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Pre-service science teachers' enhancement of environmental care behavior through conservation-based green learning methods (*GeLeM*)

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Abstract. Science learnings provide opportunities to grasp knowledge by constructing and examining explanations of a particular phenomenon. This information is obtained from a scientific process which gives learning experience to students. Green Learning Method (*GeLeM*) employs natural phenomena as learning sources; therefore, it is suitably applied in science learnings. Green Learning Method (*GeLeM*) lets students involve in nature learning directly, identifies as well as offers a solution to surrounded environmental problems. Hence, this method is closely related to environmental care behaviour emerged during learning activities. This research intended to reveal pre-service science teachers' enhancement of environmental care behaviour through Conservation-based Green Learning Method. Data collection process was carried out in the Department of Integrated Sciences, Faculty of Mathematics and Natural Sciences, Universitas Negeri Semarang on Living Organism Systematics course, odd semester, academic year of 2018/2019. The obtained results showed that 'GeLeM'-based learnings could enhance the students' environmental care behaviour. Other than that, the observation results indicated that the students' environmental care behaviour was seen during nature learnings. Pre-service science teachers must have favourable environmental care behaviour to inherit it to their future students.

1. Introduction

Science learning studies natural science phenomena through observation, experiment, drawing up a conclusion, theory construction obtained from a series of scientific activities to find knowledge, idea, and organise concept[1]. Science learning is essential in either educational process and technology development as it emerges human's interest and ability to understand the universe and to seek for answers to secrets contained in it. Other than that, science learning prepares a person to solve problems in his life. Also, it educates students to think and perform critically, analytically, logically, rationally, carefully and systematically as well as cultivates a culture of creative and independent learning[2].

Contextual science learning is a proper learning strategy as environmental problems appear a lot. A person studying science is expected to play a role in solving environmental problems [3]. Such issues are not newly noted yet remained to be a big deal as humans highly depend on the environment. Environmental damage would affect people's lives either directly or indirectly since it could not any longer support growth. Therefore, science learning must orient to the cultivation of environmental awareness by adopting an applicable learning model so that educational institutions become a place for attitude habituation [4,5].

Environmental care behaviour is a form of an individual's mental attitude reflected through behaviour, or so-called as the character. Character defines as moral and personality shaped as a result in internalisation of many virtues employed as a base of a point of view [6,7]. Environmental awareness is not thoroughly a talent or default instinct yet an outcome of an educational process in



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general. Fault in educating an individual could generate misled attitudes. Thus, favourable characters have to be formed to each person to ensoul each action he takes.

According to the Ministry of Environment of the Republic of Indonesia, there are 14 indicators to measure environmental care behavior [8], they are: (1) not burning accumulated waste; (2) enjoying planting plants; (3) realizing that the increase in earth's temperature is a matter of concern; (4) worrying about wasteful use of water; (5) feeling comfortable when the house has a water catchment area; (6) showing efforts to save electricity and fuel; (7) turning off electronic equipment if it is not used to save power; (8) using public transportation when traveling compared to private vehicles; (9) being able to care for private vehicles; (10) worrying about endangered animal and illegal trade; (11) preferring to consume locally produced food ingredients; (12) not maintaining, owning and trading protected plants; (13) sorting out plastic, food, and paper waste as well as other garbage before disposal; (14) not burying chemical waste.

Characters are interpreted as a set of attributes admired as signs of one's virtue and moral maturity. Character realisation is not easy, and its establishment requires a long educational process. Character formation begins with common behaviour in everyday life. Character education is an active effort to form habits so that the nature of the child will be carved early to be able to make good and wise decisions in daily life [9,10].

The Green Learning Method (GeLeM) invites students to directly learn with nature while identifying and offering solutions to environmental problems around them. Thus, this method is closely related to environmental care behaviour that will be seen during the learning process. The green learning refers and adopts to the Green Teacher learning model established on February 28, 2009, supported by the Ministry of Environment. By referring to the operational translation of green teachers, the green learning's operational translation includes: (a) giving students the opportunity to develop personal relationships with nature; (b) emphasising relationships with other people, species, and human activities on the planet, (c) provide direct experiences to students (e) future-oriented, (f) capable of utilizing mass media (ICT), (g) understanding traditional knowledge and local wisdom, (i) integrating several related disciplines, (j) awareness in nature learning, (k) utilizing natural resources as learning source[11]. Learning with the Green Learning Method (GeLeM) allows students to find environmental concepts and raises environmental awareness as a vehicle for learning [12].

Many experts have done studies related to environmental care. According to [13] character improvement can be achieved by direct learning that involves students actively. Whereas [14] argued that science learning and the environment are interconnected; thus, it is essential to research the development of science learning media with environmental characteristics. Conservation is closely related to environmental care; therefore it suits the environmental awareness issue as it combines several subjects of physics, chemistry, and biology. With this in mind, this study aimed to measure pre-service science teachers' environmental care through Green Learning Method (Gelem) with conservation insight. Besides, the research was expected to support the results of previous studies to be able to add references to learning methods focussing on student character reinforcement.

2. Methods

This research was an experimental one based on quantitative data. It was carried out in accordance with students' college schedule to obtain optimal results through the most effective methods and procedures. This research defined as one form of studies to improve classroom learning quality.

The data were collected Integrated Science Department, Faculty of Mathematics and Natural Sciences, Universitas Negeri Semarang in the Systematics of Living Beings courses held in the odd semester of the 2018/2019 academic year. The research population was all 76 students of the Integrated Science Department who took the course. They were divided into group 1 and group 2 which acted as the experimental and control class. There were 36 students in the experimental class and 40 students in the control class. Non-equivalent control group design was adopted which is presented in Table 1.

Table 1.The Research Design

Group	Pretest	Treatment	Posttest
Experimental	O	X1	O
Control	O	X2	O

Information: X1 = interactive multimedia –based learning

X2 = Conventional learning

O= Test of concept mastery

The research implementation consisted of several stages, namely observation, experimentation and analysis. The research instrument used to collect data was a multiple choice written test consisting of 40 questions. Quantitative data in the form of students' cognitive learning outcomes were analysed using the N-gain formula, while the environmental care behaviour data were taken through observation using an assessment rubric. The pretest and posttest values were analysed statistically to reveal the students' cognitive improvements based on the comparison between the experimental and control group's N-Gain scores. The differences in pretest and posttest data in the limited trial class were examined using the Wilcoxon test while the differences in both classes' N-Gain were revealed using t-test and Mann-Whitney test. The whole test was carried out using SPSS version 16.0 software. The decision of normality, homogeneity, and t-test was based on the comparison of probability/significance (sig) with a 5% confidence level ($p < 0.05$). Cognitive learning outcomes and behavioural data were then described to see increased learning and conclusion.

3. Results and Discussion

The study was conducted in the systematic of living things lecture, odd semester, academic year of 2018/2019. At the beginning of the learning, the pretest was administered to find out the initial abilities of the students before receiving the Green Learning method. Subsequent education was carried out outside the classroom on several learning materials, namely Kingdom of Monera, Protista, Fungi, Plantae and Animalia. The students observed the surrounding environment where there were examples of living things to be classified based on the studied kingdoms. In addition to grouping, the students were also asked to observe the environmental problems during learning. They recorded the findings and tentative solutions to the environmental issues on an observation sheet.

Further, the students' environmental care behaviour was assessed during the learning employing an assessment rubric. The scoring was done twice; before and after experiencing the Green Learning to know the score differences. Cognitive values, taken from both pre-test and post-test, were referred to as a comparison that supports the assessment of environmental care behaviour.

The average value of the pretest, posttest and N-gain for the experimental and control class appears in Table 2.

Table 2. The Average Pretest, Posttest, and N-Gain Scores in the Experimental and Control Class

Result	Experimental			Control		
	Pretest	Posttest	<i>N-gain</i>	Pretest	Posttest	<i>N-gain</i>
1. Average	75	91	0,64	73	74	0,04
2. The Highest Score	88	98		92	93	
3. The Lowest Score	42	86		38	50	

Furthermore, the N-Gain values in the experimental and control classes were analysed statistically for testing normality and homogeneity. The results of the normality and homogeneity test indicated that the value of N-Gain was normally distributed and homogeneous for both classes. Because the data were normal, then a statistical analysis of the difference in N-Gain values was performed parametrically using an independent sample t-test with the provisions of significance $p < 0.05$. Based

on the results of the different test N-Gain values, the p-value of 0.000 was obtained. According to Archambault in [15], the normalised gain criteria (N-gain) can be seen in the following table.

Table 3. The Normalised Gain Criteria (N-gain)

Criteria	Category
$N\text{-gain} > 0,70$	High
$0,30 \leq N\text{-gain} \leq 0,70$	Intermediate
$N\text{-gain} < 0,30$	Low

The control class' N-Gain was 0,04 while the experimental class was 0,64. Thus, based on the above criteria, the control class' N-Gain was lower than the experimental class'. These results showed that there was an increase in the experimental class' cognitive learning outcomes.

In addition to cognitive score assessment, the students' environmental care behaviour was also scored referring to seven indicators. Environmental care behaviour is one of the conservation soft-skills that must be possessed by prospective science teachers. According [16] behavioural evaluation criteria were adopted in which the details are presented in the following table.

Table 4. Environmental Behaviour Assessment Guideline

Percentage	Category
3,26-4,00	Excellent
2,51-3,25	Good
1,76-2,50	Low
1,00-1,75	Poor

The environmental care behaviour assessment results in the experimental class are shown in the following table.

Table 5. The Experimental Class' Environmental Care Behaviour Assessment Results

Indicator	Pre-GeLem	Post-GeLem
1 Not burning accumulated rubbish	2,34	2,74
2 Enjoying Planting Plants	1,74	2,61
3 Worrying about wasteful use of water	2,51	3,73
4 Efforts in minimalizing electricity and fuel use	2,32	3,42
5 Sorting out the plastic, food, and paper waste as well as other garbage before disposal	1,25	2,61
6 Turning off electronic equipment if it is not used to save electricity	2,45	3,21
7 Preferring to consume locally produced food ingredients	2,35	2,53

Those indicators are taken from the Ministry of Environment of the Republic of Indonesia which has been adapted to the learning activities. Among the fourteen, seven of them were adopted to this study. Further, the improved environmental care behaviour after experiencing the GeLem is seen in the following graph:

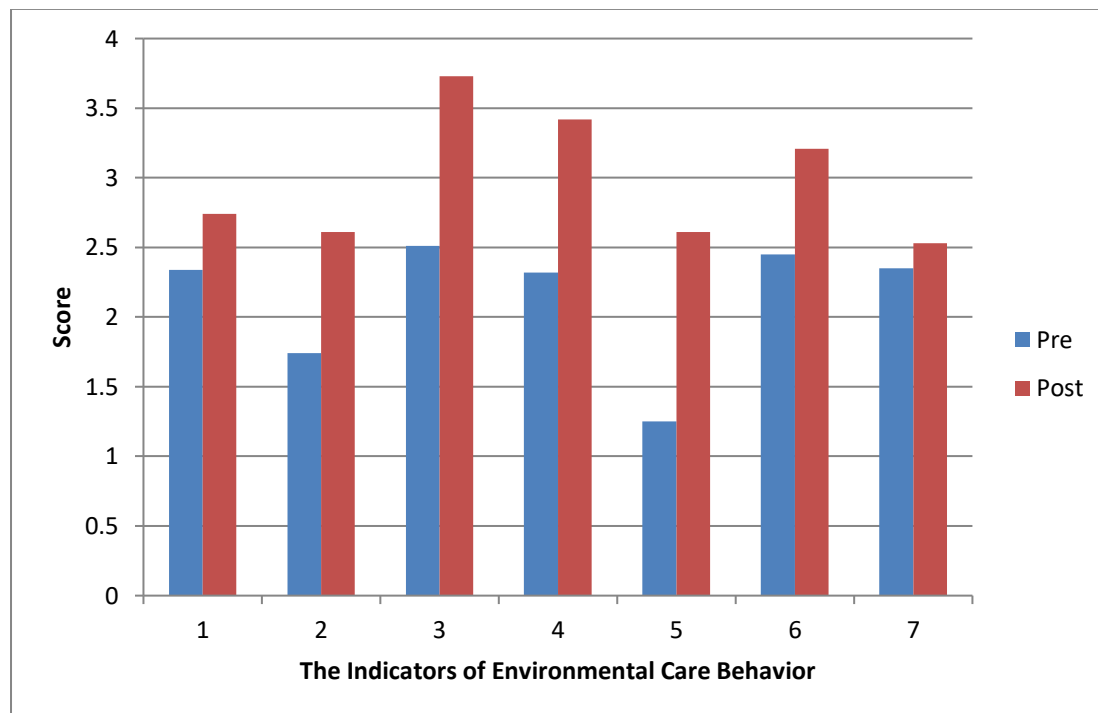


Figure 1. The Environmental Care Behavior Increase in the Experimental Class

The graph shows an increase in environmental care behaviour in each indicator. It indicated that learning using the Green Learning Method (GeLeM) could improve the pre-service science teachers' environmental care behaviour. Observations performed by the science education students allowed them to see the problems that emerged around them even a damaged environment. This activity enables them to realise that a destructive surrounding would affect the living beings including them. Everything needed by humans is provided by the environment, from food, clothing, shelter, to materials to create high-tech objects. In other words, the environment has an attachment to the lives of all beings. A good environment results from good behaviour from living things, especially human, and will give an excellent back effect for them. However, if the environment is damaged due to bad behaviours, it will also harm living things lived in it.

A nature learning is expected to enhance future science teachers' environmental awareness either as a human and teacher, and each role they take in. On the student discussion sheet, they were also asked to look for or convey solutions offered when they saw a damaged environmental phenomenon. Thus, they involved and realised directly that environmental improvements are not as easy as imagined. Future science teachers having high environmental care behaviour are expected to be able to apply and transmit their attitudes to their prospective students later. If viewed thoroughly, the experimental class increased cognitive values and environmental care behaviours. This means that the use of the Green Learning Method (GeLeM) in learning had a good impact in generating favourable prospective science teachers.

4. Conclusion

Learning with Green Learning Method (GeLeM) has been proven to improve environmental care behaviour and cognitive learning outcomes. The science education students' concern with the environment can be demonstrated when they learnt in nature. Moreover, this is very useful for them to grasp all the knowledge and understand the importance of environmental care behaviour as they will teach it to their future students.

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