Solve Integral Problems In Perspective of Visual Thinking

Solve Integral Problems In Perspective Of Visual Thinking Ability

Ummu Sholihah, Toto Nusantara, Cholis Sa'dijah, Hery Susanto

Abstract: Visual thinking is the ability, process, and results of creating, interpreting, using, and imagining ideas on images / diagrams, both on paper and with technological tools that aim to describe and communicate information / ideas and develop earlier ideas and to improve understanding. Integral is a mathematical concept that requires several representations in its discussion. This study aims to describe students' ability to think visually to solve integral problems, especially the concept of broad areas. This study used a descriptive qualitative approach, the subjects were 3 students of the Faculty of Mathematics of the IAIN Tulungagung . The results showed that visual thinking skills can be divided into three levels: Semi Local Visual, Local Visual and Semi Global Visual.

Index Terms:Problem, Problem Solving, Integral, Thinking, Visual Thinking, Level, Visual Thinking Skills.

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1 INTRODUCTION

Learning mathematics uses many symbols according to certain rules. Visual thinking is one of the basic phases of thinking while learning mathematics. There are three ways of thinking, auditory thinking, visual thinking, and kinesthetic thinking that relate to how our brain works [1]. Based on the opinion [2] that visual thinking is the ability of a person to generate, interpret and communicate information, and to develop ideas both with technological tools and on paper. This is very good for students. Based on cognitive development, concepts and attributes can be named that can be accepted, giving an example of an object correctly and giving the reasons that form the basis for defining students at the formal level [3]. Integrals and derivatives are the main topics in analysis. The Integral Principles were formulated by Isaac Newton and Gottfried Leibniz in the 17th century, using the close relationship between anti-derivatives and necessarily integrals, that is, a relationship that allows the actual values of many integrals to be easily calculated without this being required Use Riemann numbers.Research ever done ([4], [2], [5]) has shown that representations used by students to solve integral problems are related to the meaning of their attributes with integral concepts..

2. LITERATURE REVIEW

2.1. Problem Solving of Mathematics

The problem is a mismatch between goals or expectations that makes it difficult to find the right and quick answers. [6] indicates that solving problems is a process that involves the use of certain steps (heuristics), often referred to as models or steps to solve problems. Heuristics are general guidelines or steps used to solve problems.

However, these steps do not guarantee individual success in problem solving.There are several expert opinions on the steps to solve problems, including George Polya, John Dewey, Krulick, and Rudnick. George Polya is considered one of the professors in the field of problem solving. [7] make four main steps in problem solving: (a) understanding the problem; (b) prepare a settlement plan; c) implement the plan; and (d) look back.

2.2. Understanding of Thinking

Thinking is a complex thing. [8] thinking is a complex combination of words, pictures, scenarios, colors and even sounds or music. [9] Thinking is the process of forming new mental representations through information transformation through complex interactions of mental attributes such as reasoning, abstraction, thinking, drawing, solving logical problems, concept formation, creativity, and intelligence. It has also been explained that thinking is a general process of looking at a problem in the mind that causes the emergence of a new mental representation. While [10] defining thinking is a process of the brain that accesses previous representations to understand or create a new model, if it does not yet exist. Thinking means processing existing information to understand or create a new model. Therefore, the normal thinking process involves three components, namely: 1) cognitive activity, which occurs in the mind or mind of an individual and is not visible but can be closed on the basis of visible behavior; 2) a process involving some knowledge manipulation in the cognitive system, and 3) aimed at solving a problem, although information processing takes place in the mind but can be completed on the basis of visible behavior.

2.3. Visual Thinking Ability

The level of thinking in mathematics is one of them is the level of visual thinking, which is the basic level that students must have in learning mathematics. Three ways of thinking about how our brain works on the basis of sense of hearing, sight, and body sense (gestures and feelings, namely, auditory thinking, visual thinking, and kinesthetic thinking) [1]. Visual thinkers think more efficiently when the material is shown through diagrams, flowcharts, timeliness, movies, and demonstrations.The ability to think visually when learning mathematics can be a powerful tool to study mathematical problems and to give importance to mathematical concepts and their relationships [11]. [12] describe visual thinking as the ability to transform information of all kinds into images,

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- *Ummu Sholihah, IAIN Tulungagung and Malang State University, Malang Indonesia. E-mail: sholihah2280@gmail.com*
- *Toto, Cholis, Hery, lecturer Malang State University, Malang Indonesia. The graphical representation of an integral is normally used in calculations with areas under the curve, while numerical representations are used for the cumulative Riemann sum problem. Integral settlement using general integration techniques demonstrates the need for a symbolic representation. Therefore, the researcher continues to explore how he can improve students' visual thinking skills in solving integral problems.*

graphics, or other forms that can help communicate information. Proses The process of visual thinking involves four phases: *Looking, Seeing, Imagining, Showing and Telling*. *Looking* is a phase that identifies problems in seeing and reading and gathers information about problems. Seeing is the stage of understanding the relationship between the known and the questioning, the understanding of known and desirable contexts, the selection of solutions to problems and the planning of solutions to problems. *Imagining* defining a pattern with activities that describe problems and write problem-solving solutions. Showing and Telling is the phase in which students explain the problem and present the results [13].The level of visual thinking shows the depth of information processing. At the earliest level, the incoming stimuli must first undergo sensory analysis and feature analysis. At the deepest level, the object can be identified by pattern recognition and meaning. At an ever deeper level, information derived from stimuli can activate long-term associations. Subsequent processing is followed by an increasingly complex semantic and cognitive analysis [14]. There are three levels of visual thinking of the students, namely *Non-Visual* (NV), *Local-Visual* (LV) dan *Global-Visual* (GV) [5]. The visual ability of each stage are shown in Table 1 below.

***TABLE 1** VISUAL THINKING LEVEL*

Ability of visual thinking	NV	LV	GV
Understand algebra and geometry as alternative languages	×	o	o
Create specific information from the diagram	×	o	o
Graphically represent and interpret problems (concepts)	×	Δ	o
Draw and use charts to solve problems	×	Δ	o
Visually understand mathematical transformation	×	o	o

Based on the above description, the theoretical framework performed in this study can be broadly described as follows

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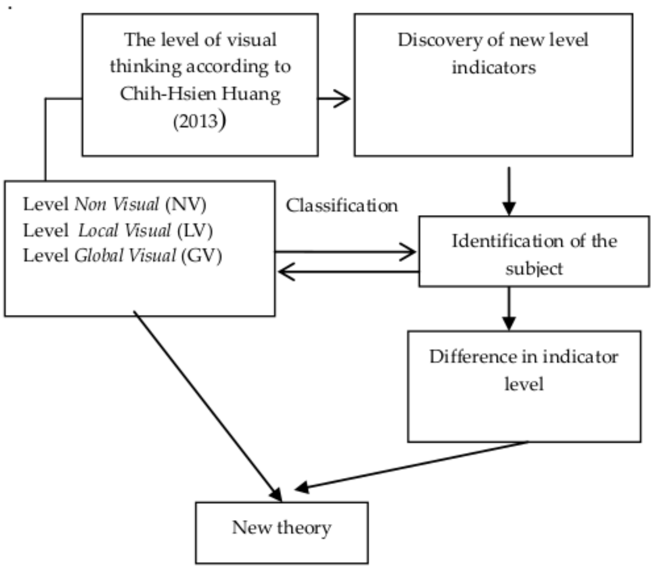

***Figure 1.** Scheme of the framework for the theory of visual thinking*

2. RESEARCH METHOD

This study uses a qualitative approach. In this study, the gap in the visual thinking of students in solving integral problems is revealed. Therefore, the appropriate type of research is descriptive research. Descriptive research will examine the circumstances, conditions, situations, events or activities whose results are described in detail from the source of the problem [15]. The selection of subjects in this study was based on purposive sampling. As subjects, 3 students from 35 students of the IAIN Tulungagung Mathematics Department were selected in the academic year 2017/2018 of the middle semester. The first activity in the selection of research subjects was to enroll students, to achieve the equality of subjects in terms of experience, and to reduce the differences due to other uncontrolled variables. The research subjects were in the same class. In the selected class, students are asked to fill in a topic selection form that includes the student's name, the GPA, the value of calculus 1, and calculus 2. Techniques for collecting data using tests and interviews. analyzed on the basis of the developed stages [16], where the analysis stage is interconnected and does not have to always be in accordance with the arrangement presented. To guarantee the validity of the data in this study used the criteria of trust level techniques, namely: (1) perseverance of observation; (2) triangulation and (3) peer checking.

4. RESULTS AND DISCUSSION

In research, the problem of using algebraic and geometric methods to calculate $\int |x + 3| \, dx$ with the upper limit of 5 and the lower limit of -5 must be solved. Based on the test results for the first subject (S1), write the answers as follows.

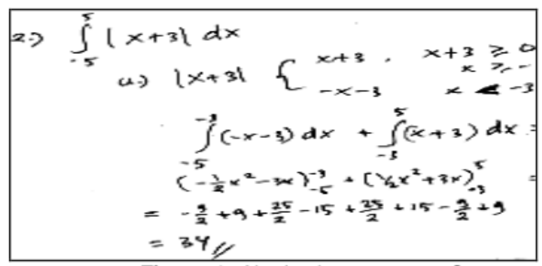

***Figure 2**. Algebraic responses S1*

In an algebraic solution, the subject seems to have understood the concept of the surface at absolute value. First, the subject describes the value of the absolute value $x + 3$, As in Figure 2, the completion step is systematic and the results are replaced 34. While geometry S1 describes the graph by first specifying the value of x and then inserting it into the equation. As shown in Figure 3 below.

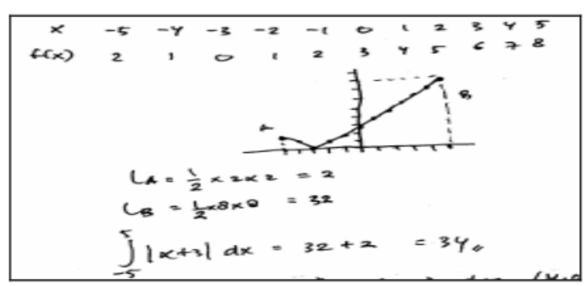

***Figure 3**. Geometry response S1*

In Figure 3, the subject calculates the area using the approximation of the triangle area. Algebraic and geometry give the same results. It can therefore be said that the subject is able to understand algebraic and geometric concepts for solving problems. This is underpinned by the following interview. This is supported by the results of the following interview.*Q Can be explained how to make no.2? A*: *We know, mam, this is an absolute value function, then this function is divided by 2 as follows (as shown on the answer sheet)Q*: *What do you think?A*: *It means that the integral means this mom.Q* : *How do you find the area? A* : *yes, neutralize then replace the upper and lower limits so that 34 can be obtained.* Sedangkan untuk S2, menyelesaikan masalah dengan langsung menguraikan harga nilai mutlak, dengan memisalkan nilai $x = 5, 4, 3, 2, 1, 0, -1, -2, -3, -4, -5$ kemudian disubtitusi ke *x+3,* seperti Gambar 4 berikut.

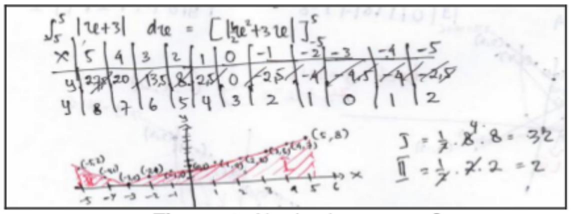

Figure 4. *Algebraic answer S2*

Based on Figure 4, it looks as if the subject creates boxes just before creating the chart and divides it into Area I and Area II. From an algebraic point of view, this does not seem to be a clear step. The subject describes it directly, then searches the area with a triangular approach and obtains the area I and the area II until finally it was not added. Next is the answer from S3.

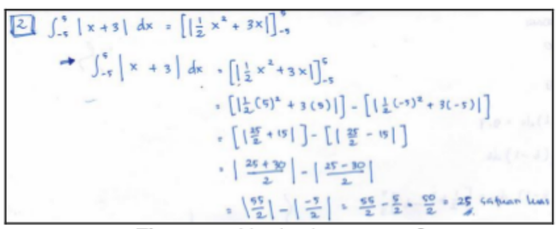

Figure 5. *Algebraic answer S3*

Figure 5 and the interviews showed that the subjects did not understand the solution of an area problem at absolute prices. Subjects only remembered the material while still in high school. The object geometry is also not complete, the final results obtained are also not correct. The analysis of the students' thinking process in solving problems raises several questions. Properties that lead to student placement at every level. Due to the existing gap, it is known that students occupying each level have almost the same characteristics, although there are several levels of indicators that show differences. S1 fulfills all indicators of visual thinking, including knowledge of the relationship between domain and integrals. By being able to use symbolic representations of the subject, it can also perfectly describe any given function. This stimulus or activity input shows an image of the definition as a visual input as explained [17] This information processing begins with the input stimulus. So we can say that S1 is at the level of Semi-Global Visual. Although S2 is able to know the relationship between area and integral, it is not perfect, but a symbolic representation could be used, but it is not perfect because the concept is still lacking in understanding. It's the same as describing any given function that is not yet perfectly aligned ([3], [9]) The recognition of patterns is the initial process of recognizing a stimulus that is received to remember a pattern. Therefore, S2 is grouped at the local visual level.Further S3 was able to use symbolic representation, but not perfect because the concept is still lacking in understanding, unable to describe any given function. in small groups and have an understanding of solving problems called instrumental understanding. Instrumental understanding is a type of understanding that refers to the use of methods or rules without knowing the reason for their use. [18] call it as *rules reasons*. Therefore, S3 is grouped at the *Semi Local Visual.* In developing visual methods to identify concepts and problems that are better, the subject can do so by deliberately repeating information to increase the length of information that remains in memory. Many students with high visualization skills can use graphics along with algebraic representations to solve problems. Aspinwall et al. They cite MacFarlane Smith's abilities and can visualize complex structures without realizing it [19] Many researchers emphasize the importance of visualization and visual thinking for learning mathematics, and visualization is a fundamental aspect in constructing the understanding of mathematical concepts for student / student difficulties. Students' difficulties are understanding, drawing diagrams, reading diagrams correctly, understanding conceptual formal mathematics, and solving mathematical problems ([2], [20], [21]). Their views on visualization suggest that visual thinking can be an alternative and the ability of students to engage in math. Paths that open up other ways of thinking than language and logic-proportional thinking are traditional proofs and manipulations of traditional algebraic symbols. Various factors can influence the process of visual thinking. [22] explains that the visual thinking process can not be linear because the process of visual thinking is influenced by many factors, namely, material, individual, and interaction. Some materials do not require visualization because of their operational expertise. For other materials, however, visualization is needed to understand the concepts of space, building level, and function diagrams. Some tasks or interactions do not require visualization, but some other interactions require visualization because they are used to explain or complete images/graphics. The fluent processing of individual mental images may be different. [23] explains that not everyone is so fluent in creating and editing images or mental images. Individual factors, definitions or associations and experiences or interactions influence the smooth processing of mental images. The processing of mental images is controlled by the purpose of the activity. Tasks and individuals can influence the processing of mental images in the mind. Based on the given description, the processing of mental images can be divided into several stages, namely the collection, processing, determination, perfecting and using of mental images.

5. CONCLUSION

Based on the discussion above, one can conclude: 1) Semi-Global Visual Level (SGV), which is located between the local visual and global visual levels, demonstrating complete competence in creating specific information from diagrams that are capable of displaying and interpret problems (concepts) graphically, drawing and using diagrams as an aid in solving problems understands the mathematical transformation visually, but the use of algebra and geometry as alternative languages is still incomplete; 2) The level of Local Visual (LV), which has full competence in the use of algebra and geometry as alternative languages and generates specific information from diagrams, is also capable of visually understanding mathematical transformations but graphing problems (concepts) and to interpret drawing and using charts as an aid in solving problems was also unable to fully show; and 3) The level of Semi Local Visual (SLV) is between the non-visual and the local visual levels. This layer can use algebra and geometry as alternative languages and generate specific information from the diagram, but they are not yet complete. Not being able to graphically represent and interpret problems (concepts), to draw and use diagrams as an aid in solving problems, was also unable to visually understand the mathematical transformation.

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