RESEARCH ARTICLE

Environmental literacy of biology teacher candidates in supporting the Walisongo Eco Green Campus program

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Abstract: Education is crucial in changing human behaviour toward environmental management. The Walisongo Eco-Green Campus (WeGreen) is a program that aims to achieve Sustainable Development Goals, so it is necessary to prepare the students of Biology teacher candidates to have good environmental literacy. This study aims to describe the environmental literacy of the students of Biology teacher candidates based on the academic year. The sampling technique used in this study was stratified random sampling. The sample of the study was 339 students of Biology teacher candidates in four different academic years. Data collection techniques used are tests and questionnaires. The data obtained from the measurement result of environmental literacy were analyzed descriptively using the mean and standard deviation formulas. The results of the Kruskal-Wallis test show a significance value of 0.451 ($p>0.05$) on the cognitive aspect and 0.535 ($p>0.05$) on the affective aspects. In addition, the result on behavioural aspects is 0.012 ($p<0.05$). There is no difference in environmental literacy (cognitive aspects and affective aspects) of the students of Biology teacher candidates based on the academic year, but there is a difference in students' behaviour aspects. Students with the most different behaviour are those in the academic year of 2019 (fifth semester).

Keywords: biology teacher candidate; environmental literacy; WeGreen campus

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Article history:
Received: 8 August 2022
Revised: 25 October 2022
Accepted: 03 November 2022
Published: 24 November 2022

10.22219/jpbi.v8i3.22122

p-ISSN: 2442-3750
e-ISSN: 2537-6204

Introduction

Efforts to conserve natural resources are a challenge in sustainable development. Environmental issues are also a national priority in the 2020-2024 National Medium-Term Development Plan (RPJMN). Environmental problems are crucial problems faced today (Sadik & Sadik, 2014). Environmental problems that occur in Indonesia are air pollution in urban areas, smoke and haze from forest fires (Kusumaningtyas & Aldrian, 2016; Madsen, 2015), forest deforestation (Austin et al., 2019; Tacconi et al., 2019), industrial and household waste (Belinawati et al., 2018; Garg et al., 2018), and soil pollution due to the use of pesticides (Joko et al., 2017). Environmental problems in Indonesia have an impact on the lives of people and other countries around them (Austin et al., 2019; Belinawati et al., 2018). Environmental problems that occur are also related to the increase in population (Ray & Ray, 2011; Weber & Sciubba, 2019). The results of the census report that the total population of Indonesia in 2020 is 270,203.9 million, an increase of 32,562.6 million from the 2010 census (Indonesian Central Bureau of Statistics, 2020). The data shows that 70.72% of the population is in a productive age with high needs and mobility. The increase in human population causes an increase in the need for a good environment and place to live (Martin et al., 2016; Ray & Ray, 2011).

Human activities are a source of environmental change. Activities without good environmental

management carried out by human will cause environmental problems (Karatekin, 2012). The increase in environmental problems encourages improvements in environmental management, one of which is using education. Education plays a role in changing people's behavior toward the environment (Conde & Sánchez, 2010; Derevenskaia, 2014; Ozsoy et al., 2012). Education help students in raising awareness about environmental problems and contributing to find the solutions (Kahyaoğlu, 2014).

Environmental education aims to help students have knowledge and understanding of the environment. Environmental education can increase the attitude of caring for the environment and reduce environmental damage in the future (Fauzani & Aminatun, 2021). Environmental education can help students develop a view of ecology and play an active role in promoting environmental care. Researchers believe that environmental education is an effective way to change behavior (Conde & Sánchez, 2010; Yu & Yu, 2017). A person is expected to develop an understanding, skills, and awareness in caring for the environment (Ichsan et al., 2019). The main objective of the development of environmental education is to develop environmental literacy (Saribas, 2015). Environmental literacy is indicated as one of the elements of learning that can solve environmental problems (Ulfah et al., 2020). A individual is said to have adequate environmental literacy if he has understanding, knowledge, character, values, ethics, and skills in preventing environmental problems and has the drive to protect and improve the quality of the current and future environment (Shamuganathan & Karpudewan, 2015).

Environmental problems are expected to be reduced by the existence of environmental education in several schools, especially with the increasing number of schools implementing environmentally friendly programs (Schüßler et al., 2019; Steg & Vlek, 2009; Szczytko et al., 2019). Many schools have obtained a title of environmentally friendly school or is known as Adiwiyata School. Adiwiyata is a program implemented to create caring, insightful, and environmentally-cultured schools. The implementation of the Adiwiyata program requires support from all school members, especially students as agents of change to create a better environment.

Based on previous research, Adiwiyata schools affect environmental literacy (Anggraini & Karyanto, 2018; Astuti & Aminatun, 2020; Meilinda et al., 2017; Waqidah et al., 2020). The same thing also happened in Turkey, showing that environmental education in schools can also grow students' environmental literacy (Ozsoy et al., 2012). Environmentally-based schools make students more aware of environmental problems because the program encourages students to be involved in activities and facilities in schools directly, such as waste recycling, waste banks, and greenhouses (Spínola, 2015). The involvement of students in environmental-based activities can improve students' environmental literacy (Karatekin, 2012). Therefore, teachers play an important role in the development of students' environmental literacy. Teachers must conduct effective learnings to develop environmentally responsible behavior of the students (Ozsoy et al., 2012). Students as the nation's next generation must be the agents of change to protect the environment.

Various studies related to the environmental literacy have been carried out, but there are no researches that reveal the environmental literacy of the students of teacher candidates at state Islamic universities. Teachers have a great responsibility in developing students' environmental literacy, so the urgency in preparing the students of teacher candidates to have good environmental literacy is very important. This research is done to describe the environmental literacy skills of the students of Biology teacher candidates based on the academic year, one of which is at Universitas Islam Negeri (UIN - State Islamic University) Walisongo Semarang.

UIN Walisongo is one of the campuses that has implemented a green campus concept. The role of UIN Walisongo in creating a green campus and its concern for environmental sustainability is realized through the Walisongo Eco Green Campus (WeGreen) program. The green campus program in the curriculum of Biology education is implemented through an educational process, scientific studies, and environmentally care actions. Based on the results of the observations of student behavior, the students still do not reflect environmental care. They still throw garbage in class, do not turn off electronic equipment after use, and do not use reusable items. Green campus is a sustainable effort to create an environmentally friendly campus. To achieve the WeGreen program, the active participation of all academic society member of the campus is required. This active participation will certainly run well if each individual has environmental literacy. This study aims to describe the environmental literacy skills of the students of Biology teacher candidates based on the academic year. This research contributes to the development of learning strategies that can train the environmental literacy skills of the students of Biology teacher candidates.

Method

This study uses a quantitative approach with a survey method. The population of the study was all students of Biology teacher candidates at UIN Walisongo Semarang with the total of 473 students. The samples of the study were 339 students of Biology teacher candidates in the academic year of 2018, 2019, 2020, and 2021. The sampling technique used was stratified random sampling. The instruments of data collection are questions and questionnaires. The instrument validity test was carried out using

Pearson correlation test with the significance value for each item of less than 0.05 ($p < 0.05$). The results of the validity test of the cognitive, affective, and behavioral aspects of the instrument show a significance value of less than 0.05 on all items. This shows that the instruments used are all valid. Furthermore, the reliability test was carried out using Cronbach's alpha value. The result shows that the Cronbach's alpha value for each element is more than 0.6. It indicates that the items that compose each element in the questionnaire are reliable.

A test was given to measure cognitive element of the environmental literacy. The test consisted of 14 questions with 7 true-or-false questions and 7 multiple-choices questions. The data collection instrument refers to the instrument developed by Liang et al. (2018). The questionnaire given was a closed questionnaire consisting of elements of environmental literacy, namely affective and behavioral. The instrument of data collection on affective element consisted of 10 statements with a 5-point Likert scale, while the instrument of data collection on behavioral element consisted of 17 statements with a 5-point Likert scale. Elements and components of the environmental literacy are presented in Table 1.

Table 1. Elements and components of the environmental literacy

Elements	Components
Cognitive	• Knowledge of nature • Knowledge of environmental issues • Knowledge of appropriate action strategies
Affective	• Environmental awareness and sensitivity • Environmental values • Attitude of decision making on environmental issues
Behavioral	• Intention to act • Environmental action strategy and skills • Involvement in the environmentally responsible behavior

The data obtained from the measurement result of environmental literacy were analyzed descriptively using the mean and standard deviation formulas to explain the level of environmental literacy. Table 2 shows the categorization of environmental literacy level.

Table 2. Categorization of environmental literacy level

Score	Category
$X \leq M - 1{,}5\ SD$	Very Low
$M - 1{,}5\ SD < X \leq M - 0{,}5\ SD$	Low
$M - 0{,}5\ SD < X \leq M + 0{,}5\ SD$	Medium
$M + 0{,}5\ SD < X \leq M + 1{,}5\ SD$	High
$M + 1{,}5\ SD < X$	Very High

Data analysis was carried out by testing the normality of the data with the Kolmogorov-Smirnov test. A normality test is used to determine the data distribution. Furthermore, the homogeneity test was done using Levene's Test of Equality of Error Variances to find the data homogeneity. Hypothesis testing was carried out with a non-parametric approach using the Kruskal-Wallis test.

Results and Discussion

The characteristics of the respondents are analyzed using descriptive analysis based on the age and the level of semester. Based on age, as many as 19 people (5.6%) are 17 years old, 116 people (34.3%) are 18 years old, 86 people (25.4%) are 19 years old, 72 people (21.3%) are 20 years old, 43 people (12.7%) are 21 years old, and two people (0.6%) are 22 years old. Based on the level of semester, the first semester students with a total of 153 people (45.3%), dominate the study. Meanwhile, there are 78 people (23.1%) of the third semester students, 73 people (21.6%) of the fifth semester students, and 34 people (10.1%) of the seventh semester students. There are three aspects measured in this study, namely cognitive, affective, and behavioral. Respondents' answers to each item in each element are analyzed descriptively with the following results.

Students' Cognitive Aspect

There are 14 questions that measure students' knowledge of environmental literacy on the cognitive aspect. Students' cognitive skills are divided into 5 categories, namely very low, low, medium, high, and very high. Data on the cognitive level of the students are presented in Table 3. Based on Table 3, the average score of students' cognitive aspect is 0.616. This shows that students can answer correctly by 61.6%. There are 40 students, dominated by first semester students, with very low cognitive scores. As

many as 47 students have low cognitive levels, which are dominated by first semester and third semester students. There are 148 students, dominated by first semester students, who have moderate cognitive level. As many as 90 students, dominated by first semester students, have high cognitive level. Last, there are 13 students with very high cognitive levels, which are dominated by fifth semester students.

Table 3. Cognitive level of the students

Category	1st Semester (2021)	3rd Semester (2020)	5th Semester (2019)	7th Semester (2018)	Total
Very Low (<0,435)	22 (55,0%)	10 (25,0%)	6 (15,0%)	2 (5,0%)	40
Low (0,435 - 0,555)	17 (36,2%)	17 (36,2%)	7 (14,9%)	6 (12,8%)	47
Medium (0,556 – 0,676)	70 (47,3%)	28 (18,9%)	35 (23,6%)	15 (10,1%)	148
High (0,677 – 0,797)	40 (44,4%)	19 (21,1%)	20 (22,2%)	11 (12,2%)	90
Very High (>0,797)	4 (30,8%)	4 (30,8%)	5 (38,5%)	0 (0,0%)	13
Average score of the cognitive aspect = 0,616					

The highest cognitive score based on the average is owned by fifth semester students. The fifth semester students were known to take ecology course during the research. In the ecology course, students gain environmental knowledge of the organization of individual interactions from the population, community, and ecosystem, to the biosphere level. They have a longer learning experience than the students of the first and third semester, who dominate low cognitive levels. The students of the first and third semester have not yet received environmental course, while the students of the seventh semester have taken an online ecology course in the previous year. Online lectures affect the learning experience obtained by seventh semester students. This is following the cognitive learning theory that learning experiences affect a person's cognitive abilities (Rahadian & Budiningsih, 2017; Wyner & Blatt, 2019). Learning is an attempt to understand something. The effort is carried out actively by students by seeking experience, seeking information, solving problems, observing the environment, and practicing something to achieve certain goals. In the learning process, there is a process of changing cognitive structures based on certain practices or experiences, as well as the results of interactions with the environment or other learning resources. According to cognitive theory, prior knowledge will determine the success of learning new knowledge (Aloqaili, 2012; Schumm & Bogner, 2016).

Regarding environmental literacy, students who have environmental knowledge will have good critical thinking skills about environmental problems, because knowledge is the basis for critical thinking (Aloqaili, 2012; Lewinsohn et al., 2014). There are three indicators in the cognitive element, namely knowledge of nature, knowledge of environmental issues, and knowledge of appropriate action strategies. As reported by Liang et al. (2018) the cognitive element refers to the ability to identify, investigate, analyze, and evaluate environmental problems and issues based on basic knowledge of ecology and socio-politics. Kamarulzaman et al. (2017) also state that the ability of students to identify and analyze problems related to the environment cannot be separated from what they have learned and understood.

The results of the normality test show that the significance value of the cognitive score is less than 0.05, which means that the three elements are not normally distributed. So, the difference test is carried out with a nonparametric approach using the Kruskal-Wallis test. The results of the Kruskal Wallis test show a significance value of 0.451 ($p>0.05$). Therefore, it can be concluded that there are no significant cognitive differences in students of the first semester, third semester, fifth semester, and seventh semester.

Based on the curriculum, the distribution of biological science courses has been given to the students since the first semester. Through the biological science course, students are expected to master the concepts, principles, and applications of Biology through scientific work to generate ideas in the management and utilization of biological and environmental resources, be skillful in utilizing information technology, and have the behavior and personality of a scientist who is responsible for solving biological problems. This of course has an impact on graduate learning outcomes of the attitudes, general skills, and special skills that must be possessed by students. The lesson plans compiled have already contained detailed learning activities, namely face-to-face activities, practicums, structured assignments, and independent assignments. Based on this description, students of all generations have received Biology science courses, so there is no cognitive difference between the students of Biology teacher candidates in all grades, either in the first semester, third semester, fifth semester, and seventh semester. No cognitive difference between the students of the biology teacher candidates in all grades is an interesting finding of this study. This is in line with the research of Nurwidodo et al. (2020) that

grade level has no significant effect on environmental knowledge. Another study also revealed that grade level had no significant effect on literacy skills, it was influenced by school heterogeneity in early literacy skills (Kim & Morrison, 2018).

Students' Affective Aspect

The category of affective aspect can be analyzed descriptively with the results in Table 4. Indicators of the affective element are environmental awareness and sensitivity, environmental values, and decision-making attitudes toward environmental issues. According to Liang et al. (2018) the affective element covers an individual's empathy and concern for the environment as well as an individual's attention on environmental quality and his awareness to take action to help prevent and solve environmental problems. This element seeks to evaluate environmental awareness and sensitivity as well as decision-making attitudes and actions towards environmental issues and values with consideration and reflective thinking about the relationship between humans and the environment.

Table 4. Affective level of the students

Category	1st Semester (2021)	3rd Semester (2020)	5th Semester (2019)	7th Semester (2018)	Total
Very Low (<3.396)	-	-	-	-	-
Low (3,396 – 3,834)	-	-	-	-	-
Medium (3,835 – 4,272)	103 (45,8%)	52 (23,1%)	46 (20,4%)	24 (10,7%)	225
High (4,273 – 4,711)	41 (44,6%)	20 (21,7%)	23 (19,0%)	8 (8,7%)	92
Very High (>4,711)	9 (42,9%)	6 (28,6%)	4 (19,0%)	2 (9,5%)	21
Average score of the affective aspect = 4,050					

Table 4 shows that there are no students who have the affective aspect in the very low and low categories, either the students of the first semester, third semester, fifth semester, and seventh semester. At each semester level, the affective aspect of the students is mostly classified as the medium category. The average score of the affective aspect is 4.050, which is referred to the medium category. Based on these data, it is known that the average score of the affective aspect of the students of all generations is categorized as medium category, which means that the students have empathy and concern for the environment and try to take action to help prevent and solve environmental problems. This is in line with what was revealed by Bergman (2016) which showed that environmental awareness by itself affects personal attitudes toward environmental management and environmentally-friendly behavior.

The results of the normality test show that the significance value of the three elements is less than 0.05, which means that the three elements are not normally distributed. So, the difference test is carried out with a nonparametric approach using the Kruskal-Wallis test. The results of the Kruskal Wallis test showed a significance value of 0.535 ($p>0.05$). Therefore, it can be concluded that there are no significant affective differences in students of the first semester, third semester, fifth semester, and seventh semester. Attitude change takes time, it does not happen instantly. Attitude is a reflection of habit, so it takes time to get used to it (Oerke & Bogner, 2013; Sadik & Sadik, 2014; Yu & Yu, 2017). Research by Nurwidodo et al. (2020) reveals that the level of environmental influence is low due to the short period for implementing environmental education programs. Environmental influence is measured by three components, namely verbal commitment, environmental sensitivity, and feelings toward the environment. Environmental influence is related to students' feelings. In contrast to environmental knowledge and thinking skills, developing a feeling to pay attention to the environment is more difficult and lengthier. As stated in Liang et al. (2018), knowledge and attitudes do not have a significant correlation. The attitude of caring for the environment is influenced by factors of personal experience, culture, mass media, religion, and emotional factors of each individual (Bergman, 2016; Chouhan et al., 2017; Oerke & Bogner, 2013; Schneller et al., 2015).

Students' Behavioural Aspect

Student behavior is divided into five categories, namely very low, low, medium, high, and very high. The categorization of each semester level can be presented in Table 5. The results of the normality test show that the significance value of the three elements is less than 0.05, which means that the three elements are not normally distributed. So, the difference test is carried out with a nonparametric approach using the Kruskal-Wallis test. The results of the Kruskal-Wallis test showed that the significance value of the

Kruskal Wallis test above was 0.012 ($p < 0.05$). There are significant differences in behavioral aspect among the students of the first semester, third semester, fifth semester, and seventh semester. A follow-up test to find out which semester students have the most different behavior was carried out with the Mann-Whitney test. The result of the Mann-Whitney test is presented in Table 6.

Table 5. Behavioral level of the students

Category	1st Semester (2021)	3rd Semester (2020)	5th Semester (2019)	7th Semester (2018)	Total
Very Low (< 2,651)	8 (53,3%)	4 (26,7%)	2 (13,3%)	1 (6,7%)	15
Low (2,651 – 3,120)	55 (52,4%)	20 (19,0%)	16 (15,2%)	14 (13,3%)	105
Medium (3,121 – 3,590)	49 (40,2%)	32 (26,2%)	28 (23,0%)	13 (10,7%)	122
High (3,591 – 4,060)	37 (48,7%)	16 (21,1%)	18 (23,7%)	5 (6,6%)	76
Very High (>4,061)	4 (20,0%)	6 (30,0%)	9 (45,0%)	1 (5,0%)	20
Average score of the behavioral aspect = 3,360					

Table 6. The result of Mann Whitney test

	1st Semester (2021)	3rd Semester (2020)	5th Semester (2019)	7th Semester (2018)
1st Semester (2021)	-	0,217	0,007*	0,345
3rd Semester (2020)	0,217	-	0,202	0,064
5th Semester (2019)	0,007*	0,202	-	0,004*
7th Semester (2018)	0,345	0,064	0,004*	-

*) Significance value α=5%

The results of the follow-up test using the Mann-Whitney test showed that the behavior of students of the first semester was significantly different from that of the fifth semester, and the behavior of students of the fifth semester was significantly different from that of the seventh semester. Thus, the behavior of these students could be classified into two groups (Table 7).

Table 7. Classification of student behavior based on difference tests

Semester	N	Group 1	Group 2
7th Semester (2018)	34	3,222	-
1st Semester (2021)	153	3,297	-
3rd Semester (2020)	78	3,391	3,391
5th Semester (2019)	73	-	3,499

Based on Table 5, the average score of students' behavioral aspect is 3.360. The very low, low, medium, and high levels of behavior are dominated by the first semester students, while the very high level is dominated by the fifth semester students, owing to the highest average score. Students who already have good environmental knowledge tend to practice what they already have. Research notes that environmentally responsible behavior is correlated with knowledge and it is likely that people with increased environmental knowledge will develop more environmentally responsible behaviors and more positive attitudes toward the environment (Fettahlıoğlu & Aydoğdu, 2020; Schüßler et al., 2019; Zheng et al., 2018). There are three indicators of behavioral elements, namely intention to act, environmental action strategies and skills, and involvement in the environmentally responsible behavior. According to Liang et al. (2018) behavioral elements focus on the individual's intention to behave in an environmentally friendly manner, act with environmental strategies and skills to identify and evaluate environmental problems, and involve in environmentally responsible behavior.

Table 7 shows that students who have the most different behavior and have the highest average score are students of the fifth semester. While students of the first semester, third semester, and seventh semester have the same behavior or are not significantly different. Based on these data, it is known that the fifth semester students of teacher candidates have the most different behavior and have the highest average score of behavioral aspect. This is in line with the knowledge of the environment owned by fifth semester students. In line with Sechi et al. (2018), knowledge or cognition is an important aspect that contributes to the formation of a person's behavior, so knowledge of the environment is very important to foster caring behavior towards the environment. The same thing was also expressed by Bergman

(2016) that knowledge of environmental issues is a prerequisite for the formation of environmental care behavior, this means that knowledge of the environment is a key component and criterion for the success of implementing environmental education programs.
Environmentally responsible behavior is one of the important factors to protect the environment from damage. Environmentally responsible behavior can be built through knowledge of ecological concepts and intentions to act on the environment. Knowledge of ecological concepts and intention to act has a direct effect on the environmentally responsible behavior (Ipikasari et al., 2020). Based on the theory of planned behavior, environmental knowledge can directly stimulate environmentally responsible behavior (Ajzen, 2012). This is also conveyed by Duerden and Witt (2010) that the theory of planned behavior shows that an individual's intention to engage in certain behavior is influenced by his knowledge. Environmental education with direct learning experiences develops environmentally responsible behavior and attitudes. Based on the research conducted by Nurwidodo et al. (2020) the environmental education program at the Adiwiyata schools is an important step in empowering environment-oriented knowledge and behavior. Individuals with environmental knowledge show more positive environmental behaviors (Duerden & Witt, 2010; Xie & Lu, 2022; Zheng et al., 2018).

Conclusion

The conclusion of this study conveys that there are no differences in environmental literacy (cognitive and affective) of students of Biology teacher candidates based on the academic year, but there are differences in their behaviour. Students who have the most different behaviour are students of the 2019 academic year. While students of the academic year of 2018, 2020, and 2021 have the same behaviour or are not significantly different. Based on the study, it is recommended for the campus to initiate a program to enhance environmental literacy of the students by strengthening the character of caring for the environment through the education process, scientific studies, and environmentally care actions.

Acknowledgment

The author would like to thank Universitas Islam Negeri Walisongo Semarang for the fund assistance of the research given from the beginning of research to publication.

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

Author Contributions

N. L. R.: method, validation; validation, analysis, writing—original draft preparation, and review and editing. N. A. C.: analysis, writing—original draft preparation, review and editing.

References

Ajzen, I. (2012). The theory of planned behavior. *Handbook of Theories of Social Psychology: Volume 1*, 438–459. https://doi.org/10.4135/9781446249215.n22

Aloqaili, A. S. (2012). The relationship between reading comprehension and critical thinking: A theoretical study. *Journal of King Saud University - Languages and Translation*, *24*(1), 35–41. https://doi.org/10.1016/j.jksult.2011.01.001

Anggraini, W., & Karyanto, P. (2018). The environmental knowledge and attitude of middle-school students in five prominent Green Schools in Indonesia. *Proceedings of the International Conference on Teacher Training and Education 2018 (ICTTE 2018), 262*(ICTTE 2018), 18–22. https://doi.org/10.2991/ictte-18.2018.4

Astuti, D., & Aminatun, T. (2020). Student's environmental literacy based on Adiwiyata and non-Adiwiyata at senior high school in Sleman, Yogyakarta. *JPBI (Jurnal Pendidikan Biologi Indonesia)*, *6*(3), 375–382. https://doi.org/10.22219/jpbi.v6i3.13629

Austin, K. G., Schwantes, A., Gu, Y., & Kasibhatla, P. S. (2019). What causes deforestation in Indonesia? *Environmental Research Letters*, *14*(2). https://doi.org/10.1088/1748-9326/aaf6db

Belinawati, R. A. P., Soesilo, T. E. B., Asteria, D., & Harmain, R. (2018). Sustainability: Citarum River, government role on the face of SDGs (water and sanitation). *E3S Web of Conferences*, *52*, 1–7. https://doi.org/10.1051/e3sconf/20185200038

Bergman, B. G. (2016). Assessing impacts of locally designed environmental education projects on students' environmental attitudes, awareness, and intention to act. *Environmental Education Research*, *22*(4), 480–503. https://doi.org/10.1080/13504622.2014.999225

Chouhan, S., Bhatnagar, B., Suman, & Kaur, M. (2017). Assessment of environmental attitude of adolescent of Bikaner City. *Studies on Home and Community Science*, *11*(1), 25–28. https://doi.org/10.1080/09737189.2017.1336308

Conde, M. del C., & Sánchez, J. S. (2010). The school curriculum and environmental education: A school environmental audit experience. *International Journal of Environmental and Science Education*, *5*(4), 477–494. https://files.eric.ed.gov/fulltext/EJ908944.pdf

Derevenskaia, O. (2014). Active learning methods in environmental education of students. *Procedia - Social and Behavioral Sciences*, *131*, 101–104. https://doi.org/10.1016/j.sbspro.2014.04.086

Duerden, M. D., & Witt, P. A. (2010). The impact of direct and indirect experiences on the development of environmental knowledge, attitudes, and behavior. *Journal of Environmental Psychology*, *30*(4), 379–392. https://doi.org/10.1016/j.jenvp.2010.03.007

Fauzani, P., & Aminatun, T. (2021). Adiwiyata program implementation in inculcating environmental care characters: A literature review. *Proceedings of the 6th International Seminar on Science Education (ISSE 2020)*, *541*(ISSE 2020), 150–154. https://doi.org/10.2991/assehr.k.210326.021

Fettahlıoğlu, P., & Aydoğdu, M. (2020). Developing environmentally responsible behaviours through the implementation of argumentation- and problem-based learning models. *Research in Science Education*, *50*(3), 987–1025. https://doi.org/10.1007/s11165-018-9720-0

Garg, T., Hamilton, S. E., Hochard, J. P., Kresch, E. P., & Talbot, J. (2018). (Not so) gently down the stream: River pollution and health in Indonesia. *Journal of Environmental Economics and Management*, *92*, 35–53. https://doi.org/10.1016/j.jeem.2018.08.011

Ichsan, I. Z., Sigit, D. V., Miarsyah, M., Ali, A., Arif, W. P., & Prayitno, T. A. (2019). HOTS-AEP: Higher order thinking skills from elementary to master students in environmental learning. *European Journal of Educational Research*, *8*(4), 935–942. https://doi.org/10.12973/eu-jer.8.4.935

Ipikasari, I., Sigit, D. V., & Komala, R. (2020). The effect of knowledge of ecological concepts and intention to act toward responsible environmental behavior of senior high school students. *International Journal for Educational and Vocational Studies (IJEVS)*, *2*(7). https://doi.org/https://doi.org/10.29103/ijevs.v2i7.2754

Joko, T., Anggoro, S., Sunoko, H. R., & Rachmawati, S. (2017). Pesticides usage in the soil quality degradation potential in Wanasari Subdistrict, Brebes, Indonesia. *Applied and Environmental Soil Science*, *2017*. https://doi.org/10.1155/2017/5896191

Kahyaoğlu, M. (2014). The research of the relationship between environmentally aware prospective teachers' qualities and self efficacy beliefs towards environmental education. *Procedia - Social and Behavioral Sciences*, *116*, 4493–4497. https://doi.org/10.1016/j.sbspro.2014.01.973

Kamarulzaman, M. S., Sailin, S. N., Mahmor, N. A., & Shaari, A. J. (2017). Correlation between LOTS and HOTS scores among UUM students. *Asian Journal of Educational Research*, *5*(3), 71–74. https://repo.uum.edu.my/id/eprint/25632/

Karatekin, K. (2012). Environmental literacy in Turkey primary schools social studies textbooks. *Procedia - Social and Behavioral Sciences*, *46*, 3519–3523. https://doi.org/10.1016/j.sbspro.2012.06.096

Kim, M. H., & Morrison, F. J. (2018). Schooling effects on literacy skills during the transition to school. *AERA Open*, *4*(3). https://doi.org/10.1177/2332858418798793

Kusumaningtyas, S. D. A., & Aldrian, E. (2016). Impact of the June 2013 Riau Province Sumatera smoke haze event on regional air pollution. *Environmental Research Letters*, *11*(7). https://doi.org/10.1088/1748-9326/11/7/075007

Lewinsohn, T. M., Attayde, J. L., Fonseca, C. R., Ganade, G., Jorge, L. R., Kollmann, J., Overbeck, G. E., Prado, P. I., Pillar, V. D., Popp, D., da Rocha, P. L. B., Silva, W. R., Spiekermann, A., & Weisser, W. W. (2014). Ecological literacy and beyond: Problem-based learning for future professionals. *AMBIO*, *44*(2), 154–162. https://doi.org/10.1007/s13280-014-0539-2

Liang, S. W., Fang, W. T., Yeh, S. C., Liu, S. Y., Tsai, H. M., Chou, J. Y., & Ng, E. (2018). A nationwide survey evaluating the environmental literacy of undergraduate students in Taiwan. *Sustainability (Switzerland)*, *10*(6), 1–21. https://doi.org/10.3390/su10061730

Madsen, M. A. (2015). Breathing easier: Indonesia works towards cleaner air. *IAEA Bulletin*, *56*(1), 20–21. https://www.iaea.org/sites/default/files/bulletin_march_-_indonesia_cleaner_air.pdf

Martin, J. L., Maris, V., & Simberloff, D. S. (2016). The need to respect nature and its limits challenges society and conservation science. *Proceedings of the National Academy of Sciences of the United States of America*, *113*(22), 6105–6112. https://doi.org/10.1073/pnas.1525003113

Meilinda, H., Prayitno, E. B., & Karyanto, P. (2017). Student's environmental literacy profile of Adiwiyata Green School in Surakarta, Indonesia. *Journal of Education and Learning*, *11*(3), 299–306. https://doi.org/10.11591/edulearn.v11i3.6433

Nurwidodo, N., Amin, M., Ibrohim, I., & Sueb, S. (2020). The role of eco-school program (Adiwiyata) towards environmental literacy of high school students. *European Journal of Educational Research*, *9*(3), 1089–1103. https://doi.org/10.12973/EU-JER.9.3.1089

Oerke, B., & Bogner, F. X. (2013). Social desirability, environmental attitudes, and general ecological behaviour in children. *International Journal of Science Education*, *35*(5), 713–730. https://doi.org/10.1080/09500693.2011.566897

Ozsoy, S., Ertepinar, H., & Saglam, N. (2012). Can eco-schools improve elementary school students' environmental literacy levels? *Asia-Pacific Forum on Science Learning and Teaching*, *13*(2), 1–25. https://www.eduhk.hk/apfslt/download/v13_issue2_files/ozsoy.pdf

Rahadian, R. B., & Budiningsih, C. A. (2017). What are the suitable instructional strategy and media for student learning styles in middle schools? *International Journal on Integrating Technology in Education (IJITE)*, *6*(4), 25–39. https://doi.org/10.5121/ijite.2017.6403

Ray, S., & Ray, I. A. (2011). Impact of population growth on environmental degradation: Case of India. *Journal of Economics and Sustainable Development*, *2*(8), 72–77. https://core.ac.uk/download/pdf/234645493.pdf

Sadik, F., & Sadik, S. (2014). A study on environmental knowledge and attitudes of teacher candidates. *Procedia - Social and Behavioral Sciences*, *116*, 2379–2385. https://doi.org/10.1016/j.sbspro.2014.01.577

Saribas, D. (2015). Investigating the relationship between pre-service teachers' scientific literacy, environmental literacy and life-long learning tendency. *Science Education International*, *26*(1), 80–100. https://files.eric.ed.gov/fulltext/EJ1056471.pdf

Schneller, A. J., Johnson, B., & Bogner, F. X. (2015). Measuring children's environmental attitudes and values in northwest Mexico: validating a modified version of measures to test the Model of Ecological Values (2-MEV). *Environmental Education Research*, *21*(1), 61–75. https://doi.org/10.1080/13504622.2013.843648

Schumm, M. F., & Bogner, F. X. (2016). How environmental attitudes interact with cognitive learning in a science lesson module. *Education Research International*, *2016*, 1–7. https://doi.org/10.1155/2016/6136527

Schüßler, D., Richter, T., & Mantilla-Contreras, J. (2019). Educational approaches to encourage pro-environmental behaviors in Madagascar. *Sustainability (Switzerland)*, *11*(11). https://doi.org/10.3390/su11113148

Sechi, G., Borri, D., De Lucia, C., & Celmins, V. (2018). Environmental learning in regions: A social capital based approach. The case of Latvia. *Environmental Education Research*, *24*(3), 343–364. https://doi.org/10.1080/13504622.2016.1214867

Shamuganathan, S., & Karpudewan, M. (2015). Modeling environmental literacy of Malaysian pre-university students. *International Journal of Environmental and Science Education*, *10*(5), 757–771. https://doi.org/10.12973/ijese.2015.264a

Spínola, H. (2015). Environmental literacy comparison between students taught in eco-schools and ordinary schools in the Madeira Island region of Portugal. *Science Education International*, *26*(3), 392–413. https://files.eric.ed.gov/fulltext/EJ1074869.pdf

Steg, L., & Vlek, C. (2009). Encouraging pro-environmental behaviour: An integrative review and research agenda. *Journal of Environmental Psychology*, *29*(3), 309–317. https://doi.org/10.1016/j.jenvp.2008.10.004

Szczytko, R., Stevenson, K., Peterson, M. N., Nietfeld, J., & Strnad, R. L. (2019). Development and validation of the environmental literacy instrument for adolescents. *Environmental Education Research*, *25*(2), 193–210. https://doi.org/10.1080/13504622.2018.1487035

Tacconi, L., Rodrigues, R. J., & Maryudi, A. (2019). Law enforcement and deforestation: Lessons for Indonesia from Brazil. *Forest Policy and Economics*, *108*(June), 101943. https://doi.org/10.1016/j.forpol.2019.05.029

Ulfah, M., Suyanto, S., & Aminatun, T. (2020). The completeness of environmental literacy aspects studied in the articles published in several countries. *JPBI (Jurnal Pendidikan Biologi Indonesia)*, *6*(1), 75–82. https://doi.org/10.22219/jpbi.v6i1.10813

Waqidah, S. N., Suciati, S., & Ramli, M. (2020). Environmental literacy-based on Adiwiyata predicate at junior high school in Ponorogo. *JPBI (Jurnal Pendidikan Biologi Indonesia)*, *6*(3), 405–412. https://doi.org/10.22219/jpbi.v6i3.12468

Weber, H., & Sciubba, J. D. (2019). The effect of population growth on the environment: Evidence from European regions. *European Journal of Population*, *35*(2), 379–402. https://doi.org/10.1007/s10680-018-9486-0

Wyner, Y., & Blatt, E. (2019). Connecting ecology to daily life: how students and teachers relate food webs to the food they eat. *Journal of Biological Education*, *53*(2), 128–149. https://doi.org/10.1080/00219266.2018.1447005

Xie, J., & Lu, C. (2022). Relations among pro-environmental behavior, environmental knowledge, environmental perception, and post-materialistic values in China. *International Journal of Environmental Research and Public Health*, *19*(1). https://doi.org/10.3390/ijerph19010537

Yu, T. Y., & Yu, T. K. (2017). The moderating effects of students' personality traits on pro-environmental behavioral intentions in response to climate change. *International Journal of Environmental Research and Public Health*, *14*(12). https://doi.org/10.3390/ijerph14121472

Zheng, Q. J., Xu, A. X., Kong, D. Y., Deng, H. P., & Lin, Q. Q. (2018). Correlation between the environmental knowledge, environmental attitude, and behavioral intention of tourists for ecotourism in China. *Applied Ecology and Environmental Research*, *16*(1), 51–62. https://doi.org/10.15666/aeer/1601_051062