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Research Article

Spatial Intelligence on Solving Three Dimensional Geometry Object Through Project Based Learning

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Abstract: One of the factors that cause students' low academic achievements is their spatial intelligence. Spatial intelligence is very important in the learning of geometry. Three-dimensional geometry object in the geometry lesson, according to the students' absorption capacity in the national examination is still in the low category. The purpose of this study is to describe the process and result of students' spatial intelligence through the learning model of Project Based Learning. The project based model uses the initial problem in the planning of complex activities by allowing students the freedom to plan well-learning activities.This research uses descriptive analysis method. Data collection methods used to test. The subject of this research are twenty-six students of VIII B.The data analyzed in this research is the test result sheet. The characteristics of the spatial visual intelligence are (1) imagination, (2) conceptualizing, and (3) problem-solving. The results of this research showed that there are 9 students of VIII B grade are capable to fulfill the three characteristics of spatial intelligence. There are 11 students have 2 characteristics spatial intelligence, 4 students have 1 characteristics spatial intelligence, and 2 students who are not capable to fulfill the characteristics of spatial intelligent.

Keywords: Characteristics spatial intelligence, Project Based Learning

I. INTRODUCTION

One of the factors that cause students' low academic achievements is their spatial intelligence. Civility itself according to Valez, Deborah, and Marilyn (2006) is a skill that includes, remembers, and transforms visual information in a spatial context. Intelligence is very important in geometry lessons (Santrock, 2010: 199). We expect teachers to be able to give more attention so that students can solve problems in three dimensions. In these three-dimensional matter can only be visualized or in the form of dimension two. According to the absorptive capacity of UN Year 2015, geometry subjects are at a low presentation. Students are still many who find it difficult in working on the problem of waking up space. Therefore, much-needed imagination and high thinking power to the spatial.

In addition to the above factors, there are other factors that cause low understanding of students and low learning achievement in addition to the spatial sphere that is applied learning model. The quality of education can be improved and the implementation of learning is more fun, it needs to be improved by applying the learning model by the teacher so that the students do not just listen to what is explained by the teacher, the students are able to learn actively in the discussion and give the bait or batik while the teacher is in question. By applying the right learning model, it is expected that the students' needs can be well facilitated, so that teachers can use to help students understand the material, improve their activity and build critical mindset.

One of the models of learning that is expected to be a means for the implementation of good learning is Project Based Leaming. In the Regulation of the Minister of Education and Culture No. 103 of 2014 (Appendix), the Learning-Based Learning Implementation Guideline is one of the learning models in the Curriculum 2013. This learning model gives students the freedom to learn to learn well, Kolabortif, able to produce work products that can be presented, and series continuously the quality of the resulting product.

Global SchoolNet (2000: iv-v) in his research on the features of Project Based Learning which is a model of learning-based learning model that provides freedom for students to learn to learn, implement collaborative projects, which in the end in this learning model can work product results Which are presented to others. Teachers act as facilitators, advisors, mentors, and supplements for students to get optimal project outcomes according to the students' creativity, imagination, and innovation. In developed countries like the United States, Project Based Learning is a widely used learning model.

Constructing a flat side space is one of geometric material, where geometry is one of the most important material in mathematics. According to Usiskin (in Safrina et al) there are three reasons for the geometry to be taught because geometry is the only field of mathematics that can relate mathematics to real-world physics, the only geometry that can enable mathematical ideas to be visualized, and geometry gives no example Single about the mathematical system Indeed geometry has an important role because it is not only for the learning process only, but also important to support some other material in mathematics.

The low understanding and achievement of student learning, mostly one of the things. Based on the data of UN exhibition in the academic year 2014-2015 the word absorption of junior high school students in Jember Regency on the matter of building flat side space is still in the low category of other materials, such as material issue, algebraic material and statistical materials and opportunities. This may indicate a problem. On those things.

Based on the above background, and to overcome these problems it is necessary to have an appropriate learning effort and fun so as to overcome the problem in the development of students' spatial powers. By applying an interesting learning model and fun then the students will be easier in understanding the lesson and develop it. The purpose of this study is to analyze and describe the spatial intelligence students in solving problems waking flat side space through Project Based Learning learning model.

II RESEARCH METHOD

The research used by researchers is quantitative-qualitative research. Researchers use the merger of these two methods because of the form of managed data in the form of scores and descriptions. In this research use two form of the variable independent variable (free) and a dependent variable (bound). The independent variable in this study is the use of project-based learning model on the subject of blocks and cubes. The dependent variable in this research is the result of the students' learning test which there is an indicator of spatial intelligence after using the project based learning model on the subject of building the flat side room of the block and cube.

The first step in this research is to determine the schedule of the research, to determine the subject of the research, and to prepare the instrument used in the research consisting of the Student Work Sheet and the Learning Results Test previously validated by 3 people Validator, namely 3 lecturers of Mathematics Education, University of Jember. The validation process is performed to determine the validity of the validity of the instrument to be used in the study. If the instrument has been declared valid then the instrument can be used in research. Conversely, if the validation results show the score is less valid, then the researchers revise the instrument in accordance with the already suggested by the validator.

In this study data collection is done by the test method. There are two tests that are used namely Student Work Sheet and Test Results Learning. Student Work Sheet is a learner's guide that is used in investigation and problem-solving in the form of experiments or demonstrations. The basis for making the learner worksheet is referring to the learning indicators to be achieved as well as the learning activities of the project based learning model. This learner's Worksheet contains a description of the steps that must be taken to solve a material problem beam and cube. The contents in Student Work Sheet play a role to encourage students to understand and remember the material, develop student thinking, and can direct students in the problem-solving process. Through project-based learning steps, students are expected to develop their spatial intelligence. First, the students are given problems, with the help of worksheets given to the students. Students are required to understand the problem. By going through several experiments using a simple tool, students will try to find alternative solutions from the case. Students will also seek to find the necessary information both from books and from their environment. Test Results Learning developed contains essays. Test Results Learning is meant to develop students' spatial intelligence after following the learning and the questions given are everyday problems. Test Results Learning also comes with answer keys and scoring guidelines. The test results are analyzed by recording the score of each student, determining the students' learning completeness based on Minimum Criteria of Completeness MTs Negeri 8 Jember, calculating the number of students who have completed. Determining classical completeness with criteria if more than or equal to 75% of the total number of students has been completed, then categorized has been completed in a classical manner. If less than 75% of the total number of students has been completed, then it is categorically incomplete. Test Results Learning consists of 4 essays on the material Build Room Side Flat Beam and Cube with an allocation of work time 60 minutes.

After analyzing the data, then made conclusions. In this research required the existence of triangular. Meleong states that triangulation is done to ensure the validity of data that utilizes something else to check or as a comparison of data. Triangulation in this research is using triangulation method.

III THE RESULTS

Based on the data processing of the Student Worksheet, it was found that spatial abilities for VIII grade students of MTs Negeri 8 Jember at each level are shown in Figure 1.

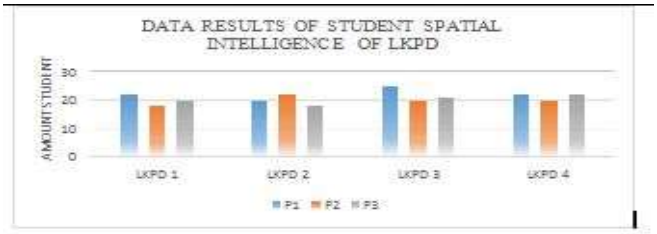

Figure 1.

Information :

P1 = Imagination The ability of students in presenting information and images relevant to problems.

P2 = Conceptual Student's ability to define the concept of the problem and relate it to prior knowledge.

P3 = Problem Solving Student's ability in determining how they will be used to accomplish problems. The ability of students in solving existing problems in a way that has been determined.

The figure 1. above shows the increase and decrease of spatial intelligence starting from Student Work Sheet 1 to Student Work Sheet 4. The highest spatial intelligence of students occurs in the imagination phase. At this stage, students are more applying their imagination to the problem of the surface

area of the cube. Student Work Sheet 2 in the imagination phase decreased, the Student Work Sheet explained about the volume of the beam is the students are still difficult in the imaginativelyunit cube that has been described. At the highest conceptual stage, there is in Student Work Sheet 2 about the volume of the beam, the student is able to determine the concept to be used and able to explain the concept that has been selected. While the decline occurred in Student Work Sheet 1, where students are still difficult in determining the concept of surface area of the beam problem. They are still confused in determining the formula to be used if one of the ribs is removed. At the highest problem-solving stage is found in Student Work Sheet 4, where the student is able to determine and explain how to solve the problem of cube volume. It is proven that the students have been able to solve the problem of how to calculate the volume of cubes if only known pile of blocks from the images provided. Decrease occurs in Student Work Sheet 2, at this stage the student's difficulty in determining how to count the number of blocks in the pattern of the pile of blocks that are not previously known.

Mathematical learning of the scientific approach of Project Based Learning model has advantages and disadvantages. The advantages of this learning are to make learners become more active, and involve learners to learn to retrieve information and show the knowledge they have, then implemented with the real world. The five scientific components and Project Based Learning are scattered into all existing learning tools, more complete learning tools to facilitate students in understanding the building materials of flat side rooms. The experiments that the students are working on in Student Work Sheet are equipped with instructions and examples of guided action steps. Most students also consider that the Student Work Sheet they use is easy to understand, interesting to read. In learning, students are taught to cooperate and share knowledge. This is seen during group work, students who already feel able to teach members of the group who are still less able. At Student Work Sheet it is also proven that students have achieved satisfactory results. As for learning weaknesses that require a lot of time to complete, learners who have weaknesses in experiments and information gathering will experience difficulties, especially when group activities in completing Student Work Sheet and presentation of discussion results. Thus, there are some learning steps that are eliminated but the five scientific components remain visible in learning.

The number of students who complete the learning basil in the classical means students is able to understand the concept of building the flat side space that has been studied. In addition, the number of students who completed can also be associated with the ability of teachers in managing to learn in the classroom and using learning tools properly. Management of good learning can be known from the classroom atmosphere, the enthusiasm attitude of teachers and students, the way teachers explain and guide students who need help in learning. Similarly, on the contrary, the unfinished student's learning achievement tends to be caused by personal factors, for example the students forget the formula of the surface area of the beam to be used, the students are unable to understand the intention of the given problem, and the students are wrong in absorbing the information provided by the teacher can also influence the test result . The following is an analysis of some student work results.

1. Results of student answers to question number 1

Problem number 1 is the surface area of the beam in everyday life. One of the student work results for number 1 is shown in Figure 2.

Figure 2

In the imaginative indicator, students write down the information that is known and the information in question. In the conceptual indicator, students use the concept of beam surface area. In the problem-solving indicator, students solve the problem according to the concept of coherence.

2. Result of student answers to question number 2

Problem number 2 is about the entire volume of blocks in everyday life. One of the student work results for number 2 is shown in Figure 3.

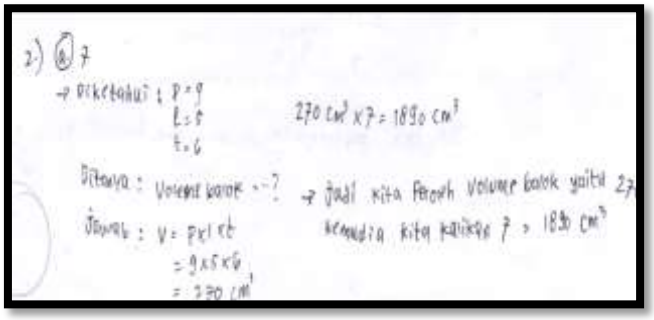

Figure 3

In the imaginative indicator, students write down the information that is known but the students are still lacking in writing the information in question. In the conceptual indicator, the student uses the concept of block volume and the result is multiplied by the number of blocks. In the problem-sloving indicator, students solve the problem according to the concept of coherence.

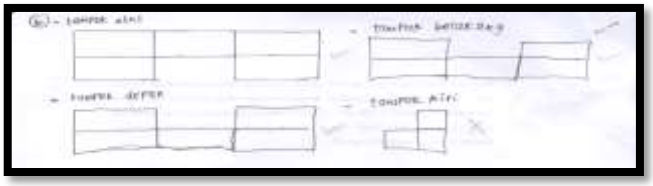

Figure 4

From Figure 4 above we can see that students are still lacking in presenting relevant information and images according to their imagination. Students describe it properly looking up,

looking back, and looking front. But in the left-looking answer students are less precise in presenting images.

3. Results of student answers to question number 3 Problem number 3 isthe surface area of the cube in everyday life. One of the student work for number 3 is shown in Figure 5.

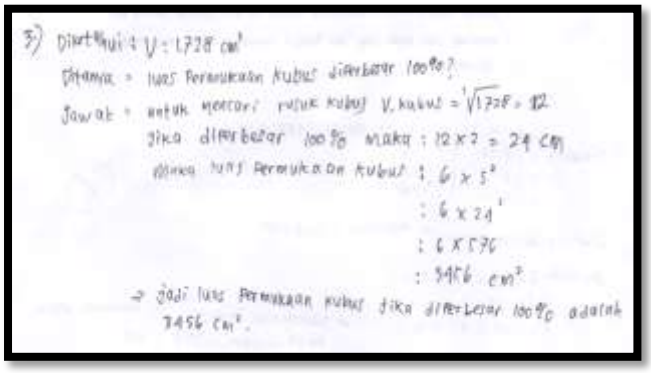

Figure 5

In the imaginative indicator, students write down the information that is known and the information in question. In the conceptual indicator, students use the concept of cube volume and surface area. In the problem-solving indicator, students solve the problem according to the concept of coherence.

4. Result of student answers to question number 4 Problem number 4 is about the volume of cubes in everyday life. One of the student work for number 4 is shown in Figure 6.

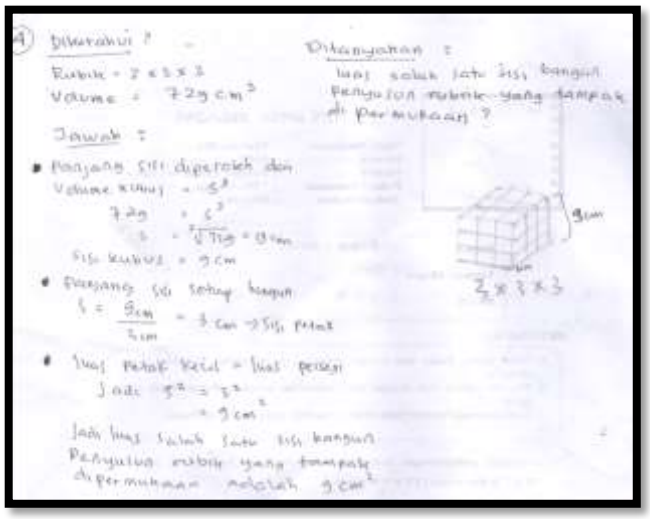

Figure 6

In the imaginative indicator, the student writes the information known, the information asked, and makes the relevant image in question number 4. In the conceptual indicator, the student uses the concept of cube volume and square area. In the problem-solving indicator, students solve the problem according to the concept of coherence.

The graph of students' spatial ability analysis seen from the Learning Results Test can be described as follows:

Results Data from Student Spatial Intelligence from Test Result Learning

Figure 7

Information :

P1 = Imagination The ability of students in presenting information and images relevant to problems.

P2 = Conceptual Student's ability to define the concept of the problem and relate it to prior knowledge.

P3 = Problem Solving Student's ability in determining how they will be used to accomplish problems. The ability of students in solving existing problems in a way that has been determined.

he graph above shows the increase and decrease of spatial intelligence from 1 to 4 questions. The highest spatial intelligence of students occurs in the imagination phase. For the number 2 problem is decreased, because many students still have not been able to imagine the picture if seen looks up, front, back and left. While low student spatial intelligence is in question number 4 on the problem-solving indicator. Student is still many who have not been able to determine the way to be used to solve the problem.

Below is the result of the diagram of the calculation of each problem, where in the test of learning outcomes there are 4 essay questions that each question there are indicators of spatial intelligence.

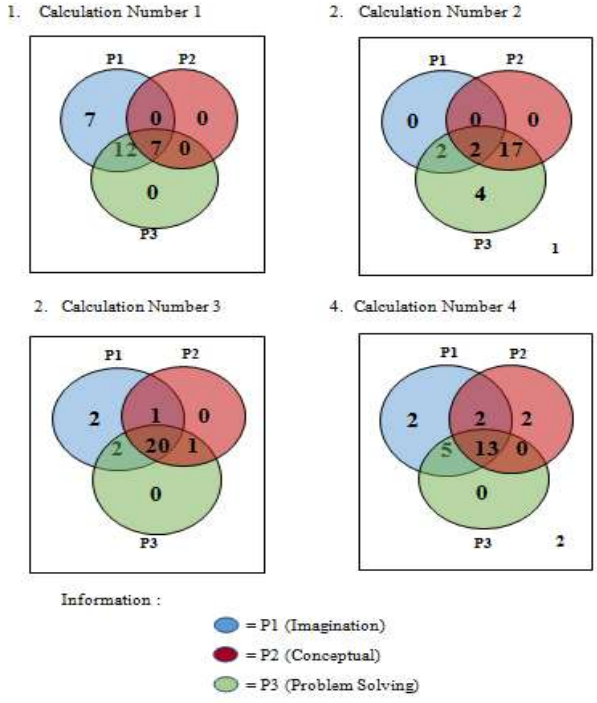

Figure 8

From the diagram above can be seen that for the calculation of the problem number 1, the most widely available in students who meet the 2 indicators of imagination and problem-solving

indicators. In the conceptual indicator, students have not fulfilled because there are comparative words in the problem that makes students confused, so still can't choose and use the concept in solving the problem. Problem number 2 is most prevalent in the conceptualizing and troubleshooting indicators. In the imaginative indicator, students are still much confused redrawing if viewed from various directions. For the calculation of the number 3, it appears that students who have met these three indicators. Students are able to imagine, conceptualize problems, and solve problems. Then in question number 4 also seen that students have met 3 indicators, 13 students are able to do the problem correctly. But there are 2 students who have not been able to fulfill these three indicators because in the process of imagining they are still confused with what is known and asked. So in choosing the concept and determine the way to be used also has not been able to fully.

Based on both graphs and diagrams above, it can be seen that in the learning model of Project Based Learning enables in developing spatial intelligence. Seen in every activity Project Based Learning there are indicators of spatial intelligence that has been fulfilled. Processes in the work of Student Work Sheet can assist students in undertaking the test results of learning. Where the results of the test students of class VIII MTs Negeri 8 Jember have met the criteria thoroughly. Thus the learning device meets the effective criteria. The results are in accordance with the theory put forward by Olkun (2003) that spatial ability can be enhanced through appropriate placement of a given material. Spatial ability can be developed that is by doing the right learning activities related to spatial. In a research, to be able to improve the spatial ability of students by way of learning through engineering drawing activities. Olkun provides small wooden beams to be made into a certain shape, then students are asked to draw from various sides perpendicularly, such as from the top, front, and side. In conclusion, Olkun states the reason why engineering drawing improves one's spatial abilities that are the basis of practice in real situations and involves real objects in drawing so as to enhance visualization. The difference of research result obtained by Nila Kurniyawati in 2013 entitled Improvement of Spatial Capability Through Learning Model Gerlach and Ely On Cube and Beam Discussion. Lessons learned thoroughly through the Gerlach and Ely learning models that there is an increase in spatial ability on the subject of cubes and beams. Improvements that occur in accordance with indicators that have been used by researchers that include mentioning the properties of wake-up space in accordance with the concept of learning, mentioning examples of real objects that resemble waking space in accordance with the concept of learning, visualize the image in question and then operate the numbers into the formula, drawing Or to draw up space in accordance with the concept of learning, and make props that resemble waking space in accordance with the concept of learning. It can be seen from the results of achievement of indicators that researchers expected to exceed even the expected researcher. While in this research, using Learning Model in developing the spatial ability where the indicator of spatial ability consists of the stage of imagination, conception, and problem-solving. The research was conducted by Marinda Ditya Putri Ari in 2013, The Effectiveness of Project Based Learning on Achievement of Problem-solving Ability of Class X Student of SMK. Based on these results it can be concluded that the Project Based Learning model is effective towards the achievement of problem-ssolving skills of class X students of SMK Negeri 9 Semarang on linear program materials. While in this study using Project Based Learning model on building flat side space to develop the spatial ability. Research conducted by Cahya Islami in 2015 is a study of the spatial abilities of students who are reviewed by sex. While in this research is reviewed from the ability of all students of class VIII-B MTs Negeri 8 Jember. Based on the description above, it is known that in school MTs Negeri 8 Jember, especially class VIII-B has been implementing the learning process well. For learning result tested devices, students who do not complete do not meet the indicators of spatial intelligence, but have not met the overall indicators of spatial intelligence consisting of imagination, conceptualization, and problem-solving. Thus it can be said that the test result of learning has been effective if used.

IV CONCLUSSION

Spatial intelligence in class VIII-B MTs Negeri 8 Jember fulfills the characteristics of imagination, conceptualization, and problem-soliving. The imagination indicator is fulfilled when the student can redraw the wake when viewed top, front, rear, right, and left view of the beam and cube arrangement on the problem. In addition, in this indicator students are able to write down what is known and asked based on the information presented on the question. In the conceptual indicator has been fulfilled when students are able to connect to the known data with the concept they have. Students are able to write down the concept related to the problem. Students are said to have met the problem-solving indicators when students are able to use the means to be used in solving the problem. Students are able to calculate well so that they can solve the problem correctly. All indicators are met for the students of class VIII B MTs Negeri 8 Jember. Of the total of 26 students who participated in the learning result test, there were 3 indicators of spatial intelligence in solving the problem of building a flat side room of 9 people. There are 11 people who meet 2 indicators of spatial intelligence, 4 people are only able to meet 1 indicator of spatial intelligence, and 2 people are not able to meet all indicators of spatial intelligence. Three suggestions given by researchers (a) to the next researcher, is expected to further strengthen the indicator of spatial intelligence in order to be able to analyze the characteristics of spatial intelligence owned by students. Time in doing the test should be added, so that students feel free in answering according to ability owned. The time spent asking questions is also useful to do the test questions. (B) to teachers are expected to provide more practice questions related to spatial intelligence, so that students feel no difficulty again in working on problems related to geometry. In addition, teachers are also expected to train students' representational skills in imagining a 3D build or visualizing images in the

minds of students. (C) for students to hope for more spell-related problems. Spatial intelligence will greatly assist students in understanding the geometric material they find difficult.

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