# IDENTIFICATION OF THE STAGES AND WEAKNESS OF THE STUDENT REASONING IN LOGICAL THINKING BY THE SET

**Darmadi.**

Universitas PGRI Madiun

Email : darmadi.mathedu@unipma.ac.id

*Abstrak*

*The main competence in learning mathematics is to improve the ability of reasoning. To get the competence, the student of the education courses math of Universitas PGRI Madiun compulsory courses logic and set. This paper discusses the stages and the weakness of the student reasoning in the logical thinking with the set. Based on the results of a descriptive research-qualitative study program conducted in mathematics education earned the stages and the weakness of the reasoning of the students in the logical thinking with the set. Stages of reasoning of the students in the logical thinking with the set as a means of visualization are: 1) Connect each set with the premise, 2) Connect both premises and pay attention to the possibilities of possible illicit; and 3) paying attention to both possibilities as the basis for the with draw of the conclusion. Weaknesses of student reasoning in logical thinking with the set as visualization are: 1) Students see problems separately and have not been able to connect with the conclusion or the premise of the set that's been studied; 2) Students can already connect to the problems with the concept of the set but haven't been able to connect between premise; 3) Students can already connect the premise to the concept of set, but less thorough so as to give an answer that is less precise; and 4) Students can already connect to premise by the concept of the set and had a thorough look at all the possibilities so as to provide an answer with precision.*

*Key Word: The Stages and Weakness; The Student Reasoning in Logical Thinking*

## 1. INTRODUCTION

Reasoning ability is indispensable to obtain the truth. Although absolute truth belongs to God, but humans had minds to be able to reasoning. Some focus on discussing the science of reasoning. Several tests of potential academic or psychological test always use reasoning. Critical reasoning is needed to life every day. The ability of logical thinking on mathematics known as logico-mathematical knowledge logico-mathematical knowledge or knowledge of necessary truths (Nel Noddings, 1999).

Same expert defined the term of reasoning. Matsumoto defined reasoning as thinking in a linear and logical manner to draw conclusions from facts or the classification of things or events using general principles to infer order in the information; The particular sequence of ideas used to arrive at a conclusion (David Matsumoto, 2009). On a large dictionary Indonesian Language, reasoning minds means or reach or the power of thought. So the reasoning process, means way, to reasoning (Indonesian Language Dictionary, 2008).

For reasoning, it takes some aspects. Nickerson wrote down the aspects for reasoning as follows (Raymond, 1986).

Reasoning encompasses many of the processes we use to form and evaluate beliefs—beliefs about the world, about people, about the truth or falsity of claims we encounter or make. It involves the production and evaluation of arguments, the making of inferences and the drawing of conclusions, the generation and testing of hypotheses. It requires both deduction and induction, both analysis and synthesis, and both criticality and creativity.

Reasoning is logical and systematic thinking processes to form and evaluate the confidence in a statement. Reasoning needs to be proposed and elaborated to establish, maintain, or alter the belief that a conclusion is correct. Reasoning involves inference, namely the process of decline of logical consequence and involving also the withdrawal process summary/conclusion (conclusion) of a series of statements. Withdrawal process conclusion can be deductive or inductive. Reasoning has an important role in the development, creation, evaluating, and testing a theory or hypothesis.

High level thinking skills more specific such as reasoning (YokiAriyana,2018). For reasoning, the complex information processing is required. Despite the complexity of the bernalar are relative, i.e. datu individuals with individual can vary, but for the bernalar at least it takes the process of remembering, knowing, understanding, applying, analyzing, and evaluating. The level of cognitive development of the students greatly affect the ability of the students ' reasoning.

The level of development of students is on late adolescence (17-20 years) (Barbara Fadem). The adolescent develops moral, ethics, self-control, and concerns about humanitarian issues and word problem. Same adolescents, but not all, develop the ability for abstract reasoning (Piaget's stage of formal operations). If the identity crisis is not handled effectively, the adolescent may suffer from role confusion in which he does not know where he belongs in the world. With role confusion, the adolescent may dispay behavioral abnormalities with criminality or an interest in cults.

The set is defined as a collection of objects that have a particular nature and clearly defined (Noeryanti). With the definition of this limit, or an object (concrete or abstract) can be categorized into or become a member of the set or not. Set the material is taught starting 7th grade or middle school level first. At the college level, are studied in greater depth on the material sets and set logic and logical or or introduction to the basics of mathematics. The name used may be different, but the material and contents are actually the same. The emphasis given by the teacher or lucture that can vary.
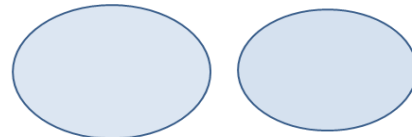
The concept of the set is important to learned because very useful for basic logical thinking or reasoning. Two sets are the same provided they have the same members. Let A and B be sets. We call A a subset of B provided each member of A is a member of B; we denote this by A $\subseteq$ B and also say that A is contained in B or B contains A. The union of A and B, denoted by A

∪ B, is the set of all points that belong either to A or to B; that is, $A \cup B = \{x | x \in A \ or \ x \in B\}$. The word or is used here in the nonexclusive sense, so that points which belong to both A and B belong to A ∪ B. The intersection of A and B, denoted by A∩B, is the set of all points that belong to both A and B; that is, $A \cap B = \{x | x \in A \ and \ x \in B\}$. The complement of A in B, denoted by B-A, is the set of all points in B that are not in A; that is, $B-A = \{x | x \in B, x \notin A\}$ (H. L. Royden and P. M. Fitzpatrick . 2010).

The relationship of two or more sets of can be expressed in the form of a venn diagram. A venn diagram is a visual representation of the relationship of one or more of the set. The visual representation is a mental picture of the individual to a concept. Visualization can be used to help in understanding the definition (Darmadi. 2015) and solving problems (Darmadi, dkk. 2016).  Use a venn diagram as a visualization intended to ease student so as not too focused to formalities.  Picture or visualization of both those concepts is as follows.
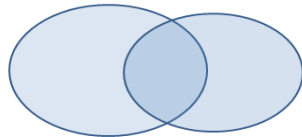
**Figure 1.** The image of intersection of two set                **Figure 2.** The image of interdependent of two set

In addition, the concept of a set of widely used for studying higher mathematics materials, such as topology, the set of fuzzy set theory, or the other. The concept of set underlies virtually all branches of mathematics (Sugiarto, Isti Hidayah. 2011). However, the more interesting is the application of the concept of the set to logic thinking.

This paper discusses the identification of the stages and weakness of the reasoning of the students in logical thinking with the set. The author's knowledge, no one has examined or identify the stages of reasoning by using the concept of a set. The identification of weaknesses in student to reasoning needed so that teachers can be noticed in learning so that more optimal learning. In addition, the novelty of this writing is the reasoning used is using visualization.

## 2.  RESEARCH METHODS

Research methods used to obtain the mathematical problem solving in learning mathematics is a descriptive exploratory research methods with qualitative approaches.

The subject of research is the study of mathematical education course students teaching faculty of Science Universitas PGRI Madiun with criteria 1 semester of the academic year 2019/2020 new and follow the course of mathematical logic and the set. Thus, guaranteed authenticity and the breadth of data.

The problems taken from the subject matter that eventually inspired the research. The problem was appointed as a research instrument is as follows.

*See a-valid-ness of the withdrawal of the following conclusions:*
Premise*:*

> *P1: There are no college professor which rich*
> *P2: Several poets are rich people*

*Conclusion:*

> *K1: Some poets are not professors*

Respondents or student be required to resolve the issue of the above using visualisasi as a task. Before the problem is given, an analysis of the issue made to ensure the acquisition of the data. In addition, problems are arranged in the form of sheets of reserved and valid to the expert.

Data retrieval is done with the interview-based tasks. An interview conducted in great depth with a semi-structured format. Structured interview model was chosen for simplicity in the search data as well as data can be obtained that are wide and deep. However, it is said to be semi-structured remain underway to get the data.

Validation of data triangulation used the time to get valid data at once guarantee saturation data. Data triangulation is done based on the data provided by some of the subject after categorization.

Valid data is analyzed with the reduction, categorization, exposure, so that they obtained conclusions. The reduction of the intended data is data that has nothing to do with the theme. Categorization of data is meant to be clumped or identify ways of reasoning and the mistakes of students in reasoning. Exposure data was conducted to describe the results of his research. The withdrawal of the conclusions obtained based on results of analysis of the data so obtained identification of the stages and weakness of the reasoning of the students in logical thinking with the set.

## 3.  RESULTS OF THE STUDY

### 3.1. The stages of student reasoning in logical thinking with the set as a means visualization

The results showed the presence of four categories of student answers.Steps that can be done to answer the problem that was given is as follows.

a.  Connecting the premise with the concept of the set

There are two minor premise on the problem given. premise can be connected with the concept of set. premise is input information. Set concept is a scheme that has been owned by students from previous lessons.

Premise 1 stated that "*there are college professor which rich*". There are two sets be established, namely: the set of college professors and the set of rich people. The corresponding set of two connection information premise 1 (P1) is each other off. The visualitation of the premise 1 can be described as follows.
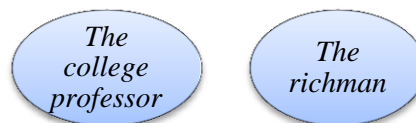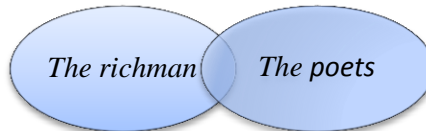


**Figure 3.** Visual representation premis 1

After the connect information with the scheme that had been owned, occurs the process of assimilation.Some students have not been able to connect existing information of premise 1 with the concept of set that has been accepted

Premise 2 states that "*saveral poets are rich people*". There are two sets be established, namely: the set of the poet and the set of the rich people. The corresponding set of two connection information is intersection with each other. The visualitation ofthe premise 2 (P2) can be described as follows.
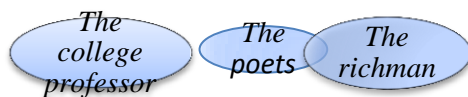


**Figure 4.** Visual representation premis 2

After the connect information with the scheme that had been owned, occurs the process of assimilation. The problem is some students have not been able to connect existing information of premise 2 with the concept of set that has been accepted

Problems given to students who already know the basic concepts of operations on the set of as mutually interdependent and intersect. The activity of connecting each set with the premise occurs due to input information premise is known. Input for this activity is premise 1 and premise 2. The output of this activity is the Figure 3 and Figure 4. In this activity, students have to think visually. The mind of the students bring up, process, and utilize mental imagery (Sugiarto, Isti Hidayah. 2011). The mind conjures up mental imagery after connect visual input (premise 1 and premise 2) with the description of the concept of a set of mutually intersection. Mind to cultivate mental imagery by specifying and refining mental imagery. Selected mental imagery is the venn diagram overlapping intersection to premise 1 and the venn diagram are interdependent to premise 2. Enhanced mental imagery by adding an explanation set 1 as a set of the rich people and the second set as the set of the poet. Mind harness mental imagery with represented in the answer sheet so that the retrieved Figure 3 and Figure 4. Students who do not represent tend not to think visually.

b. Connect the two premise and pay attention to the possibilities
Both premise form relationships. Relations of premise form several possibilities.The relationship between the two premise gives two possibilities as follows.



**Figure 5.** A visual representation         **Figure 6.** A visual representation of

possibilities 1                         possibilities 2

After the connect of informations with the scheme that had been owned, occurs the process of assimilation. The problem is some students have not been able to connect existing informations of the premise.

Relationships between premises provides some possibility that needs to be checked one by one. Visual input to connect a second activity is Figure 3 and Figure 4. The visual output of this activity is the Figure 5 and Figure 6. In this activity, students have to think visually. The mind of the students bring up, process, and utilize mental imagery (Darmadi. 2015). The mind conjures up mental imagery after noticing visual input the results of previous activities i.e. Figure 3 and Figure 4. Mind cultivate mental imagery by specifying relationships and improve our mental imagery with relations to the other. Selected mental imagery is likely possibilities 1. Enhanced mental imagery with the possibility of adding 2. Mind harness mental imagery with represent it in the answer sheet so obtained relationship possibilities 1 as in Figure 5 and possibilities 2 as shown in Figure 6. Students who do not represent tend not to think visually.

c.  Pay attention to both possibilities as the basis for the withdrawal of the conclusion
    Having regard to all the possibilities, the right answers can be obtained. As in the case of a given conclusion "some poets are college professors", the possibility 1 indicates that there are no poet who became a full Professor, probably 2 indicates that there are more of the poet and Professor. Thus, although the possibility of 2 actually, but due to the possibility of 1 is wrong, then the conclusion is given is not valid. In this activity, students have to think visually. The mind of the students bring up, process, and utilize mental imagery (Darmadi. 2015). The mind conjures up mental imagery after noticing visual input the results of previous activities, namely picture possibilities 1 and picture 2 possibilities. Mind to cultivate mental imagery by determining and perfecting the relationship with a given conclusion. Mental imagery chooses possibility 1 for compared to a conclusion so that the conclusion is true because not all poets College Professor. Enhanced mental imagery by choosing and possibly 2 to also compare with the conclusions given as some poet not a college professor. Mind harness mental imagery with represent it in the form of conclusions. The proper conclusion to this issue is valid.

Of course, students can think of another way. Based on the theory of development, the knowledge representation of the students in the order is enactive (using concrete objects), iconic (using mental imagery) and symbolic (using symbols or number) (Schunk D H, 2012).

### 3.2. Weaknesses of student reasoning in logical thinking with the set as visualization

However, the steps above reasoning will be used as the basis for designation or discussion so we can the weaknesses of student reasoning or logical thinking with the set as the means visualization, yaitu:

a. Some students viewed the problems separately and have not been able to connect with the conclusion or the premise set that's been studied. Students in this category provide answers for various reasons, however, cannot be explained by a venn diagram. This means that the student did not connect with the conclusion or the premise of the set. Therefore, the answer to the student does not have a strong reason in arguing and imprecise.

b. Some students can already connect to the problems with the concept of the set but haven't been able to connect between premise. Students in this category give answers and explain using a venn diagram. That is, students connect the existing statements with the concept of the set. However, the student replied that there is no relationship between premise 1 with 2. This means that students are not yet connect premise 1 with the premise 2. Students haven't been able to connect the connection-connection. Therefore, the reasons given students to draw conclusions. As a result, students ' answers are not right.

c. Some students can already connect premises to the concept of set, but less thorough so as to give an answer that is less precise. Students in this category give answers and explain using a venn diagram on both premises and to connect it so get the relationships between premise. However, students do not pay attention to all the possibilities of relations between premises. The relationship between an open relationship is premise, namely: can be obtained several possibilities. This means that students have time to connect with the concept statement set and connect between premise to draw conclusions. But because less carefully (do not pay attention to all possible), the student can answer correctly and can be wrong. Students haven't been able to think comprehensively. Comprehensive thinking is to think thoroughly.

d. Some students can already connect with the concepts of sets and premise already carefully looking at all the possibilities so as to provide an answer with precision. Students in this category give answers and explain using a venn diagram on both premises, connect both premises, and pay attention to the possibilities of koneksi between premises. This means that students have time to connect with the concept statement set, connect relationships between premises, pay attention to the possibilities of connection between premises. Thus, students tend to answer exactly.

The ability to connect information in a problem with the knowledge already owned has a significant role in reasoning. Connectionism is a term often used for governing explanation learning Thorndike, because he assumes that the learning process involves strengthening ties between neural (connection) conditions stimulate by the respons (Hergenhahn B R and Olson M H. 2008). Some of the connections must be made to be able to solve the problem given.
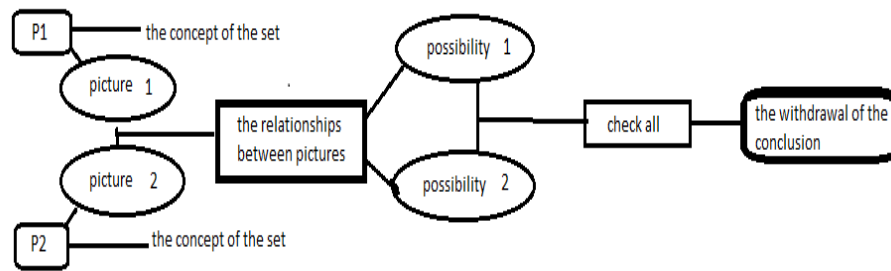
**Figure 7.** Connection in reasoning by the set

For reasoning, the student needs to connect with the concepts given premise of the set so that the retrieved visualization. After that, students should be able to link the figures that have been obtained so that obtained its possibilities. After that, students need to check all possible conformity with conclusions that are given so that conclusion or the correct answer.

In the study, teacher or lecture need to pay attention to students ability in connect new information received with the knowledge that has been owned until acquired new knowledge. Furthermore, the new knowledge will still need to connect with other new knowledge so that it forms a more recent knowledge again. In addition, it will also need to pay attention to the possibilities of connection so acquired knowledge intact against the problems faced. So, the next, the best resolution is obtained. Learning is an interactive process that happens on many levels (Jensen E, 2008). Weaknesses shown students showed levels of student ability in reasoning by using a set of concepts as a means of visualization.

## 4. Conclusions

Based on the results of such research, identified the phases of student reasoning and some disadvantages berlogika students in reasoning with the set, namely:
a. The stages of student reasoning in logical thinking with the set as a means visualization is
    1) connect each set, with the concept of premise
    2) connect both premise and pay attention to the possibilities of possible illicit
    3) Pay attention to both possibilities as the basis for the withdrawal of the conclusion
b. Weaknesses of student reasoning in logical thinking with the set as visualization is
    1) Student viewed the problems separately and have not been able to connect with the conclusion or the premise of the set that's been studied;
    2) Students can already connect to the problems with the concept of the set but haven't been able to connect between premises;
    3) a student can already connect premises to the concept of set, but less thorough so as to give an answer that is less precise;
    4) Students can already connect to premise by the concept of the set and had a thorough look at all the possibilities so as to provide an answer with precision.

## 5. References

Barbara Fadem.  High-Yield Behavioral Science 2<sup>nd</sup> edition. Lippincott Williams & Wilkins. A Wolters Kluwer Company. Newark New Jersey

Darmadi, Benny Handoyo, Woro Dyah Ayu Pratiwi. 2016. Visual Thinking Student Profile Prospective mathematics teacher With learning styles in solving Trigonometric Problems Auditorial. Math mathematics education Didactic: Journal Vol. 2, no. 1, January-April 2016 © STKIP PGRI Banjarmasin.

Darmadi. 2015. Visual Thinking Student Profiles of prospective teachers of mathematics in understanding the Formal definition of a sequence Converging based on Gender differences. Journal LPPM IKIP PGRI Madiun. Vol. 3 No. 1 January 2015

Darmadi. 2015. Visual Thinking Student Profiles of prospective teachers of mathematics in understanding the Formal definition of a sequence Converging based on Gender differences. Journal LPPM IKIP PGRI Madiun. Vol. 3 No. 1 January 2015

David Matsumoto. San Francisco State University. 2009. The Cambridge Dictionary of Psychology. Published in the United States of America by Cambridge University Press, New York. San Francisco State University

H. L. Royden and P. M. Fitzpatrick . 2010. *Real Analysis, Fourth Edition.* English reprint edition by Pearson Education as Prentice Hall. Asia Limited and China Machine Press.

Hergenhahn B R and Olson M H. 2008. Theories of Learning. Pearson Education. Dialihbahasana oleh Tri Wibowo B S. Jakarta: Kencana

Indonesian Language Dictionary. 2008. The National Ministry of education language centre Jakarta.

Jensen E. 2008. Brain-Based Learning: The New Science of Teaching & Training..Corwin Press. A Saga Publications Company. Thousand Oaks, California

Nel Noddings. 1999. *Constructivist Views on The Teaching and Learning of Mathematics. National Council of Teachers of Mathematics.* United States of America.

Noeryanti. TeoriHimpunan: ModulLogikaMatematika. Sanata Dharma. Yogyakarta.

Raymond S. Nickerson, Reflections on Reasoning (Hillsdale, NJ: Lawrence Erlbaum Associates,Publisher, 1986).

Schunk D H. 2012. Learning Theories: an education perspective. Sixth Edition. Pearson Education. Ink. Pustaka Pelajar. Yogyakarta.

Sugiarto, Isti Hidayah. 2011. The basic Introductory learning materials for Mathematics (PDM) Jurusan Matematika FMIPA UNNES. Semarang

YokiAriyana, MT. Widyaiswara PPPPTK IPA Bandung. Dr. Ari PudjiastutiM.Pd. Widyaiswara PPPPTK PKn IPS Kota Batu. Reisky Bestary, M.Pd. Widyaiswara LPMP Provinsi Riau. Prof. Dr. Zamroni, Ph.D Universitas Negeri Yogyakarta (2018). Buku Pegangan Pembelajaran Berorientasi pada Keterampilan Berpikir Tingkat Tinggi. Direktorat Jenderal Guru dan Tenaga Kependidikan Kementerian Pendidikan dan Kebudayaan