

The influences Of Vee Diagram On Animal Ecology Lab To Learning Outcomes And Logical Thinking

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Abstract: During this time, the student is less understanding the significance of animal ecology lectures, so that students are less able to apply it in real of life. Animal ecology lecture consists of lectures and practicum. The purpose of this research was to increase knowledge of animal ecology and logical thinking of students using the diagram Vee on Animal Ecology lab. Research method was quasi experiment. The study population was student of prospective teachers Biology at 6th Semester as much as 9 classes taken courses Ecology animals, samples taken purposing sampling by 2 classes. This research was conducted by using a diagram Vee during practicum. Data obtained from the results of learning tests and logical thinking using the Test of Logical Thinking (TOLT). Data processing with the T test using SPSS. The results showed that there was influence using Vee diagram of the learning outcomes and logical reasoning and intellectual development of students.

Keywords: Vee Diagram, Animal Ecology Lab, Learning Outcomes, Logical Thinking

INTRODUCTION

Studying ecology is study of interaction between living things with their environment. Studying Ecology looks like a simple and easy, but in fact most of the students do not understand the essence of the subject¹. This animal ecology courses divided into two activities, namely lectures and practicum. Nevertheless, often students do not understand the meaning and less can be applied in everyday life. It demonstrated an average yield of the final value of animal ecology course that is still less than expected, but it was shown as well as a report or essay writing process generally results of studies on the ecology is still not quite right. Animal Ecology learning outcomes that have been achieved biology student, biology teacher candidates on average in 2012 was 63 and in 2013 was 66. Of these learning outcomes is still below expectations. Students are less able to apply in everyday life, particularly with regard to the phenomena of nature and conservation.

Intellectual development of students is very important to know, in order to provide learning in a proper way. TOLT measurement results still indicate the level of intellectual

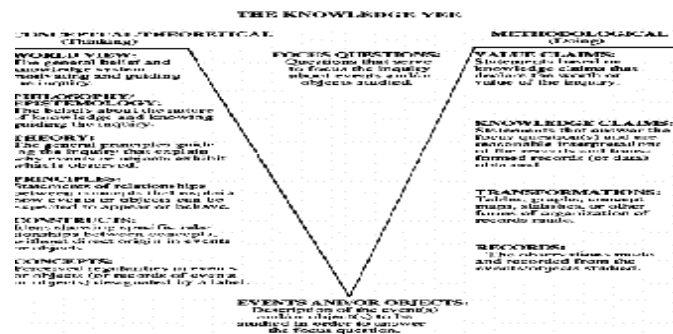
¹ Muh Barid Nizarudin Wajdi, “Landasan Historis Perkembangan Teknologi” (2017).

development of students of biology, at the stage of concrete still above 50%.² Student is supposed to have the intellectual development of formal operational (Piaget, 1964). This indicates that the student is actually some still difficult to learn abstract. So that there should be an improvement in the learning activities³.

Vee diagram is one way to organize the process of solving an interesting problem. This chart has been developed but has not seen its potential as an organizing model of project based learning in the classroom. Use of the Vee diagram is intended to help the learning process using the graph to build knowledge. It can help communication between a research associate. Through graphs, students can establish communication through certain stages and help students to find something new. Students are able to understand where to position them in a process and how to continue making progress. Hapsari D. P, Suciati S, and Marjono (2012)⁴ research results, showed that the learning activity using Vee diagrams can improve cognitive ability, affective and psychomotor. For teachers, the use of Vee Diagram as a graphic guide to explain the instructions on the research process. These charts provide a structure to direct and discuss the process, an important value for communications and a useful structure arrangement. Activities stages of learning using Vee diagrams can develop scientific capability.

RESEARCH METHOD

This research method used quasi experiment. The population was the sixth semester students who took courses ecology of animals in 2014 in Biology Education about 9 classes at the university. The university is located in a small town in West Java. Students entering the university was not through a rigorous selection⁵. The sample was taken purposively about two classes, for the treatment and control. Animal Ecology lecture is divided into two activities, namely in classroom lectures and laboratory experiments. Lectures in class implemented before the practicum, by the method of presentation, discussion and question and answer, while the lab were done as follows: 1. practicum model used was Project Based Learning (PjBL) 2. The media used was vee diagrams.



² P. K. Suprpto, "Pengembangan Program Perkuliahan Anatomi Tumbuhan Berbasis Visuospatial Melalui Representasi Mikroskopis Sistem Jaringan Tumbuhan Untuk Meningkatkan Penalaran dan Penguasaan Konsep Calon Guru Biologi," (Disertasi, Bandung: Universitas Pendidikan Indonesia, 2012).

³ Muh Barid Nizarudin Wajdi, "Metamorfosa Perguruan Tinggi Agama Islam," *AT-Tabdzib: Jurnal Studi Islam dan Muamalah* 4, no. 1 (2016): 92–109.

⁴ D. P. Hapsari, Suciati S., and Marjono "Pengaruh Model Inkuiri Terbimbing dengan Diagram V (Vee) dalam Pembelajaran Biologi Terhadap Kemampuan Berpikir Kritis dan Hasil Belajar Siswa," *Jurnal Pendidikan Biologi* 4, no. 3 (2012): 16-28.

⁵ Muh Barid Nizarudin Wajdi, "Paradigma Pergeseran Educational Technology Menuju Instructional Technology" (2017).

Fig. 1. Vee Diagram (Novak & Gowin, 1985)⁶

Gowin’s Vee showing 12 epistemological elements operating in the construction of knowledge or in an analysis of a unit of knowledge. 3. The study was conducted in 6 sessions 4. The material covered during the course of a study are: individual, population, community and ecosystem Lectures on class control and treatment classes held together, but the control class, practicum does not use vee diagrams. Practicum conducted in accordance with the instruction manual lab work. Learning outcomes data collection techniques implemented based on the results of cognitive tests and then the data is processed using T test with SPSS. Data Logical thinking is measured by the results of the Test of Logical Thinking.

RESULT AND DISCUSSION

Cognitive Learning Outcomes

Cognitive learning outcomes measured were the result of post-test, i.e. after the students following study of animal ecology. Practicum was done by using project based learning models with a scientific approach comes with a diagram and without diagram Vee as a control. The results were the average post-test using Vee diagram was 21.94, the maximum score was 26 and the ideal score 30, while learning without Vee diagram obtained an average of cognitive postes was 19.73, the maximum score of 24 (Tab.1).

Table 1. Measurement of Cognitive Student Learning Outcomes

Measurement	V-Diagram	Control
the average of post test	21.94	19.73
the maximum score	26	24
the minimum score	14	15
ideal score	30	30
standart deviasi	2,86	2,29

Normality test data were analyzed using SPSS software, using the Shapiro-Wilk test, shows the following findings:

	Tests of Normality					
	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Stats	df	Sig.	Statis	df	Sig.
	c			c		
diag vee	.116	36	.200*	.952	36	.122
control	.133	26	.200*	.971	26	.638

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

⁶ J. D. Novak and D. B. Gowin, *Learning How to Learn* (New York: Cambridge University Press, 1985).

Number on the Shapiro-Wilk column Sig. for the value of the class (using Vee Diagram) is 0.122 which was above 0.05 ($x < 0.05$), then H_0 is accepted, it means that the sample came from a normal distributed population. Similarly, the numbers in the column Shapiro-Wilk Sig. for the value of the class without the Vee diagram was 0.638 which was above 0.05 ($x > 0.05$), then H_0 was accepted, it means that the sample comes from a normal distributed population. Guidelines for decision-making was if significant value < 0.05 , then reject H_0 and vice versa if the significance value > 0.05 then accepted H_0 .

GROUP STATISTICS					
	Kelas	N	Mean	Std. Deviation	Std. Error Mean
Nilai	Diagr Vee	36	21.94	2.858	.476
	Control	26	19.73	2.290	.449

Table Group Statistics warned that the number of data/samples, the average result learning, and standard deviation. The average grade in the class using vee diagrams (21.94) was better than control (19.73) also a standard deviation using a class diagram vee (2,858) better than control (2,290).

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Nilai	Equal variances assumed	1.635	.206	3.263	60	.002	2.214	.679	.856	3.571
	Equal variances not assumed			3.381	59.290	.001	2.214	.655	.904	3.524

Sig. column Levene's Test was 0.206 then the value sig. (0.628) $> \alpha$ (0.05), then H_0 was accepted. Thus, both groups had the same variance (homogeneous). The t-test was used for both sets of data derived from normally distributed population, as well as two sets of data had the same variance (homogeneous) so that parametric statistical test was then performed using independent t test. By using the computer program SPSS, data output was obtained as follows:

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Therefore, these two numbers sig. (2-tailed) is below 0.05 (0.002 and 0.001), then Ho was rejected. This means that there was significant cognitive achievement of students in the implementation of the vee diagram on animal ecology courses.

Making Skills Vee Diagram

Skills to diagram vee judged by the work of making diagrams vee. Students create charts learning vee during the process and the results are collected. Task vee diagrams created per student. Indicator assessment is a question of focus, principles and concepts, objects or events, notes or transformation, knowledge claims and claim value.

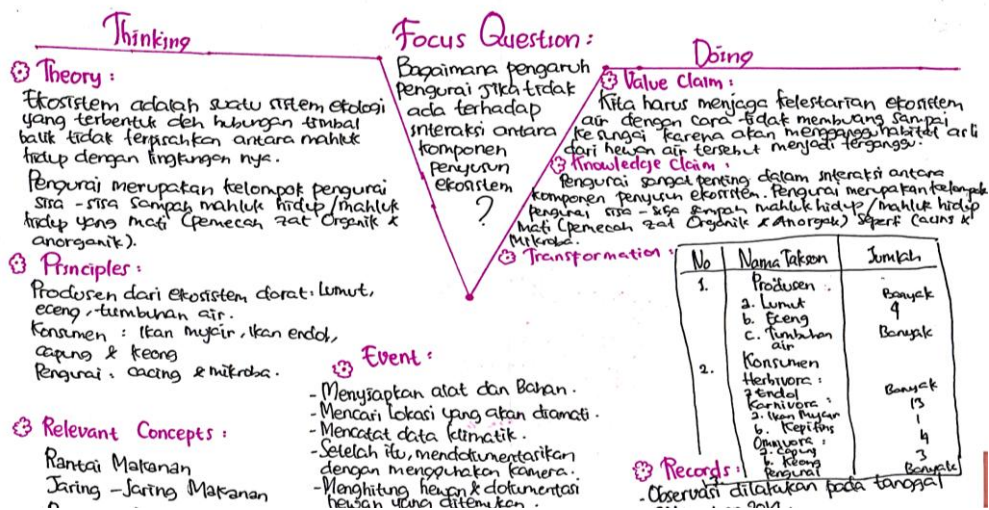


Fig. 2. Student's Vee Diagram

Students created diagrams vee with 11 epistemological elements for constructing knowledge.

Table 2. The average Yield Assessment Vee Diagram Sheet Student

	average	score ideal
focus question	2.4	3
objects/ events	2.4	3
principles and concept	2.7	4
Notes/Transformatio	2.3	3
n		
average	2.2	4
value claims	0.8	1

(Novak & Gowin, 1985)⁷

The results of the above assessment (Tab.2) can be explained as follows:

1. The first assessment, the average value of the student making the focus question was 2.4, while scores ideal was 3, so that it could be stated that the students were able to make

⁷ Novak and Gowin, *Learning How to Learn*.

- inquiries focus. Students were able to make inquiries identified, including the concept, showing large objects or events, or objects that were wrong and activities identified in relation to the laboratory.
2. The second assessment of sports and events, the average student create objects and concepts was 2.4, while scores ideal was 3. This showed that the students were able to enter the great events and the accompanying objects identified, and was consistent with the focus of the question, some suggest what vee would be noted in the diagram.
 3. The third vote on principles and concepts. The results of student assessment in this statement got the value of 2.7, while the ideal score was 4. It was clear at this stage most students could only afford one of all the relevant concepts and principles and identified, only a few were able to make two types of relevant principles or concepts identified.
 4. The fourth assessment records or data transformation got an ideal score of 2.3 and 3, meaning that the record or transformation identified, but the transformation was not consistent with the intent of focusing questions.
 5. The fifth assessment was the claim of knowledge, students gained an average of 2.2, while the ideal score was 4, indicating that knowledge claims made included the concepts used in the context improver or generalizations were still largely in accordance with the notes and transformation.
 6. The sixth was the claim value assessment, the student gets a score of 0.8, while the ideal score was 1, meaning that most students were able to make a claim that was consistent about the importance of the investigation, described the used of scientific knowledge claims for pure or implementation effort.

Logical Reasoning

Reasoning students measured through TOLT (Test of Logical Thinking) (Tobin and Capie, 1981), a written test consisting of 10 questions and consisted of 5 variables component of reasoning, namely the control variable, proportion, correlation, probability and combinatorial reasoning.

The results indicated that the logical thinking practicum using Vee diagrams could improve logical thinking better. if we look at each variable reasoning, then the lab using vee diagrams could increase the proportional variables, correlational, and combinatorial better (Tab. 3)

Table 3. TOLT Post test results of students

reasoning variable	item no.	diagram vee (%)	control (%)
proportional	1	80,6	61,5
proportional	2	75	53,8
control variable	3	2,7	3.8
control variable	4	0	0
probability	5	0	3.8
probability	6	0	7,7
correlational	7	0	0
correlational	8	33,3	22,2
combinatorial	9	72,2	57.6
combinatorial	10	44.4	15.4

The level of intellectual development

Results TOLT (Test of Logical Thinking) students were divided into three categories based on the stages of intellectual development TOLT score obtained by the students, which were the concrete operational stage of development (score: 0-1), stage of development of transitional (score: 2-3) and the stage of development of operational formal (score: 4-10). Diagram vee intellectual affect the development of the students, as shown by the results of the intellectual development of concrete smaller operational and transitional phase and formal operational better (Tab.4).

Table 4. Intellectual development phase of the students after learning

Tahap Perkembangan	diagram Vee (%)	control (%)
Formal operational (4-10)	50	42.3
Transitional (2-3)	36,1	34.6
Concret operasional (0-1)	13,9	26.9

Vee diagram on lab animal ecology effect on knowledge in this regard was the cognitive learning students. Cognitive learning outcomes using Vee diagram showing better results compared with the controls, as well as to think logically, shown reasoning and intellectual development.

Learning and practical used vee diagrams, train students to make statements about the conceptual and methodological details and problem solving. Students designed their own model of practicum through Vee diagram components. The components that had to be made in making the student is the focus question Vee diagram, conceptually divided into conceptual structure, concept and object (event), and the methodology is divided into records, the data transformations/interpretations, knowledge claims and value claims.

Some components in the diagram vee requires students to learn more seriously. The learning model used was project based learning, forcing the students to design their own courses, ranging from observations, making hypotheses, collecting data, analyzing, evaluating to make conclusions. The combination of a learning project based learning model with Vee diagram on lab could stimulate students to think and do much more active, because the student should compile a component in the diagram vee forcing students to make inquiries focus, conceptual structure, relationship, developing the concept, and events.

In the methodology, vee diagram components which should be produced by the students was a record, then transform the data and then making claims to knowledge and value claims. Activities in learning using vee diagrams provide positive influence on cognitive learning outcomes of students in the subject of Animal Ecology. Sulun, Evren, and Sulun. (2009)⁸ conducted a study the effect of the Vee diagram, the network lab in vegetables. The results showed that the method of the lab network diagram V plant on vegetables, showed better results.

⁸ Yusuf Sulun, Aysegul Evren, and Ali Sulun, "The Effect of The Usage of V-Diagrams on The Students Success in Biology Laboratory," *Erzincan E_itim Fakültesi Dergisi Cilt-Say* 11-2 (2009).

Study the ecology should have a good knowledge and have a good ability of logical thinking. Interaction that occurred should be a logical relationship. The ability to predict interactions that will occur in the ecosystem needed a good logical thinking ability. Logical thinking was very supportive in studying the ecology, especially in correlating one concept to another related understanding and conservation of natural events.

Results skill diagram vee systematic consisting of components focus question, conceptually divided into conceptual structure (thinking), concept and object (event), and methodology (doing) was divided into records, the data transformations/Interpretations, knowledge claims and value claims good able to make students think and improve learning outcomes and think logically.

From these results, it appeared that the student was skilled in making the focus question, data/events, making notes and transformation of data as well as the claim value, but still not good on the principles and concepts as well as knowledge claims. Improvement of skills should continue to be implemented to get maximum results.

Vee diagram is heuristic and constructivism (Thiessen, 1993),⁹ the inquiry and scientific (Calais, 2009),¹⁰ so that Vee diagrams can develop the ability to think logically. Lawson, Adi and Karplus (1979). said there are five characteristics of reasoning formal, namely: 1) identifying and controlling variables: define the identification and control of the variables as students' ability to identify the variables most appropriate, especially in solving the problem, 2) the ability to think combinatorics: the ability to think that combines several factors later concluded as a result of the merger, especially in solving problems, 3) the ability to think of correlation: the ability to analyze problems by using relationships or causal, 4) the ability to think of probability: This way of thinking to solve problems through various trends encourage students to explore the probability 5) the ability to think in perspective: as a proportion of problem-solving skills and combine proportion to one another. Thus, the child at the formal operational stage using a fifth this way in his reasoning.

Students use diagrams vee, looked develop better in proportional reasoning and combinatorics, but the least developed on correlational reasoning. Using vee diagrams, control variables and probability reasoning does not develop. Proportional reasoning is the ability to understand the situation of the comparison. In the real world, this is a major aspect of many everyday tasks. For example, making a perfect cup of tea with the tea bag has been steeped ensure for the proper amount of time and the correct amount of sugar and milk added. Put the right amount of detergent into the wash to the amount placed into the washing machine. This reasoning has been growing since early i.e. when the concrete intellectual development. Nevertheless, exercises for the development of proportional reasoning remain to be implemented, as indicated by the results of the study that the development of proportional reasoning consistently better seen in a matter of no 1 and no 2 (Tab.3) using vee diagrams. With a vee diagrams train students to solve problems in proportion.

Bernoulli (in Batanero et al, 1994)¹¹ described that the combinatorics as art to mention all

⁹ R. Thiessen, "The Vee Diagram: A Guide for Problem Solving," *Aims Newsletter*, May-June, 1993.

¹⁰ G. J. Calais, "The Vee Diagram as a Problem Solving Strategy: Content Area Reading/Writing Implications," *National Forum Teacher Education Journal* 19, no. 3 (2009).

¹¹ C. Batanero, Juan D. G., and Virginia N. P., "The Assessment Challenge in Statistics Education"

the possible ways in which a certain number of objects can be mixed and combined so as to ensure the results are possible. According Batanero, which was included in combinatorics i.e. combinations, permutations, concepts, formulas, sampling models, distribution models, reimbursement and applications. The results showed that learning using vee diagram combinatorics stimulate the development of better reasoning compared with the control. The activities of the event or designing experiments, making the data transformation makes inclusion in the form of knowledge claims and value claims in the vee diagrams can help improve the ability of reasoning combinatorics. Thus, vee diagrams can assist students in combining several factors for the solution of problems encountered in everyday life.

Correlational reasoning is defined as the mindset of the individual is used to determine the strength of the mutual or reciprocal relationship between variables. Correlational reasoning is the basis for the establishment of relations between variables; The relationship allows for predictions for scientific exploration.¹² Correlational reasoning in this study showed there was a tendency to use vee diagrams better compared with controls. Attributing activity on component relationships and concepts to train students to improve correlational reasoning abilities. Vee diagrams in this study could not boost the ability of control variables and probability reasoning, because it was not deep vee diagrams determine vari-observation variable, and less to train students to seek opportunities or any other possibility in solving problems.

Reasoning (reasoning) is a general concept that refers to one of the thought process to come to a conclusion as a new statement of some other statements which are already known. Copi (1986) refer to a specific way of thinking reasoning as to draw conclusions from premises. Piaget (1964) provides an overview of the intellectual system of children at developmental stages that describe the extent of its reasoning, namely (a) the sensory motor (0-2 years), (b) pre-operational (2-7 years), (c) the concrete operational (7-11 years) and (d) formal operations (11 and over).

The results showed that the percentage of students who were included in the lower concrete operational on student learning using vee diagram (Tab. 4). In the transitional stage of development, students with learning vee diagrams higher than controls. In the formal operational intellectual development of students with learning vee diagrams higher than controls. Thus, learning by using vee diagrams tend to improve the operational stage of development of the student.

Concrete operational development, are: 1) Ordering, namely the ability to sort objects according to size, shape, or any other characteristic. 2) Classification, i.e. the ability to name and identify a set of objects according to appearance, size, or other characteristics, including the idea that a series of objects can include other objects in the series. 3) Decentering, the child begins to consider some aspects of a problem to be solve. 4) Reversibility that children begin to understand that numbers or objects can be changed, then returned to its initial state. 5) Creation, which understand that the quantity, length, or the number of objects was not related to the arrangement or appearance of the object or the objects. 6) Elimination of egocentrism, i.e. the

(University of Granada), <http://www.stat.auckland.ac.nz/~iase/publications/assessbkref>

¹² Lawson A. E., Adi H., and Karplus R., "Development of Correlational Reasoning in Secondary Schools: Do Biology Courses Make A Difference?," *The American Biology Teacher* 41, (1979): 420-425.

ability to see things from another's perspective (even if they think the wrong way).

Formal reasoning includes the reasoning combinatorics, correlational reasoning and proportional reasoning. Flavell forward some characteristics of formal operational thinking, namely: 1) the hypothetical deductive thinking. To formulate many alternative hypotheses in response to the problem and check the data against each hypothesis to make appropriate decisions. But he does not have the ability to accept and reject the hypothesis. 2) think proportionately, a child at the formal operational stage of thinking is not limited to objects or events that concrete, it can handle any statement or proportions that provide data concrete. It can even handle proportion contrary to fact. 3) combinatorial thinking. Thinking activities covering all combinations of objects, ideas or proportions are possible. 4) the reflexive thinking. Children in this period to think as adults. He can think back on a series of mental operations. He also expressed his mental operations with symbols (Dahar, 1989). So that takes time and a willingness that is high enough to learn to use vee diagrams. Vee diagram is less structured than conventional teaching methods. Vee diagram consists of a V-shape to separate the theoretical/conceptual (idea) of the methodology (perform) an element of the investigation. Both sides are actively interact with one another through the use of focus question (s) that are directly associated with the event and/or objects.¹³

Vee diagrams could be used lab animal ecology. Activity connecting between theory and work, as well as arrange the elements in the diagram vee able to increase knowledge and logical thinking.

CONCLUSION

The results of this study could be concluded that the ecology lab animals using vee diagrams could affect: 1). Student results learning to be better; 2) Thinking logically better students were divided into logical reasoning student and intellectual development of students, especially proportional reasoning, correlational and combinatorics. Vee diagrams could be used in animal ecology lab, students were expected to apply ecology of animals in everyday life with the correct logic.

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¹³ M. C. Alvarez and V. J. Risko, *The Use of Vee Diagrams with Third Graders as A Metacognitive Tool for Learning Science Concepts* (Tennessee State University, 2007), malvarez@coe.tsuniv.edu

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