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THE RELATIONSHIP BETWEEN LEARNING EXPERIENCES ON ENVIRONMENTAL CHANGE AND ENVIRONMENTAL LITERACY OF GRADE X HIGH SCHOOL STUDENTS

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Abstract. A learning experience is one of the key demands in science learning. Biology, as part of science, is also expected to help develop students' environmental literacy. This study aims to determine the relationship between learning experiences on environmental change materials and environmental literacy among grade X students of SMAN 1 Sleman, in the context of global warming. This study is an ex-post facto correlation study using mixed methods. The study was conducted at SMAN 1 Sleman with a sample of 130 grade X students. Data collection used a Likert-scale questionnaire, multiple-choice tests, and essays, supported by interviews with teachers and students. The data analysis technique in this study used descriptive statistical analysis and the Pearson Product-Moment correlation test. From the results of the correlation test, it was found that there was a positive and significant relationship between learning experiences on environmental change material and environmental literacy in the context of global warming. This study aims to provide insights into the relationship between learning experiences and students' environmental literacy. Teachers can use the results of this study as a basis for creating meaningful learning experiences for students.
Keywords: Environmental change, Environmental literacy, Learning experience

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INTRODUCTION

In today's era, environmental issues are a crucial topic. One of the environmental issues currently facing the world is climate change, often referred to as global warming. Global warming refers to the increase in Earth's temperature resulting from the trapping of solar heat energy in the Earth's atmosphere by layers of greenhouse gases, including methane (CH4), carbon monoxide (CO), chlorofluorocarbons (CFCs), and carbon dioxide (CO2) (Agustian et al., 2018). Global greenhouse gas observations conducted by the Global Atmospheric Watch (GAW) from January 1980 to April 2021 show an annual increase in greenhouse gas levels (BMKG, 2021). Furthermore, according to the 2018 greenhouse gas inventory report by the Ministry of Environment and Forestry, greenhouse gas emissions increased by 450,928 Gg CO2e compared to 2000 (KLHK, 2020).

The increase in global temperatures due to increased greenhouse gases will have several impacts, including changes in seasons and wind direction, which then lead to prolonged rainy and dry seasons. Prolonged rainy seasons can lead to flooding, while prolonged dry seasons can result in drought. Furthermore, rising global temperatures will also lead to the melting of polar ice,

resulting in increased sea levels and changes in ocean salinity. This condition impacts the habitats and ecosystems of animals at the poles and in the ocean (Wardhana, 2010). Therefore, concrete action is necessary to promote environmental awareness and mitigate the impact of global warming.

Environmental awareness is fundamental to preventing various environmental damages, particularly those caused by human activities (Santoso et al., 2021). However, according to data from the Indonesian Statistics Agency, the level of environmental apathy in Indonesia in 2017 was still relatively high, at 0.51, indicating that the public still lacks concern for the environment and its current environmental problems (Statistik, 2018). Therefore, fostering environmental awareness in children and adolescents is crucial to addressing current environmental issues (Stevenson et al., 2013).

Schools, as mandatory formal educational institutions, should develop various student competencies through the learning process (Cahyani & Pertiwi, 2024). Through the learning process, students can achieve new behavioural changes as a result of their experiences through interactions with their environment. One competency that needs to be developed to address the problem of global warming is environmental literacy. According to the North American Association for Environmental Studies, environmental literacy is an awareness and concern for the environment and its problems, grounded in knowledge, skills, and motivation to find solutions and prevent new problems from arising (Nugraha & Octavianah, 2020).

Environmental literacy comprises four key components: environmental knowledge, cognitive skills in addressing environmental problems, and attitudes and behaviours toward the environment (Prasetiyo, 2017). Environmental literacy is a crucial component of biology literacy that needs to be improved. Environmental literacy is part of the 21st-century interdisciplinary themes outlined by P21 and the American Association of Colleges of Teacher Education (AACTE) (Greenhill, 2010). However, in reality, environmental literacy currently receives insufficient attention in the teaching process. This finding is consistent with research by Widianingsih et al. (2017), which examined the environmental literacy level at SMA N 1 Sukoharjo and found that environmental literacy remains low. This condition is due to the inadequate implementation of optimal learning and the underutilisation of learning tools to promote environmental literacy. Another study by Nasution (2016), which examined the environmental literacy levels of tenth-grade high school students in Samboja, showed that one high school had a low level of environmental literacy. This result suggests that environmental literacy has not been a widely developed skill in learning (Aprilianti & Suratsih, 2023).

Learning about the environment under the 2013 curriculum is found in the topic "Environmental/Climate Change and Waste Recycling," which is taught in tenth-grade high school. By studying this material, students have gained learning experiences about the environment. These learning experiences are crucial for students because they make learning more meaningful, both in terms of the process and the outcomes (Saefi, et. al., 2025). Through these learning experiences, teachers can also enhance the quality of learning to help students reach their full potential (Megawati, 2018).

One school still implementing the 2013 curriculum for tenth-grade students, and being an Adiwiyata school, is SMA N 1 Sleman. As an Adiwiyata school, SMA N 1 Sleman has programs related to environmental awareness. However, based on the researcher's observations and educational practices, student learning outcomes have not yet led to the development of environmental literacy. To face the challenges of the 21st century and the growing problem of global warming, educators need to assess the extent to which students possess environmental

literacy skills, aiming to identify gaps in previous learning experiences.

Therefore, the objectives of this study were to determine: 1) an overview of students' learning experiences on environmental change, 2) the level of students' environmental literacy in the context of global warming, and 3) the relationship between learning experiences on environmental change and the environmental literacy of grade 10 students at SMAN 1 Sleman in the context of global warming. Understanding the relationship between learning experiences and environmental literacy is expected to inform the evaluation of learning activities in schools, thereby improving student learning experiences. Furthermore, this information is expected to shift teachers' paradigms regarding the importance of environmental literacy for students.

METHOD

This research is an ex post facto correlational study employing a combination method, also known as a mixed-methods approach. Ex-post facto research is a study used to examine causal relationships that were not anticipated by the researcher (Muliadi, 2020), as the activity/phenomenon being studied has already occurred (Sappaile, 2010). Meanwhile, the combination method, also known as the mixed method, is a research approach that combines quantitative and qualitative methods in a study to obtain more comprehensive, valid, reliable, and objective data (Cohen, et. al., 2018). This research was conducted at SMA N 1 Sleman on May 8-22, 2023. The research sample consisted of all grade X students at SMA N 1 Sleman, while the research population comprised grade X students from MIPA 1, MIPA 2, MIPA 3, and MIPA 5, totalling 130 students. The sample was taken using a purposive sampling technique. Data collection on learning experiences and environmental literacy, in terms of behavioural and attitudinal aspects, employed a Likert-scale questionnaire, whereas data collection on environmental literacy in the knowledge and cognitive skills aspects utilised multiple-choice and essay tests. The data analysis techniques used were descriptive statistical analysis and the Pearson Product-Moment correlation test.

RESULTS AND DISCUSSION

This study examines the level of learning experience and environmental literacy among class X MIPA students at SMA N 1 Sleman, as well as the relationship between these two variables. Data obtained through questionnaires, tests, and interviews are as follows.

Results

Learning Experience on Environmental Change Material

The learning experience questionnaire consists of 20 statements developed from 5 learning experience indicators based on the scientific approach in the 2013 curriculum, namely observing, asking, collecting information, processing information, and communicating. The statistical description of the research data on learning experiences related to environmental change materials is presented in Table 1.

Based on the statistical description of the research data on learning experiences related to environmental change materials, the level of student learning experience can be determined using Azwar's (2012) formula, as shown in Table 2.

Table 1. Descriptive analysis of learning experiences

N	Valid	130
	Missing	0
Mean		59.00
Median		59.00
Mode		60
Std. Deviation		6.219
Minimum		45
Maximum		79

Table 2. Level of learning experience

No	Interval Class	Frequency	Percentage	Category
1	68,32925 < X	7	5%	Very high
2	62,10975< X ≤ 68,32925	28	22%	High
3	55,89025 < X ≤ 62,10975	60	46%	Moderate
4	49,67075< X ≤ 55,89025	26	20%	Low
5	X ≤ 49,67075	9	7%	Very Low

Based on Table 1, it can be seen that the learning experience of environmental change material of students at SMA N 1 Sleman is mostly in the medium category with a percentage of 46% followed by the high category with a percentage of 22%, the low category 20%, the very low category 7% and the very high category 5%. Based on the scientific approach outlined in the 2013 curriculum, there are five aspects of the learning experience. The descriptive analysis and the level of learning experience in each aspect are presented in Table 3.

Table 3. Descriptive analysis of each aspect of the learning experience

	N	Minimum	Maximum	Mean	Std. Deviation
Observing	130	8	15	11.48	1.437
Asking	130	6	16	11.19	1.813
Gathering Information	130	7	16	12.12	1.619
Processing Information	130	8	16	12.22	1.596
Communicating	130	5	16	11.98	1.778
Valid N (*listwise*)	130				

Based on the statistical description of the research data on learning experiences with environmental change materials in each aspect, the level of students' learning experience in each aspect can be determined using Azwar's (2012) formula, as shown in Table 4.

Based on Table 4, it can be seen that of the five aspects of the learning experience, the aspect of collecting information has the largest number in the high and very high categories, namely 27% and 9%. Then followed by aspects of processing information, namely 26% and 8%. The very low and low categories are most common in the questioning aspect, namely 32% and 5%, followed by the very low and low categories, next is the communicating aspect, 25% and 5% and the observing aspect, which has a very low and low percentage of 22% and 7%.

Environmental Literacy in the Context of Global Warming

Environmental literacy variable data were obtained from an attitude and behaviour questionnaire consisting of 20 statements, which used a Likert scale, as well as a knowledge and cognitive skills test comprising 15 multiple-choice questions and five essay questions. A statistical description of the environmental literacy research data is shown in Table 5.

Table 4. Level of learning experience on environmental change material in each aspect

No	Aspect	Interval Class	Percentage	Category
	Observing	13,6355 < X	8%	Very high
		12,1985 < X ≤ 13,6355	15%	High
1		10,7615 < X ≤ 12,1985	48%	Moderate
		9,3245 < X ≤ 10,7615	22%	Low
		X ≤ 9,3245	7%	Very Low
	Asking	13,9095 < X	11%	Very high
		12,0965 < X ≤ 13,9095	15%	High
2		10,2835 < X ≤ 12,0965	37%	Moderate
		8,4705 < X ≤ 10,2835	32%	Low
		X ≤ 8,4705	5%	Very Low
	Gathering Information	14,5485 < X	9%	Very high
		12,9295 < X ≤ 14,5485	27%	High
3		11,3105 < X ≤ 12,9295	34%	Moderate
		9,6915 < X ≤ 11,3105	24%	Low
		X ≤ 9,6915	6%	Very Low
	Processing	14,514 < X	8%	Very high
	Information	12,918 < X ≤ 14,514	26%	High
4		11,322 < X ≤ 12,918	42%	Moderate
		9,726 < X ≤ 11,322	19%	Low
		X ≤ 9,726	5%	Very Low
	Communication	14,647 < X	8%	Very high
		12,869 < X ≤ 14,647	20%	High
5		11,091 < X ≤ 12,869	42%	Moderate
		9,313< X ≤ 11,091	25%	Low
		X ≤ 9,313	5%	Very Low

Table 5. Descriptive analysis of environmental literacy

N	Valid	130
	Missing	0
Mean		83.07
Median		83.00
Mode		80
Std. Deviation		6.594
Minimum		63
Maximum		103

Based on the statistical description of the environmental literacy research data, the level of environmental literacy among students can be determined using the Azwar (2012) formula, as shown in Table 6.

Table 6. Environmental literacy levels

No	Kelas Interval	Frekuensi	Persentase	Kategori
1	92,961 < X	10	8%	Very high
2	86,267 < X ≤ 92,961	26	20%	High
3	79,773 < X ≤ 86,267	59	45%	Moderate
4	73,179< X ≤ 79,773	26	20%	Low
5	X ≤ 73,179	9	7%	Very Low

Based on Table 6, it can be seen that the environmental literacy of Class X students of SMA N 1 Sleman is mostly in the medium category, with a percentage of 45% followed by the high and low categories, which have the same percentage of 20%, the very high category 8% and the very low category 7%. Environmental literacy comprises four aspects: knowledge, cognitive skills, attitudes, and behaviour. The following descriptive analysis of students' environmental literacy in each aspect is shown in Table 7.

Table 7. Descriptive analysis of each aspect of environmental literacy

		Attitude	Behavior	Knowledge	Cognitive Skills
N	Valid	130	130	130	130
	Missing	0	0	0	0
Mean		32.55	27.58	10.75	12.20
Median		33.00	28.00	11.00	12.00
Mode		34	26	12	12
Std. Deviation		2.768	2.787	2.172	2.544
Minimum		25	19	2	4
Maximum		40	34	15	18

Based on a descriptive analysis of each aspect of the learning experience, the students' learning experiences in each aspect can be categorised according to the scale proposed by Azwar (2012), as shown in Table 8.

Table 8. Environmental literacy levels in each aspect

No	Aspect	Interval Class	Percentage	Category
		14,008 < X	1%	Very high
		11,836 < X ≤ 14,008	42%	High
1	Knowledge	9,664 < X ≤ 11,836	30%	Moderate
		7,492 < X ≤ 9,664	18%	Low
		X ≤ 7,492	10%	Very Low
		16,016 < X	8%	Very high
		13,472 < X ≤ 16,016	18%	High
2	Cognitive Skills	10,928 < X ≤ 13,472	42%	Moderate
		8,384 < X ≤ 10,928	31%	Low
		X ≤ 8,384	2%	Very Low
		36,702 < X	7%	Very high
		33,934 < X ≤ 36,702	35,3%	High
3	Attitudes	31,166 < X ≤ 33,934	20%	Moderate
		28,398 < X ≤ 31,166	32,3%	Low
		X ≤ 28,398	5,3%	Very Low
		31,7605< X	8%	Very high
		28,9735 < X ≤ 31,7605	32%	High
4	Behavior	26,1865 < X ≤ 28,9735	22%	Moderate
		23,3995 < X ≤ 26,1865	30%	Low
		X ≤ 23,3995	8%	Very Low

Based on Table 8, it can be seen that the aspect with the highest percentage in the high and very high categories is the knowledge category, at 42% and 1%, respectively. The cognitive skills aspect has the highest number of low and very low categories, namely 31% and 2%; the attitude aspect has the majority number in the high and very high categories, namely 35.3% and 7% and the behaviour aspect has the majority number in the high and very high categories, namely 32%

and 8%.

The Relationship Between Learning Experiences on Environmental Change Material and Environmental Literacy in the Context of Global Warming

The results of the analysis of the relationship between learning experiences on environmental change material and environmental literacy in the context of global warming are shown in Table 9.

Table 9. Results of the correlation test of learning experiences with environmental literacy

		Learning Experience	Environmental Literacy
Learning Experience	Pearson Correlation	1	.449**
	Sig. (2-tailed)		.000
	N	130	130
Environmental Literacy	Pearson Correlation	.449**	1
	Sig. (2-tailed)	.000	
	N	130	130

**. Correlation is significant at the 0.01 level (2-tailed).

Based on the results of the Pearson Product-Moment correlation test using IBM SPSS Statistics 25, the significance value of both data sets is 0.000. By reviewing the basis for decision making, where the significance value of the data is less than (<) 0.05, which means there is a significant relationship between the learning experience of environmental change material and students' environmental literacy. The level of this relationship is then assessed using R-squared to determine how much the learning experience variable contributes to environmental literacy. The results of the R Square learning experience with environmental literacy are shown in Table 10.

Table 10. R-Square results of learning experiences with environmental literacy

Model Summary

Model	R	*R Square*	*Adjusted R Square*	*Std. Error of the Estimate*
1	.449[a]	.202	.195	5.914

a. Predictors: (Constant), Learning experience

Based on the R-square analysis, the coefficient value was 0.202, or 20.2%. This value indicates that learning experiences contribute 20.2% to environmental literacy, with the remaining 79.8% attributed to other factors not examined in the study. The results of the R-squared test for each aspect of the learning experience related to environmental change are shown in Figure 1.

Based on the graph in Figure 1, it can be seen that the aspect of learning experience that contributes the most to environmental literacy is communicating with a percentage of 19%, followed by the aspect of processing information at 14.9%, the aspect of collecting 13.6%, the aspect of asking questions at 7.5% and the aspect that provides the smallest contribution is observing at 4.7%.

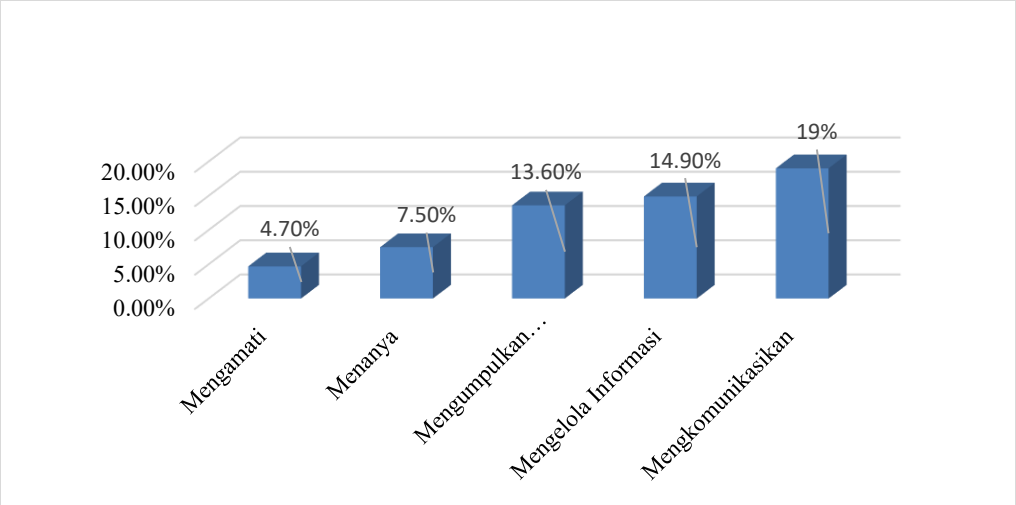

Figure 1. Contribution of each aspect of the learning experience to environmental literacy

Discussion

Learning Experience on Environmental Change Material

Based on Figure 1, it can be seen that the learning experience of students on environmental change at SMA N 1 Sleman is mostly in the moderate category, with a percentage of 46%. This result aligns with the results of interviews with grade 10 biology teachers at SMA N 1 Sleman, who stated that biology learning is more oriented towards Problem-Based Learning and Project-Based Learning. The teacher believes that these two learning models make learning easier to understand and encourage students to be more active. In these learning models, the teacher provides stimuli in the form of problem videos or assigns students to identify problems in their surroundings. With these stimuli, students will be more interested in learning and have their curiosity stimulated. Good learning experiences can be formed through student activities supported by the teacher's ability as a facilitator in applying new ideas, models, or methods deemed appropriate to develop student competencies (Megawati, 2018). Furthermore, experience emphasises that the more concrete a student's learning, the more learning experiences they gain (Megawati, 2018).

Based on the scientific approach in the 2013 curriculum, there are five aspects of the learning experience: observing, reasoning, gathering information, processing information, and communicating. Figure 2 shows that, of each aspect of the learning experience studied, the highest percentages were in the information gathering aspect, with 27% in the high category and 9% in the very high category. This condition results from the integration of problem-based learning and project-based learning models, which encourage students to be more active in thinking and seeking information to solve problems and projects around them, thereby providing a deeper and more meaningful learning experience (Riyanto, 2009).

The second-highest percentage was in the information processing aspect, at 8% and 26%, respectively. This result is because the problem-based learning model implemented by teachers guides students in analysing environmental issues around them. This result is also in line with the results of interviews with students with codes A14 and B18 who explained that the problems used in learning are problems in the surrounding environment or those commonly encountered either around their homes or on social media so that this is more stimulating for students in studying the problems because they already have knowledge and experience regarding the problems (Tyas, 2017). In addition, a biology teacher for Grade X at SMA N 1 Sleman also explained that learning

is done partly online and partly offline. When returning offline, the teacher guides students to form groups and solve one of the problems they have previously worked on online. This condition can enhance the aspect of information processing because, through group discussions, students exchange information and collectively process the information obtained until a solution is found (Zakaria et al., 2019).

The very low and low categories were most prevalent in the questioning aspect, at 32% and 5%, respectively. According to an interview with a grade 10 biology teacher at SMA N 1 Sleman, it was explained that students initially feel uninterested, so teachers must be creative in encouraging them to ask questions actively. Research by Nurhakim (2017) indicates several factors that cause students to not engage in questioning activities, including students not being accustomed to expressing their opinions, which leads to feelings of embarrassment and a lack of confidence in their questions (Hardianty, 2017).

The next most prevalent category was the communication aspect, at 25% and 5%. According to an interview with a grade 10 biology teacher at SMA N 1 Sleman, environmental literacy learning was conducted both online and offline. When learning was conducted online, interaction was reduced because the teacher only assigned assignments, and students submitted them. Meanwhile, when learning was offline, project-based learning was employed, where the final results were compiled in research reports rather than being presented. Online learning resulted in a lack of interaction between teachers and students. This lack of interaction can cause students to feel a distance between teacher and student, making them reluctant to answer or ask questions (Djamarah, 2016). Report writing is a form of written communication . However, not everyone skilled at writing can effectively communicate their writing verbally (Rahmah & Sodiq, 2021), so verbal communication between students remains necessary.

The observation aspect had very low and low percentages, at 22% and 7%, respectively. Based on interviews with a grade 10 biology teacher at SMA N 1 Sleman, biology lessons on environmental change were mostly conducted online due to conflicts with the grade 12 exam schedule. This condition forced learning to take place at home. Students' observations were also required to be conducted independently. This result is consistent with interviews with students with codes B3 and B30, who stated that they were given the task of independently observing environmental issues around their homes. This independent observation is less effective because observation practices in learning will only be effective if students and teachers equip themselves with tools that meet the observation needs (Pahrudin & Pratiwi, 2019). However, because observations are conducted at home, not all students have adequate equipment for observation, so the results of student observations do not meet the teacher's expectations (Listiyani & Budiwati, 2022). Furthermore, biology teachers stated that the long distance makes it impossible for them to control student observations, so they can only do what they can. In contrast, in observation activities, teachers should be able to control and understand student involvement in the observation (Pahrudin & Pratiwi, 2019).

Environmental Literacy in the Context of Global Warming

Figure 3 shows that the environmental literacy of 10th-grade students at SMA N 1 Sleman is predominantly in the moderate category, with a percentage of 45%. Students have gained experience learning about environmental change through the problem-based learning model implemented by their teachers, which has enabled them to develop the knowledge and skills necessary to solve environmental problems in their surroundings. According to Widianingsih et al. (2017), problem-based learning can enable students to actively construct knowledge and

develop skills to solve real-world problems in their surroundings. Furthermore, according to teacher interviews, SMA N 1 Sleman is an Adiwiyata school, where environmental stewardship practices are instilled, which in turn influences students' attitudes and behaviour (Limawati, 2018).

Environmental literacy encompasses four key aspects: knowledge, cognitive skills, attitudes, and behaviour. Figure 4 shows that the lowest scores are in the knowledge category, at 42% and 1%, respectively. This result indicates that students possess a high level of knowledge regarding the environment and the issue of global warming. Based on interviews with tenth-grade biology teachers at Sleman State Senior High School 1, it was stated that the problems used in environmental change learning are not limited to local issues but also address environmental issues. One example is global warming. Teachers must be able to accommodate concrete learning materials that meet the needs of students (Purba et al., 2023). Through accommodating learning experiences, students can develop competencies in understanding nature scientifically (Anggrella & Sudrajat, 2024).

The next aspect of environmental literacy is cognitive skills, with the majority of students falling into the moderate category (42%). However, this aspect also has the highest number of students in the low and very low categories (31% and 2%, respectively). The cognitive skills aspect includes understanding environmental analysis, identifying environmental problems, and developing action plans (Rahmah, et al., 2019). In this case, most students have a high level of knowledge about the environment and global warming, but are unable to analyse and provide solutions to these problems. Based on interviews with students with codes B3, B18, and B30, it was stated that biology teachers' lessons covered various environmental issues, including global warming. However, due to the numerous other environmental issues, the discussions were less in-depth. The 2013 curriculum adopted the concept of "Student-Centred Learning," requiring students to be more active and independent in the learning process (Oishi, 2020). However, this meant that students lacked the independence to seek information on their own actively (Sari et al., 2022).

The next aspect of environmental literacy is attitude. Figure 4 shows that the attitude aspect is most often in the high category, at 35.3%. The attitude aspect encompasses students' views on the environment, sensitivity to environmental conditions, and concern for and interest in the environment (Rahmah, et al., 2019). This result indicates that the majority of students have a high level of environmental sensitivity and concern. According to Azwar (2013), a person's attitude is influenced by several factors, including personal experience, the influence of others considered important, culture, mass media, educational institutions, and religious institutions. In this regard, students' attitudes toward the environment are also influenced by activities outside of the learning environment, such as the Adiwiyata program implemented by SMA N 1 Sleman, which is related to environmental issues and can impact student attitudes.

The next aspect of environmental literacy is behaviour, with the most frequently occurring aspect in the high category, at 32%. The behavioural aspect encompasses concrete actions taken towards the environment, such as protecting and preserving it. In this regard, the majority of students have demonstrated behaviours that promote environmental protection and preservation. Behaviour emerges from attitudes. When attitudes toward the environment are strong, so are behaviours toward the environment (Sujana et al., 2018).

Student behaviour can be shaped through learning outcomes from interactions and learning experiences. In this case, student behaviour at SMA N 1 Sleman is influenced by learning activities that occur outside the classroom. One learning activity that can influence student behaviour is a habituation approach (Muhtadi, 2011). Interviews with teachers and students with codes A14, B3, and B18 revealed that SMA N 1 Sleman includes a monthly environmental cleanup program and

a cleanliness competition. Furthermore, there are Adiwiyata ambassadors who are student pioneers in environmental programs such as recycling, waste sorting, and composting. Habituation makes students accustomed to doing things without prior instruction (Marwiyati, 2020), as they become accustomed to doing them, which in turn influences their behaviour (Hamdani, et. al., 2025).

The Relationship Between Learning Experiences on Environmental Change Material and Environmental Literacy in the Context of Global Warming

Based on the results of the Pearson Product-Moment correlation test, the significance value for both data sets was 0.000. By reviewing the basis for decision-making, where the significance value of the data was less than (<) 0.05, H1 was accepted (H0 was rejected), indicating a significant relationship between learning experiences on environmental change and students' environmental literacy. The correlation test results showed a Pearson correlation coefficient of 0.449. This result indicates a positive relationship between the two variables. This positive value indicates that the higher the level of learning experience on environmental change, the higher the level of environmental literacy. This result is in line with research by Hayati (2020) that experiential learning (learning that focuses on providing experiences) can improve environmental literacy. Using the Pearson correlation coefficient value, the level of relationship between the two variables can be determined. Based on the categorisation of correlation coefficient interpretation according to Cohen et. al. (2018), a correlation coefficient of 0.449 indicates a moderate relationship between the two variables.

Based on the R-square analysis in Table 10, the coefficient value was 0.202, or 20.2%. This value indicates that learning experiences contribute 20.2% to environmental literacy, with the remaining 79.8% coming from other factors not examined in the study. According to McBeth & Volk (2010), environmental literacy comprises four components: knowledge, attitudes, behaviours, and cognitive skills. Although learning using the 2013 curriculum also emphasises attitudes, online learning on environmental change results in students only experiencing the knowledge aspect, as online learning makes it difficult for teachers to reinforce attitudes and skills (Zahrawati, 2021). Furthermore, according to Fietkau & Kessel, other factors can influence environmentally conscious behaviour, including attitudes, values, knowledge, the possibility of acting ecologically, behavioural incentives, and feedback (Japardy & Halim, 2022). Therefore, other components of environmental literacy are not included in learning (Putra & Suhartini, 2025).

Figure 5 shows that the learning experience aspect contributing the most to environmental literacy is communication, at 19%, followed by information processing at 14.9%, collecting at 13.6%, questioning at 7.5%, and observing at 4.7%, respectively. Communication contributes significantly to environmental literacy compared to other aspects. This finding aligns with research (Makiyah et al., 2021) that found communication skills significantly contribute to problem-solving abilities, or cognitive skills.

CONCLUSION

The learning experience of environmental change material for class X MIPA students at SMA N 1 Sleman is dominated by the medium (46%), high (22%), low (20%), very low (7%), and very high (5%) categories. The level of environmental literacy among class X MIPA students of SMA N 1 Sleman in the context of global warming is distributed across five categories: medium (45%), high (20%), low (20%), very high (8%), and very low (7%). Based on the results of the Pearson Product-Moment correlation test, it is evident that there is a significant and positive relationship between the learning experience of environmental change materials and the

environmental literacy of class X MIPA students at SMA N 1 Sleman, particularly in the context of global warming. Based on the results of this study, teachers are expected to provide students with good learning experiences, enabling the optimal development of their skills and competencies, particularly in environmental literacy.

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