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Diagram Vee and mind mapping application to develop conceptual understanding of plant reproduction

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Abstract. The most common issue in Bio reproduction class was a lack of students understanding about the concepts. This study aimed to compare between 2 instructional media of lesson study, Vee Diagram and mind mapping, which has made a better understanding about Bio reproduction among students, with an implementation of lesson study. The study was conducted in Biology Education Study Program Faculty of Teacher Training and Educational Sciences Pakuan University, on March until May 2017. The second-year students of IVB and IVC were chosen as the participants along with a team of Bio reproduction lecturers as the conductor of the experiment and also as an observer. The topic for the study was Plant Reproduction. The methodology of this study was a quasi experiment. The IVB class used Vee diagram, while IVC class used mind mapping. The study was conducted in two cycles with three steps (plan, do and see). Data were collected by observation, paper and pencil test, and documentation technique. The result showed that a conceptual understanding of IVB was better on average than IVC. Based on the result and data analysis, it can be concluded that Vee diagram can improve a better students' understanding of bio reproduction especially on plant reproduction than mind mapping.

1. Introduction

Bio reproduction is one of the compulsory subjects which students of biology education study program should take at semester IV. This subject studies the structure of reproductive organs and reproductive process in plants and animals. Based on team meeting of lesson study on a Bio reproduction subject at stage plan, an early stage of lesson study which focused on identification of learning problems, lecturer revealed that students' activity and enthusiasm in learning process was very low. This resulted in a lack of conceptual understanding, particularly related to reproduction process in plants. Mostly the material was presented theoretically with limited use of media such as PowerPoint slides without students' involvement. The learning process was more dominated by lecturer so it was teacher-centered. Based on these problems, lecturers' team tried to use various instructional media in order to enhance students' activity and their enthusiasm. Among various media which have been developed, Vee diagram and mind mapping were chosen in this study because both of them brings together the concept of meaningful learning.

Vee diagram was firstly developed by Gowin. This media leads to students creative thinking and help students to understand their knowledge and the process of knowledge building itself [1]. According to



Novak [2], Vee diagram was an effective media to achieve meaningful learning and it was able to develop metacognitive thinking skills. The use of Vee diagram could facilitate students to learn better [3]. Implementation of Vee diagram also has a good influence on the process and students' outcomes and also can be used as a teaching and learning strategy which allows students to explore and understand the specific knowledge [4]. Vee diagram could help students, teachers, or researchers to understand the object of research related to the questions and solutions of the problems [5]. These indicated that Vee diagram is an invaluable tool in the learning process which leads students to construct their own knowledge in accordance with the principles of constructivism. Evren & Sulun [6] revealed that Vee diagram engaged students to construct their own knowledge, so it made the learning process more meaningful. The use of Vee diagram also could stimulate metacognitive skills and provide accurate information to students [7].

Mind mapping or mind map was firstly investigated by Novak in the late 1970s, but it popularized by Tony Buzan. According to Buzan [8], mind map was an external expression of an integrated knowledge in the individual mind. The mind map can be used in various phases of instruction, for example, to revise, practice and improve knowledge, and as a feedback [9]. Novak [10] revealed four ways the use of mind map, that is mind map as a learning strategy, teaching strategy, a medium to construct the concept and content of a single subject and instruction, and a medium to gather information of students' comprehension. Mind mapping was a form of writing notes creatively and effectively, easy and efficient for students to generate their ideas, and to notes materials or tasks.

Based on those problems, the research questions in this study were: 1) is there a difference on students' conceptual understanding of plant reproduction between students who learn with Vee diagram and mind mapping? 2) which is the most effective media in developing students' conceptual understanding of plant reproduction? The general objective of this study was to improve students' conceptual understanding of plant reproduction through the implementation of lesson study-based instructional media. Whereas the specific objective was to study the effect of Vee diagram and mind mapping to students' conceptual understanding of plant reproduction in Biology Education Study Program, Faculty of Teacher Training and Educational Sciences, Pakuan University.

2. Method

The study was conducted on March to May 2017, the second semester of the academic year 2016-2017, in Biology Education Study Program, Faculty of Teacher Training and Educational Sciences, Pakuan University. The sample in this study was fourth-semester students of class B and C. This study was conducted on Bio reproduction subject on the topic of plant reproduction, using a quasi-experimental method. This study consisted of two variables, which is Vee diagram and mind mapping as an independent variable, while students' conceptual understanding as a dependent variable. Vee diagram was used in class IV B and mind mapping was used in class IV C.

Lesson study in this research consists of 3 stages: Plan, Do, and See. Stage Plan as a first part of lesson study was did collaboratively by a team of lesson study including the identification of problems in Bio reproduction course, review the experience on teaching, prepare lesson design and chapter design, formulate methods, model, or learning technique, provide teaching materials, prepare instructional media, arrange students' worksheet, prepare observation sheet and some equipment which needed for documentation of learning process. Stage Do include two main activities, that is the implementation and observation of learning process. Learning activity was done in accordance with what has been defined in stage plan. Observation of learning process was performed to find out the facts that emerged during the learning process. Design of media in each class (Vee diagram or mind mapping) was assigned to students during Stage Do with some guidance from the lecturer. Stage See such an activity review, evaluation, or reflection to the learning process. All of the suggestions in the stage See will be a material to the process of revision on stage plan or do in the second cycle.

Structure of Vee diagram according to Gowin [1] and has been combined by Afamasaga [11], Evren & Sulun [6], Olivares et al. [12], is presented in Figure 1. The second media is mind mapping. Mind mapping has already known by students. This made it easy for a lecturer to explain mind mapping. Structural design of mind mapping was referred to the 7 steps [8].

Data in this study were collected by paper and pencil test, observation of students' and lecturer's activities, interviews, and audiovisual technique. Quantitative data of paper and pencil test were analyzed by descriptive statistics.

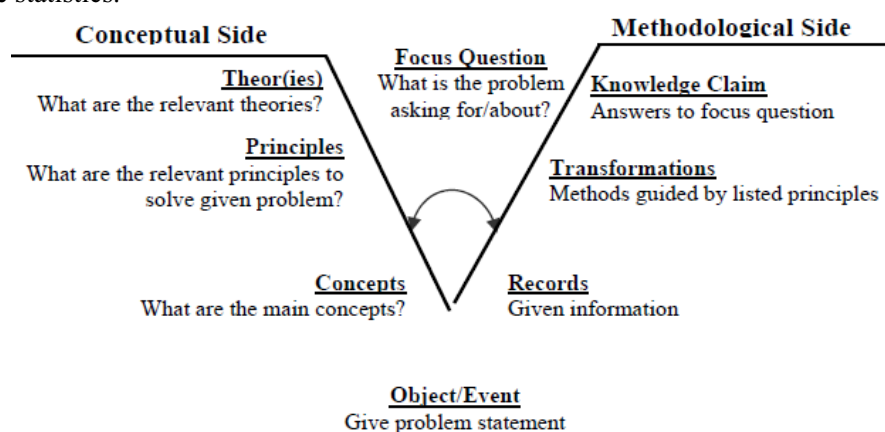


Figure 1. Structure of vee diagram.

3. Result and discussion

Students' conceptual understanding can be seen from the results of the test on two groups, both of which use Vee diagram or mind mapping. Based on the result of descriptive statistics (Table 1), the average value of group with Vee diagram was 70.07, while the group with mind mapping was 60.35. These indicated that the average value of a conceptual understanding of plant reproduction in Vee diagram group was better than mind mapping group.

Table 1. Conceptual understanding of group Vee diagram and mind mapping.

No	Value	Vee Diagram	Mind Mapping
1	Maximum	88	76
2	Minimum	40	24
3	Average	70.07	60.35

A hypothesis test was then performed using the t-test, which preceded by a test of normality and homogeneity. Chi-square was used for normality test. The result showed that the value of $X^2_{\text{calculated}}$ for Vee diagram group was 2.24, while mind mapping group was 4.77. Both of them were smaller than value of X^2 in the table (7.81) on the testing level $\alpha = 5\%$. This analysis showed that both data comes from normal distribution sample. Homogeneity test showed that $F_{\text{calculated}} 1.67 < F_{\text{table}} 2.33$. This meant that both of variance were homogeneous.

Hypothesis test using t-test showed that the value of $t_{\text{calculated}} 2.92 > t_{\text{table}} 1.99$, so H_1 received. This meant that there was a significant difference between students' conceptual understanding of plant reproduction which used Vee diagram and mind mapping. Based on the average of students' conceptual understanding in both groups, students with Vee diagram perform better than students with mind mapping. This was due

to the learning process with Vee diagram facilitate students to explore and understand the learning materials more comprehensively. The use of Vee diagram can facilitate students to learn better [3], because Vee diagram allows students to explore and understand specific knowledge [4]. Vee diagram has a structure in V shape and more comprehensive elements than mind mapping so it more influence students to understand the concepts.

Afamasaga [11] stated that the structure of Vee diagram (Figure 1) with various label and guided questions provides guidance on systematically to the students to give a reasons for the problems (Event/Object) and the provided information in identifying relevant principles, theory, formal definition, and primary rules (Principles) and (Concepts) which can lead to development of proper methods and procedure (Transformation) to find the answers (Claim Knowledge) to (Focus Question). Vee diagram was analyzed quantitatively to determine the coherency between conceptual side and methodology side, such do the principles support to given solution? Do the list principles are the most relevant to the given solution? Do knowledge claims supported by listed principles and transformation?

Evren and Sulun [6] explained that the structure and component elements in designing Vee diagram naturally leads students to the research process. The students were guided through the active participation in the scientific process. In this process, students made a comparison between prior knowledge and new knowledge after designing Vee diagram. Vee diagram encourages students to build new knowledge, so this produces more meaningful learning.

Learning atmosphere in the content of gametogenesis was alive in Class IV B (with Vee diagram) than Class IV C (with mind mapping). This was seen in the presentation session or class discussion. Students of IV B showed good self-confidence during the lesson, whether presentation, when students asking questions, and answer the questions. Evren et al. [13] stated that the use of Vee diagram could enhance the dimension of self-confidence.

The emergence of students' self-confidence during learning activities is possible because students were trained and required to think deeply in designing Vee diagram, start from connecting events, focus questions, collect and explain theory, principles, concepts, and value which can be taken from each learning materials (value claim), transform learning materials into a form which is easy to understand, do records, and draw a conclusion. The use of Vee diagram encourages students to think deeply [13]. The habit of thinking deeply in designing the structure of Vee diagram will develop metacognitive thinking skills. Novak [2] explained that Vee diagram was an effective media for meaningful learning and it was able to develop metacognitive thinking skills. Vanhear [7] also stated that the use of Vee diagram could stimulate metacognitive thinking skills. Vee diagram also could systematized knowledge to coordinate what has been known, though, decide, and done [12]. This enhances the students' ability to answer the questions better.

4. Conclusion

Based on the results of research and data processing, it can be concluded that there were significant differences in conceptual understanding of plant reproduction between groups of students who use Vee diagram and mind mapping. The use of Vee diagram provides better conceptual understanding compared to mind mapping in the topic of plant reproduction.

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