Mathematical problem solving based on Kolb’s learning style

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Abstract. Problem solving is essential in mathematics teaching and learning. Mathematical problem solving as finding a way around difficulty and solution to a problem that is unknown. Learning style can be used by students in processing information and can help students in learning. Kolb’s learning style characteristic examined include converger, diverger, accommodator and assimilator. The purpose of this study is to describe about mathematical problem solving based on Kolb learning style. This study used descriptive qualitative method. The subject of the study consisted 4 students of National Senior High School Pekalongan which selected using purposive sampling. The research instruments were questionnaire and problem solving task. Data validity used method triangulation. Data analyses were done through data collection, data reduction, data presentation and conclusion. The results show that students with converger and accommodator learning style are better than diverger and assimilator learning style in mathematical problem solving.

1. Introduction

Mathematics is a science related to abstract objects hence most students have difficulties in understanding mathematical concepts. Mathematical problem solving is an important thing that should get teacher’s attention, especially to develop students ability in their problem solving. Problem-solving involves many cognitive processes that require students to understand information and find solutions to problems [1]. Mathematics curriculum aims to provide student environments in which students can make observation, discover, solve problems, share, and discuss their solutions with friends [2]. Mathematics teaching should be informed by teacher’s knowledge of student’s learning styles. Full knowledge of student’s learning styles could help mathematics teacher in planning instruction that suits all student [3]. Different teaching strategies can be used to help students develop their communication, problem solving and critical thinking skills, attitudes and abilities [4]. To get the optimal result in problem-solving, there are several problems solving steps that should be well-organized used [5]. Many well-known scholars in mathematics had referred to problem-solving as thought, actions, or participation in the particular situation normally unobserved, a strange one without previous observation or knowledge [6].

An individual has a different character in thinking, acting, and solving problems. As with the students, these differences in characteristics can affect the way in which information is acquired during learning. Learning style is the way in which individuals use to perceiving and processing
information [7]. When the learning styles of students in a class and the teaching style of their teacher are seriously mismatched, those students may become uncomfortable, bored, and inattentive in class [8] as a consequence, they may lose interest in the course, the curriculum and themselves, and in some cases may change to other courses or drop out of studies altogether [9].

The difference of learning style chosen by each individual reflects the fastest and the best way through which the individual understand information from the environment [10]. Kolb's learning style based on learning theory where knowledge is created through experience. Experiential learning is a creative tension between the four learning modes that is responsive to contextual demands [11]. In an ideal experiential learning cycle, one learns from concrete experience, then observes as well as think through the experience and profound experiences of the past through Reflective Observation. The result of reflective observation will produce a certain hypothesis or presumption, which is termed Abstract Conceptualization. These presuppositions will be tested and generate new experiences through Active Experimentation. New concrete experiences will be reprocessed through Reflection Observation, and so on so that this learning cycle will recur.

2. Methods
This research used the qualitative descriptive method. The research was conducted in National Senior High School which is one of the schools favorite in Pekalongan in academic year 2018/2019 (X Grade). The subjects consist of four students using purposive sampling. Purpose of selection of subjects with purposive sampling is the researchers can choose individuals as subjects of research and understand the phenomenon on their research focus [12].

The selected subjects consisted of 4 students with details of one students in each Kolb’s learning style which is converger, diverger, accomodator, and assimilator. The category of Kolb’s learning style was obtained based on questionnaire. The instruments of this research were tested worksheets and questionnaire. The data was obtained from the student's test answers. Data validity used method triangulation. Methods Triangulation emphasize the use of different data collection methods or techniques for the same or similar data [13]. The data analysis technique was reducing the data, presenting the data and conclusion. Reducing data is selecting, focusing and simplifying the data obtained. Presenting the data arranges the information in narration and the reducing result is used to get the conclusion.

3. Results and Discussion
Mathematical problem solving test carried out in grade X national senior high school in Pekalongan. The test to determine mathematics problem solving skill. The questionnaire based on Kolb’s learning style. Kolb has described four basic learning styles are converger, diverger, assimilator, and accomodator. Incorporated within each learning style is a combination of two of the four learning modes are concrete experiences (CE), reflective observation (RO), abstract conceptualization (AC), and active experimenttion (AE). In this research used polya’s problem solving, consists of several stages namely understanding the problem, devising a plan, carrying out the plan, and looking back. The results of mathematical problem solving based on Kolb’s learning style description of each subject is shown as follows.

Converger
The converger learning style describes individuals who learn by way of concrete experience and reflective observation [14]. Individuals with a converger learning style experience a situation and then later look at the situation through many perspectives, learning from each [15]. Students with convergent learning styles use theory in making decisions, solving problems by developing individual strategies and approaches. Some indicators of a convergent learning style: viewing information through abstract and actively processed conceptualization, prefer to experiment with new things and be skilled with the practical application of the flutters have the ability to solve problems and make decisions based on a search solution for questions or problems.
The test result on Figure 1 with converger learning style, showed that student carried out planning, monitoring, and evaluation process appropriately on understanding the problem step. Students had understood what was known and asked, students know what to do first to solve the problem. In devising a plan, students thinking the steps through imagination and thinking of formulas that could be used to solve the problem. In carrying out the plan, students make plans systematically, sequentially, and conceptually. It was shown that students can simplify the problems and search for problem solving in a sequence and correct manner. In looking back step, student will check the problems and work that has been done so they can implement the strategy they have choosen to solve the problem correctly [16].

**Diverger**
The diverger learning style obtains information through concrete experiences and often relies on feelings. Students have the ability to imagine and be creative in connecting information with other information. Some indicators of divergent learning styles: tend to gather information and use imagination to solve problems, view information through concrete experience, more comfortable in group work [17].

As shown in Figure 2 with diverger learning style, students had understood what was known and asked, students know what to do first to solve the problem. In devising a plan students got the idea to solve the problem, students strategized how the next steps should be taken to solve the problem. Although students get the problem in carrying out the plan, student had not carried out the planning process completely. It was shown that student did not write the next step to determine value of $x$. In looking back step, student did not re-check their answers.

**Accomodator**
The accomodator learning style tend to be more intuitive than logic, tend to act on persuasion or instinct rather than logical thinking, and gain information based on the real experience they
experience. Some student indicators of the accommodator learning style: can relate learning to the real world, like planning and be engaging directly in new experiences [18].

Based on Figure 3, the results of S3 answers indicated that students had understood what was known, asked, and from what is known, students know what to do first to solve the problem. In devising a plan, students were able to simplify the problem, because it has been taught by the tacher. In carrying out the plan, student had not solved the problem. Because the student had difficulty in the final stage. In looking back step, student can look back at the completion steps that have been done, but he is not sure of the answers obtained because he has not found the final soution.

**Assimilator**
The assimilator learning style focuses on concrete concepts and ideas, in presenting their information in sequence, structured, and detailed [19]. Students analyze something abstract, solve problems logically, step by step by starting from assumptions and concluding at the end of the completion stage. Some indicators of the learning style of assimilator: solving problems using trial and error rather than doing a careful examination of the facts, understanding the various information gathered from multiple sources, summarized in brief and clear explanations, and tending to learn abstract concepts rather than practical application.

The result on Figure 4 with assimilator learning style, students had understood what was known and asked, students know what to do first to solve the problem. In devising a plan student had not carried out planning process correctly. In carrying out the plan, student solved the problem based on the previous plan. In looking back step, student will check the problems and work that had been done. Unfortunately student’s answers were incorrect because solving the problem is not right from the first step.
Most of the students are unable to identify the problem and define the goal which influence the interpretation result [20]. The students were having difficulties in calculation. So, students made errors in their solving-procedure as well as got the wrong answer. The students mostly used strategies that taught by the teacher but they were not able to use several other strategies. Besides, when we looked at the student's answer, it was seen that students prefer use same problem solving strategies. Students could either not solve the problem or the same strategy was used by the ones who could solve the problem [21]. Using various strategies for solving the problem can contribute to the development of the mental structures of the students.

4. Conclusion
Based on the research, it can be concluded that students can solve the problem well. The results showed that students with converger and accommodator learning style better than diverger and assimilator learning style in mathematical problem solving. In theory, students who prefer the converger learning style have dominant learning abilities of abstract conceptualisation and active experimentation. They tend to focus on practical application of concepts and ideas, and quickly to make a decision or obtain one correct answer.

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