The multiple intelligence optimize activity using discovery learning models that improve learning outcome in trigonometry course

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Abstract. The aim of this research was to describe the Multiple Intelligence optimize activity using discovery learning models that improve learning outcome in trigonometry class. The type of this research was classroom action research, with the steps were planning, implementing, observing and reflecting. The subject of this research was students of Mathematics Education who took trigonometry class in the first semester of the academic year 2017/2018. The instrument used was a test of Multiple Intelligence, observation sheet and learning outcome test. The results of the analysis of activity observation sheet with discovery learning and Multiple Intelligence tests obtained: 1) Linguistic intelligence was optimized with the discussions and respond to the problem, 2) Mathematical-logical and intrapersonal intelligence optimized through the activities of verification, 3) musical intelligence was optimized through listening to music in the application of the concepts activity, 4) Space-visually intelligence optimized through working on the problems in the application concept activity, 5) interpersonal intelligence was optimized through data collection activity occurred cooperation in solving the problems 6) Space-spatial intelligence could optimized directly by expressing the concept after making the observation and manipulation of props. The average of learning outcome increased in every cycles, the average of learning outcome in the 1st cycle was 69,92. The average of learning outcome in the 2st cycle increased to 78,45. The average of learning outcome in the 2st cycle increased to 85,48.

1. Introduction

Every individual has the ability and different way to obtain the knowledge. There were students who understand the course easier with a learning experience that is often encountered in real life and they had their own experience so the knowledge acquired in more depth. There were also students who would be easier to understand the course if they made gestures to get the concept, either through props or other learning media. Therefore, lecture should facilitate the intelligence of each individual with a variety of learning implements. Lecture could used different strategies while teaching mathematics. Reviews These strategies are classified as analytics, interactive and introspective [1].

Multiple Intelligence strategy aimed at facilitating the students with a wide range of unique mindset in the implementation of learning, and activities to understand the course so it could be carried out
based on intelligence dominant for each individual through a variety of activities. Gardner has written process students different kind of minds and therefore learn, remember, perform and understands in different ways [2]. So lectures needed to recognize the dominant intelligence possessed learners. Since all children do not learn in the same way, they cannot be assessed in the same way. Knowing how each student learn will allow the lecture to properly assess the child’s progress [3]. Nine types of multiple intelligences can be found in every human being. Some of the multiple intelligences can be highly dominating whereas some of the multiple intelligences can be in low range [4].

Table 1. Nine types of multiple intelligent.

| Analytical               | Interactive                  | Introspective            |
|--------------------------|------------------------------|--------------------------|
| Logical-Mathematical Intelligence | Verbal-linguistic Intelligence | Existential Intelligence |
| Musical-Rhythmic Intelligence | Interpersonal Intelligence   | Intrapersonal Intelligence |
| Naturalistic Intelligence | Body-Kinesthetics Intelligence | Visual-Spatial Intelligence |

In this research, based on intelligences multiple test results was obtained six types of dominant intelligence that possession by student in the trigonometry class academic year 2017/2018. The dominant multiple intelligences included: logical-mathematical intelligence, verbal-linguistic intelligence, interpersonal intelligence, intrapersonal intelligence, visual-spatial intelligence.

Multiple intelligence strategy should be applied in classes in order to boost up the students' learning skills [5], so lectures must considered how to optimize the intelligence in learning that would have an impact on increasing activity and learning outcomes. Multiple Intelligence provide opportunities for the student to learn according to Reviews their needs, interests, and talents. And student get a positive learning experience and improve the ability to find solutions in troubleshooting issues [6]. Lecturers needed to package their teaching style to be easily captured and understood by students. Activities carried sought to stimulate the reasoning brain, improved intelligence by giving students questions, and using out class reality or real surroundings area to improve the understanding and understanding the concept.

Understanding the concept and planning support involved multiple intelligences owned by the students would assisted in determining the settlement of the problem. According to Anwar [7] that creative thinking is a way of generating ideas that can in some way be applied to the world. This often involves problem solving particular aspects of Intelligence utilizing, for example linguistic, mathematical and interpersonal. Multiple Intelligence for the strategy to be implemented optimally required methods that could help the formation of student activity and maximizing reasoning in understanding the material. The method applied was discovery learning method. Steps that contained in discovery learning was maximized to optimize the dominant intelligence possessed by students. Which is a learning that encourages students to carry out discovery activities to construct Reviews their own knowledge with lecture guidance [8]. The step of this learning is include 1) stimulating, 2) identifying, 3) collecting, 4) Processing, 5) verifying, and 6) drawing conclusion [9].

In the implementation of learning activities undertaken to optimize the form of intelligence possessed by each individual that was in stimulation phase, lecturers presented a problem and asked students to observe was a form to optimize space visual-spatial intelligence. Stating the problem phase, students wrote a hypothesis after observing a given problem. This activity facilitated and optimized the verbal-linguistic intelligence. Collecting data phase, students obtained the data through the use of props or perform activities outside the classroom. These activities facilitated and optimized the body-kinesthetics intelligence. In the data collection activities, the students had to work closely with members of the group and communicate in order to correct the obtaining data. Exchanging thoughts and heard each other mutually. This activity facilitated and optimized interpersonal intelligence. Verification phase was guided to be able to analyse the obtaining data in the form of a special case to be stated in the form of symbols, definitions or concepts in general. In this activity facilitated and optimized the logical-mathematical intelligence. In this phase the ability to be able to make decisions based on the data has been facilitating and optimizing the intrapersonal intelligence of
student. Students presented the results of group discussing in front of class and other students respond to the results of the discussion. In this activity has facilitated and optimized the verbal-linguistic intelligence of student.

Applying the concept by working on the problems - problems in the form of arithmetic, logical thinking which was accompanied by music. This activity facilitated and optimized the logical-mathematical intelligence and musical-rhythmic intelligence of the student. Students asked to present the results of group discussions and workmanship problems. This activity facilitated and optimized the linguistic intelligence of the student. Formulating conclusions step, lecturer asked student to draw general conclusions on the activities that have been carried out. This activity facilitated and optimized the intrapersonal intelligence of the student. Through activities that cover all steps in discovery learning, could optimized multiple intelligences that owned by students. Multiple intelligences base instructional activities can make learning easier and more interesting [1].

2. Methods
This research was Classroom Action Research in several cycles. The subjects of this research were students who took trigonometry class in Mathematics Education Study Program Faculty of Teacher Training and Education University of Bengkulu at odd semester of academic year 2016/2017. The implementation of each cycle consists of steps: planning, implementing, observing and reflecting. The steps could be seen in the following table:

| Steps of classroom action research | Action |
|-----------------------------------|--------|
| Planning                          | Planning the activities to be carried out with the discovery learning model and matched with the dominant multiple intelligence based on multiple intelligence test results. Making the test results, observation sheets and lesson plans in each cycle. |
| Implementing                      | Carrying out the multiple intelligence tests |
| Observing                         | Carrying out the discovery learning models |
| Reflecting                        | Carrying out the observation of student activities |
|                                   | Carrying out the observation during the learning process using discovery learning models. |
|                                   | Analysing the data obtained during the class of acting and observing |
|                                   | Determining steps needed to be taken for improvement. |

Observing consisted of 12 aspects including the components by using discovery learning model and would be held cycle test at the end of each cycle to determine the success of learning. Learning outcomes and observation data were analysed to determine success in each cycle. The research would be continue until passing the learning indicators. The learning indicators in this research were:

- Discovered how to optimize multiple intelligence on the application of discovery learning models in trigonometry class through observation sheets of student activities.
- Application the multiple intelligence strategy by using the discovery model in trigonometry class in Mathematics Education Study Program Faculty of Teacher Training and Education University of Bengkulu improved student learning activities, if the total score of observation sheets is > 24 or in the Active category.
- Application the multiple intelligence strategy by using the discovery model in trigonometry class in Mathematics Education Study Program Faculty of Teacher Training and Education University of Bengkulu improved student learning outcomes, if the average test score at the end of the cycle is ≥ 65.
3. Results and discussion
The action started from the initial problem obtained that students did not seem to do much activity and construct their own knowledge, students received information from lecturer and lecturer did not assist students in developing their intelligence. Because of the problems, designed student activities in understanding the material by involving students in discovering concept through student worksheets, whose activities were based on the dominant multiple intelligence owned by students. Learning was carried out in groups; each group has variation of dominant multiple intelligence. Student worksheets were designed using discovery learning models. As a supplement to the book, providing additional information for a particular class, can help student worksheets will be able to attract students when combined with specific teaching methods [10]. Each meeting in each cycle was done saving activities and learning outcomes tests. Observation and learning test results in each cycle could be seen from the following table 3:

| Cycle | Activity Criteria | The Average of Learning Outcomes | Classical completeness |
|-------|------------------|----------------------------------|------------------------|
| 1     | Quite Active     | 69.92                            | 61.76%                 |
| 2     | Quite Active     | 78.45                            | 70.59%                 |
| 3     | Active           | 85.48                            | 91.18%                 |

In the 1st cycle, there were still many problems that were found to be less active group discussion, this was caused by students who not yet accustomed to expressing ideas or ideas especially when observing and determining hypotheses. Group discussion activities still dominated only by particular students in the group. Students who were able to find answers directly write down the answers without asking their opinions to be discussed. To solve the problems in the 1st cycle, as expressed by Soancalt many teachers and students assume that the process of teaching mathematical problem solving as a very complicated activity to do [11]. Activities undertaken to optimize multiple student intelligence were in stimulation activities at the first step of discovery learning.

To get the concept of trigonometry comparisons in Quadrant I, Quadrant II, Quadrant III and Quadrant IV, students observed Figure 1 and asked students to submit problems related to these images. This activity optimizing student intelligence that was space intelligence - Visual. To be able to find concepts, students asked to observe images and read reference from books to be able to submit hypotheses from observations, this was the step of stating a problem and optimizing student intelligence, that was linguistic intelligence. We can do debates, storytelling, reading, listening etc. Activities in mathematics classroom [12]. In order for students to be able to determine hypotheses and express ideas or ideas from observations, the lecturer guided by giving questions that trigger students to be able to discuss in groups.

Data collection step, accuracy was needed. In this step, students completed the worksheet and must cooperated with group members and communicated so that could obtained accurate data. Exchanged ideas and listened to each other. This indicates that the student is confident with the written answers,
In detailing the ability of students to write in accordance with the steps that must be done and able to develop answers through various explanation [13]. Data collection guided to get the concept of trigonometry comparison has been arranged in the questions contained in the worksheet. In this activity facilitated and optimized student’s interpersonal intelligence. The number of activities contained in learning could improve students' intelligence and understanding of learning material. The proof stage was carried out by connecting all the data that has been collected and the used of basic concepts, that was the definition of trigonometry comparisons previously held by students to prove the hypothesis that has been made. In a scientific approach, using guided discovery, teachers help students to construct their knowledge by engaging activities in the process of knowledge construction, thus developing the thinking ability of students [14]. This activity facilitated and optimized student’s logical-mathematical intelligence and intrapersonal intelligence.

Students presented the results of group discussion in front of the class. And other students responded to the results of the discussion. This activity has facilitated and optimized student’s Verbal-linguistic Intelligence. Applying concepts by working on questions in the form of arithmetic and application of concepts that have been found by previous students. The questions made in the form of application of concepts, while working on problems accompanied by music, "rhythm" activity can be used while teaching mathematics in the classroom under this intelligence [12]. This activity facilitated and optimized student’s logical-mathematical intelligence. Conclusion formulation step. Lecturer asked students to draw general conclusions on the activities that have been carried out. This activity facilitated and optimized student’s intrapersonal intelligence.

In the 1st cycle, the dominant intelligence that got the highest score was students who had dominant in intrapersonal intelligence and logical-mathematical Intelligence. This was influenced by the questioning and collaboration activities carried out by students who had intrapersonal intelligence in completing group assignments. While for students who had logical-mathematical intelligence were caused by the ability to understand concepts through constructivism activities and data analysts to find concepts.

In the 2nd cycle implementation of learning and observing results found that students who had dominant intrapersonal and interpersonal intelligence were accustomed to work together between group members, exchanging opinions and responding to ideas that were being demonstrated. When analysing data to get a concept, it was found that students who had visual-spatial intelligence had not been active in group discussions. Asked the group members who understand to explain and asked students who did not understand to ask so that there was discussion in the group. Dominant intelligence who got the highest score was a student with a dominant musical-rhythmic intelligence. This was influenced by the level of concentration and accuracy when working on problems that accompanied by music.

In the 3rd cycle, the results of observations and observation sheets found students had been active in asking and responding to other groups' questions at the time of presentation. During the group discussion it was seen that students with dominant interpersonal intelligence and verbal-linguistic intelligence were able to guide group members through question and answer and exchange opinions. Students have also been able to reflect and associate the data found to make one conclusion. Dominant intelligence that got high scores were students with musical-rhythmic intelligence and intrapersonal dominant intelligence.

Activities undertaken to optimize multiple intelligence that was students who had the dominant intelligence of visual space could be optimized for the ability at the stimulation step, students facilitated by observing images and expressing opinions and ideas through observing activities. Reflection writing is an inner understanding [1]. Another form was to use props to find concepts. Students who had linguistic intelligence facilitated by conducting group discussions, students asked to express their opinions. In the data collection step, students who had interpersonal intelligence facilitated by group work activities. At this time students asked to help each other and work together and did questions and answers.
The activity at the verification step was to optimize students who had mathematical-logical and intrapersonal intelligence. Because at this step students asked to use the data obtained to find concepts. The conclusion step, this activity facilitated students with intrapersonal intelligence. Students were given a number of questions to think and recall the concepts they have found. This activity also facilitated students who had linguistic abilities to express and explain the findings of their respective groups. After the concept found, students also asked to work on the application of concepts. This activity facilitated students who had logical-mathematical intelligence. The questions were done by listening to music, this activity facilitated students who had musical intelligence. Students could more concentrated when working on questions and improved accuracy in the application of concepts.

The results of observations and learning outcomes tests in the 3rd cycle indicated that the used of discovery learning could motivated students to be actively involved in learning activities, as also found by Wulandari The use of guided discovery learning in mathemetic learning receiver good responses from student [15]. The use of worksheets really helped lecturer in designing activities, so that the dominant multiple intelligence possessed by students can be optimized, the use of student worksheets-based multiple intelligences could optimized the creative thinking ability of students.

4. Conclusion

Optimizing student multiple intelligence activities by using discovery learning models to improve student learning outcomes can be done by designing worksheets considering the dominant multiple intelligences owned by students, using props to collect data, giving direction so students can help each other in groups, and giving questions in the application while listening to music while working on the problem.

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