

Efforts To Increase The Understanding Of Algebraic Concepts By Using The Vee Heuristic Strategy

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Abstract: The background of this research is because the ability of students in elementary algebra courses, especially the root form material is still low. This is found to be relatively the same at the beginning of semester 1 from year to year. The purpose of this study is to improve students' understanding of concepts in elementary algebra by using the heuristic vee learning strategy. This research is a classroom action research conducted on the first semester students of Mathematics Education Study Program at the Faculty of Teacher Training and Education of Ahmad Dahlan University, Yogyakarta academic year 2018/2019. The study was conducted in two cycles. Each cycle consists of 4 stages, namely; (1) Plan (2) Do, (3) See, and (4) Reflection. Every learning process uses the heuristic vee strategy. The subjects of this study were 35 students. The ability to understand student Algebra concepts is collected using an essay test. The results revealed that the ability to understand algebraic concepts of students taught using Vee heuristic strategies increased. This can be seen from the value of the average test result cycle 1 is 55 and cycle 2 is 78.

Index Terms: algebra, classroom action research, Vee Heuristic, increase the understanding of concepts

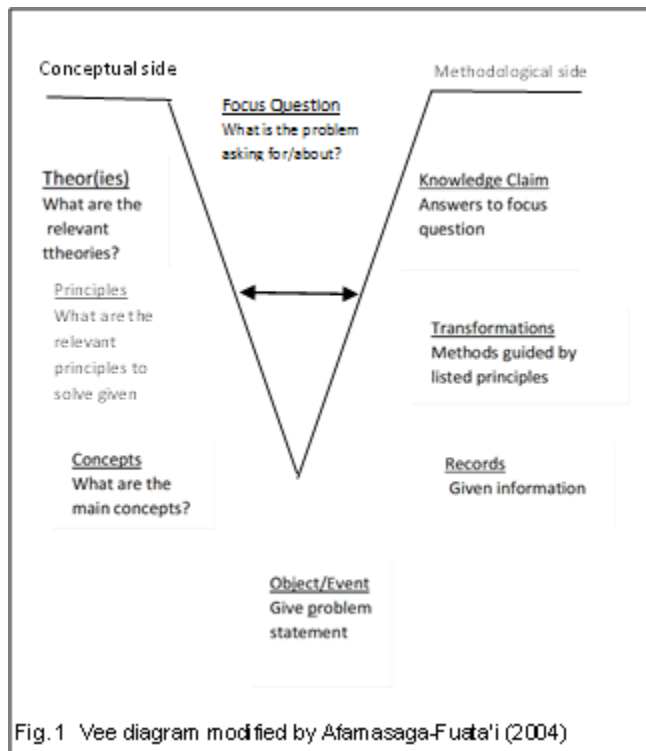
1 INTRODUCTION

The ability of students to understand root form concepts in elementary algebra material in the Mathematics Education Study Program at the Faculty of Teacher Training and Education of Ahmad Dahlan University is still low, both on the material similarities as well as on inequality material. This material is one part of elementary algebraic material given to first semester students. This root form material has actually been given in high school, but why their conceptual comprehension ability is still low. The low concept ability in the root form material is suspected because students pay less attention to the prerequisites that must be fulfilled in the material. Understanding is not just about remembering facts, but related to the ability to explain, interpret or the ability to capture the meaning of a concept. Mathematical learning difficulties experienced by students relate to imperfect learning abilities and students assume the previous concepts will not be used again so that there is a gap between what is desired and what happens in the field. These deficiencies can be revealed from the resolution of incomplete mathematical problems. This incompleteness can be suspected because of an incorrect understanding of the concepts and principles in solving the mathematical problems that are needed. Mathematical concepts and principles can also be related to the ability of these students in terms of understanding mathematical concepts. In various cases, a student who successfully completes a mathematical problem, but is unable to explain how he obtained or carried out the settlement process.

He was unable to explain why certain steps were taken, why he did it, and how he could do it [5]. Activities in the classroom were still classified as passive which resulted in students not being able to explore with their own knowledge. This has an impact on the knowledge that students have is not "long term memory" so it is not uncommon for them to forget learning so quickly because the concepts they have are only memorizing, not understanding. Therefore, important steps in solving problems need to be done [7], [8], [9], [10], [11]. Giving a problem in the study of mathematics, will lead students to use heuristics as to investigate and explore the best patterns to customize them to think critically [1], [2]. Based on Calais's research, vee diagrams (heuristic learning) are ideal strategies for improving students' abilities in science and mathematics investigations [3]. Likewise the results of the study by Singh et al. ; 'that the heuristic method of teaching mathematics be employed to enhance student's development of mathematical thinking' [14],[16]. Heuristic approach is introduced as a tool to develop students' mathematical thinking skills. Students who have strong belief of applying heuristics approach show better experience in identifying a mathematical problem. They also show inclination in the progress of mathematical understanding which is developed through multiple strategies employed in solving mathematical problems [15]. Vee heuristic or vee diagrams were introduced by D. Bob Gowin in 1977. The vee diagram was used as a teaching aid based on Ausubel's meaningful learning theory [4]. Vee diagrams are used to guide students in their laboratory experience, facilitate reflective thinking in learning and plan their own discoveries. Vee heuristic consists of two sides, on the left is the conceptual aspect and on the right side of the methodology, these two aspects are directly connected by the event or the object placed at the point (bottom) vee form, event or object is the most important part to formulate the invention. The top of the vee heuristic is the focus question that the solution will look for and relate to the event or object at the vee end. From this information, the components of the vee heuristic learning strategy in general are conceptual, event or object, focus questions, and methodological side. The vee diagram format is taken from the Afamasaga-Fuata'i modification [5] as shown in figure 1. Vee heuristic learning

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strategy is one way to present learning material in a "V" shape chart by pouring in initial knowledge which is then linked to further knowledge which is outlined in more detail in the form of constructing initial knowledge with new knowledge.



The steps in the learning process with vee heuristic strategies are as follows:

- 1) Orientation, focusing student attention related to subject matter,
- 2) Disclosure of students' initial ideas, asking students to conduct investigations through student worksheets. Lecturers do not justify or blame the concept of students,
- 3) The focus of the investigation, posing problems related to investigations carried out in the form of key questions,
- 4) Constructing new knowledge, students conduct investigations or solve problems from key questions given by lecturers, and
- 5) Evaluate student ideas. Thus students can see the incompatibility of previously owned ideas and then improve them.

The structure of one's knowledge in a scientific discipline can basically be characterized by questions that are the focus of the study, key concepts, conceptual system construction, reliability and relevance of the methods and mechanisms of work applied [6]. Students' understanding of the production of claims of mathematical knowledge should be illustrated in the construction of diagram V for mathematical problems that are solved. Thus, efforts to assess the structure of learners' knowledge of the problems faced can be achieved through the evaluation of Vee's diagram of problem solving that was constructed.

2 METHOD

This research is a classroom action research conducted on the first semester of 2018/2019 academic year Mathematics

Education Study Program, Teacher Training and Education Faculty, Ahmad Dahlan University, Yogyakarta. The study was conducted in two cycles. Each cycle consists of 4 stages, namely; (1) Plan (2) Do, (3) See, and (4) Reflection. Every learning process uses the heuristic vee strategy. The research subjects were 35 students. The ability to understand student Algebra concepts is collected using an essay test. Data analysis using descriptive quantitative.

3 RESULTS

The research conducted on 35 students of mathematics education study programs using vee heuristic strategies with the following steps:

- 1) Orientation, focusing student attention related to root form material.
- 2) Disclosure of students' initial ideas, asks students to conduct investigations through student worksheets which contain simple root form questions.
- 3) The focus of the investigation, posing problems related to the root form carried out in the form of key questions; that is, what requirements must be fulfilled in the completion of the root form.
- 4) Constructing new knowledge, students conduct investigations or solve new problems from root forms that are more complex than the key questions given by the lecturer.
- 5) Evaluate student ideas. Students can see the incompatibility of previously owned ideas and then fix them.

Based on the learning and evaluation process carried out, the results are as follows: When students are given questions about simple root shapes; they do it by looking at functions under the root sign or by squaring the two segments, with the reason that the root sign disappears. They do not pay attention to the prerequisites so that the problem can be solved correctly, namely the condition that the value of the function under the root sign must be ≥ 0 . But that is not enough, other conditions must be considered, especially the form of inequality. When students are given a more complex root form problem, for example in the form of fractions $(P(x))/Q(x)$, students cannot solve the problem by taking into account the requirements that must be comprehensively fulfilled. Students are not careful and thorough in the algorithmic process when solving the next steps (operational ability) when solving root form problems. When students are given questions about simple root shapes; they do it by looking at functions under the root sign or by squaring the two segments, with the reason that the root sign disappears. They did not pay attention to the prerequisites so that the problem was resolved correctly, that is, there is a condition that the function value under the root sign must be ≥ 0 . But that is not enough, other conditions must be considered, especially the form of inequality. When students are given a more complex root form problem, for example in the form of fractions $(P(x))/Q(x)$, students cannot solve the problem by taking into account the requirements that must be comprehensively fulfilled. Students are not careful and thorough in the algorithmic process when solving the next steps (operational ability) when solving root form problems.

Examples of student work in cycle 1

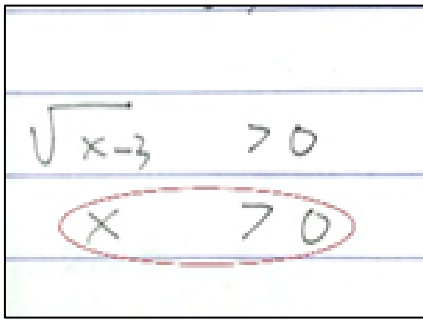


Fig. 2. Student work in cycle 1

Example 1:

From the work, students:

- a. Do not write conditions under the root mark.
 - b. The conclusion is wrong and the steps are incomplete..
- Examples of student work in cycle 2

Example 2:

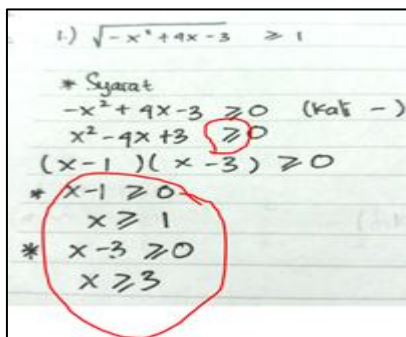


Fig. 3. Student work in cycle 2

From the work, students:

- a. Writing down the conditions under the root sign is correct.
- b. There is an operational error that is done by multiplying the process (-1), but the sign of inequality does not change.
- c. The next step is wrong, not paying attention to the terms of the multiplication of the two tribes as a whole.

Example 3:

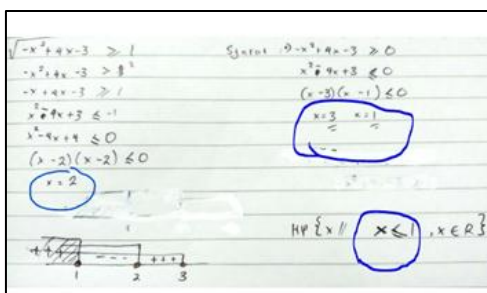


Fig. 4. Student work

From the work, students:

- a. Writing down the conditions under the root sign is correct.

- b. There is an operational error that is the inequality settlement process.
- c. The conclusion is wrong, do not pay attention to the conditions in the previous step.

The results of understanding algebraic concepts as indicated by the value of the test results after learning to use vee heuristic strategies in the root form material of cycle 1 and cycle 2 are presented in table 1.

TABLE 1
TEST SCORES FOR 'ROOT FORM' CYCLES 1 AND 2

Description	Cycle 1	Cycle 2	Information
The lowest value	50	70	increases
The highest score	65	90	increases
The average value	55	78	increases

Based on table 1, it appears that there is an increase in understanding of concepts in the form of root material for students of mathematics education study programs after learning using vee heuristic strategies. This is like other material, heuristic strategies can help understanding concepts and the ability to solve material problems taught [1], [3], [4], [10]. Similarly this is consistent with Novotná's research, J. et al. that heuristic strategy is one way to develop students' creative approaches to problem solving. The described experiment is a part of a longitudinal research focusing on improvement of culture of problem solving by pupils [13]. Students who have strong belief of applying heuristics approach show better experience in identifying a mathematical problem. They also show inclination in the progress of mathematical understanding which is developed through multiple strategies employed in solving mathematical problems. [15].

3. DISCUSSION

The essence of solving mathematical problems is exploring and building relationships between various branches of knowledge in mathematics. The heuristic approach is able to describe how these branches of knowledge are united by several basic and universal principles during the transfer of mathematical knowledge in the process of solving mathematical problems [12]. Students' understanding of algebraic material, especially in root form material which is still experiencing difficulties, needs to be evaluated in the learning process. Form of roots, in which there are implicit conditions that must be understood by students. Understanding the concepts and steps in the process of resolving these root form problems, needs to be emphasized, especially the emphasis on requirements that are implicitly needed. The root form which contains implicit conditions must be understood by students. Students of mathematics education study programs, are not only required to understand the root material but also must be able to master how to teach the material. Because they are also math teacher candidates. Understanding the concepts and steps in the process of solving this root form problem, needs to be stressed especially the emphasis on the requirements that are implicitly needed. Therefore, important steps in problem solving need to be done [7], [8], [9], [10], [11]. In the learning process the material requires a better strategy, delivered hierarchically from simple to complex forms. The heuristic vee strategy is able to change the way it understands the concept of the root form and is able to improve the ability

to solve the root form problem for the better. This is in line with the research of Hoon et al. (2013) "Heuristic approach is introduced as a tool to develop students' mathematical thinking skills [15]. Likewise, according to Calais, the vee diagram (a heuristic learning) is an ideal strategy to improve students' abilities in scientific and mathematical inquiry [3]. If necessary, be asked for help when a deadlock occurs while resolving this root form problem. Giving a problem in the study of mathematics, will lead students to use heuristics as to study and explore the best patterns to accustom them to think critically [1], [2].

5 CONCLUSION

Algebraic material, especially the root form which implicitly contains conditions that must be fulfilled in its completion requires emphasis in learning. Vee heuristic strategy is one of the effective strategies in learning algebraic material so that understanding concepts and the ability to solve problems with the material is better.

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