The effect of mind mapping on the concept comprehension abilities for grade x automotive student of vocational public schools in Sijunjung regency

D Sefriyanti¹, H Syarifuddin¹, I M Arnawa¹,² & Ali Asmar¹

¹Department of Mathematics Education, Universitas Negeri Padang, Indonesia
²Department of Mathematics, Universitas Andalas, Indonesia

Email: dewisefriyanti48@gmail.com

Abstract. Concept comprehension abilities is a very important aspect in learning mathematics. The low of concept comprehension abilities will affect the quality of student learning, which in turn has an impact on the low achievement of students in school. This also happened at the Vocational public School in Sijunjung regency. One effort that can be done in reacting to it is through the selection of learning models that can create a learning environment that makes students active. Mind Mapping technique is an alternative to increase student activity in learning. This type of research was quasi-experimental. The instrument used in this study was a test consisting of an initial ability test to see students' initial abilities consisting of high and low initial abilities, a final test to see students' mathematical concept comprehension abilities. Data was analyzed by using the Mann Whitney U test and two-way ANOVA. Based on the results of data analysis, several conclusions were obtained, namely: (1) The Concept comprehension abilities of students who learn with Mind Mapping Techniques was higher than students who learn with conventional learning; (2) Concept comprehension abilities of high, moderate, and low prior knowledge who learn with Mind Mapping techniques was higher than students who study with conventional learning; (3) there is no interaction between model of learning and prior knowledge.

1. Introduction

In Republic Indonesian Ministry of Education Regulation No. 22 of 2006 concerning the standard content of mathematics subjects stated that the the main purpose of learning mathematics in school is that students have the ability to understand concepts and problem solving that are good for continuing to the next level of higher education and to solve problems in everyday life. But until now, mathematics ability of Indonesian students at all levels of education has not shown the best results as expected [1-13]. Various attempts were made by the government to improve the quality of education such as curriculum renewal, teacher capacity building, procurement of textbooks, complementing educational facilities and infrastructure. Improvements were made for all fields of study including mathematics. However, we are faced with the problem of low student learning outcomes, which leads to low quality education and student interest in learning. One possible reason is that they consider mathematics a difficult and very confusing subject.

Given the important role of mathematics, in the process of learning mathematics students are required to be able and directly involved in finding concepts and being able to solve mathematical problems they face. Mathematics learning that does not involve students actively will cause students to not be able to use their mathematical abilities optimally in solving mathematical problems. In addition, mathematics learning that does not attract students' interest causes students not to pay attention to lessons in class, so students do not understand and are less familiar with mathematical concepts. As a result, they are unable to solve mathematical problems properly, which in turn results in their learning being low. Problem solving ability is the most important aspect that must be possessed by students. Learning problem
solving is the main goal of learning mathematics, because problems are an unavoidable fact in human life [14].

Based on the observation at automotive students of grade X in Vocational Public Schools of Sijunjung regency, it was founded that the low learning outcomes of mathematics were caused because most students were less motivated to learn mathematics. This is because students assume that mathematics is a difficult and scary subject. If they are going to test they tend to memorize these formulas without understanding the meaning contained in these formulas. This condition, besides making it difficult for students to understand concepts, can also affect student learning outcomes. Things like this in addition to making it difficult for students to understand concepts and connecting relevant concepts can also affect student learning outcomes. This can be seen from the average national exam of students. This lack of interest in learning occurs when mathematic learning takes place and causes students to not want to take math learning activities seriously.

To overcome the conditions above, teaching strategies that are appropriate for students are needed to be able to master and understand concepts. So far the efforts that have been made by teachers, especially mathematics teachers in vocational schools in Sijunjung regency is to increase the number of exercises so that students are skilled in using formulas and can remind them longer, to deepen students' understanding of the material taught by the teacher giving assignments at home and discussed at the next meeting. In order to make the effort to be better in understanding concepts, the teacher should be a liaison concept in a meaningful category.

One alternative that teachers can do so that students learn more meaningfully is to use mind mapping. Through mind mapping, students can be shown how the concepts are interrelated with each other, so that when mind mapping students can "see" the subject matter more clearly and learn it more meaningfully. The use of media or teaching aids can be effective if the teacher can manage the learning process well in class, therefore a teacher must be able to choose and use the right methods in teaching so that learning objectives are achieved. Teachers must be wise in determining an appropriate model that can create conducive classroom situations and conditions so that the learning process can take place in accordance with the expected goals [15].

The Mind Mapping Method is a learning method developed by Tony Buzan [16], head of the Brain Foundation. Mind maps are creative note-taking methods that make it easy for us to remember lots of information. After completion, the notes made form a pattern of ideas that are interconnected, with the main topic in the middle, while the subtopics and details become the branches. These branches can also expand again to smaller material. As the structure of human descendants that can continue to develop until the end of the day arrives, so that a human hereditary system is formed until the end. Mind maps mimic this thought process, allowing individuals to move around the topic. Individuals record information through symbols, images, emotional meanings, and colors. This mechanism is exactly the way the brain processes various information that enters. Because mind maps involve both sides of the brain, you can remember information more easily.

To make a mind map, the teacher should use a colored ballpoint and start from the middle of the paper. If possible, students use paper extensively to get more space. Then follow the steps: (1) Write the main idea in the middle of the paper and cover it with circles, squares or other shapes; (2) Add a branch that comes out of the center for each main point or idea. The number of branches will vary depending on the number of ideas and segments. Use a different color for each branch; (3) Write keywords or phrases in each branch that he developed for details. Keywords are words that convey the essence of an idea and trigger your memory. If you use the abbreviation so you can easily remember the meaning for weeks afterwards; (4) Add symbols and illustrations to get better memories. Mind Mapping plays an important role in meaningful learning, with Mind Mapping students trained in thinking, students are asked to think about concepts or events that they already know. Meaningful learning takes place more easily when new concepts are linked to concepts that are inclusive, inclusive concepts are the main concepts that are more general in nature. Mind Mapping must be arranged in a hierarchical manner, this means that the more inclusive concepts are at the top of the map, the more they are sorted down to the less inclusive concepts.
Schema formation in students can be done through the activity of making mind maps in the learning process. Mind mapping is how the brain works to process information. This information is conveyed in the form of communication. The ability of students to relate existing material to each other and increase the formation of schemes in the brain of students and remind them of what students have learned, activate the whole brain, group concepts, transfer information from short-term memory to long-term memory. For example, to study matrices starting with the elements in the matrix, then arrange a mind map like Figure 1.

![Mind Map Matrix topic](image)

Figure 1. Mind Map Matrix topic

Thus these concepts will create a meaningful learning atmosphere. If the structure of lesson content is arranged in a way that is directly related to the needs of students and presented in impressive learning conditions, meaningful learning will emerge. Mathematics teaches a concept is important. This is because of the ordered nature of mathematics so that a concept will be used continuously in other concepts. It is clear that in composing Mind Mapping there are a number of systematic steps, so that later obtained a form of Mind Mapping that is easily understood both by the teacher and by students.

Concept comprehension abilities is one of the important goals in learning mathematics. Concepts are the building blocks for higher thinking. By knowing the concepts and structures included in the material being discussed, students will understand the material that must be mastered, this shows that material that has a certain pattern or structure will be easier to understand and remember [17]. Understanding concepts is a key aspect of learning. One important learning goal is to help students understand the main concepts in a subject, not just remember the separate facts. In many cases, understanding of concepts will develop if the teacher can help students explore topics in depth and give them appropriate examples of concepts.

To see concept comprehension abilities in mathematics learning can be seen from indicators of concept understanding [18] namely: (1) restating a concept; (2) classifying objects according to certain characteristics according to the concept; (3) provide examples and non-examples of concepts; (4) presents concepts in various forms of mathematical representation; (5) developing the necessary and sufficient conditions of a concept; (6) using, utilizing and choosing certain procedures or operations; (7) applying concepts or logarithms in problem solving. The main purpose of this research is answering the following research questions. (1) Are the Concept comprehension abilities of students who learn with Mind Mapping Techniques was higher than students who learn with conventional learning?; (2) Are concept comprehension abilities of high, moderate, and low prior knowledge who learn with Mind Mapping techniques was higher than students who study with conventional learning?; (3) Are there interaction between model of learning and prior knowledge?

2. Materials and Methods
This research was conducted using a quasi-experimental method with a quantitative approach. There were two sample groups in this study, namely the experimental group conducted with the Mind Mapping model and the control group with conventional learning. The independent variable in this study was the learning model and the dependent variable was the concept comprehension abilities. The prior
knowledge of students was as a moderator variable. The population in this study were automotive students of grade X in Vocational Public Schools of Sijunjung regency. The sampling techniques was random sampling. The instrument in this study was an essay concept comprehension ability test. The test was validated and tested before conducted, so that a valid and reliable test was obtained. To answer the first and third research question was used two-way ANOVA, while for the second research questions was used Mann-witney test. All data in this study were analyzed by using SPSS 21.0 on a 5% level of significance.

3. Results and Discussion

The results of the research data in the form of maximum value (Xmax), minimum value (Xmin), mean, standard deviation (SD), and number of students (N) for each student's initial ability are presented table 1. The data in Table 1 shows that: (1) the average of concept comprehension abilities of students in experiment class was higher than control class, (2) the average of concept comprehension abilities of students with high prior knowledge in experiment class was higher than control class, (3) the average of concept comprehension abilities of students with moderate prior knowledge in experiment class was higher than control class, (4) the average of concept comprehension abilities of students with low prior knowledge in experiment class was higher than control class.

Furthermore, to determine if the difference is significant, the mean difference test is conducted. Since the data groups compared are not normal distributions, then the mean difference test used is the Mann-Witney test (U) which results as in Table 2.

| Class   | Prior Knowledge | N  | Xmax | Xmin | Mean | SD  |
|---------|----------------|----|------|------|------|-----|
| Experiment | High         | 6  | 95   | 89   | 90.7 | 4.5 |
|         | Moderate      | 14 | 90   | 67   | 81.7 | 16.1|
|         | Low           | 4  | 78   | 33   | 61.7 | 21.3|
|         | Total         | 24 | 95   | 33   | 80.6 | 17.4|
| Control | High          | 4  | 67   | 44   | 61.1 | 11.1|
|         | Moderate      | 13 | 78   | 22   | 43.6 | 16.0|
|         | Low           | 5  | 22   | 11   | 24.4 | 12.2|
|         | Total         | 22 | 78   | 11   | 42.4 | 18.3|

Table 2 show that the average of concept comprehension abilities of students in experiment class was higher significantly than control class, either for high, moderate, or low prior knowledge. Furthermore, in order to find out if there is any interaction between the learning model and the prior knowledge, the two-way ANOVA test is done, the result is stated in Table 3.
Table 3 shows that: (1) the average of concept comprehension abilities of students in the experiment class was higher significantly than the control class, (2) There is an average difference on concept comprehension abilities between the three students' prior knowledge, (3) There is no interaction between the learning model and the prior knowledge.

Why The Mind Mapping Method (MMM) can improve students concept comprehension ability? There are at least two reasons, first Learning mathematics based on MMM meet the characteristics of Ausubel's meaningful learning, i.e. (1) Explain the relationship or relevance of new materials to old materials; (2) First the most general ideas are given and then the more detailed things, called progress differentiation; (3) Show the similarities and differences between new materials and old materials; (4) Ensure that existing ideas are fully mastered before new ideas are presented. Ausubel strongly emphasizes that it is important for teachers to know the concepts that students have, so one way for teachers to know the extent to which the concepts students have and so that the concepts taught are always related and cannot be separated is to use concept mapping techniques [16, 19].

Second, MMM has many advantage when compared to conventional approach i.e. (1) provide a comprehensive view of the subject matter or broad area; (2) enables someone to plan a route or frame of mind for an essay; (3) gathering large amounts of data somewhere; (4) encourage problem solving by letting see creative breakthroughs; (5) Mind Map is fun to see, read, digest and remember; (5) stimulating the synergy of the left and right brain in a person; (6) help someone in running themselves without obstacles; (6) help someone in developing ideas; (7) helping someone make it easier to summarize the contents of a book so that it becomes an interesting note and easy to learn [16, 19].

4. Conclusion

Based on the results of research and discussion, several conclusions are obtained, namely: (1) The Concept comprehension abilities of students who learn with Mind Mapping Techniques was higher than students who learn with conventional learning; (2) Concept comprehension abilities of high, moderate, and low prior knowledge who learn with Mind Mapping techniques was higher than students who study with conventional learning; (3) there is no interaction between model of learning and prior knowledge.

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