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The Effectiveness of the Indonesian Forest Honeybee Conservation E-Module on Students' Environmental Literacy Ability

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Abstract

This study aims to analyze the effectiveness of the Indonesian forest honeybee conservation e-module on students' environmental literacy skills in natural resource management courses. This study uses a one-group pretest and posttest design. The sample in this study was 22 students of natural resource management class who were selected using the purposive sampling technique. The learning was carried out 5 times, starting with the pretest and ending with the posttest. The data collection instrument used a multiple-choice test of as many as 29 questions which were conducted online using google form. Data analysis using N-Gain Score. The results showed that the gain-score was 0.8. So, can be concluded that the effectiveness of the Indonesian forest honeybee conservation e-module is quite high in improving students' environmental literacy skills, especially in the aspects of ecological knowledge, conservation knowledge, the attitude in presenting data and information, scientific behavior (having curiosity and caring for the environment), and wise behavior and responsible.

Keywords: *E-Module, Environmental Literacy, Conservation*

1. Introduction

Institutions of higher education can play an integral role in the education and development of adult environmental literacy (Halimi et al., 2020; Hwang et al., 2020). People with higher levels of education tend to be more environmentally literate. Undergraduate students who become more environmentally literate during their college years will have a greater tendency toward pro-environmental behaviors as adults that can have a profound effect on the environment. Because the educational years spent in higher education are brief and formative, universities should use this time with students wisely and strategically (Lloyd-Strovas et al., 2018). Natural resource management is one of the courses that can be used to develop environmental literacy. One of the natural resources owned by Indonesia as a country with high biodiversity is forest honey bees. Honey bees are one of the potential forest resources to be developed in its cultivation. This is due to the abundant source of bee forage (almost all plants that produce flowers can be used as a food source) both from forest plants, crops, and estate crops (Setiawan et al., 2016). Forest beekeeping is defined by place i.e. the bee colonies are living within the forest and foraging on the nectar and pollen of forest trees. Forest beekeeping is not honey hunting, which involves the taking of honeycomb from wild honey bee nests, located in natural cavities within the forest, usually hollow trees but also cavities in rocks, the ground, and cliffs (Requier et al., 2019).

Beekeeping plays a major role in improving biodiversity and increasing crop production through pollination (Minja & Nkumilwa, 2016). Besides, being able to have high economic value, this honey bee commodity can also support the increase in income and welfare of the community. Thus, it can also be said that the development of forest honey bees, can be expected to support the optimization of the management and preservation of forest resources (Malamassam, 2020). Knowledge about forest honey bee conservation in

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Indonesia is very important to be taught in the hope that attitudes and behaviors can contribute to building environmental literacy skills from students.

Environmental literacy focuses on four main aspects (Maurer & Bogner, 2020; Veisi et al., 2019), namely: "affect" (environmental sensitivity, attitudes, and values); "behavior" (personal investment, responsibility, and active involvement); "knowledge" (e.g. question about the relationship to environmental behavior); and "skills" (e.g. derived from the Tbilisi document). Construction of meaning in environmental literacy does not occur through the attainment of ecological knowledge in isolation but as a result of information acquired from interactions with the environment. Knowledge, attitude, and behavior are often identified as essential components of environmental literacy. Knowledge requires the individual to comprehend information regarding the relationships between humans and natural systems, while attitude involves an individual's beliefs, values, and feelings toward the natural world. Thus, environmental literacy is holistic and distinct from simple awareness or personal knowledge and developed within specific contexts, where behaviors can change as a result of changes in attitudes and knowledge (Lloyd-Strovas et al., 2018).

The delivery of knowledge can be done using teaching materials. One of the learning materials that students can use as independent teaching materials is an e-module. One of the advantages of this e-module is that it is equipped with a comprehensive topic discussion but with language that is easily understood by students. E-module is also equipped with pictures and videos that will clarify the contents of the topic so that the concept of the topic to be explained will be well visualized. E-module will also be equipped with instructions for conducting simple experiments, questions to test the user's ability as well as discussions so that the user will immediately get a correction of the questions being worked on (Purwanto et al., 2020; Sugiani et al., 2019). Using an e-module in learning activities makes skill improved than a conventional module, including environmental literacy skills (Arthur et al., 2019; Imaningtyas et al., 2015; Khasanah et al., 2017; Sahronih et al., 2019; Serevina, 2018; Sunarsih et al., 2020; Suwatra et al., 2018). Based on these problems, the effectiveness test of Indonesian forest honeybees' conservation e-module on the ability of students' environmental literacy in natural resource management courses.

2. Method

This study uses a one-group pretest and posttest design (Figure 1) involving 22 students of natural resource management class in the study program of biology at Universitas Negeri Malang that was selected with the purposive sampling. Data collection is done at the beginning before learning using e-module and at the end after using e-module. Learning takes place during 5 meetings. In one meeting, students learn one learning activity in e-module (e-module has 5 learning activities). Data retrieval is performed using multiple-choice tests. The test is done online through the google form facility. The environmental literacy test instrument consists of 29 questions, the grid of which can be seen in Table 1.

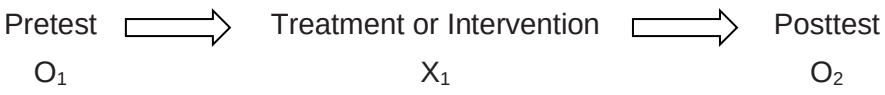

Figure 1. One-group pretest and posttest design (Leedy & Ormord, 2013)

Table 1. Grid of environmental literacy tests

No	Environmental Aspects	Problem Number	Multiple Choice Types
1	Ecological Knowledge	1, 2, 3, 4, 5, 6, 7, 9, 11, 12, 13, 14, 18, 23, 25	Multiple choice (4 options with 1 correct answer, choosing the wrong answer will be worth 0)
2	Knowledge of Local Wisdom	10, 15, 19, 22, 24	Multiple choice (4 options with 1 correct answer, choosing the wrong answer will be worth 0)

No	Environmental Aspects	Problem Number	Multiple Choice Types
3	Knowledge of the Benefits of Honey Bees for Health	8, 21	Multiple choice (4 options with 1 correct answer, choosing the wrong answer will be worth 0)
4	Conservation Knowledge	2, 16, 17	Multiple choice (4 options with 1 correct answer, choosing the wrong answer will be worth 0)
5	The attitude in Presenting Data and Information	26	Multiple choice (4 options with multiple scores, no wrong choice or 0 value)
6	Scientific Behavior (Having Curiosity and Caring for the Environment)	27	Multiple choice (4 options with multiple scores, no wrong choice or 0 value)
7	Wise Behavior and Responsible	28	Multiple choice (4 options with multiple scores, no wrong choice or 0 value)
8	Participate in Nature Conservation Activities	29	Multiple choice (4 options with multiple scores, no wrong choice or 0 value)

Data analyzed using N-Gain score. The N-Gain score (*g*) is matched by the effectiveness category in Table 2. The formula calculates the N-Gain Score (*g*) (Hake, 1999) as follows:

$$g = \frac{\text{pretest score} - \text{posttest score}}{100 - \text{pretest score}} \quad (1)$$

Table 2. The effectiveness category based on N-Gain score (*g*) (Hake, 1999)

N-Gain Score (*g*)	Effectiveness Category
$g < 0{,}3$	Low Effectiveness
$0{,}7 > g > 0{,}3$	Medium Effectiveness
$g > 0{,}7$	High Effectiveness

3. Result and Discussion

Results

Environmental literacy is a learning approach that seeks to increase student involvement through the use of the environment as a learning resource. This approach assumes that the learning activities will attract students if what is learned is taken from the environment, so what is learned is related to life and beneficial to the environment. The environmental approach means linking the environment in a teaching and learning process where the environment is used as a learning resource. To understand the material that is closely related to daily life, environmental approaches are often used. So, it can be said that the environment around is a source of learning that can be optimized for the achievement of quality educational processes and outcomes (Mansir & Karim, 2020; Marhaeni et al., 2018; Ramadan et al., 2020). Based on the results of environmental literacy analysis 22 students in the natural resource management class obtained an average pretest value of 55,4 and an average posttest value of 90 with the description of the average results of environmental literacy in each aspect can be seen in Table 3.

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Table 3. Summary of N-Gain score *(g)* analysis results on student environmental literacy ability

No	Environmental Aspects	Average of N-Gain *(g)*	Category
1	Ecological Knowledge	0,8	High Effectiveness
2	Knowledge of Local Wisdom	0,5	Medium Effectiveness
3	Knowledge of the Benefits of Honey Bees for Health	0,6	Medium Effectiveness
4	Conservation Knowledge	0,9	High Effectiveness
5	The attitude in Presenting Data and Information	1,0	High Effectiveness
6	Scientific Behavior (Having Curiosity and Caring for the Environment)	0,7	High Effectiveness
7	Wise Behavior and Responsible	1,0	High Effectiveness
8	Participate in Nature Conservation Activities	0,4	Medium Effectiveness
Overall Average		**0,8**	**High Effectiveness**

Based on the summary of the results of the analysis N-Gain score (Table 3), it can be known that the effectiveness of Indonesian forest honeybees' conservation e-module is highest in improving aspects of the attitude in presenting data and information and aspects of wise behavior dan responsible (g = 1,0) and the lowest in improving the aspect of participating in nature conservation activities (g = 0,4). While *Gain score (g) obtained* for the overall aspect of environmental literacy is 0,8. This indicates that the effectiveness of the Indonesian forest honeybees' conservation e-module is quite high in improving students' environmental literacy skills.

According to some previous research results, the use of integrated science teaching materials integrated with the use of technology media, such as e-modules, can improve the literacy ability of learners (Imaningtyas et al., 2015; Suryanti et al., 2018). E-module is that it is equipped with a comprehensive topic discussion but with language that is easily understood by students (Logan et al., 2021; Widyastuti & Susiana, 2019). The e-module is also equipped with pictures and videos that will clarify the contents of the topic so that the concept of the topic to be explained will be well visualized (Asrial et al., 2019, 2020). The e-module will also be equipped with instructions for conducting simple experiments, questions to test the user's ability as well as discussions so that the user will immediately get a correction of the questions being worked on (Purwanto et al., 2020; Sugiani et al., 2019).

Contributions of teaching materials in changing a person's behavior towards the environment can be seen in the content of teaching materials through strategies by changing the way of thinking of learners first through the development of students' thinking skills to get decisions and have the willingness to act (Krnel & Naglic, 2009; Taqiyyah et al., 2017). Content in the learning materials included general scientific terms and knowledge that applied to the local communities and could be used in classrooms with students. The learning materials served the dual purpose of allowing students and teachers to construct their knowledge of local ecological structures and to be actively engaged in the learning process. Directly related to and implicit in this focus on local knowledge construction in the learning materials was the inclusion of constructivist pedagogy that has been noted is an important component of environmental literacy. The learning materials utilized the constructivist approach by allowing students to work with local and meaningful real-life situations that personally affected them (Locke et al., 2013; Schneiderhan-Opel & Bogner, 2020). In the Indonesian forest honeybees' conservation e-module, environmental literacy and local wisdom are inserted in each learning activity so that students are familiar with questions related to ecological knowledge and knowledge of local wisdom.

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High levels of environmental knowledge stimulate a university student's concern, attitudes, and personal responsibility toward environmental protection. More specifically, environmental knowledge was reported to be a significant predictor of environmental concern, attitudes, and responsibility. Environmental knowledge had significant indirect relationships with environmental attitudes and responsibility. An adult with more knowledge of environmental issues tends to care about the environment more in everyday life and shows more favorable emotional bonding toward the environment. In this aspect, as suggested by some researchers, environmental knowledge regarded as a cognitive component of environmental literacy could be used effectively to explain some affective components, namely concerns, attitudes, and personal responsibility (Teksoz et al., 2012).

Undergraduate students who become more environmentally literate during their college years will have a greater tendency toward pro-environmental behaviors as adults that can have a profound effect on the environment (Lloyd-Strovas et al., 2018). Small changes in a person's behavior can have a big impact (Littledyke, 2008). Tbilisi declaration defines an environmentally literate person as one who is aware and sensitive to the total environment; understands environmentally associated problems; acquires values and concern for the environment and participates in environmental protection; acquires skills for solving environmental problems and works for the solution of the environmental problems. An environmentally literate citizen recognizes environmental problems when they arise; evaluates environmental issues before acting; prefers long-range benefits; takes action for solving environmental problems; recognizes lifelong learning about environmental problems; recognizes the human-nature relationship; treats public and private property with the same respect; recognizes the needs of future generations; recognizes the impact of population increase on the depletion of the natural resources; works to maintain the diversity of the total environment (Teksoz et al., 2012).

Factors that can affect environmental literacy can be grouped into (Arnon et al., 2015; Genc & Akilli, 2016; Shamuganathan & Karpudewan, 2015; Vaninee et al., 2016; Veisi et al., 2019) 4 categories, namely: personality factors (perception of moral responsibility, environmental concern, environmental sensitivity, locus of control, environmental attitudes and responsibility, verbal commitment, values, etc.); cognitive factors (knowledge and skills); demographic factors (age, gender, income, residence, parental education level, etc.); external factors (external influences, pressure groups, opportunities to choose different actions, etc.).

4. Conclusions and Suggestions

Based on the results of the study, the effectiveness of the Indonesian forest honeybee's conservation e-module is quite high in improving students' environmental literacy skills, especially in the aspects of ecological knowledge, conservation knowledge, the attitude in presenting data and information, scientific behavior (having curiosity and caring for the environment), and wise behavior and responsible. While the effectiveness of e-modules for other aspects of environmental literacy such as knowledge of local wisdom, knowledge of the benefits of honey bees for health, dan participation in nature conservation activities can be more optimized by conducting field studies on honeybees.

References

Arnon, S., Orion, N., & Carmi, N. (2015). Environmental literacy components and their promotion by institutions of higher education: an Israeli case study. *Environmental Education Research*, *21*(7), 1029–1055. https://doi.org/10.1080/13504622.2014.966656.

Arthur, R., Rouf, F. A., Rahmayanti, H., & Maulana, A. (2019). Plumbing work competence instrument in the field of civil engineering. *Journal of Physics: Conference Series*, *1402*(2). https://doi.org/10.1088/1742-6596/1402/2/022019.

Asrial, Syahrial, Kurniawan, D. A., Chan, F., Septianingsih, R., & Perdana, R. (2019).

Multimedia innovation 4.0 in education: E-modul ethnoconstructivism. *Universal Journal of Educational Research*, *7*(10), 2098–2107. https://doi.org/10.13189/ujer.2019.071007.

Asrial, Syahrial, Maison, Kurniawan, D. A., & Piyana, S. O. (2020). Ethnoconstructivism E-Module to Improve Perception, Interest, and Motivation of Students in Class V Elementary School. *JPI (Jurnal Pendidikan Indonesia)*, *9*(1), 30–41. https://doi.org/10.23887/jpi-undiksha.v9i1.19222.

Genc, M., & Akilli, M. (2016). *Modeling the relationships between subdimensions of environmental literacy*. *0389*(March). https://doi.org/10.1080/1533015X.2016.1141724.

Hake, R. R. (1999). Analyzing Change/Gain Scores. *AERA-D - American Educational Research Association's Division D, Measurement and Research Methodology*, *1*(1), 1–4.

Halimi, F., AlShammari, I., & Navarro, C. (2020). Emotional intelligence and academic achievement in higher education. *Journal of Applied Research in Higher Education*, *June*. https://doi.org/10.1108/JARHE-11-2019-0286.

Hwang, G. J., Wang, S. Y., & Lai, C. L. (2020). Effects of a social regulation-based online learning framework on students' learning achievements and behaviors in mathematics. *Computers and Education*, *160*, 104031. https://doi.org/10.1016/j.compedu.2020.104031.

Imaningtyas, C. D., Karyanto, P., Nurmiyati, N., & Asriani, L. (2015). Applying E-Module Based on Problem Based Learning to Increase Scientific Literacy and Decrease Student's Misconception in Ecology at Grade X MIA 6 of SMA N 1 Karanganom Academic Year 2014/2015. *Proceeding Biology Education Conference*, 185. https://jurnal.uns.ac.id/prosbi/article/view/6726.

Khasanah, A. N., Sajidan, S., & Widoretno, S. (2017). Effectiveness of critical thinking indicator-based module in empowering student's learning outcome in respiratory system study material. *Jurnal Pendidikan IPA Indonesia*, *6*(1), 187–195. https://doi.org/10.15294/jpii.v6i1.8490.

Krnel, D., & Naglic, S. (2009). Environmental literacy comparison between eco-schools and ordinary schools in Slovenia. *Science Education International*, *20*(1), 5–24. https://eric.ed.gov/?id=EJ890652.

Leedy, P. D., & Ormord, J. E. (2013). *Practical Research: Planning and Design* (10th ed.). Pearson, Merril Prentice Hall.

Littledyke, M. (2008). Science education for environmental awareness: approaches to integrating cognitive and affective domains. In *Environmental Education Research* (Vol. 14, Issue 1). https://doi.org/10.1080/13504620701843301.

Lloyd-Strovas, J., Moseley, C., & Arsuffi, T. (2018). Environmental literacy of undergraduate college students : Development of the environmental literacy instrument (ELI). *School Science and Mathematics*, *118*(3–4), 84–92. https://doi.org/10.1111/ssm.12266.

Locke, S., Russo, R., & Montoya, C. (2013). Environmental education and eco-literacy as tools of education for sustainable development. *Journal of Sustainability Education*, *4*(January), 10. http://www.jsedimensions.org/wordpress/content/environmental-education-and-eco-literacy-as-tools-of-education-for-sustainable-development_2013_02/.

Logan, R. M., Johnson, C. E., & Worsham, J. W. (2021). Development of an E-learning Module to Facilitate Student Learning and Outcomes. *Teaching and Learning in Nursing*, *16*(2), 139–142. https://doi.org/10.1016/j.teln.2020.10.007.

Malamassam, D. (2020). Development of model for honey bee management in hasanuddin university educational forest. *IOP Conference Series: Earth and Environmental Science*, *486*(1). https://doi.org/10.1088/1755-1315/486/1/012027.

Mansir, F., & Karim, A. (2020). Islamic Education Learning Approaches in Shaping Students' Emotional Intelligence in the Digital Age. *Hayula: Indonesian Journal of Multidisciplinary Islamic Studies*, *4*(1), 67–86. https://doi.org/10.21009/004.01.04.

Marhaeni, A. A. I. N., Dantes, N., & Paramartha, A. A. G. Y. (2018). Teacher Assessment Literacy: Discrepancies in Authentic Assessment Practice in EFL Context. *International Conference on Educational Assessment and Policy*, *2*, 18–21. https://doi.org/10.26499/iceap.v2i1.90.

Maurer, M., & Bogner, F. X. (2020). Modelling environmental literacy with environmental knowledge, values and (reported) behaviour. *Studies in Educational Evaluation*, *65*(January 2019), 100863. https://doi.org/10.1016/j.stueduc.2020.100863.

Minja, G. S., & Nkumilwa, T. J. (2016). The Role Of Beekeeping On Forest Conservation And Poverty Alleviation In Moshi Rural District,Tanzania. *European Scientific Journal, ESJ*, *12*(23), 366. https://doi.org/10.19044/esj.2016.v12n23p366.

Purwanto, A., Nurjayadi, M., Suluya, R., & Ichsan, I. Z. (2020). EM-SETS: An integrated e-module of environmental education and technology in natural science learning. *International Journal of Advanced Science and Technology*, *29*(3), 7014–7025.

Ramadan, Z. H., Putra, E. D., & Baskara, A. (2020). Environmental Literacy in Elementary School 111 Pekanbaru (A Naturalistic Inquiry Study at Adiwijaya School National Level). *Budapest International Research and Critics in Linguistics and Education (BirLE) Journal*, *3*(1), 306–317. https://doi.org/10.33258/birle.v3i1.809.

Requier, F., Garnery, L., Kohl, P. L., Njovu, H. K., Pirk, C. W. W., Crewe, R. M., & Steffan-Dewenter, I. (2019). The Conservation of Native Honey Bees Is Crucial. *Trends in Ecology and Evolution*, *34*(9), 789–798. https://doi.org/10.1016/j.tree.2019.04.008.

Sahronih, S., Purwanto, A., & Sumantri, M. S. (2019). The effect of interactive learning media on students' science learning outcomes. *Proceedings of the 2019 7th International Conference on Information and Education Technology*, 20–24. https://doi.org/10.1145/3323771.3323797.

Schneiderhan-Opel, J., & Bogner, F. X. (2020). FutureForest: Promoting Biodiversity Literacy by Implementing Citizen Science in the Classroom. *American Biology Teacher*, *82*(4), 234–240. https://doi.org/10.1525/abt.2020.82.4.234.

Serevina, V. (2018). Development of E-Module Based on Problem Based Learning (PBL) on Heat and Temperature to Improve Student ' s Science Process Skill. *TOJET: The Turkish Online Journal of Educational Technology*, *17*(3), 26–36. https://eric.ed.gov/?id=EJ1184205.

Setiawan, A., Sulaeman, R., & Arlita, T. (2016). The Business Development Strategy of Beekeeping of Setia Jaya Farmer's Group in The Village Rambah Jaya Sub-District Bangun Purba, District Rokan Hulu. *Jom Faperta*, *3*(1), 1–9.

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.

Sugiani, K. A., Degeng, I. N. S., Setyosari, P., & Sulton. (2019). The Effects of Electronic Modules in Constructivist Blended Learning Approaches to Improve Learning Independence. *International Journal of Innovation, Creativity and Change*, *9*(10), 82–93.

Sunarsih, S., Rahayuningsih, M., & Setiati, N. (2020). The Development of Biodiversity Module Using Discovery Learning Based on Local Potential of Wonosobo. *Journal of Innovative Science Education*, *9*(1), 1–11. https://journal.unnes.ac.id/sju/index.php/jise/article/view/31178.

Suryanti, D., Sinaga, P., & Surakusumah, W. (2018). Improvement of Students' Environmental Literacy by Using Integrated Science Teaching Materials. *IOP Conference Series: Materials Science and Engineering*, *306*(1). https://doi.org/10.1088/1757-899X/306/1/012031.

Suwatra, W., Suyatna, A., & Rosidin, U. (2018). Development of Interactive E-Module for Global Warming to Grow of Critical Thinking Skills. *International Journal of Advanced Engineering, Management and Science*, *4*(7), 543–549. https://doi.org/10.22161/ijaems.4.7.7.

Taqiyyah, S. A., Subali, B., & Handayani, L. (2017). Implementasi Bahan Ajar Sains Berbahasa Inggris Berbasis Metakognitif Untuk Meningkatkan Kemampuan

Pemecahan Masalah Siswa SMP. *Jurnal Inovasi Pendidikan IPA*, *3*(2), 224–234. https://doi.org/10.21831/jipi.v3i2.14859.

Teksoz, G., Sahin, E., & Tekkaya-Oztekin, C. (2012). Modeling Environmental Literacy of University Students. *Journal of Science Education and Technology*, *21*(1), 157–166. https://doi.org/10.1007/s10956-011-9294-3.

Vaninee, H. S., Veisi, H., Gorbani, S., Falsafi, P., & Liaghati, H. (2016). The status of literacy of sustainable agriculture in Iran: A systematic review. *Applied Environmental Education and Communication*, *15*(2), 150–170. https://doi.org/10.1080/1533015X.2016.1164097.

Veisi, H., Lacy, M., Mafakheri, S., & Razaghi, F. (2019). Assessing environmental literacy of university students: A case study of Shahid Beheshti University in Iran. *Applied Environmental Education and Communication*, *18*(1), 25–42. https://doi.org/10.1080/1533015X.2018.1431163.

Widyastuti, E., & Susiana. (2019). Using the ADDIE model to develop learning material for actuarial mathematics. *Journal of Physics: Conference Series*. https://doi.org/10.1088/1742-6596/1188/1/012052.