

Khairil Hadi, Dazrullisa, Endang Susantini, Sunu Kuntjoro. (2022). The Influence of Environment-based Biology Learning Integrated with Local Wisdom and Character Education on Student's Higher Order Thinking Skills and Environmental Care Attitude. *International Journal of Early Childhood Special Education (INT-JECSE)*, 14(1): 663-672. DOI: 10.9756/INT-JECSE/V14I1.221079

Received: 03.10.2021 Accepted: 19.12.2021

Khairil Hadi¹
Dazrullisa²
Endang Susantini^{3*}
Sunu Kuntjoro⁴

The Influence of Environment-based Biology Learning Integrated with Local Wisdom and Character Education on Student's Higher Order Thinking Skills and Environmental Care Attitude

Abstract

Teachers are required to improve the learning quality that is indicated by an increase of learning outcomes and student's good behavior. The present study examined whether environment-based biology learning materials integrated with local wisdom and character education had an effect on students' higher order thinking skills (HOTS) and environmental care attitudes. This study used quantitative research approach with a quasi-experimental research and a post-test only control design. There were 200 tenth-grade students and 10 biology teachers participating in this study. The data were analyzed using Multivariate Analysis of Variance (MANOVA) and independent sample t-test. The results showed that there was a significant effect of students' higher order thinking skills and students' environmental care attitudes between students who were taught using the developed teaching materials and those who were taught using textbooks ($F(2, 197) = 1.077, p < 0.001$; Wilks Lambda = 0.478, $\eta^2 = 0.522$). The use of environment, local wisdom, and character education in developing teaching materials provided new nuances in the learning process, where students did not only have knowledge but also attitudes and skills. In addition, students could understand the ideas or messages of the subject matter very well. Although the results portrayed in this study depicted that the class taught using the developed teaching materials was better than the class taught using textbooks, it could not be denied that the teacher's pedagogical mastery also determined the success of the teaching and learning process.

Keywords: Biology Learning, Teaching Materials, Higher Order Thinking Skills, Students' Environmental Care.

Introduction

The present condition of the younger generation of Indonesia reflects the reality of a drastically declined state of morality (Kesuma,

2011). The indications of moral degradation are emphasized by the increase in drug abuse, free sex, crime, violence, and many other misconducts. This incident is caused by an

Khairil Hadi¹, STKIP Bina Bangsa Meulaboh, Aceh, Indonesia.
Dazrullisa², STKIP Bina Bangsa Meulaboh, Aceh, Indonesia.
Endang Susantini^{3*}, Universitas Negeri Surabaya, Jawa Timur, Indonesia.
Email: endangsusantini@unesa.ac.id
Sunu Kuntjoro⁴, Universitas Negeri Surabaya, Jawa Timur, Indonesia.

identity crisis and failure in character education development (Agung, 2011). Earth's inhabitants currently face critical environmental problems, such as global warming, the expansion of deserts and dry areas, the biodiversity crisis, water, and air pollution, as well as social problems such as inter-religious and ethnic conflicts (Shaw & Oikawa, 2014). Irfianti et al. (2016) opine that environmental problems are not only caused by adults, but today's teenagers also cause environmental damage. In line with that, Liesberg et al. (2011) add that some teenagers deny the importance of endangering environmental problems and are ignorant of such problems that seem irrelevant to their lives but are very impactful nonetheless.

Solving environmental problems should start early through education in schools. This can be done by providing environmental reinforcement to students so that they can develop and nurture the attitude of caring for the environment, i.e., a feeling or action to improve and manage the environment correctly and accordingly in order to strive for a sustainable life. Simbolon (2020) argues that an attitude of caring for the environment is a reaction in the form of a person's concern for the environment. In general, this attitude is manifested in a person's willingness to state and commit actions that can improve and maintain environmental quality in every behavior related to the environment (Yousuf & Bhutta, 2012; Sarjou et al., 2012). That said, if the attitude of caring for the environment is actualized in the form of action, then students who care about the environment will always protect the environment.

The lack of awareness of Indonesian students on environmental problems stems from the lack of learning systems that include environmental education (Rarasandy et al., 2013). Motivation and role models from the environment are of importance in nurturing the students' concerns towards the environment (Nurchaili, 2010). This includes trying to find out ways to preserve the environment and taking simple actions to care for the environment. With an understanding of the environment provided at school, students are expected to develop awareness in learning to be responsible and have a positive attitude towards the environment. Students who are given environmental reinforcement will become leaders and make policies that favour environmental preservation (Campbell et al., 1999; Lake et al., 2010). Jianpeng et al. (2017) suggest that the basic concepts in shaping an attitude of caring for the environment consist of institutional factors and school management, students' conceptual knowledge, environmental factors, and educational strategies.

In addition, the problem of students' thinking skills is also an important matter of concern.

Higher-order thinking skills are very important to be developed through learning science, particularly biology, as a provision for students to face challenges in the future. However, in reality, the thinking ability of students in Indonesia is still relatively low. Questions used to test higher-order thinking skills can encourage students to have an in-depth concept of a particular material (Barnett & Francis, 2011). The Program for International Student Assessment (PISA) reports that Indonesian students' achievement was only able to rank 64th out of 65 countries in 2012, 62nd out of 70 countries in 2015, and 74th out of 79 participating countries in 2018 (OECD, 2012; OECD, 2016; Schleicher, 2018). In the field of science, in 2018, the average score of Indonesian students reached 389 compared to the OECD average score of 489. This illustrates that Indonesian students still have weaknesses in the field of science because they are only able to achieve an average score of 79.6 %.

Theoretical Framework

A country's development is mostly affected by the quality of its human resources, which also determine the competitiveness between nations. In this decade, the issues of caring for environment, culture (local wisdom), and character education have been the main focus of Indonesian government. Besides, the government tries to eradicate various problems of students' thinking skills. Many alternative solutions have been proposed to cope with the problems, one of which is through education (Hadi et al., 2019). Such conditions encourage the education sector to continuously improve to produce qualified human resources (Hadi et al., 2020).

Teacher is a determining factor in the success of increasing human resources. A teacher is an individual that possesses certain sets of knowledge and skills through sequences of processes and time. Teachers are the frontline agents that bear an important role in the advancements of a country. It represents the subsystems in classroom management and takes full responsibility in many aspects (Al-Zoubi et al., 2019). Therefore, teacher is required to generate innovative learning process, one of which is advancing the quality of teaching materials. Pedagogical innovation can meet 21st century learning expectations (Sailin & Mahmor, 2018). Folb et al. (2011) state that learning innovations as outlined in textbooks can provide better learning outcomes and increase the efficiency and effectiveness of learning process.

In the meantime, instructional media refer to the particular sets of material or information that aims to help students in learning activities. Regarding the use of learning instructional media,

teachers often face difficulties in composing the proper learning and choosing from the resources available in order to help the students in achieving the expected competence output. In line with this, Arlitasari et al. (2013) state that the improvement of the quality of instructional media and its use is imperative amid the development of curriculum. Good teaching materials must be developed according to the needs including geographical, ethnographic, and regional wealth characteristics (Hadi et al., 2018a).

The preliminary study and interview conducted with several high school teachers in Aceh Barat and Nagan Raya districts showed that despite teachers having implemented environment-based learning, they were lacking the proper instructional media that integrated with local wisdom and character education. The environmental-based learning process conducted was therefore not in accordance with the learning syntax of the scientific approach. Regarding the students' level of thinking, according to Bloom's taxonomy, the students in the research site showed a lack of competence in solving questions of analysis, evaluation, and creating criteria. This signifies that the students are still lacking in high-order thinking skills. In addition, the students show a lack of awareness and care towards the environment. This was highlighted by the scattered garbage often found behind the school building and the lack of waste management in the school. However, the school has socialized the 3R system (reduce, reuse, and recycle) and has provided the waste classification system and separate bins according to the type of waste (organic and inorganic). Therefore, the research team deemed it necessary to develop environment-based teaching materials that integrate local wisdom and character education. On top of that, the learning instructional media resulting from the development were tested to measure the effectiveness of students' higher-order thinking skills and environmental care attitude.

The integration of environment in teaching materials provides students an authentic learning. Hidayati et al. (2012) suggest that one of the ways in gaining knowledge is by experiencing a meaningful, easy, and real-world-based learning. Environmental education is emphasized on changing attitudes, so the steps undertaken are to confront students with existing environmental problems (Khanafiyah, 2013). By utilizing environment as a learning medium, students are expected to be able to develop and conserve natural resources and improve the quality of human resources. Environmental integration can improve critical thinking skills and can be implemented in future learning processes (Atman & Monroe, 2007). The environment studied by students is in the form of natural conditions,

objects, animals, plants, humans, or things, which are used as teaching materials (Sutanto & Nadiroh, 2012).

The values of local wisdom are in the form of positive values, both in terms of religion, culture, customs, social, arts, natural resources, and other habits carried out by a community in a place (Hadi et al., 2018a). Implementing and habituating local wisdom is important because it is a means for students to better understand and love their culture (Afiqoh, 2018). Utilization of local content in learning also might enrich learning materials (Glasson, 2010). There are several stages that can be used by teachers to create local wisdom-based learning model including identifying the state and potential of the area, determining functions and objectives, determining criteria and study materials, and developing a lesson plan based on local wisdom.

Moral degradation is indicated by increasing drug abuse, pre-marital sex, crime, violence, and many other impolite behaviors. The source of this multidimensional crisis and the decline of the nation is the identity crisis and the failure to develop national character education (Agung, 2011). The implementation of character education in learning is carried out through a) integrating character education in the school curriculum by means of teachers conducting analysis of basic competence through identifying the values contained in learning materials and designing lesson plans that focus on character education, b) considering the learning methods to develop the student's character, c) conducting classroom management to foster an attitude of cooperation and tolerance among peers (Janah, 2018). The implementation of these characters in biology learning can be carried out by associating the learning materials with the predetermined character values (Hadi et al., 2018b). If the teacher consistently integrates character education in the subject matter, it will most likely produce students with good character (Sugiyono & Purwastuti, 2017). In the midst of technology-based era, it is important to teach students about Indonesian characters so that preserving Indonesian cultures and local wisdoms could be more effective (Utaminingsih, 2017).

Methods

This study used quantitative research approach with a quasi-experimental research and a post-test only control design. Wisdom & Creswell (2013) stated that quantitative data had great potential to unravel effectiveness or influential interventions. In regard to the present study, quantitative research approach was used to obtain data related to students' higher-order thinking skills and students' environmental care attitudes.

Participants

There were 200 tenth-grade high school students from 10 schools in Aceh participating in the present study. They were chosen using random sampling technique. The treatment given to the participants consisted of treatment using textbook (X0) and treatment using environmental-based teaching materials integrated with local wisdom and character education (X1).

Data Collection and Analysis

The instruments used in the present study were observation sheets, student environmental awareness questionnaires, and student's higher order thinking skills test. Observation sheet was carried out during the learning process to document the whole phenomena occurred in the classroom, including the student-teacher interaction. A rating scale from 1 to 4 was employed on this observation sheet (1 = not good; 2 = fair; 3 = good; 4 = very good). Questionnaire was used to determine the attitude of caring for the environment conveyed by the students. The questions and statements in this questionnaire consisted of positive and negative questions. The rating scale also used a scale from 1 to 4. For positive questions, 1 = disagree, 2 = disagree, 3 = agree, and 4 = strongly agree. Whereas in coping with the negative questions, 4 = disagree, 3 = disagree, 2 = agree, and 1 = strongly agree. Test was a tool to measure student's higher order thinking skills in which the test used multiple choice format. The contents of the instrument consisted of three indicators, namely analysis (C4), synthesis (C5), and evaluation (C6).

Data Analysis

Both observational and questionnaire data were analyzed using a simple statistical formula, namely the percentage formula that was then interpreted in the form of description.

Table 1.

Conversion of the percentage value of the observation results

Percentage (%)	Conversion
81-100	Very good
61-80	Good
51-60	Fair
≤ 50	Not good

Data of higher order thinking skills test were analyzed using inferential statistics using Multivariate Analysis of Variance (MANOVA) and Independent Sample t-Test. Before testing the hypothesis, a classic test was carried out on the data collected, namely normality and homogeneity tests. The normality test was carried out using Kolmogorov-Smirnov, while the homogeneity test was carried out using Box's Test of Equality of Covariance Matrices. Analysis was performed using SPSS® software.

Results

The results of the observation showed that the teacher in the experimental class was categorized as very good in carrying out the learning process with an average score of 82.80% and the control class was categorized as good with an average score of 79.80% (see Figure 1).

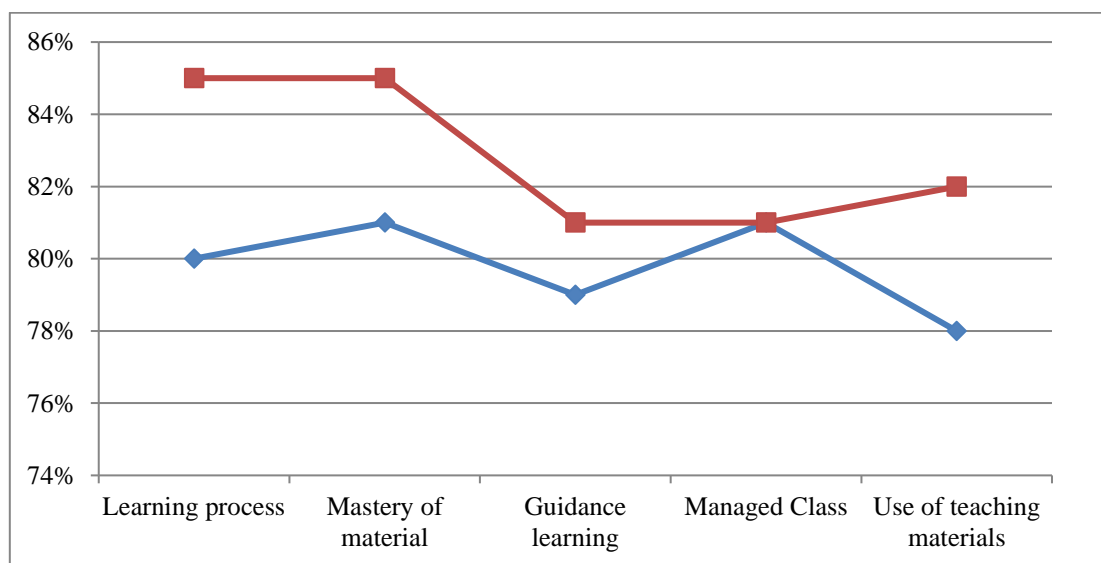


Figure 1.

The results of teacher observations in the implementation of learning process

Shapiro-Wilk test was conducted to analyze the normality of the data on students' higher order thinking skills and environmental care attitudes. The results showed that higher order thinking skills in the control class ($W(100) = 0.976$, $p = 0.069$) and the Experiment class ($W(100) = 0.975$, $p = 0.055$) were normally distributed (see Table 2). The data on students' environmental care attitudes in the control class ($W(100) = 0.975$, $p = 0.053$) and the experimental class ($W(100) = 0.976$, $p = 0.068$) were also normally distributed (see Table 2). The homogeneity test result depicted the Box's value was 1.669 ($p = 0.648$), then the covariance matrix between groups was assumed to be homogeneous (see Table 3).

Table 2.

Normality test results using Shapiro-Wilk test

	Class	Shapiro-Wilk		
		Statistic	df	Sig.
Higher Order Thinking Skills	Control	.976	100	.069
	Treatment	.975	100	.055
Environmental Care Attitudes	Control	.975	100	.053
	Treatment	.976	100	.068

a. Lilliefors' Significance Correction

Table 3.

Homogeneity test results using Box's Test of Equality of Covariance Matrices

Box's M	1.669
F	.550
df1	3
Df2	7.057E6
Sig.	.648

The results of the multivariate test showed that there was a significant influence on the mastery of students' higher order thinking skills and environmental care attitudes between students who were taught using environmental-based teaching materials integrated with local wisdom and character education and those who were taught using textbooks ($F(2, 197) = 1.077$, $p < 0.001$; Wilks Lambda = 0.478, $np^2 = 0.522$) (see Table 4). Furthermore, the univariate results showed that class differences caused significant differences in higher order thinking skills ($F(1, 198) = 134,813$, $p < 0.001$, $np^2 = 0.405$) and

students' environmental care attitudes ($F(1.198) = 117.148$, $p < 0.001$, $np^2 = 0.372$) (see Table 5).

Table 4.

Wilks' Lambda Multivariate test results

Effect	Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	
Class	Pillai's Trace	.522	1.077E2 ^a	2.000	197.000	.000	.522
	Wilks' Lambda	.478	1.077E2 ^a	2.000	197.000	.000	.522
	Hotelling's Trace	1.093	1.077E2 ^a	2.000	197.000	.000	.522
	Roy's Largest Root	1.093	1.077E2 ^a	2.000	197.000	.000	.522

Table 5.

Univariate test results using Between – Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Class	High Order Thinking Skills	11612.880	1	11612.880	134.813	.000	.405
	Environmental Care	8476.020	1	8476.020	117.148	.000	.372
Error	High Order Thinking Skills	17055.840	198	86.141			
	Environmental Care	14320.590	198	72.353			

Based on the Independent Sample t-Test test (see Table 6 and Table 7), the sig value was obtained (2 tailed) of $p = 0.000$, it could be

concluded that there was a difference in the average students' learning outcomes between students who were taught using environmental-based teaching materials integrated with local

wisdom and character education and those who were taught using textbooks on higher-order thinking skills and students' environmental care.

Table 6.

The difference between thinking abilities

		Levene's Test for Equality of Variances		t-test for Equality of Means				
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
High_Order_Thinking	Equal variances assumed	.012	.913	-11.611	198	.000	-15.240	1.313
	Equal variances not assumed			-11.611	197.838	.000	-15.240	1.313

Table 7.

The difference between students' environmental care attitudes

		Levene's Test for Equality of Variances		t-test for Equality of Means				
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Environmental care attitudes	Equal variances assumed	.546	.461	10.823	198	.000	-13.020	1.203
	Equal variances not assumed			10.823	197.683	.000	-13.020	1.203

Discussion

Learning biology as part of learning science needs to include facts experienced daily by students. As a part of the natural sciences field, Biology subject emphasizes scientific processes or work based on the ability to think and solve problems since science is obtained through the process of reasoning, scientific investigation, and experimentation in explaining natural phenomena (Tasiwan et al., 2014). In accordance with the present study, the teaching materials were developed by conducting a needs analysis, including an analysis of environmental sources, local wisdom, and student's character. The materials contained in the teaching materials refer to real-life phenomena that exist around students' environment. Sources of the environment are in the form of natural conditions, objects, animals, plants, and humans existing in the students' environment. Local materials can be obtained from all conditions and real life as well as

phenomena that exist in the students' environment. While, the character material is developed through character values that have been determined in the 2013 curriculum. Furthermore, environmental sources, local materials, and character values are adjusted to the core and basic competencies and the syllabus according to the applicable curriculum. Therefore, the application of environmental-based biology learning integrated with local wisdom and character education is considered to have the power to improve students' higher-order thinking skills and environmental care attitudes.

Innovation of teaching materials can produce new teaching materials as the goal of achieving effective and efficient learning. Silaban (2015) states that the quality of learning becomes low when educators are only fixated on conventional teaching materials without any creativity to develop the materials innovatively. Innovation in education is often associated with renewal that comes from the results of creative thinking,

findings, and modifications that contain ideas and methods used to overcome an educational problem (Situmorang, 2006). Innovations in the form of environmental use, local wisdom, and character education in teaching materials can provide new nuances in the learning process, where students not only have the ability to think but also have attitudes and skills.

The success of the learning process carried out by the teacher is indicated by a change in students' affective, cognitive, and psychomotor (Hadi et al., 2019). The research hypothesis shows that the experimental class taught using environmental-based teaching materials integrated with local wisdom and character values is better than the control class using textbooks in improving students' higher order thinking skills ($p = 0.000$) and environmental care attitude ($p = 0.000$). By the use of the developed teaching materials, students can understand the ideas or messages of the subject matter so that the learning process is meaningful. Vighnarajah (2008) states that meaningful learning does not only take place in the classroom but more importantly includes and reflects student experience. Lim et al. (2020) state that compared to traditional teaching, blended learning has the potential to enrich, engage, and enhance student learning experiences and further enhance learning outcomes.

Some of the advantages in the application of learning by integrating science, environment, local wisdom and character and community education will make students conceive better attitude and environmental care, increase mastery of students' concepts, elevate students' academic achievement, and affect students' higher order thinking skills (Kim & Roth, 2008; Glynn & Winter, 2004; Benninga et al., 2003; Hadi et al., 2019).

The implementation of the developed learning instructional media in this study allows the students to be actively involved in the learning process. The students are allowed to discover the solution to the questions proposed in the learning by themselves. The problems proposed to involve questions of Biology subjects in daily life. Moreover, the guidance and motivation provided by the teachers to the students can increase the students' learning motivation and readiness. Therefore, this could increase the students' active participation, concentration, and enthusiasm in the learning process and during the question session. The implementation of this program can also provide reinforcement of students' method of thinking to aid them in accomplishing high order thinking skills compared to the students that use learning material package book. Regarding the improvement of the students' thinking capacity, teachers are required to design an explicit learning situation in helping students to acquire

and utilize in-depth knowledge, skills, and disposition to solve high order thinking skill problems. In line with that, Costa et al. (2001) argues that the learning process of high order thinking skills must involve the components of teaching to think, teaching thinking, and teaching about thinking.

In addition, the developed learning instructional media also provide real and meaningful learning experience to students. This is based on the incorporation of daily life concepts and examples into the learning process. Hence, the students can understand the learning material easier and engage actively in constructing their own knowledge and in establishing the correlation between their experience and the learning materials they have learned.

In addition, regarding the attitude of care towards the environment, the experimental class allows students to construct moral knowledge that can be used to make decisions in behaving towards the environment. Therefore, the students can develop the feeling of environmental awareness and gain new knowledge to prevent environmental damage. The process of instilling environmental awareness to students requires the teacher to have environmental literacy (Rusmawan, 2017). Another impact of learning using environmental-based teaching materials that are integrated with local wisdom and character education is that it can stimulate students' curiosity about phenomena in the environment. This is in line with Sousa et al., (2016) that point out that environmental education is the most appropriate medium for delivering knowledge, skills, and environmental awareness. Another method to increase environmental awareness is by instilling religious and spiritual values in all aspects of education. This functions to encourage the students to conduct God's orders and learn to be responsible for themselves. Further, the environmental awareness attitude is also influenced by the activities facilitated by the school, such as assignment of class picket, prevention of littering, and cooperation in school environment preservation. The environmental awareness is also influenced because of the encouragement from the students themselves and their environment. The same statement was also expressed by Simbolon (2020) that the formation of an attitude of concern for the environment does not necessarily arise without the efforts of oneself and the social environment.

Although the results in this study show that the class taught using developed teaching materials is better than the class taught using textbooks, it cannot be denied that the teacher's pedagogical mastery also determines the success of the teaching and learning process in this study. Mulyasa (2002) states that no matter how good a curriculum is, the results still depend

on the teacher and students' actual activity in class. The information and knowledge the student acquire depend on how the students are taught by their teachers (National Research Council, 1996:28). The teacher's role is to help and encourage students to develop particular set skills; the teacher also acts as a source of information, advice, and knowledge (Jones, 2007). In addition, teachers also function to provide direction and encouragement for students to discover knowledge by themselves (Terpollari, 2014). Pedagogical skills are an important component in teacher preparation and professional development programs to ensure teachers ably carrying out proper teaching and learning activities in the classroom (Susantini et al., 2016). Boz & Boz (2008) state that teachers must also have general pedagogical knowledge, not only the specific ones, because it includes general knowledge about teaching such as classroom management, guidance, and feedback. Esmaili et al (2015) state that the learning process can result in good progress of students' competence if the following characteristics are met: 1) teacher listens to students' opinion during the learning process; 2) shows authority in criticizing students; 3) does not show a negative attitude; 4) pays attention to students' circumstances and feelings in learning; 5) explains lessons and adjusts one's speech based on the students' situation; 6) encourage and reward the students; and 7) observe differences in their behavior.

In an experimental class, teachers can correlate the learning contents with students' real experience in order to create an understandable learning situation. Steiner (2004) emphasizes that students appreciate a teacher that can correlate, expand, and contextualize the present situation into other situations. Teachers of natural sciences education must be aware of the students' understanding capacity. In addition, the teacher can also act as role model to instill habituation to the students. That is to say, a teacher in an experimental class can create a comfortable situation and condition that allows the students to be attentive to the environment.

Conclusion

The integration of the environment, local wisdom, and character education in the teaching materials developed in this research can provide opportunities for students to play an active role and be directly involved in the learning process. Students are given the opportunity to find their answers to the problems that have been posed in the learning process. Thus, the learning process can include three components of higher-order thinking skills, namely (1) teaching to think, (2) teaching thinking and (3) teaching about thinking.

In addition, the developed teaching materials also contain moral knowledge material as a reference for decision-making in attitude and behavior towards the environment. Thus, students can develop a sense of care and gain new knowledge to prevent environmental damage. To support environment-based learning, local wisdom, and character education in learning, teachers are required to have adequate pedagogical abilities (class management, providing guidance, question strategies, and feedback) and environmental literacy.

Acknowledgement

The authors thank the Ministry of Education, Culture, Research, and Technology that has supported the present study through granting the research proposal in 2020 to 2021.

References

- Atman, J., & Monroe, M. (2007). The effects of Environment-Based Education on Students' Critical Thinking Skills and Disposition Toward Critical Thinking. *Environmental Education Research*, 10(4), 507-522.
- Agung, L. (2011). Character Education Integration in Social Studies Learning. *International Journal of History Education*, 12(2), 392-403.
<https://ejournal.upi.edu/index.php/historia/article/view/12111/7240>
- Arlitasari, O., Pujayanto, P., & Budiharti, R. (2013). Development of Integrated Science Teaching Materials Free of Mutual Themes with the Theme of Biomass Renewable Alternative Energy Sources. *Journal of Physics Education*, 1(1), 81-89.
<https://jurnal.fkip.uns.ac.id/index.php/pfisika/article/view/1783/0>
- Afiqoh, N., Atmaja, Tri, H., & Saraswati, U. (2018). Instilling the Value of Local Wisdom in Learning History of the Subjects of Islamic Development in Indonesia in Class X Social Studies Students at SMA Negeri 1 Pamotan for the 2017/2018 Academic Year. *Indonesian Journal of History Education*, 6(1), 42-53.
<https://journal.unnes.ac.id/sju/index.php/ijhe/article/view/27353>
- Al-Zoubi, Z., Shamroukh, N., & Banyounis, N, A. (2019). Teachers Carrying out their Professional Roles as View of Zarqa Town's Teachers. *European Journal of Contemporary Education*, 8(4), 715-725.
- Benninga, J.S., Berkowitz, M.W., Kuehn, P., & Smith, K. (2003). The relationship of character education implementation and academic achievement in elementary

- schools. *Journal of research in character education*, 1(1), 19-32.
<https://sil0.tips/downloadFile/the-relationship-of-character-education-implementation-and-academic-achievement?preview=1>
- Boz, N., & Boz, Y. (2008). A qualitative case study of prospective chemistry teachers' knowledge about instructional strategies: Introducing particulate theory. *Journal of Science Teacher Education*, 19(2), 135-156. <http://dx.doi.org/10.1007/s10972-007-9087-y>
- Barnett, J.E., & Francis, A.L. (2011). Using higher order thinking questions to foster Critical Thinking: a classroom study. *Educational Psychology: An International Journal of Experimental Educational Psychology*, 32(2), 201-211.
<https://doi.org/10.1080/01443410.2011.638619>
- Campbel, J.W., Waliczek, T. M., & Zajicek. (1999). Relationship Between Environmental Knowledge and Environmental Attitude of High School Student. *The Journal of Environmental Education*, 30(3), 17-21.
- Costa, P.T., Terracciano, A., & McCrae, Robert, R. (2001). Gender differences in personality traits across cultures: robust and surprising findings. *Journal of Personality and Social Psychology*, 81(2), 322-331.
- Folb, B.L., Wessel, C.B., & Czechowski, L.J. (2011). Clinical and academic use of electronic and print books: the Health Sciences Library System e-book study at the University of Pittsburgh. *Journal of the Medical Library Association*, 99(3), 218-228.
- Glynn, S.M., & Winter, L.K. (2004). Contextual Teaching and Learning of Science in Elementary Schools. *Journal of Elementary Science Education*, 16(2), 51-63.
<https://doi.org/10.1007/BF03173645>
- Glasson, G.E., Mhango, N., Prii, A., & Lanier, M. (2010). Sustainability Science Education in Africa: Negotiating Indigenous Ways of Living with Nature in the Third Space. *International Journal of Science Education*, 32(1), 125-141.
<https://doi.org/10.1080/09500690902981269>
- Hidayati, D., Puspitawati, P, P., & Kuntjoro, S. (2012). Development of Environmentally Oriented LKS Around the School on Ecosystem Materials at MAN Pamekasan. *Jurnal BioEdu*, 1(2), 14-16.
<https://ejournal.unesa.ac.id/index.php/bioedu/article/download/480/378>
- Hadi, K., Dazrullisa, D., Manurung B., & Hasruddin, H. (2018a). Development of biological teaching materials based on local wisdom integrated character education and problem based learning models for senior high school in aceh barat-Indonesia. *International Journal of Research and Review*, 5(9), 106-115.
https://www.ijrrjournal.com/IJRR_Vol.5_Issue.9_Sep2018/IJRR0015.pdf
- Hadi, K., & Manurung, B. (2018). Biology Teaching Materials Based on Character Value. In *Journal of Physics: Conference Series*, 1114(1).
- Hadi, K., & Manurung, B. (2019). The Effect of Teaching Materials Based on Local Value Integrated by Character Education through PBL Models on Students' High Order Thinking Skill. *Britain International of Humanities and Social Sciences (BloHS) Journal*, 1(2), 213-223.
<http://doi.org/10.33258/biohs.v1i2.54>
- Hadi, K., Dazrullisa, D., Susantini, E., & Kunjtoro, S. (2020). The Role of Teachers as Agents in Biological Learning in Senior High Schools, Aceh, Indonesia. *Solid State Technology*, 63(2).
<http://solidstatetechnology.us/index.php/JST/article/view/4029>
- Irfianti, M.D., Khanafiyah, S., & Astuti, B. (2016). Perkembangan Karakter Peduli Lingkungan Melalui Model Experiential Learning. *Unnes Physics Educational Journal*, 5(3), 72-79.
- Jones, L. (2007). *The Student-Centered Classroom*. New York: Cambridge University Press, 13-25.
- Jannah, IN, Chamisijatin, L., & Husamah, H. (2018). Implementation of Character Education in Science Learning at Xy Junior High School, Malang City. *Journal of Biotech*, 6(1), 1-14.
<http://eprints.umm.ac.id/44782/>
- Kim, M., & Roth, W.M. (2008). Rethinking the ethics of scientific knowledge: A case study of teaching the environment in science classrooms. *Asia Pacific Education Review*, 9(4), 516-528.
<http://doi:10.1007/BF03025667>
- Kesuma, D., Triatna, C., & Permana, J. (2011). Character Education Theory and Practice Studies in Schools, Bandung: PT. Remaja Posdakarya.
- Khanafiyah, S., & Yulianti, D. (2013). The problem based instruction model in environmental physics lectures is to develop an attitude of environmental concern. *Indonesian Journal of Physical Education*, 9(1).
- Baartman, L.K., & De Bruijn, E. (2011). Integrating knowledge, skills and attitudes: Conceptualising learning processes

- towards vocational competence. *Educational Research Review*, 6(2), 125-134.
- Jianpeng., Lingyan, Y., & Qiheng, S. (2017). Effect of Perceptions of the Learning Environmental and Approaches to Learning on Chinese Undergraduates Learning. *Journal Studies in Educational Evaluation*, 55(1): 125-134.
- Lim, C.L., Ab Jalil, H., Maa'rof, A.M., & Saad, W.Z. (2020). Self-regulated learning as a mediator in the relationship between peer learning and online learning satisfaction: A study of a private university in Malaysia. *Malaysian Journal of Learning & Instruction*, 17(1), 51-75.
<https://doi.org/10.32890/mjli2020.17.1.3>
- Nurchaili. (2010). Shaping Student Character Through Teacher's Example. *Jurnal Pendidikan dan Kebudayaan*, 16(3), 233-244.
<https://media.neliti.com/media/publications/138747-ID-membentuk-karakter-siswa-melalui-ketelad.pdf>
- OECD. (2012). *PISA 2012 Results in Focus What 15 Year Olds Know and What They Can Do with What They Know*. OECD.
<https://www.oecd.org/pisa/keyfindings/pisa-2012-results-overview.pdf>
- OECD. (2016). *PISA 2015. Result in Focus*. New York: Columbia University.
<https://www.oecd.org/pisa/pisa-2015-results-in-focus.pdf>
- Rarasandy, L., Indriyanti, D.R., & Santosa, K. (2013). Biology Learning Leads to Planting Environmental Care Characters in Environmental Management Materials. *Gazette of Educational Sciences*, 42(2), 129-136.
- Rusmawan. (2017). Eco-literacy in the Context of Social Studies Education. *SOSIODIDAKTIKA: Social Science Education Journal*, 4(2), 39-50.
<http://journal.uinjkt.ac.id/index.php/SOSIO-FITK/article/view/7990>
- Steiner, R.L. (2004). The evolution and applications of dual-stage thinking. *The Antitrust Bulletin*, 49(4), 877-909.
<https://doi.org/10.1177/0003603X0404900404>
- Situmorang, M., & Marudut, S. (2006). Learning Innovation in Analytical Chemistry II Course. *Journal of Mathematics and Science Education*, 1, 114-119.
<https://smk3ae.wordpress.com/2008/05/19/inovasi-pembelajaran-pada-mata-kuliah-kimia-analitik-ii/>
- Sarjou, A.A., Soltani, A., Afsaneh, K., & Mahmoudi, S. (2012). A study of Iranian students' attitude towards science and technology, school science and environment, based on the ROSE project. *Journal of Studies in Education*, 2(1), 90-103.
- Nadiroh, A., & Susanto, A. (2012). Application of Environmental-Based Learning Model to Develop Science Process Skills and Improve Cognitive Learning Outcomes in Class X Sma Muhammadiyah 1 Metro Academic Year 2011/2012. *BIOEDUKASI (Journal of Biology Education)*, 3(2).
- Shaw, R., & Oikawa, Y. (Eds.). (2014). *Education for sustainable development and disaster risk reduction*. Tokyo: Springer.
<https://doi.org/10.1007/978-4-431-55090-7>
- Silaban, R., Septiani, B., & Hutabarat, W. (2015). Preparation of Innovative Chemistry Teaching Materials Integrated Reaction Rate Material for High School Student Character Education. *Journal of Tabularasa PPS Unimed*, 12(1), 78-88.
- Susantini, E., Faizah, U., & Prastiwi, M.S. (2016). developing educational video to improve the use of scientific approach in Cooperative learning. *Journal of Baltic Science Education*, 15(6), 725-737.
<https://doi.org/10.33225/jbse/16.15.725>
- Sousa, E., Quintino, V., Palhas, J., Ridrigues, A, M., & Teixeira, J. (2016). Can Environmental Education Actions Change Public attitudes? An Example Using the Pond Habitat and Associated Biodiversity. *PloS one*, 11(5), 1-13.
<https://doi.org/10.1371/journal.pone.0154440>