

# The Implementation of Discovery Learning-Based E-Module: Effectiveness of Using Vee Diagram in Concept's Construction and Learning Achievement in Environmental Topics

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**Abstract**—This study aims to check effectiveness of using the discovery learning based E-module assisted by vee diagram in enhancing learning achievement in environmental topics. These achievements explain the process of students to construct their ecological knowledge because it is related to learning outcomes. A quasi-experimental approach was undertaken to ascertain the effects of the implementation of vee diagram assisted E-module on concepts construction and achievement of students towards environmental topics. This study employed quantitative methods of research specifically posttest control group design. Two comparable classes of grade ten senior high school students at Karanganyar were involved in this study. Data were gathered using achievement test, questionnaire and semi structured interview. The data gathered from the achievement test was analyzed statistically using the non parametric test of Mann-Whitney. The data from questionnaire and interview were reported descriptively. Findings showed that class using E-module assisted by vee diagram performed better learning achievement compared to the teacher centered class. This is because of student has opportunities to be involved in constructing their concept of environmental. Vee diagram helps student to remember, propose, arrange, compare and analyze concepts that in turn will affect their learning achievement in environmental concepts and ecoliteracy as well.

**Keywords:** *discovery learning, vee diagram assisted E-module, concept's construction, learning achievement, ecoliteracy*

## I. INTRODUCTION

Ecoliteracy consist not only realeted knowledge but also to individual sensitivity and action to promote the society environment [1]. Ecoliteracy concept has been growth following the concept of sustainable environment development and environmental education [2,3]. Ecoliteracy is the level of environmental knowledge and individual behavior intention to orient attitudes and actions in accordance with the knowledge possessed [4]. Environmental knowledge is one of the basic of ecoliteracy.

Environmental quality is very dependent on the level of knowledge, attitudes and behavior [5]. Low environmental quality because there are various environmental problems. Increased environmental problems can occur due to ecological intelligence is less, so that sensitivity to the environment is low [6]. Environmental knowledge will be directly proportional to the environmental attitudes and the responsible environmental behavior [7].

Ecoliteracy can be applied in the education. Education can empower awareness, sensitivity and concern for the environment with responsible behavior [5]. Low environmental knowledge can affect the behavior intention of students so that students's ecoliteracy can be said to be low. Increased students's ecoliteracy can do with the improvement of learning. Improvements can be done with strengthening cognitive structures and meaningful learning. The election of models and learning strategies that are appropriate to the characteristics of students can influence meaningful learning success [8]. One model of learning undertaken to address a variety of learning problems is to apply discovery learning.

Discovery learning is one instructional model to find the concept independently. Students play an active role in the learning process to solve the problem of finding a concept [9]. Discovery learning is designed to help students understand the structure or the key ideas of a discipline in solving everyday problems [10]. The use of discovery learning model aims to encourage students to be more active in learning. Discovery learning is student oriented learning that trains student independence do that student's cognitive processes can be improved [11].

One way to strengthen the cognitive structure of ecoliteracy concept is to develop teaching materials. Teaching materials that can help students and teachers in the learning process is a module [12]. The development of the material being taught is one way to support the module as a quality instructional material. The progress of science and technology that continues to grow requires teachers to be

more innovative and creative. E-module is a display of information presented electronically and arranged for the purpose of self-learning [13][14]. Advantages of E-module is interactive and can display images, audio, video, animation and equipped with formative tests [15]. E-modules used in the study have been adapted to the dimensions of the NEP criteria and indicators of environmental change materials are applied in schools.

The implementation of discovery learning based E-module will be more effective to construct student's knowledge when combined with a vee diagram because it can help students grasp the meaning of learning by focusing questions that encourage students to think [16]. Students are encouraged to find questions and observations made during the experiment. Vee diagram can reveal the knowledge already known, the knowledge that has been obtained and how to analyze the data that has been obtained. The vee diagram emphasizes more thinking and doing activities so that it is expected to optimize science based learning [17]. Discovery learning based E-module of using vee diagram is expected to be the solution of the problem of low school ecoliteracy and assist students in finding new concept.

**II. METHOD**

The research was conducted at Karanganyar Senior High School on environmental change material in the second semester of academic year of 2018/2019. The learning media used is E-module assisted vee diagram. This type of research is quasi experiment. The sample used is a class X with each of the 36 students who are determined by random cluster sampling technique. The study design used is the only group posttest design (Table 1).

TABLE 1. DESIGN RESEARCH

Class	Treatment	Posttest
Experiment	√	√
Control	-	√

Data collection on this research in the form of test and non test. Data were gathered using achievement test, questionnaire based NEP instrument, and semi structured interview. The questionnaire instrument used consist of a NEP instrument with a Likert scale to determine readiness the student behavior. Readiness the student behavior is categorized in the level of measurement of NEP that is proecological, middleecological and antieecological. The indicator of NEP instruments consist of limits to growth, rejection of exemptionalism, the possibility of an ecocrisis, fragility of nature balance and antianthropocentrism. Lesson observation sheet used as a measure of achievement in the learning. The achievement test was analyzed statistically using the non parametric test of Mann-Whitney. The use of learning media with E-module assisted vee diagram has been integrated with syntax of discovery learning based NEP indicator.

**III. RESULTS AND DISCUSSION**

*A. The Impact of Implementation Discovery Learning based E-module assisted Vee Diagram*

The data described is data ecoliteracy posttest results, the poll result of the NEP and the observation of the lesson

activities. The results of the second posttest data computation experimental class analyzed to see the impact of media use ecoliteracy learning for students. Based on the results of student ecoliteracy posttest data calculation, the results of the experimental class is better than the results of the control class. Description ecoliteracy student posttest results are shown in Table 2.

TABLE 2. DESCRIPTION OF POSTTEST RESULTS DATA STUDENTS ECOLITERACY

Statistics Results	Control Class	Experiment Class
Mean	74.17 *	77.50 *
Median	75	80
Max	60	50
Min	90	95
variance	49.28	96.42
N	36	36

Table 2 shows that the ratio of the average value of learning outcomes ecoliteracy dimensions of knowledge in experimental class is higher than the average value ecoliteracy dimension of knowledge in the control class. The average value of the experimental class is 77.50, the control group was 74.17. It shows that the implementation of discovery learning based E-module assisted vee diagram has an effect on students' learning outcomes ecoliteracy of knowledge in the experimental class. Variance control class is smaller than the experimental class. This situation shows that the level of diversity in the control class value is smaller or more homogeneous than the experimental class. Median on experimental class is higher than the control class. The analysis results discovery learning based E-module of using vee diagram can be seen in Table 3.

TABLE 3. ANALYSIS OF THE EFFECT OF THE APPLICATION OF DISCOVERY LEARNING BASED E-MODULE ASSISTED VEE DIAGRAM

Test	Result	Conclusion
Mann Whitney	0.012 < 0.05	There is a difference significant

Table 3 shows that Mann Whitney test results significance value less than 0.05. The result leaves H0 rejected so that there is a difference singnifican on the dimensions of knowledge between the control and the experimental class. The analysis results of the implementation using discovery learning based E-module assisted vee diagram that the acquisition value ecoliteracy posttest results between the control and the experimental class classes that implement the discovery learning based E-module assisted vee diagram significantly different. These results prove that the discovery learning based E-module assisted vee diagram dimensional effect on students' knowledge ecoliteracy.

Application of discovery learning based E-module assisted vee diagram resulted in increased knowledge dimension students's ecoliteracy. The increase dimensions of knowledge ecoliteracy achievement supported by the learning outcomes that integrate syntax of discovery learning with E-module assisted vee diagram so that the learning process can be carried out properly and systematically. Discovery learning based E-module assisted vee diagram is very relevant to establish the concept of environmental changes in high school students of class X because students can express ideas and connect knowledge

already possessed by knowledge be studied. Discovery learning based E-module is equipped with a supporting media that vee diagram is used to measure and organize all the ideas presented by the students. Vee diagram can be a solution to the weakness of the model of discovery learning.

Syntax of discovery learning consists of stimulation, problem statement, data collection, data processing, verification and generalization [19]. Stimulation and problem statement syntax integrated with vee diagram to write the focus of the students question with how to find and resolve environmental problems. The discovery and problem solving is done through investigation and connection with aspect of New Ecological Paradigm (NEP). This process makes students become active and independent in finding answers to the problems encountered. Students are guided so that their own to seek solutions and the knowledge that accompany so students can produce knowledge of the learning process meaningful.

In the next syntax that is data collection, students collect data by writing theories, concepts, and principles that they have learned previously associated with focused questions. Students also choose the way of working and objects that will be used to collect data. This process, enables students to make an important record of the findings. Application of discovery learning based E-module assisted vee diagram can help students to construct knowledge with the participation of the students involved in the learning process, so that learning becomes meaningful.

This is particularly relevant to Bruner's theory that learning is an active process that is performed by student to discover new things and solving problems [18]. Students learn by participating using concepts and principles that have been known to gain knowledge [19]. Knowledge gained from the process of the invention has several improvements including knowledge can survive long in the memories of the students, the concepts and principles in students' cognitive structure can be more easily applied in the face of new problems and the reasoning that students can increase during discovery learning.

Data processing activities associated with the NEP on syntactic aspects of data processing consists of the transformation of the data in the form of sketches, charts, tables or images to be easily understood. In the syntax verification, the student to verify the data by linking to the theory, concepts and principles that have been written early. Students can connect between the conceptual and methodological. In the last activity the students conclude relevant concepts derived focus question. Based on a series of syntax discovery learning based vee diagram that has implemented student can produce meaningful learning because students do these activities directly and find the right way to solve the problem based on the knowledge that has been previously owned [20]. Discovery and meaningful learning theory comes from the constructivist paradigm.

The basic principle of the constructivist approach is student learning so that students actively construct new knowledge of data [20]. Integration and construction of new knowledge occurs when students change information that is understood by the student that the teacher's role as facilitator in implementing E-module-based discovery learning is very important vee diagrams. The teacher's explanation on how

to use vee diagrams greatly affect students in the process of searching for knowledge related to the focus of the question. It is relevant to Ausubel learning theory which states that teachers should develop the cognitive potential of students through the learning process meaningful. The implications of the study meaningfully is a learning process that generates meaning by way of new material show teacher associated with concepts that are relevant to everyday life.

The increase achievement ecoliteracy of knowledge dimensions more affected by the implementation of discovery learning based E-module because the content of discovery learning based E-modul is made such that the presence of its components include: syllabus, learning Implementation Plan, and posttest assessment instruments in the form of matter. The components in the discovery learning based E-module made by prioritizing the components NEP as a benchmark to measure student ecoliteracy and combined with the material indicators of environmental change. NEP concept used is divided into five components, namely a limit to growth, anti-anthropocentrism, the balance of nature, rejection of exemptionalism, and the possibility of an ecocrisis. NEP components have their respective roles in improving student ecoliteracy.

Improved results of ecoliteracy knowledge dimension is also supported by learning outcomes which apply vee diagram so that teaching and learning activities can be run well and students can easily understand the material. Application of vee diagrams help the students to dare to express opinions and convey the principal ideas with a focus on the question vee diagrams that may affect student learning outcomes. In addition, students still need the guidance of the teacher to make the formulation of the problem so that the learning goes according to the learning objectives. The learning process with Vee diagrams can make the learning becomes meaningful because students can construct their own knowledge. Students construct knowledge by completing each stage of the diagram vee interconnected [21]. The meaningful learning generates more critical ideas if the concepts obtained by students can be applied in overcoming problems in daily life so that ecoliteration is expected to be empowered.

#### *B. The Effect of Implementation Discovery Learning based E-module assisted Vee Diagram on Students's Behavior Intention*

Ecoliteracy learning outcomes research data on the readiness of the students behave NEP is obtained from the questionnaire. Data from NEP questionnaire was used to measure the readiness of individual behavior towards the environment. NEP questionnaire contained 15 statements. Ecoliteracy learning outcomes research data on the knowledge dimension control class and experimental class can in Figure 1

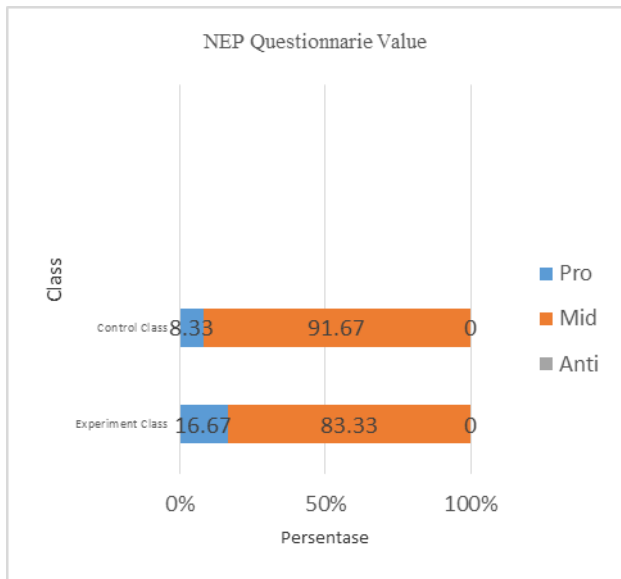


Figure 1. Acquisition Value on NEP in Achieving Readiness Questionnaire Student Conduct

Figure 1 shows that the experimental group had a questionnaire acquisition value higher than the control class. NEP questionnaire is divided into three category namely, pro ecological, middle ecological and anti-ecological. Control class's percentage of pro ecological category of 8.33% and amounted to 91.67% ecological middle. Experiment class that implement the discovery learning based E-module assisted vee diagram has percentage ecological pro category 16.67% and amounted to 83.33% ecological middle. Control class and experiment class didn't has the percentage of anti-ecological. Based on the percentage of the acquisition value of the NEP in achieving behavior intention, the control class's student and experimental class has behaved good behavior. Behavior intention is good shown by existing categories of pro ecological and ecological middle of each class. The experiment class's behavior intention has towards the environment is better than the control class because the experimental class has pro ecological percentage higher than the control class. This is due to students accustomed to give ideas and opinions in the form of a solution to the problems posed during the learning takes place. Students are given the environmental issues on the stimulation and problem statement syntax. Students are encouraged to find a concept that begins from showed problems. The behavior intention a person is affected by cognitive structure of human beings from birth [22]. Students respond to every problem with each character possessed by the cognitive structures [22]. Good cognitive structure of readiness to behave can affect students. Improvement of cognitive structures can be done with the application of meaningful learning that the application discovery learning based E-module assisted vee diagram can be used to improve students's cognitive structure so that students become well readiness to behave. The results of each item on the questionnaire NEP statement can be seen in Figure 2.

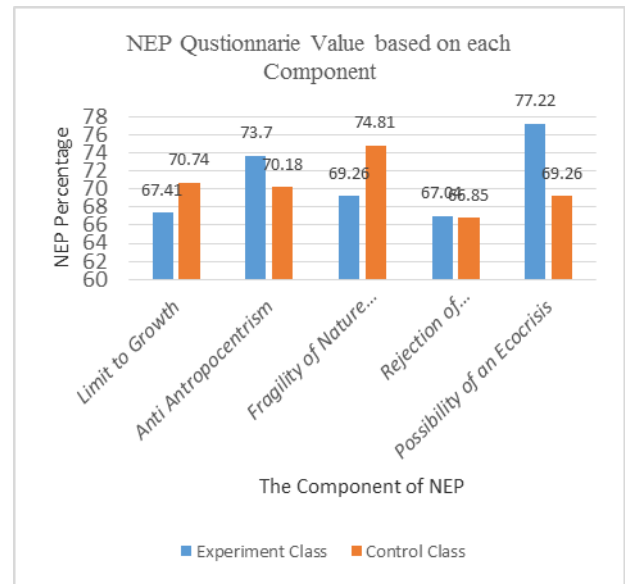


Figure 2. Results Achievement Percentage Each item statement NEP

Figure 2 shows the comparison of the percentage values for each NEP item statement that has been grouped into five NEP components. The experimental class has increased value for the acquisition of anti-anthropocentrism and the possibility of ecocrisis. However, the two components decreased acquisition value is the limit to growth and fragility of balance nature. The rejection of the exemptionalism component decreased slightly in value when compared to the control class. This is due to the discovery learning based E-module which integrates the components of the NEP. The integration between the stages of learning and the discovery of the syntax of vee diagrams can be more effective in the process of building students' ecoliteracy concepts.

Characteristics of discovery learning based E-module assisted vee diagram in accordance with the objectives of environmental education. The Learning process is more emphasized on activities that can change attitudes[23]. The learning step used is students are given existing environmental problems so students can be solve the problems with a friendly attitude towards the environment. Discovery learning is student centered learning. The purpose of student centered learning is to recognize the importance of the learning experience and provide a design that is suitable for supporting the learning outcomes to be achieved.

The results of dimension knowledge and behavior intention good student shows indicators are formulated and implementation of discovery learning based E-module assisted vee diagrams can make students more aware of and sensitive to the activities of keeping the surrounding environment. Students can help improve the quality of the environment with the knowledge, attitudes and behavior that they have to protect the environment [5]. The results of this study indicate that knowledge as one dimensional in ecoliteracy has increased proportional to the readiness of the students behaved. The environmental knowledge will be directly proportional to the environmental attitudes [7].

The results of this research can be used to support educational programs that focus on sustainable development. The education process can be implemented by using discovery learning based E-module assisted vee diagram. Discovery learning based E-module can help students to learn independently and build their own knowledge. Vee diagram can train students with a scientific approach resulting in a growing knowledge. Knowledge as a result of meaningful learning can influence students' readiness to behave better so that students can be empowered ecoliteracy.

#### IV. CONCLUSION

Based on the research that has been done can be concluded that the implementation of discovery learning based E-module assisted vee diagram has an influence on the concept's construction and learning achievement in environmental topics. Application of discovery learning based E-module assisted vee diagram can empower students ecoliteracy so that students can play an active role in order to safeguard the environment.

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