7	Very good
C2	38.1	Very less	35.8	Very less	80.9	Good	67.9	Enough
C3	44.1	Very less	35.8	Very less	67.9	Enough	61.8	Enough
C4	40.5	Very less	39.5	Very less	65.5	Enough	67.9	Enough
C5	52.3	Very less	38.2	Very less	77.3	Good	80.3	Good
C6	61.9	Enough	43.2	Very less	91.7	Very good	85.2	Very good

Description: Ex: Experimental Class; K: Control Class.

Table 4 shows that the percentage of scores for each cognitive level of concept mastery is highest in the experimental class, namely in indicators C1 (100%) and C6 (91.7%) with the criteria of "Very Good", while C2 and C5 each obtained 80.9% and 77.3% with the criteria of "Good". The percentage of C3 and C4 is 67.9% and 65.5 with the criteria of "Enough".

Indicators with a high level of cognitive mastery of concepts, namely indicators C5 (evaluating) and C6 (creating) have a higher percentage score than indicators C3 (applying) and C4 (analyzing). This indicates that students have better abilities in understanding high-level cognitive levels *(high order thinking skills)* compared to low-level cognitive levels *(low order thinking skills).* This is because students in the experimental class understand the phenomena presented better because learning is integrated with local wisdom values such as woven fabrics, traditional houses, and pottery. In addition, students are also trained to solve causal problems in compiling arguments, so that students can solve problems in questions compared to the control class that is given treatment using conventional learning. As for indicators C3 (applying) and C4 (analyzing) , students have difficulty choosing each effect presented in the problem phenomenon. This is due to a lack of understanding of the concepts, principles, and theories in the material on global warming, resulting in students making mistakes in choosing each effect that is likely to occur and has an impact on the arguments given by students.

Furthermore, to find out the difference in the increase experienced by the two classes quantitatively and the influence of the given model, a hypothesis test needs to be conducted. However, before conducting a hypothesis test, first conduct a hypothesis prerequisite test, namely the homogeneity test and the normality test.

Table 5. Results of the Homogeneity Test of Concept Mastery in the Experimental Class and Control Class

Test	Class	Amount Student (n)	s^2	Average	Criteria	F_{hituna}	F_{tabel}	Information
Pretest	Experiment	28	120.62	52.42	Very less	1.23	1.90	Homogeneous
	Control	27	98.43	44.74	Very less			
Posttest	Experiment	28	56.35	79.79	Good	1,029	1.90	
	Control	27	54.73	75.44	Good			

Table 6. Results of the Normality Test of Concept Mastery in the Experimental Class and Control Class

Test	Class	Amount Student (n)	dk	Average	Criteria	X^2_{tabel}	X^2_{hituna}	Information
Pretest	Experiment	28	5	52.25	Very less	11,070	9,565	Normally Distributed
	Control	27		45.3	Very less		6,367	
Posttest	Experiment	28	5	81.36	Good	11,070	3,354	
	Control	27		75.5	Good		3,820	

Table 5. Shows that the values obtained for F_{hitung}each test, namely the *pretest* data (1.23) and *posttest* (1.029). Both produce results $F_{hitung} \leq F_{tabel}$, so that it can be concluded that the two classes are said to be homogeneous.

Table 6. shows that the value χ^2_{hitung} on *The pretest of* the experimental class and the control class were 9.565 and 6.367 respectively, while the *posttest results* of the experimental class and the control class were 3.354 and 3.820, so it can be concluded that these results indicate that $\chi^2_{hitung} \leq X^2_{tabel}$ *the pretest* and *posttest* data in both classes are normally distributed.

Hypothesis testing is carried out after the hypothesis prerequisite test, namely the normality test and the homogeneity test. Based on the results of the hypothesis prerequisite test analysis, it was found that the data in both classes were said to be homogeneous and normally distributed so that the hypothesis test could be continued. In this study, the hypothesis test used by the researcher was the MANOVA test assisted by SPSS *Version 21 software* . The following are the results of the hypothesis test in Table 7.

Table 7. Results of Concept Mastery Hypothesis Test

Significance	Significance Level	Information
0.039	0.05	H_a *diterima*

Table 7 shows that **the first alternative hypothesis** $(H_{a1})$is accepted. Based on the hypothesis test that has been carried out, the results obtained are $0{,}039 \leq 0{,}05$, so it can be concluded that there is an influence of the integrated causal learning model of local wisdom on the mastery of concepts in the global warming material of class X students . The increase in students' mastery of concepts after being given treatment is because the application of this integrated causal model of local wisdom is able to increase student learning activities where students are trained to solve causal problems and require more than one answer. In addition, local wisdom integrated into learning can also increase students' interest and interest in learning because the phenomena presented are closely related to everyday life, such as traditional houses, woven fabrics, and pottery.

Based on the discussion above, the results of the study indicate that the application of a causal learning model integrated with local wisdom can be used as an alternative in physics learning. This is supported by Anshori (2019) who stated that the application of a causal learning model in the experimental class made students' mastery of concepts develop better. This can happen because in causal learning activities, students are trained to think causally and analytically. In line with the opinion of Rokhmat (2023) who explained that the causal thinking approach is centered on student activities. Student activities in the experimental class took place when students completed the Student Worksheet (LKPD) and during discussion activities, so it can be concluded that the causal learning model integrated with local wisdom has proven to be more effective in improving concept mastery and can be used as an alternative in physics learning.

3.2 Environmental Literacy

The results of the initial test *(pretest)* of environmental literacy of students in the experimental class and the control class are included in the low category. This can be seen from the average value of environmental literacy skills of the two classes, namely in the experimental class of 57.107 with the highest value (73) and the lowest value (30) and the control class obtained an average value of 57.111 with the highest value (73) and the lowest value (29), so it can be concluded that the values obtained by students in both classes are included in the "Poor" criteria. The low average value of the environmental literacy *pretest* of students can be caused by several things, including students have not received global warming material according to their level and students are not used to thinking openly in solving a phenomenon. According to Rahmawati *et al.,* (2015) this shows that both classes before being given treatment using the learning model still have the same initial abilities and are not significantly different.

Furthermore, both classes were given a final test *(posttest)* after both classes were given different treatments, namely the experimental class was given treatment using a causal learning model integrated with local wisdom, while the control class was given treatment using conventional learning. The average *posttest score* for environmental literacy in the experimental class was 82.11 with the highest score (97) and the lowest score (69), while the control class obtained an average score of 76.11 with the highest score (92) and the lowest score (60). Both classes are included in the "Good" criteria, but when viewed based on the average score of students, the experimental class has a higher average score than the average score of students in the control class. This shows that the treatment given to the experimental class using a causal learning model integrated with local wisdom has proven to be more effective in improving environmental literacy compared to the conventional learning model in the control class.

The application of the integrated causal learning model of local wisdom in the experimental class gave better results on students' environmental literacy skills compared to the control class which applied conventional learning. This can be seen in Table 8. And Figure 2. where it can be seen that environmental literacy showed a higher increase in the final test *(posttest)* of the experimental class compared to the control class.

Table 8. Data on the Results of *the Pretest* and *Posttest* of Environmental Literacy of Students in the Experimental and Control Classes

Test	Class	Amount Student (n)	Max Value	Min Value	Average	Criteria
Pretest	Experiment	28	73	30	57,101	Not enough
	Control	27	73	29	57,111	Not enough
Posttest	Experiment	28	97	69	82.11	Good
	Control	27	92	60	76.11	Good

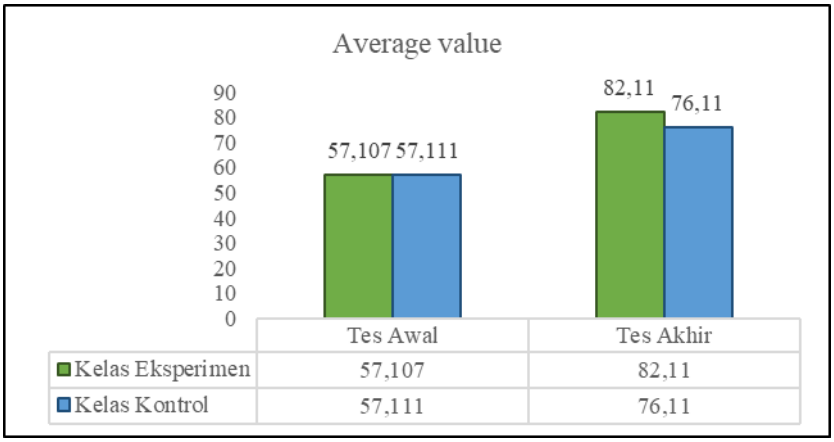

Figure 2. Average Value of Environmental Literacy of Experimental Class and Control Class

The application of the integrated causal learning model of local wisdom can help students improve environmental literacy. This is evidenced by the average value of the final test *(posttest)* of students' environmental literacy increasing, especially in the experimental class that was treated with the integrated causal learning model of local wisdom, while in the control class the average value of students was still low and only had a slight increase. The application of conventional learning models has little effect on students' environmental literacy because learning is not associated with local wisdom. According to Ilhami (2019), environmental literacy can be interpreted as awareness of the environment or activities based on environmental protection.

Pretest and *posttest* scores for each environmental literacy indicator for students in the experimental and control classes in Table 9.

Table 9. Recapitulation of Percentage of *Pretest* and *Posttest* Scores for Each Environmental Literacy Indicator for Students in the Experimental and Control Classes

Environmental Literacy Indicators	Environmental Literacy *Pretest* Scores for Each Indicator							
	Pretest				*Posttest*			
	Ex	Criteria	K	Criteria	Ex	Criteria	K	Criteria
(ILL-1)	62.4	Enough	60.5	Enough	79.2	Good	77.8	Good
(ILL-2)	57.8	Not enough	52.5	Very less	86.4	Very good	75.8	Good
(ILL-3)	54.5	Not enough	56.2	Not enough	82.3	Good	75.9	Good
(ILL-4)	53.5	Not enough	50.8	Very less	80.4	Good	64	Enough

Description: Ex: Experimental Class; K: Control Class.

Furthermore, to find out the difference in the increase experienced by the two classes quantitatively and the influence of the given model, a hypothesis test needs to be conducted. However, before conducting a hypothesis test, first conduct a hypothesis prerequisite test, namely the homogeneity test and the normality test.

Table 10. Results of the Environmental Literacy Homogeneity Test for the Experimental Class and Control Class

Test	Class	Amount Student (n)	s^2	Average	Criteria	F_{hituna}	F_{tabel}	Information
Pretest	Experiment	28	119.58	57,101	Not enough	1.21	1.90	Homogeneous
	Control	27	145.41	57,111	Not enough			
Posttest	Experiment	28	66.32	82.11	Good	1.06	1.90	
	Control	27	62.11	76.11	Good			

Table 10. Shows that the values obtained in F_{hitung}each test, namely the *pretest* data (1.21) and *posttest* (1.06). Both produce results $F_{hitung} \leq F_{tabel}$, so that it can be concluded that the two classes are said to be homogeneous.

Table 11. Results of the Environmental Literacy Normality Test for the Experimental Class and Control Class

Test	Class	Amount Student (n)	dk	Average	Criteria	X^2_{tabel}	χ^2_{hituna}	Information
Pretest	Experiment	28	5	56.93	Not enough	11,070	8,592	Normally Distributed
	Control	27		57.39	Not enough		10,379	
Posttest	Experiment	28	5	82.25	Good	11,070	3,932	
	Control	27		76.28	Good		1.41	

Hypothesis testing is carried out after the hypothesis prerequisite test, namely the normality test and the homogeneity test. Based on the results of the hypothesis prerequisite test analysis, it was found that the data in both classes were said to be homogeneous and normally distributed so that the hypothesis test could be continued. In this study, the hypothesis test used by the researcher was the MANOVA test assisted by SPSS *Version 21 software* . The following are the results of the hypothesis test in Table 12.

Table 12. Results of Environmental Literacy Hypothesis Testing

Significance	Significance Level	Information
0.008	0.05	H_a *diterima*

Table 12 shows that **the second alternative hypothesis** $(H_{a2})$is accepted. Based on the hypothesis test that has been carried out, the results obtained are $0{,}008 \leq 0{,}05$. These results indicate that the application of the integrated causal learning model of local wisdom has an effect on increasing students' environmental literacy. The increase in students' environmental literacy after being given treatment is because the application of the integrated causal model of local wisdom is able to increase students' learning activities where students are trained to solve causal problems. In addition, the value of local wisdom integrated into learning can also increase students' interest in learning because the phenomena presented are closely related to everyday life, such as traditional houses, woven fabrics, and pottery. Based on the discussion and research results, it shows that the application of the integrated causal learning model of local wisdom can be used as an alternative in physics learning.

3.3 Hypothesis Testing

Hypothesis testing is carried out after the hypothesis prerequisite test, namely the normality test and the homogeneity test. Based on the results of the analysis of the prerequisite analysis test, it was found that the data were normally distributed and homogeneous so that the hypothesis test could be continued. In this study, the hypothesis test used by the researcher was the Manova test using the SPSS *Version* 21 program. The data tested were data on the mastery of concepts and environmental literacy of students in the experimental class and the control class. The MANOVA test is a statistical technique used to calculate the significance test of the average difference simultaneously between groups for two or more dependent variables (Purnomo *et al.*, 2022). The following is the Manova test results data in Table 13.

Table 13. MANOVA Test Results

Significance	Significance Level	Information
0.01	0.05	H_a *diterima*

Based on Table 13. Shows that **the third alternative hypothesis**(H_{a3}) accepted. Based on the hypothesis test that has been conducted, the results obtained are a significance value of 0.01 which is smaller than the significance level $\alpha = 0{,}05$ or $0{,}01 \leq 0{,}05$. These results indicate that there is an influence of the integrated causal learning model of local wisdom on the mastery of environmental concepts and literacy in the global warming material of class X students.

4. Conclusion

Based on the results of the research conducted at SMAN 1 Lembar, referring to the results of the hypothesis testing as described previously, several conclusions can be drawn. **First,** there is an influence of the integrated causal learning model of local wisdom on the mastery of concepts in the global warming material of class X students. **Second,** there is an influence of the

integrated causal learning model of local wisdom on environmental literacy in the global warming material of class X students. **Third,** there is an influence of the integrated causal learning model of local wisdom on the mastery of concepts and environmental literacy in the global warming material of class X students, so it can be concluded that the application of the integrated causal learning model of local wisdom can be used as an alternative in learning.

Acknowledgment

All praise and gratitude to the presence of Allah SWT for all the blessings of health and smoothness so that the author can complete this research. Thank you to my beloved parents, extended family, and friends who always pray and give support. The author also expresses gratitude to the supervisor who has guided and directed the author in completing this research. The researcher also expresses gratitude to the principal, teachers, staff, and students of SMAN 1 Lembar who have supported the implementation of this research.

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