Journal of Education and Practice
ISSN 2222-1735 (Paper) ISSN 2222-288X (Online)
Vol.11, No.21, 2020


# Analysis of Student's Visual Thinking Difficulties in Learning Using PBL Models with Metacognitive Approach

Maulidya Silvana Sari Sitompul, Edy Surya, Bornok Sinaga
State University of Medan, Jl. Willem Iskandar Psr. V Medan, Indonesia

**Abstract**
This study aims to find out: 1) Improvement of students 'visual thinking skills after being taught by using a problem-based learning model with a metacognitive approach, 2) Indicators of students' visual thinking abilities are more dominant after using the problem-based learning model with a metacognitive approach, 3) To find out the difficulty of students who are able to think visually in solving problem. This research belongs to the type of descriptive qualitative research. The research subjects were 23 students. The instruments in the data collection process were interview guidelines and test sheets. This study uses data collection techniques including test methods, interview methods and documentation. The results of the research process found that student difficulties as follows: 1) Weaknesses in calculating, 2) Difficulties of students in transferring knowledge, 3) Understanding of mathematical language is lacking, and 4) difficulties in visual perception. Factors that cause students to experience difficulty in solving visual thinking questions are as follows: 1) Factors that cause students to experience difficulty in solving problems are difficulties experienced by students in arithmetic operations, 2) Factors that cause students to experience difficulties in transformation are the ways of student learning that is only memorizing formulas that result in quickly forgetting, and lack of practice working on problems.
**Keywords** : analysis, visual thinking skills, visual thinking, PBL models, metacognitive approaches.
**DOI:** 10.7176/JEP/11-21-02
**Publication date:**July 31st 2020

## 1. PRELIMINARY

Education is defined as a conscious and planned effort to create an atmosphere of learning and learning process so that students actively develop their potential to have spiritual spiritual strength, self-control, personality, intelligence, noble character, and the skills needed for professional educators especially school-teacher elementary, middle school and lecturers in tertiary institutions.

Mathematics is a subject that is taught starting from Elementary Schools (SD) to Higher Education (PT). It shows how important the role of mathematics in the world of education and technological development today. Learning mathematics in elementary school is the basis for the application of mathematical concepts at the next level. The importance of the role of mathematics is also seen in its effect on other subjects. According to Sword (2005: 2) three ways of thinking of a person related to how the brain processes based on the sense of hearing, vision, body senses (body) and feelings, namely auditory thinking, visual thinking, and khinesthetic thinking. This can be seen in the following picture:

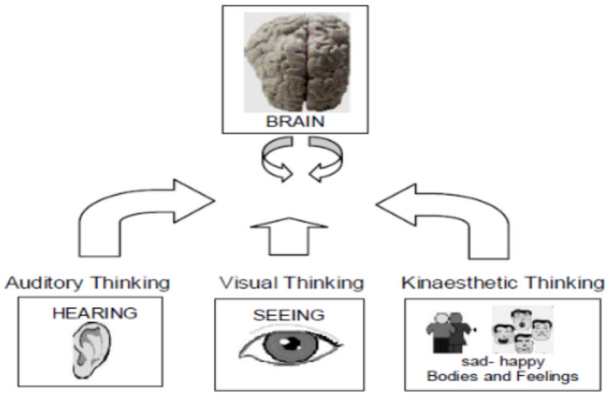



**Figure 1.1 Three Ways of Thinking**

One of the three ways of thinking to facilitate students in learning mathematics is visual thinking. Wileman describes visual thinking as the ability to convert information from all types into images, graphics, or other forms that help communicate information. Hershkowitz visual thinking is also defined as the ability to represent, transform, generalize, communicate, document and reflect objects or objects into visual information.

Mathematics teacher in learning in class can give noble values and character development by imagining in his mind (visual thinking) what values and characters can be included in mathematics material or teaching material (Surya: 2010). Learning should be based on problems in everyday society (contextual) that can be used in learning

to students.

Research on appropriate learning models or methods for students in developing students' thinking abilities has been done, and many researchers agree that problem based learning is an effective approach to train students to learn things through their own findings and also fun learning. Problem Based Learning (PBL) is one of the constructivism learning methods that prioritizes student centered learning. When using PBL the teacher's main task is to help students to solve problems. The teacher not only emphasizes the achievement of cognitive goals but must also pay attention to the dimensions of cognitive processes, especially metacognitive knowledge and metacognitive skills (Ikram: 2017). The process of learning mathematics mustcan involve students' thought processes and activities actively by developing behavior metacognitive.

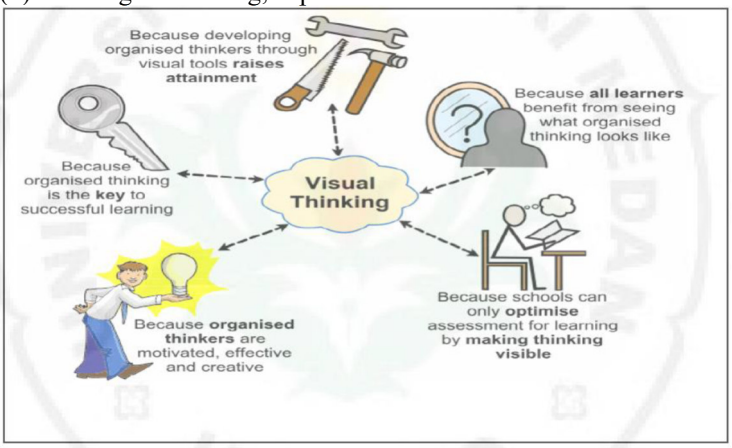
From the description that has been stated, it is seen the importance of improving students' visual thinking abilities because this is in accordance with the objectives of learning mathematics. With the ability to think visually, it is expected to have an impact on the mental development and personality of students and increase student mathematics learning outcomes. One learning approach that researchers believe can improve visual thinking skills is the metacognitive approach.

## 2. LITERATURE REVIEW

### 2.1 VISUAL THINKING

Thinking is the most important power and is a characteristic that distinguishes humans from animals. Thinking is an activity that can never be separated from human life, because as long as humans live humans will continue to think. The definition of thinking was raised by many experts. According Purwanto that thinking in a broad sense is associating with abstractions, while in the narrow sense of thinking is putting down or searching for relationships between abstractions such as responses, memories, understandings and feelings.

According to Surya (2014) Visualization is an action where an individual forms a strong relationship between internally building something that is accessible obtained through the senses. The steps of visual thinking according to Bolton (Nurdin, 2012: 29) in Ariawan, R (2017) are: (1) Looking, at this stage, students identify problems and their interrelationships, they are seeing and gathering activities; (2) Seeing, understanding problems and opportunities, by selecting and grouping activities; (3) Imagining, generalizing steps to find solutions, pattern recognition activities; (4) Showing and Telling, explains what is seen and obtained then communicates it.




(Surya: 2016)

**Figure 2. The Importance of Visual Thinking**

Yin (2009) identifies the important role of visual thinking, among others: To understand problems, simplify problems, look at problems to related connections, meet individual learning styles, as a substitute for calculations, as a tool to check answers, and to change problems into in mathematical forms. With visualization, students can actively represent the picture of thought in their minds so that they can solve the mathematical problems of school and mathematical problems in their daily lives. Student learning independence can grow in learning and mathematical problem solving processes.

### 2.2 PROBLEM BASED LEARNING MODEL

Problem-based learning (PBM) is also called Problem Based Learning. Problem-based learning is a learning model that uses problems as a starting point for learning. Problems that can be used as learning tools are problems that meet the context of the real world (real world), which is familiar with the daily lives of students. Problem-based learning is designed primarily to help students develop thinking skills and problem-solving skills, learn the role of adults by experiencing them through various real situations or situations that are simulated and become independent and autonomous learners. This can be illustrated as in Figure 2.2 below:

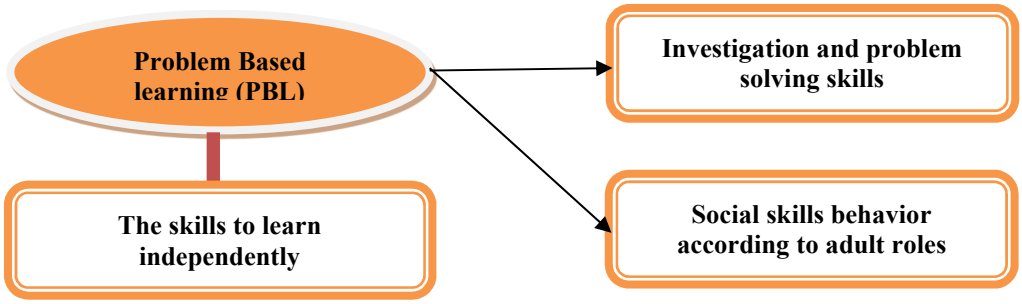



**Figure 3. Illustration of Problem Based Learning**

According to Ibrahim (in Trianto, 2010: 97), the role of teachers in the classroom using problem based learning strategies, among others, are as follows:

a. Asking problems or orienting students to authentic problems, which are real-life problems everyday.
b. Facilitating / guiding investigations such as making observations or conducting experiments
c. Facilitating student dialogue, and
d. Support student learning.

**Table 2.3. Syntax of Problem Based Learning**

| Step | Teacher's Behavior |
|---|---|
| Stage-1<br>Student orientation to problems | The teacher explains the learning objectives, explains the logistics needed, proposes phenomena or demonstrations or stories to bring up problems, motivates students to get involved in solving selected problems. |
| Stage-2<br>Organizing students for learning | The teacher helps students to define and organize learning tasks related to the problem. |
| Stage-3<br>Guide individual and group investigations | The teacher encourages students to gather appropriate information, carry out experiments to get explanations and problem solving. |
| Stage 4<br>Develop and present the work | The teacher helps students plan and prepare appropriate work such as reports, videos and models and helps them share assignments with their friends. |
| 5th stage<br>Analyze and evaluate the problem solving process | The teacher helps students to reflect or evaluate their investigation and the processes they use. |

(Trianto, 2010: 98)

## 2.3 METAOGNITIVE APPROACH

The metacognition approach is learning that instills in students how to control and manage cognitive activities contained in the process of planning (planning), monitoring (monitoring), and evaluating (evaluating) information or knowledge possessed by someone in solving problems. The metacognitive approach refers to the IMPROVE method developed by Mevarech and Kramarski (Kramarski and Mizrachi, 2014: 171-172) which emphasizes the importance of constructing mathematics through self questioning that focuses on:

a.Question understanding of the problem

This question encourages students to reflect on problems before they are solved. In an understanding question, students must sort out the problem, describe the problem in their own words and try to understand the meaning of the problem.

b. Connection question

This question encourages students to see similarities or differences between the problems they are working on now and the problems they have solved first.

c.Strategy question

This question encourages students to consider the right strategy to solve the problem given and give reasons.

d. Reflection question

This question encourages students to reflect on the way or strategy that has been proposed. It aims to make students careful in answering various problems.

Metacognition learning helps teachers develop their thinking abilities. In learning activities that use the metacognition approach can be done by asking metacognition questions to students, thereby activating students' thinking processes. In the metacognition approach students can find out what abilities they have and what they need in their learning activities.

## 3. RESEARCH METHODS

The study was conducted using qualitative descriptive research. Qualitative research aims to describe the mathematical difficulties of the research subject then described. This research focuses on changing perceptions, behaviors, actions, and motivations, which are described holistically. The results of the study are described in language and words in a specific context by utilizing several scientific methods (Moleong, 2016).

The study was conducted at Nur Ihsan Middle School Medan. The research subjects were 23 students of IX-4 SMP Nur Ihsan Medan in the 2019/2020 Academic Year. Eight subjects represent each of the two students with various levels of ability, namely high ability, medium ability, low ability and very low ability.

Research data were collected using tests, interviews and observations. Data analysis was obtained from the results of observational analysis, the test results were then collated with the analysis of the results of interview transcripts with research subjects.

## 4. RESEARCH RESULT

After carrying out learning for 4 (four) meetings continued tests on students to see students' visual thinking abilities. Corrected answer sheets based on scoring guidelines are judged based on valid, objective, fair, integrated, comprehensive and continuous, systematic, toxic criteria, accountable principles (Permendikbud No. 23 CHAPTER IV article 5 of 2016).

From the results of the tests that have been corrected, the results of the visual thinking abilities test are presented in the table below, which is the grouping of students' visual thinking abilities as follows:

**Table 1. Grouping Students' Visual Thinking Ability Levels**

| Student Ability Category | | Ability Level | Total students | Percentage (%) Overall |
|---|---|---|---|---|
| Number | Alphabet | | | |
| 3.85 - 4.00 | A | High | 2 | 8.7% |
| 3.51 - 3.84 | I- | | | |
| 3.18 - 3.50 | B + | Is | 10 | 43.5% |
| 2.85 - 3.17 | B | | | |
| 2.51 - 2.84 | B- | | | |
| 2.18 - 2.50 | C + | Low | 8 | 34.8% |
| 1.85 - 2.17 | C | | | |
| 1.51 - 1.84 | C- | | | |
| 1.18 - 1.50 | D + | Very low | 3 | 13.0% |
| 1.00 - 1.17 | D | | | |
| total | | | | 100% |

Based on 23 students 'visual thinking ability test results, the students' level of visual thinking ability was obtained into four levels, namely high, medium, low, and very low. The diagram of students' visual thinking ability level is presented in the picture as follows:

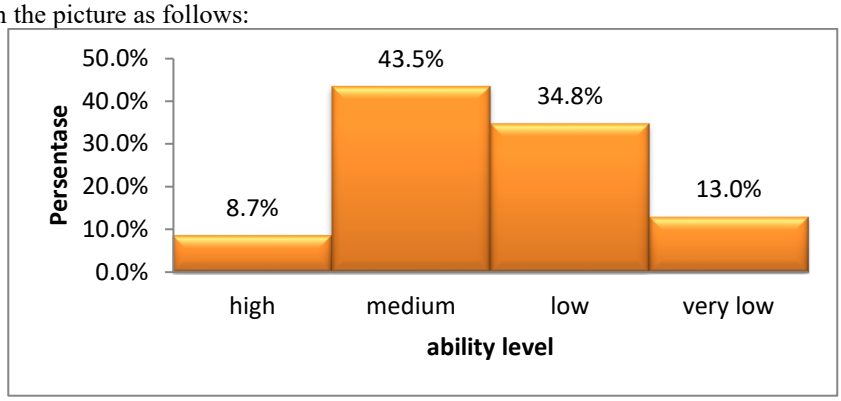



**Figure 4. Students' Visual Thinking Ability Levels**

Of the 23 students, it can be seen that the level of visual thinking ability of "moderate" students has the most number, 10 students with a percentage value of 43.5%. As for the level of visual thinking ability of students with high ability as many as 2 students with a percentage value of 8.7%, for the level of visual thinking ability of students with low ability as much as 8 students with a percentage of 34.8%, for the level of thinking ability visual ability students "very low" as many as 3 students with a percentage value of 13.0%.

Percentage of students 'visual thinking abilities, obtained by the level of students' visual thinking abilities at the stage of understanding the problem higher. For the percentage obtained by the level of visual thinking ability at the stage of seeing and imagining stages, reaching 60.8%. At the stage indicator illustrates namely reaching 73.9%. While the communicating stage indicator is 43.5%, and the stage indicator represents 17.4%. The following

level of students' visual thinking ability on the indicator, can be seen in Figure 4.2 as follows:

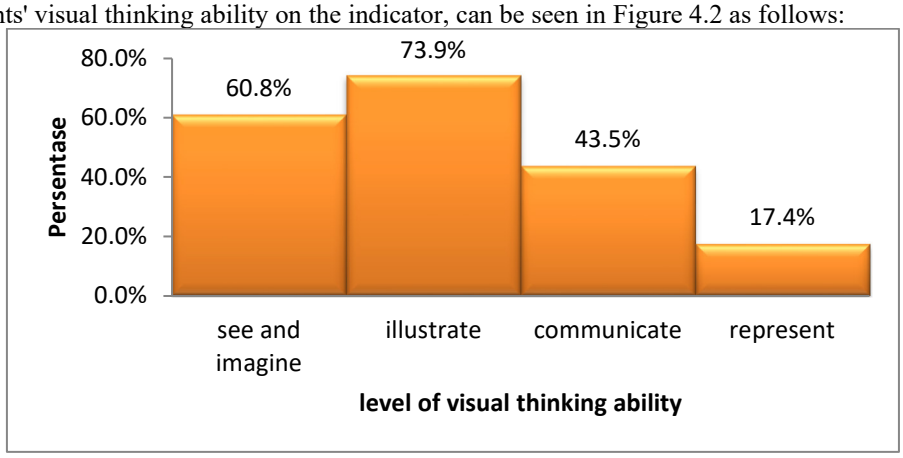



**Figure 5. Students' Visual Thinking Ability Levels on Indicators**

Based on Figure 5 the percentage results obtained at the level of students' visual thinking ability of each indicator can be seen that the lowest percentage is at the stage of representing followed by indicators of communicating then seeing and imagining, and the highest is describing, so it can be concluded that there are still many students who experience difficulties in carrying out the representing stage.

In the process of learning mathematics it is found many students have difficulty in solving math problems. One obstacle faced by students, namely students is difficult to solve the problem of story problems. Student difficulties can also occur because students do not pay attention to the steps in solving problems. In the matter of mathematical stories requires steps to make it easier to think in mathematical visuals. From 23 students, the level of visual thinking ability is obtained by the students with moderate ability and more are followed by students with low ability and students with high ability. In detail the results obtained by the level of students' visual thinking ability with very low ability of 13.0%, low ability of 34.8%, medium ability of 43.5%, and high ability of 8.7%.

Based on the level of visual thinking ability more students are of medium ability. Besides that, only two people are highly capable. In addition, the results of student answers related to the answers to the test of visual thinking skills given as a whole have not been good. This is because students are still not accustomed to working on problems that lead to visual thinking.

## 5. CONCLUSION

Based on the analysis of the research data and the discussion that has been described in this study, several findings were obtained, namely the achievement of the stated research objectives. The conclusions obtained, namely:

1. The level of visual thinking ability of class IX-3 students at SMP Nur Ihsan Medan in the medium category. High level of ability there are 2 students or 8.7%. The ability level is medium there are 10 students or 43.5%. Low level of ability there are 8 students or 34.8%. The level of ability is very low there are 3 students or 13.0%.
2. The level of visual thinking ability at the stage of seeing and imagining indicators is 60.8%. At the stage indicator illustrates namely reaching 73.9%. While the communicating stage indicator is 43.5%, and the stage indicator represents 17.4%. Based on the results of the percentage obtained at the level of visual thinking ability of students each indicator can be seen that the lowest percentage is at the stage of representing.
3. The causes of difficulties often experienced by students are: a) The ability to think visually at the stage of seeing and imagining, 73.9% of students are able to see and imagine problems and 26.1% of students have difficulty, b) At the stage of describing, 60.8% of students are able describe problems and 39.2% of students have difficulty, c) In the communicating stage, 43.5% of students are able to communicate problems and 56.5% of students have difficulty, d) At the stage of representing, 17.4% of students are able to represent problems and 82 , 6% of students have difficulty. Based on the results achieved in this study, it was concluded that the greatest difficulty students in completing the test of visual thinking ability is at the fourth stage, which is to represent.

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