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Science interdisciplinary learning approach: a study interdisciplinary thinking skills and literacy environment

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ABSTRACT

The formation of environmental literacy in the education system through education for sustainable development (EfSD) experiences many obstacles. The aim of the research is to analyze the impact of interdisciplinary science learning for interdisciplinary oriented education for sustainable development to improve interdisciplinary thinking and environmental literacy of prospective teachers. The experimental method with a quasi-experimental pretest posttest group design was used in this study. The data collection technique used is an environmental literacy questionnaire and an interdisciplinary thinking test. Data analysis technique used independent t test. The results obtained were that the science interdisciplinary learning effective in improving interdisciplinary thinking performance and environmental literacy. The performance of students' interdisciplinary thinking affects environmental literacy of students. The university forms student teacher candidates who have the ability to think interdisciplinary so that they can manage science learning in an interdisciplinary and environmentally literate manner. The implication of this research is the importance of fostering interdisciplinary thinking and environmental literacy at all levels of education.

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1. INTRODUCTION

Environmental literacy is defined as the product of several components of disposition, knowledge, competence, and behavioral responses to the environment that influence each other [1]. Environmental literacy is assumed to display behavior that is responsive to environmental protection [2]. Solution to environmental problems by building environmental literacy [3]. Efforts to educate the public to be literate about the environment must start from the early grades through effective environmental education [4]. Environmental literacy must be grown from elementary, secondary, tertiary level schools, and finally becomes an environmentally literate society. Continuous learning programs are needed to form environmental literacy at every level of formal or non-formal education. Formation of environmental literacy in schools and universities can be done through the realization of education for sustainable development (EfSD).

EfSD provide direction to educational research, classroom teaching, and improving teacher education. In EfSD science education is one of the curriculum orientations [5]. However, the pedagogy of implementing EfSD around the world is still very weak [6] so that education reform with EfSD is still quite difficult to do. The realization of global EfSD requires a strong model to incorporate EfSD into the curriculum [7]. The science education curriculum must be socially oriented. Science education must be related to EfSD [8]. The EfSD approach demands the implementation of an education-oriented skills teaching paradigm for sustainable development [9]. Develop a deep understanding of complex environmental, economic and social systems, and the interrelationships between systems in a sustainable world [10]. The EfSD-oriented science learning model applies interdisciplinary science [11]. Interdisciplinarity is a path for implementing EfSD in schools [12]. Scenarios have been developed as a means of integrating knowledge in interdisciplinary studies of social sciences and science [13]. One of the pragmatic ways is to integrate knowledge of scientific and social disciplines by incorporating local community knowledge [14]. Local community knowledge is constructed as scientific knowledge and is used as a source of learning. For example, the reconstruction of traditional herbal medicine in scientific science [15]. This research use ethno-science with the construction of local community knowledge in conserving Palangka Raya peatlands becomes scientific science as a source of learning.

2. LITERATURE REVIEW

One of the learning models used is interdisciplinary problem-based learning (IPBL) learning. IPBL model combines two different learning models, namely problem based learning (PBL) and interdisciplinary learning (IL). The seven stages of classic are clarifying concepts (clarifying concepts), finding problems (defining the problem), determining concepts related to the problem (analysing the problem/brainstorming), classifying problems (problem analysis/systematic classification), setting goals for problem solving (formulating learning objective), selp study (self-study), and discussion (discussion) [16]. IL refers to learning knowledge from one or more scientific disciplines, focusing on collaboration and interaction between disciplines [17]. IL is an approach to learning and developing students with interdisciplinarity to develop their readiness for interdisciplinary practice, integrating interdisciplinarity to solve problems [18]. IL is learning using interdisciplinary steps by drawing a disciplinary perspective and the second step is integrating knowledge and producing a more comprehensive understanding [19]. Interdisciplinary science learning for EfDS provides opportunities for lecturers, teachers, and environmental researchers to participate in shaping community sustainable environmental literacy [20]. Activities that are temporary with a practice-based interdisciplinary approach have shown growing awareness of the environment. Environmental literacy in students can be grown through environmental education [21]. The teacher education program can be used as a conservation program for an area [22]. Achievement of sustainable development competencies in tertiary institutions through project and problem-based pedagogy [23].

A practice-based interdisciplinary approach can be used as a way to connect universities, schools and communities [24]. This approach provides an opportunity for lecturers, teachers, environmental researchers to participate in forming community sustainable environmental literacy [25]. Interdisciplinary thinking is one way to increase environmental literacy [26]. Therefore, the importance of research on EfSD-oriented science learning models. Therefore, the importance of IPBL science learning with an EfSD-oriented model is carried out. The aim of this research is to analyze the impact of EfSD-oriented science learning on improving students' interdisciplinary thinking skills and environmental literacy. This research has the novelty of measuring the impact of IPBL science learning with an EfSD-oriented to improve interdisciplinary thinking skills and environmental literacy. The research that has been carried out is eco-schools have an effect on the environmental literacy of elementary school students in Türkiye [27]. Self-confidence is related or related to attention to the environment in elementary school students' environmental education [28]. Environmental literacy in students can be grown through environmental education [29].

3. RESEARCH METHOD

The experimental method with a quasi-experimental pretest posttest group design was used in this study. Data collection techniques used tests and questionnaires. The initial literacy questionnaire was developed with three variables and 48 items. An environmental literacy questionnaire in the form of Google Form was distributed to 143 prospective teacher student respondents. Student responses from Google Form were analyzed using SmartPLs 3 f. The average variance extracted (AVE) value of the knowledge and behavior variables above 0.5 is in the valid category [30]. The competency variable value is 0.353 but can be accepted as a valid variable [31]. The environmental literacy questionnaire instrument has internal reliability consistency from the composite value of reliability and Cronbach's alpha [32]. The sample of this research was 60 prospective physics teacher students from two groups, namely the control class and the experimental

class. The sampling technique used was purposive with the consideration of students living in peatland areas. The interdisciplinary thinking performance instrument according to five experts and practitioners is categorized as valid based on the Aiken coefficient value. The initial development of the objective dimension has nine items, but in content validation there are only six valid items. In the second trial, only three items were used with the consideration that the rubric would be simpler and more practical to use as input from experts. The data analysis technique used is the independent t test to compare the performance of interdisciplinary thinking and environmental literacy.

4. RESULTS AND DISCUSSION

The effectiveness of learning can be seen from the increase in students' interdisciplinary thinking performance before and after learning. The output of the SPSS 18 t test for normality and homogeneity tests of student interdisciplinary thinking performance found that the data was normal and homogeneous so that it was continued for hypothesis testing. Levene's test for equality of variances scores with sig. .000 is smaller than 0.05 so that Ho is rejected and Ha is accepted. The results of data analysis using SPSS are presented in Table 1.

Environmental literacy data, before the hypothetical test is carried out, is tested for the validity of the data with the normality and homogeneity tests with the help of SPSS 18. The prerequisite analysis test shows that the data is normal and homogeneous. Hypothesis testing was carried out using a different test to see the difference in the average value of environmental literacy before and after learning. The results of data analysis were obtained a sig. 0.00 is less than 0.05 for the dimensions of knowledge and competence. Behavioral dimension with sig. 0.026 is smaller than 0.05. Based on the results of this analysis it can be said that there are differences in student environmental literacy before and after learning. The results of data analysis using SPSS are presented in Table 2.

Table 1. Data analysis of interdisciplinary thinking performance of prospective teachers

Test	Student interdisciplinary thinking performance	
	Pretest	Posttest
Means	12.2000	38.9333
Normality	Skewness Statistics: 5.477 (normal)	Skewness Statistics: 1.061 (normal)
Homogeneity	Levene's test for equality of variances; Sig.: 0.000 (Homogeneous)	

Table 2. Analysis of environmental literacy data for prospective teachers

Test	Environmental literacy data	
	Knowledge and competence	Behavior
Means	Pretest: 10.40 Posttest: 11.90	Pretest: 28.5667 Posttest: 30.7333
Normality	Statistical skewness: -1.098 (normal) Statistical kurtosis: 0.672 (normal)	Statistical skewness: 0.215 (normal) Kurtosis statistic: -0.233 (normal)
Homogeneity	Sig. Levene statistic: 0.203 (Homogeneous)	Sig. Levene statistic: 0.874 (Homogeneous)
Hypothesis	t-test for equality of means. Sig. 0.000 (Ho rejected and Ha accepted)	t-test for equality of means. Sig. 0.026 (Ho rejected and Ha accepted)

The hypothesis test was carried out with the help of SPSS 18, before the multiple regression test was carried out, the prerequisite test was carried out with the results of the three variables being normal and linear. Interdisciplinary thinking performance data of normal and homogeneous students from the previous analysis prerequisite test. At this stage, the variable linearity prerequisite test is added. The output of the ANOVA SPSS table is sig. 0.038 is less than 0.05 so that the dependent variable of student interdisciplinary thinking performance (X) has a significant linear relationship to the independent variable of student environmental literacy (Y1). Hypothesis testing can be done because the independent and dependent variables are linear. The SPSS 18 table output shows a coefficient of determination (R square) of 0.215 greater than 0.05 so that the dependent variable of student interdisciplinary thinking performance (X) has a significant effect on the independent variable of student environmental literacy. The output of the ANOVA SPSS 18 analysis is presented in Table 3.

The results of the data analysis concluded that learning has an effect on the performance of interdisciplinary thinking and environmental literacy of prospective teacher. The learning outcomes in the form of environmental literacy and student interdisciplinary thinking performance in extensive trials show an increase in student interdisciplinary thinking performance and student environmental literacy. Interdisciplinary problem-solving activities in learning improve students' interdisciplinary thinking

performance [33]. Through this learning model students have knowledge about peatland conservation which influences their conservation attitude. As with the findings of previous researchers, the knowledge dimension has a strong positive relationship to the competency dimension [34]. Environmental literacy possessed by students makes them skills and behave in conservation. Several studies have shown that competence has a high relationship to behavior [35]. Interdisciplinary learning as an implementation of EfSD aims to increase environmental literacy and form student or student sustainable development competencies. Students who have the competence for the sustainable development of peatlands will have the behavior of maintaining and protecting peatlands. Universities can use the conservation model in science learning to increase students' environmental literacy. The environmental literacy of prospective teacher increased significantly. It's just that learning with interdisciplinary science and peatlands has never been done before so students are very enthusiastic about learning and are able to increase students' knowledge, competence, and behavior in peatland conservation. The problem of peatland damage can be overcome by developing community environmental literacy [36]. This learning model can be said to be a model of conservation through education by increasing community environmental literacy [37]. This learning model is an education-based peatland conservation model as an EfSD strategy.

Table 3. Analysis of ANOVA test

Model	Sum of squares	Df	Mean square	F	Sig.
Regression	234.383	2	117.191	3.706	0.038
residual	853.778	27	31.621		
Total	1088.161	29			

Preservice teacher tudents organize science interdisciplinary learning at school with the aim of forming students' environmental literacy. Environmentally literate students will become environmentally literate people. Environmental literacy of students, students and the community will conserve peatlands in a sustainable manner. Interdisciplinary science and peatland conservation can be carried out to link natural science and social science content [38]. Interdisciplinary scenarios are a tool for integrating knowledge in the interdisciplinary study of the social sciences and sciences [33]. This approach provides an opportunity for lecturers, teachers, environmental researchers to participate in forming community sustainable environmental literacy [39]. Universities can use the conservation model in science learning to increase students' environmental literacy. Many studies have shown that environmental literacy including conservation attitudes can be developed in schools and universities [40]. If this model is implemented at the university level, the EfSD education program can be used as a conservation program for an area [41]. Sustainable development competencies can be included in the development of academic programs. Learning model based on interdisciplinary learning with science interdisciplinary [42], problem-based [43], project based [44], as well as adopting sustainable development goals effective for increasing interdisciplinary thinking and environmental literacy of prospective teachers [45]. Teachers' integrated knowledge influences interdisciplinary learning so that the formation of interdisciplinary thinking skills is the initial stage carried out at universities in lectures. Based on the research results, student science teacher candidates organize interdisciplinary science learning in schools with the aim of forming environmental literacy in students capable of implementing EfSD.

5. CONCLUSION

Science learning integrated with environmental conservation influences the interdisciplinary thinking skills and environmental literacy of prospective teacher students. In addition, there is a relationship between interdisciplinary thinking skills and environmental literacy of prospective teachers. Science learning that integrates environmental conservation can increase the role of schools in protecting the environment for sustainability. Therefore, it is important for teachers to apply learning that connects with environmental problems so that sustainable development occurs. The implication of the results of this study is that the interdisciplinary learning model for natural sciences and peatland conservation can increase the environmental literacy of students, students and the community, which will lead to a caring attitude towards and conservation of peatlands. Therefore, this model can be an alternative in carrying out efforts to prevent environmental damage, especially peatlands.

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