



THE INFLUENCE OF THE RESEARCH-BASED MONOGRAPH TO IMPROVE PRE-SERVICE TEACHERS' KNOWLEDGE, ATTITUDE, AND BEHAVIOR

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ABSTRACT

This study intends to analyze the influence of the research-based monograph as a learning resource to improve pre-service teachers' knowledge, attitudes, and behavior towards the environment. This study is a quasi-experimental study using the Nonequivalent Control Group design. The research sample is 67 pre-service biology teachers using Cluster Sampling. Data were collected using environmental literacy instruments and analyzed descriptively and using the ANCOVA test. The results of the ANCOVA test showed that there was a significant effect on the use of the monograph on environmental literacy. Knowledge domain obtained 0.047, attitude domain 0.186, and behavioral field 0.986. This research concludes that using the monograph in learning affects aspects of ecological and environmental knowledge. Nevertheless, it has not had a significant effect on parts of attitude and behavior.

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Keywords: attitude; behavior; environmental; knowledge; literacy; monograph

INTRODUCTION

Environmental crises include greenhouse gas emissions, deforestation, drought, rising temperatures on the earth's surface, pollution in soil, water, and air. Such environmental problems result in various health problems, species extinction, food shortages, and climate change that threaten the survival of life on earth (Faize & Akhtar, 2020; Wassie, 2020). Furthermore, Arora et al. (2018) state that various environmental problems that occur today, both on a global and national scale, are primarily derived from human behavior. Cases of pollution and environmental damage stem from irresponsible, indifferent, and selfish human behavior. Kumurur (2008) also adds that ecological problems are caused main-

ly by human attitudes and behavior. Individuals' behavior toward the environment reflects their environmental literacy (Pe'er et al., 2007; Yustina et al., 2020).

One solution to address environmental issues is developing a society with environmental literacy and more responsible behavior towards the environment (Ozsoy et al., 2012). The global community has made efforts to hold international conferences to discuss environmental issues, such as the Belgrade Conference, Tbilisi Conference, and the Earth Summit (Abd Rahman & Nasri, 2018). The primary purpose of these conferences is to build a community with knowledge, awareness, positive behaviors, skills, and actions in preserving the environment. Future generations need to be given supplies and insights into the atmosphere to form an environmentally literate generation. However, learning that effectively contributes to students' environmental literacy

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is still less than optimal (Liu et al., 2015). This is also compounded by the lack of exceptional learning that can empower the literacy of students and the community. Students should learn the ecological values that regulate all life and build a sense of connection with nature through personal exploration in environmental education (Jongdee & Klunklueng, 2012). In educational institutions such as colleges and universities, the community has the opportunity to cultivate a sense of concern for the environment in various ways.

One way is that colleges and universities can develop a model of environmental sustainability education as an environmental learning laboratory and a place to develop new technologies to address environmental problems for society. The statement is in line with the research of Pitman et al. (2018) that environmental education should be based on ecological knowledge and understanding of the earth's functional systems in supporting human life. Williams (2017) also states that environmental knowledge in environmental education should be taught and implemented in all curricula supported by training programs. A person's level of environmental literacy can be assessed in terms of knowledge, attitudes, and behaviors responsible for the environment. Several researchers concluded that the application of environmental literacy through environmental education could influence aspects of knowledge, attitudes, and behavior in theory and practice in students (Abd Rahman & Nasri, 2018; Goulgouti et al., 2019; Ikhsan et al. 2019; Wilujeng et al. 2019; Faize & Akhtar, 2020).

Analysis of several previous research findings revealed that the awareness and active participation of students related to the environment tend to be low and worrying (Abd Rahman & Nasri, 2018; Goulgouti et al., 2019; Ikhsan et al., 2019; Wilujeng et al., 2019; Faize & Akhtar, 2020). Liang et al. (2018) found that undergraduate students have a relatively low environmental knowledge and behavior level, while environmental attitudes reach a moderate level. In addition, several researchers reported that male students' environmental knowledge was higher than that of female students, but in terms of attitudes and behavior, female students were superior (Liang et al., 2018; Sarabi et al., 2020). On the other hand, through the learning process, educational institutions also contribute to increasing students' environmental knowledge, attitudes, and behavior (Sarabi et al., 2020).

Based on observations and initial interviews in animal ecology, it has not explicitly conducted environmental literacy learning and empowerment in students. Therefore, there is a need to empower environmental literacy in students using monograph media based on research results. This study aims to guide students to adapt to the real world, become critical and creative thinkers, solve problems, and make their own decisions. Students who have environmental literacy skills and an attitude of caring for the environment can build a sense of love for the environment and able to maintain the existence of abundant natural resources in Indonesia because, with a good attitude and understanding of environmental literacy, students can act more aware of the environment (Nasution, 2016). One of the efforts that the academic world can make in instilling environmental literacy in society is to conduct learning that is focused on building the concept of society and applying it in dealing with environmental problems, namely by using media or learning resources based on research results. Local environment problems can be used as a source of contextual learning constructed from research results (Yani et al., 2021).

According to Liang et al. (2018), one of the efforts to improve environmental literacy in knowledge, attitudes, and behavior in the design and development of curricula is to enhance environmental education in higher education. In addition, several researchers state that using learning resources based on local environmental issues and potential can improve environmental literacy (Suryawati et al., 2020), critical thinking skills, and ecological knowledge (Sakti et al., 2021). As Krakauer (2020) explains, monograph books play an essential role in expanding knowledge in science. Therefore, a research-based monograph was used as a learning resource for pre-service biology teachers in this study. Research-based learning is a learning model that includes examining, synthesizing, and assessing information and allowing students and lecturers to improve their knowledge assimilation and application. It is implemented in constructivism that includes four aspects: learning that constructs students' understanding, learning through the development of initial knowledge, learning that involves social interaction processes, and meaningful learning achieved through real-world experience (Susiani et al., 2018).

A monograph of research results is one of the media that can improve one's understanding of a specific topic or study. Research related to the application of monographs has also been conducted to improve fishers' knowledge, herbal users, and scientific evidence of herbs (Islam et al., 2017; Tan et al., 2020). A monograph is scientific writing in a book whose substance is discussed only on one topic or matter in competence science. The content of the monograph must meet the requirements of a complete scientific work, namely the formulation of problems that contain novelty, problem-solving methodology, data support, or up-to-date theory that is complete and clear, and there are conclusions and bibliography. A monograph is a form of learning media that can be used. Books and other learning materials are a tool that helps students learn more effectively (Isfaeni et al., 2018). Therefore, a learning monograph needs to be developed to encourage students to learn through scientific research: asking questions, analyzing data, reasoning, and formulating data-based explanations. The monograph focuses on developing scientific skills in data analysis and interpretation and is intended to enhance students' conceptual understanding (Jongdee & Klunklueng, 2012) because the monograph consists of an empirically based analysis of research findings/insights of the authors (Kraukauer, 2020).

This study used a monograph on the study of animal ecology and the environment. Since this topic has many sub-materials, it is difficult for students to understand and be worked on by species and directly related to the environment. So that only one topic associated with Odonata ecology is dealt with in this monograph. The order Odonata includes dragonflies, which are significant ecological indicators and perform essential ecological services (Tang & Visconti, 2021). Odonata is one of the natural resources or species that need to be protected, and their habitat is taken care of. Indonesia has about 900 dragonfly species, contributing to about 14% of the world's dragonfly biodiversity. The island has a high level of diversity; Papua with 375 species, Kalimantan 291 species, Sumatra 257 species, Java 183 species, Maluku 149 species, Sulawesi 146 species, the Sunda Islands 96 species, and the last is Bali with 58 species. Several experts have conducted research related to dragonflies, among others: in European countries led by Kalkman et al. (2018) and Kadoya et al. (2009), who studied the crisis on dragonflies in Japan; Clausnitzer et al. (2012) examined the diversity and conservation of dragonflies in Africa; Luke et al. (2017)

examined dragonflies in Sabah, Malaysia; as well as Palita et al. (2016) in India. Odonata research has been conducted in Indonesia for nearly 250 years (1773-2019), with topics such as diversity or biodiversity (140 publications), taxonomy, and systems (142 publications), dominating the field. Other research topics are about history and the molecular area but with only one scientific journal. Because of Indonesia's unique geographical position as an archipelago, researchers are constantly drawn to the country to learn new things. On the other hand, topics related to ecology, conservation, learning, ethnozoology about Odonata have not been studied in depth (Lupiyaningdyah, 2020). This study is intended to fill a more profound gap about the use of monographs in learning. This research is expected to increase public awareness of local dragonfly conservation and change the attitudes and behaviors of pre-service biology teachers to maintain dragonfly habitats and ecosystems. Does the use of monographs based on research on Odonata diversity affect the environmental literacy of pre-service biology teachers?

METHODS

This research is a quasi-experimental study, and the research design used is a nonequivalent control group design (Creswell & Creswell, 2017). This type of design consists of two groups, namely the experimental group and the control group. The experimental group and the control group were given a pretest first. Then the experimental group was assigned a learning treatment using a monograph based on research results, while the control group was given a conventional learning treatment. Finally, both the experimental and control groups were given a posttest to see the treatment effect on the experimental group. Therefore, it is possible to know the improvement or change in the experimental group and compare it with the control group. The study design is presented in Table 1.

Table 1. Research Design

Group	Pre-test	Treatment	Post-test
Experimental Class	O ₁	X	O ₂
Control Class	O ₃	-	O ₄

(Description: O₁ = Early ability of Experimental Class, O₂ = Later ability of Experimental Class, O₃ = Early ability of control class, O₄ = Later ability of control class, X = Treatment for Experimental Class)

The population in this study is students who are pre-service biology teachers. The sampling technique was performed using Cluster Sampling as many 67 pre-service biology teachers, consisting of 2 classes. Class A is the control group with 34 people divided into nine men and 25 women, and class B is the experimental group with 33 people divided into 11 men and 22

women. These two classes are equivalent based on analyzing the students' GPA values in the two classes. Due to the Covid-19 pandemic, the learning process is carried out online, both in the control and treatment classes. The treatment class used a monograph as a learning resource, while the control class used a dictation prepared by the lecturer as a learning resource.

Table 2. The Instrument of the Aspect of Environmental Knowledge

Aspect Environmental Literacy	Indicator	Instrument
Knowledge toward ecology and environment	Ecology knowledge	Multiple choice test on environmental literacy
	Identification of environmental issues	
	Analysis of environmental issues	
Attitude toward environment	Commitment on environment	Questionnaire of attitude toward the environment
	Awareness of environment	
Behavior toward environment	Real commitment	Questionnaire of behavior toward the environment

Dunlap (2008); Milfont & Duckitt (2010)

The research instrument used by the researcher is an environmental literacy test question with 30 questions, for the knowledge aspect 30, an attitude questionnaire toward the environment, and a behavior questionnaire toward the environment. All test questions have been tested for validity. The reliability test results showed that the question items used in the environmental literacy questionnaire have a high-reliability index, namely 0.623. It follows Cronbach's Alpha criteria classified by the reliability index, where the value of 0.90-1.00 is very high; 0.70-0.89 is

high; 0.30-0.69 is medium, and 0.00-0.30 is low. Furthermore, it is said that instruments that have an index of more than 0.60 are stated as instruments with high reliability. These three aspects are presented in Table 2. Environmental literacy questionnaires were developed to obtain information from the participants in the study. Measured environmental literacy consists of three aspects: aspects of knowledge, attitudes, and behavior. The dimensions of attitudes assessed were on a scale of five.

Table 3. Indicators on the Aspect of Ecological and Environmental Knowledge

Indicator	Number
Understanding of Earth	1, 7, 13
Roles of Living Things	2, 8, 14, 18
Humans' roles in life	3, 9, 15, 19
Understanding of Ecology	4, 10, 20, 22, 24, 28, 30
Understanding of Environment	5, 11, 17, 21, 23, 25, 29
Understanding of Conservation	6, 12, 16, 26, 27

Hollweg et al. (2011)

The monograph used in this experiment is a monograph on the diversity of Odonata from Bengkulu freshwater (Figure 1). This monograph contains factual, conceptual, and procedural knowledge of the diversity of Odonata constructed from the results of research and studies of relevant literature. This monograph went through a process of construct validation by a team of experts and a small empirical proof. The mono-

graph consists of an introductory unit, problems, problem-solving methods, benefits of Odonata, diversity of Odonata in Bengkulu, molecular identification, and conservation of Odonata. The monograph was developed based on research on Odonata from freshwater in Bengkulu and used in animal ecology in biology education. Odonata in Indonesia is better known as a dragonfly.



Figure 1. Monograph

The data collection techniques used in this study are pretest and posttest, which are analyzed descriptively. Hypothesis testing was performed using ANCOVA. However, before testing, the hypotheses and data were analyzed using the normality test of the One-Sample Kolmogorov-Smirnov Test and Levene's Test of Equality of Error Variances homogeneity.

RESULTS AND DISCUSSION

The results of the analysis show that all data usually are and homogeneously distributed. The data used in this study is the acquisition of the pretest and posttest. A summary of the results of data analysis can be seen in Tables 4, 5, and 6 presented.

Table 4. The Summary of All Normality Testing

Data Group	Class	Kolmogorov-Smirnov ^a		
		Statistic	df	Sig.
Knowledge_Pretest	Control_class	0,130	32	0,182
	Experiment_class	0,122	38	0,166
Knowledge_postest	Control_class	0,141	32	0,108
	Experiment_class	0,100	38	0,200*
Behaviour_Pretest	Control_class	0,112	32	0,200*
	Experiment_class	0,136	38	0,073
Behaviour_Postest	Control_class	0,127	32	0,200*
	Experiment_class	0,122	38	0,164
Attitudes_pre	Control_class	0,148	32	0,071
	Experiment_class	0,101	38	0,200*
Attitudes_pos	Control_class	0,106	32	0,200*
	Experiment_class	0,110	38	0,200*

The presentation of Table 4 shows that the test was successfully performed and was declared normally distributed because it obtained a

significance value of $\rho > 0.05$ on the aspects of knowledge, attitude, and behavior towards the environment.

Table 5. The Summary of All Homogeneity Testing

	Levene Statistic	df1	df2	Sig.
Knowledge_Pretest	0,020	1	68	0,887
Knowledge_postest	0,324	1	68	0,571
Behaviour_Pretest	1,538	1	68	0,219
Behaviour_Postest	1,080	1	68	0,302
Attitudes_pre	1,104	1	68	0,297
Attitudes_pos	0,521	1	68	0,473

A summary of Ancova's results, the effect of monograph use on environmental literacy, aspects of knowledge, attitudes, and behaviors towards the environment are shown in Table 6.

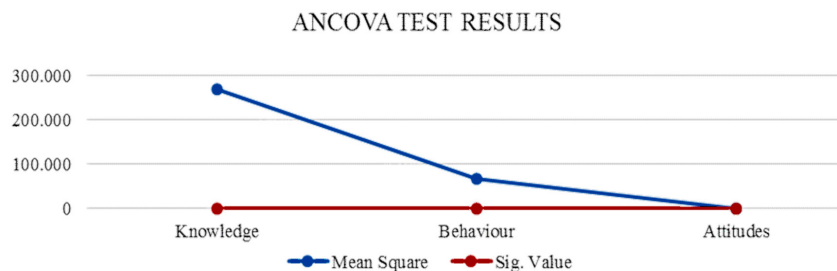
Table 6. Test Results on The Effect of Monograph on Environmental Literacy

No	Variable	Mean Square	Sig.
1	Knowledge	269,819	0,047 *
2	Behavior	66,764	0,186
3	Attitudes	79,96	0,986

* significant on level 5%

The data in Table 6 show that not all areas of environmental literacy are affected by the use of monographs. The use of monographs in learning has a significant influence on the aspect of knowledge ($p < 0.05$) but has no significant in-

fluence on the aspect of behavioral ($p > 0.05$) and the aspect of attitude ($p > 0.05$). Thus, the monograph only influences environmental competence in the knowledge aspect.

**Figure 2.** The Results of Knowledge, Attitude, and Behavior

Based on the results of hypothesis testing, the application of monographs based on research results significantly affects the understanding of aspects of ecological and environmental knowledge (Figure 2). Understanding environmental knowledge is fundamental to society because it is one element in continuing education in the 21st century, such as ecological literacy (Balgopal & Wallace, 2009; Deans & Deans, 2018). The introduction and understanding of the application of ecological knowledge can be applied in universities to advance new values in environmental and social priorities. In addition, ecology provides expertise and competencies to students to realize sustainable development.

There are some reasons why research-based monographs can significantly affect aspects of environmental, ecological knowledge. First,

monograph based on research results are believed to have learning stages following the needs of learning to improve aspects of students' environmental literacy knowledge. Second, books can be used as a learning resource to facilitate students' learning experiences throughout the learning process. Third, the presence of books in learning activities in the classroom can help improve students' understanding of concepts and other competencies. It is supported by further research that monographs are essential in science learning because they allow for explanations in long narratives and coherent synthesis (Krakauer, 2020), such as monographs that explain the uniqueness of lizard egg sacs (Stewart & Blackburn, 2020). Other results also prove that after using monographs, there is an increase in the understanding of safety procedures for fishers (Islam

et al., 2017) and the knowledge of the types of herbs for their users (Tan et al., 2020). This is because monographs consist of empirically proven narratives of research results/findings by authors (Krakauer, 2020). This monograph contains factual, conceptual, and procedural knowledge of the diversity of Odonata, constructed from the results of research and studies of relevant literature based on local environmental problems.

Monograph are chosen as a learning medium in college learning because monograph have several advantages. The graphic features of printed books can make it easier for students to understand a concept. Since printed books are orthographic and do not trigger eye fatigue, they effectively assist students in understanding concepts (Jeong, 2012). Printed media allows students to learn in a more relaxed and convenient setting. It also has graphic characters that do not make the eyes get tired quickly. The aspect of eye fatigue is critical when using learning media, especially books. When comparing printed books with online books (e-books), the findings show that printed books are more eye-friendly (Jeong, 2012). Graphic characters in printed book media, both writing (letters) and images can make it easier for students to understand the material learning (Isfaeni et al., 2018). Robinson et al. (2014) and Luckie et al. (2017) also state that print book media effectively improves the learning process. It supports that cognitive development requires understanding, discovery, and purpose for connection to learning (Greenwood, 2015). Through this constructivist approach, students will improve their understanding of knowledge material (Tuncel & Bahtiyar, 2015). This makes learning meaningful.

The second reason is that the monographs used are based on practical experience. The local environment is used as an educational resource to provide students in developing environmental literacy and promoting awareness of knowledge into action. Further previous research revealed that students' problem-solving, critical thinking, and concept discovery skills could be empowered through increased research-based learning (Alshehry, 2014; Srikoon et al., 2014). When combined with a scientific approach, it will effectively improve scientific literacy (Usmeldi et al., 2017). Student curiosity can also be enhanced by research-based learning (Liu & Li, 2011; Walington et al., 2011). According to Mayub et al. (2020), students' activities, skills, and knowledge of science learning can be enhanced by research-based education.

Environmental knowledge is often considered an essential element of ecological literacy. Without a basic knowledge of the environment, it is impossible to assess environmental problems and environmental actions (Liu et al., 2015). Understanding the concepts of ecological knowledge can be empowered through research-based learning. Research-based learning is a teaching system that uses authentic learning approaches, problem-solving, cooperative learning, hands-on, and inquiry, guided by constructivist philosophy. Research-based learning is a learning model that integrates research into the learning process to construct knowledge by formulating hypotheses, collecting data, analyzing inference, and writing reports. Research-based learning models provide opportunities for students to learn and construct knowledge from research procedures such as seeking information, formulating hypotheses, collecting data, analyzing, drawing conclusions, and writing reports (Susiani et al., 2018). Research-based learning procedures are applied in learning adopt from Peter Tremp's theory, such as formulating common questions, an overview of research literature, defining the question, planning research activities, methods/methodology of clarification, conducting investigations, analyzing data, interpretation, and consideration of results, reports, and presentation of results (Susiani et al., 2018).

The use of monograph books as a learning resource does not affect the attitudes and behavior of aspiring biology teacher students. This finding is supported by Paço and Lavrador's (2017) findings that suggest that aspects of environmental knowledge and attitudes are less correlated than aspects of environmental behavior. In contrast to Sakti et al. (2021), the results state that monographs can influence students' ecological knowledge, which affects attitudes and behavior towards the environment. The difference in these results is due to the use of the developed questionnaire; pre-service biology teachers answer the questionnaire reasonably. However, students tend to give no to the actual answer. In addition, the use of questionnaires raises concerns about biased answers. The bias response is a meter's response that does not reflect the actual situation. Another influencing factor is when monograph use occurs online so that zoom meetings restrict learning activities.

One other form of measurement that may be used is observation. So far, statements are more accurate for recording student attitudes than questionnaires. Bahri and Corebima (2015) state

that it makes sense to interpret attitudes based on emerging behaviors. In other words, determining a person's attitude towards something can be seen through his behavior, because behavior is one of the indicators of individual behavior. It should be noted that certain behaviors are sometimes deliberately revealed to hide their original color. Thus, the observed behavior can be an indicator of a particular behavior in the context of a particular situation (Bahri & Corebima, 2015). The lack of influence in this study can also be attributed to the formation of attitudes and behaviors that take a long time because it can also be influenced by internal and external factors, especially psychological social factors (Shehu, 2015).

Even so, society in the future must have the skills to act following their expertise (Holdsworth & Sandri, 2014). In the world of education, an educator must play a role in providing insights to students on environmental issues around them. Learning science contextually will make students have a better attitude towards the environment. The younger generation with a good attitude towards the environment will be more concerned about the sustainability of the environment and better maintain the sustainability and security of existing natural resources (Wilujeng et al., 2019). Environmental education will be more effective when students actively participate in the learning process (Locke et al., 2010). Several other researchers have found a positive relationship between environmental knowledge and environmental attitudes (Pe'er et al., 2007).

Students' attitudes are determined by the knowledge they have. Therefore, mastery of ecological and environmental expertise is essential to produce students' positive attitudes. In addition, the development of cognition at the analysis, synthesis, and evaluation level is believed to influence attitudes. At this level, students acquire the values of life that can grow and develop attitudes towards the environment through the process of accommodation and assimilation of knowledge, experience, and values into the minds of students (Mahanal et al., 2010).

The three aspects of environmental literacy have a relationship with each other. The findings of Faize and Akhtar's (2020) research revealed a positive relationship between environmental knowledge and attitudes towards the environment in the experimental group. According to some research, environmental knowledge, environmental behavior, family income, and demographic fac-

tors such as gender, age, and educational level all influence attitudes (Pe'er et al., 2007; Tuncer et al., 2009; Yavetz et al., 2009). Knowledge of the environment and a responsible attitude towards the environment are essential factors to improve environmental sustainability (Wu & Chen, 2014).

In addition, research results present that responsible behavior is related to knowledge in which individuals with good environmental knowledge will have more responsible environmental behavior and a more positive attitude toward the environment (Pe'er et al., 2007; Yavetz et al., 2009). Nevertheless, it seems that attitudes influence responsible behavior (Pe'er et al., 2007; Yavetz et al., 2009; Liu et al., 2015). According to Christensen and Knezek (2015), a positive attitude towards the environment can create environmentally responsible behaviors, especially those related to ecology (Bradley et al., 2010). The results of this study are in line with Biesbroek et al. (2010), that found that high environmental knowledge can lead to behaviors toward the environment. High environmental knowledge of environmental, social, and economic issues will help increase students' environmental awareness.

CONCLUSION

Based on the results of data analysis and discussion, it can be concluded that the monograph based on the results of this research can develop students' understanding of conceptual knowledge about conservation and the dragonfly ecosystem. These findings implicate that monograph based on research results can be recommended to be applied in the learning process to empower students' environmental literacy. Budding teachers can create monographs with different materials and combine them with other learning models. The world of education, especially colleges, also needs to apply media and learning resources based on research results in improving students' environmental literacy.

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