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Original Paper

Analysis of Thinking Ability Intuition of Mathematical Education Study Program Students Based on Realistic Mathematical Approaches

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Abstract

Intuitive is a process of thinking based on intuition that is a purification of conclusions that are strongly reasoned through feeling and indispensable in learning mathematics. The research objectives were: describe the ability of mathematical intuition thinking (Kb-iM) and the effectiveness of the application of realistic mathematical approaches from students of Mathematics Education Study Program FMIPA Medan State University. The sample of the study was 36 students in the 2015 class who were / had attended the Kapita Selekta Mathematics School course. The research instrument was in the form of 8 items of objective test of mathematical intuitive thinking ability. This test was developed based on the formulation of indicators that are built from supporting theories. The results of data analysis show that: (1) for the pre-test Kb-iM the range = 0.88; smallest score 2.38; biggest score of 3.25; average = 2.86 and standard deviation = 0.24. The same thing with the Kb-iM post-test obtained a range of values = 1.30; smallest score 2.60; biggest score 3.9; average = 3.24 and standard deviation = 0.31. Average values mean that the level of initial achievement of students' mathematical intuitive thinking skills was only 71.5% and after realistic mathematics learning it had reached 81.0% or an increase of 10%. This fact gave the meaning that realistic mathematical learning approaches play a positive role to improve students' mathematical intuitive thinking skills. At the end of the study it turned out that the level of mathematical intuitive thinking ability of students was at least at the moderate level.

Keywords

mathematical intuitive thinking, students, realistic mathematics

1. Introducation

Mathematics is a science that has the characteristics of deductive reasoning, namely the truth of a concept or statement obtained as a logical result of the previous truth. According to Hudojo, to learn the concept of B which is fundamental to concept A, one needs to first learn the concept of A, without understanding the concept of A it is impossible for that person to understand the concept of B. Mathematics also contains hierarchically structured concepts (ordering concepts). The Liang Gie revealed that mathematics is a large structure built by humans to provide an understanding of the universe.

Someone who has experienced difficulties or lost motivation to learn mathematics due to one or several factors will be relatively difficult to repair as soon as possible. This difficulty is caused by the hierarchical arrangement of interrelated mathematical concepts as interrelated prerequisites to learn the next concept. However, learning mathematics is often faced with the challenge of immediately determining a decision in the process of resolving routine or non-routine real problems. Sometimes the decisions obtained are not for logical reasons or tangible evidence. The objects of study in mathematics are abstract, which only exists in the mind, whereas what is seen and learned is only an image or painting to make it easier to learn. The mathematical object according to Bell, can be divided into two parts, namely the direct object, in the form of: facts, skills, concepts and principles. Indirect objects include transfer of learning, inquiry abilities, and problem solving skills, self-discipline and appreciation of the structure of mathematics.

Mathematics is a science that is deductive and axiomatic, where the process of getting conclusions or generalizations is based on the set of understanding bases, definitions, and previous postulates or theorems. Every axiomatic system always contains propositions that cannot be demonstrated and defined, so it is necessary to consider smart and instant thinking through an intuitive process. According to Meier, intuition is a purification of conclusions that are strongly reasoned through feeling and are indispensable in learning mathematics. Kusuma and Saefuddin say that, in mathematics learning, there is a known ability to think mathematically. Mathematical thinking when associated with the concept of thinking can be seen as a way to increase understanding of mathematics by compiling data and information obtained through research or study of mathematical objects.

Humans have real nature, meaning that humans tend to believe in something if it can be felt by the five senses. Thus the nature of abstract mathematical objects made many students find it difficult to understand mathematics which eventually led to mathematical phobia. The task of educators as teachers is to make someone able to face problems in order to maintain life. For that, educators must always try to find a way so that all problems can be actualized to get a solution. The combination of the need for intuition in finding mathematical solutions with human nature that tends to reality, it is not excessive if in increasing students' intuition needs to be studied in mathematics learning through a realistic approach. Educators must be able to make the experience of thinking mathematically through the learning process. Because according to Burke and Milner, that intuitiveness is not something that

arises immediately, but is a result of long experiences and the involvement of emotional elements in it. Realistic approach is a learning that refers to philosophical and learning theory Freudenthal said that, mathematics is a human activity. This means that mathematics is not given as finished material, but students or students as active learners construct their own mathematical knowledge themselves through their activities. In supporting activities to empower or facilitate students or students, the right learning approach is needed in accordance with the demands and characteristics of the material and their conditions. One of them is a realistic approach that allows learners to be required to build their knowledge through challenges, conflicts or contextual problems that are familiar with the real world of children. From the background above, it is necessary to do a study in the form of research by applying mathematical learning through a realistic approach to improve students' mathematical intuition skills.

Based on the description above the research formulation is: (1) How to increase the ability of mathematical intuition thinking students of Mathematics Education Study Program FMIPA Medan State University through the application of realistic mathematical approaches? (2). How effective is the realistic approach to students' mathematical intuition thinking skills in the Kapita Selekta course at the Mathematics Education Study Program FMIPA Unimed Medan?

2. Research Methods

1) Research Population and Samples

The population in this study were all students of Mathematics Education Study Program FMIPA UNIMED grade 2015/2016. The sample was taken by the class of students taking the KapitaSelekta course and / or the Development of Mathematics Teaching Program (P3M) at random.

2) Instruments and Data Collection Methods

Data collection instruments are in the form of 8 items of objective test of mathematical intuitive thinking ability. Data collection techniques are carried out by conducting tests and / or observations on the research sample.

3) Data Analysis

Analysis of the data used in this study, and in accordance with the data needed is descriptive and inferential statistical analysis, which analyzes the changes in student behavior or preferment before and after treatment the application of realistic mathematical approaches in learning.

4) Research Descriptions

This research is a kind of descriptive research that aims to provide an overview of the application of mathematics learning through a realistic approach in improving the ability of mathematical intuitive thinking of students in the field of mathematics.

5) Research Implementation Procedure

a. Initial section: Field observation, management of permits to research, determine settings and research subjects, and prepare research equipment.

b. Core part: Enter the field (setting), carry out learning with a realistic approach, collect data, process

data analysis, and formulate research results.

c. Making research report.

3. Discussion

3.1 Description of Instrument Validation Test

Based on the theoretical basis, indicators of mathematical intuitive thinking (Kb-iM) were developed and based on the formulation the items of the test were designed. The validation process is carried out theoretically through 5 experts. Questions come from the results of adoption, adaptation and engineering in accordance with the indicators formulated. This is done with the consideration that, the indicator is expected to measure the intuitive ability of the study sample. The results of content or theoretical validation are used to revise content or test reductions based on evaluations from the validator, namely: (1) improve the question editor so that it is more easily understood by participants, (2) modify questions that might not measure intuitive abilities for reasons too easy or too difficult, (3) modify questions that do not match the indicators that have been formulated.

Another indicator to guarantee the validity of the items after this validity is to calculate the Content Validity Ratio (CVR) with the formula: CVR = (n_e- (N / 2)) / ((N / 2))

Description, CVR: content validity ratio

n_e: number of validators stating essential test items

N: number of validators

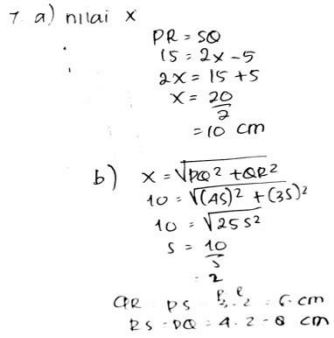
Based on the criteria for CBR values, there are 4 out of 12 items that are invalid, namely points 1, 5, 8, and 11. This is in accordance with the results of the empirical validity test using the SPSS 20 program, that item is the item validity coefficient (rxy) < 0.50 are items 1, 5, 8, and 11. Cronbach-Alpha coefficient (α-cronbach) = 0.838 or instrument reliability includes very good categories or has the reliability and consistency of the instruments in the excellent category.

3.2 Description of Early Ability of CB-iM

Before collecting data at the end of the activity as post-test data (after the application of a realistic mathematical approach), pre-tests are conducted to administer the initial data of intuitive thinking skills from the study sample. This data is used as a comparison to the post test data. This is needed to analyze the impact of applying the treatment to the application of the Realistic Mathematical approach. From the calculation results it can be seen that the individual score range is in the range of 1 to 3; on average in the range of 2.75 to 3.25; standard deviation in the range 0.21 to 1.42; average total score = 2.86. The search results turned out that there were 23 people (64%) who had an intuitive thinking ability score above the total average, and 13 people (36%) who had a score below the total average. This value indicates that the initial ability of mathematical intuitive thinking from students / samples is still not in accordance with the ideal criteria / level.

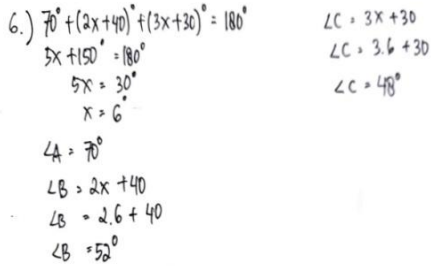
3.3 Description of the Kb-iM Answer Sheet and Post Data

After applying the realistic mathematical approach in the discussion for 4 weeks, a test was conducted to reveal the Kb-iM data from 36 research samples. Based on the answer sheet from the test results from 36 study samples, it turns out that the ability to think mathematically is very varied, based on the overall 8th completion of the questions tested or based on the indicators represented by the test items.



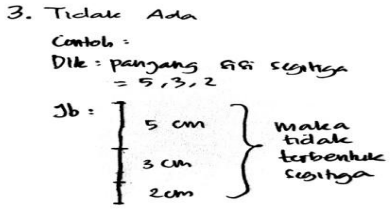
There were 8 people (22.2%) samples that had errors in solving question number 1 (representing indicator 1). One example of the results of the sample work representing this group is presented below. This group is not creative to apply the Pythagoras formula algebraically, unable to combine and associate known prices to find the price needed before searching the length of the QR and PS sides. The results of this group's work relatively do not show a good solution.

The same thing for question number 9 which represents indicator 3 of competence 3, it turns out there are still 4 people (19.4%) who do not show the ability to think intuitively to build and associate mathematical models or algebraic forms to find prices that support angular quantities on any triangle.



This fact shows a lack of precision calculation. This is one indication of the lack of sharpness and precision of intuitive thinking from this group. It should be creative to use the concept of straight angle to calculate the amount of angle requested in the problem.

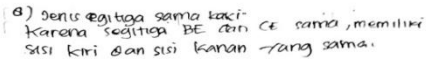
The search results for the sample answers for question number 10 which represent indicators on basic competency 3, in fact there were 18 people (50%) who made the wrong solution.



This means that they were not able to think of guessing exactly 3 integers (totaling 10) as a line length that deserves to form a triangle. In pairs 3, 3, 4 or 2, 2, 4 can form an isosceles triangle. There are still other forms of error which decide that triangles are not possible.

In general, from the inductive form, it can be concluded that none of the triangular shapes can be constructed from 3 numbers which are 10 units in length. The solution to this problem is not to use formal evidence or mathematical algorithm rules, but can be done quickly based on the concept of the triangle itself. Like the opinion of Rorty in Dane & Pratt, looking intuitively as an immediate apprehension that directs a person's subjective consideration in understanding a fact or solving a problem. His subjective consideration is that the triple line above can form a triangle area. The next question, is there still another form?

The results of the investigation are based on the questions that represent indicator 3 in the 4th competency, it turns out that the error is quite varied and overall there were 21 people (58.3%) from the sample who made mistakes for the answers given.



One form of a very fatal error is to conclude that BE = CE from the ABCD.EFGG cube, because these two sides are sides located in different fields (diagonal sides and cube spaces).

A person's spatial ability plays an important role in supporting his intuitive thinking ability, where the speed of thinking to decide something will affect one's intuitive power. Failure to decide the side of BE = CE will have an impact on the conclusion of the type of BCE triangle. Errors like this were done by 5 people (13.8%) from the sample.

Based on the assessment of the answer sheets from 36 units of the sample obtained scores / grades of mathematical intuitive thinking ability (Kb-iM). This data was collected based on 8 items of test instruments representing 4 indicators of CB-iM. A summary of the results of calculations using SPPS 20 is presented in Table 1.

Table 1. Statistics Data Post-Test Kb-iM (N = 36)

Statistik	N	Range	Minimum	Maximum	Sum	Mean	Std. Deviation	Variance
POSTES	36	1,30	2,60	3,90	116,90	3,24	,31	,099
PRETEST	36	,88	2,38	3,25	103,13	2,86	,24	,059
Valid N (listwise)	36							

From the Table it appears, for the Kb-iM post-test data were: range value = 1.30; smallest score 2.60; biggest score 3.9; average = 3.24 and standard deviation = 0.31. The same component for the Kb-iM pre-test: range = 0.88; smallest score 2.38; biggest score of 3.25; average = 2.86 and standard deviation = 0.24. Average values mean that, at the beginning, the level of achievement of students' mathematical intuitive thinking was only 71.5% and after realistic mathematics learning it has reached 81.0%; there is an increase of 10%. From post-test data and categories: low ($x \leq \bar{X} - S$), medium ($\bar{X} - S < x < \bar{X} + S$) and height ($x \geq \bar{X} + S$) obtained as in Table 2.

Table 2. Pre-Tests with Kb-iM Post-Tests for the Achievement Category

Categorey / Group	Low ($\bar{x} \leq 2,9$)	Middle ($2,9 < \bar{x} < 3,5$)	High ($\bar{x} \geq 3,5$)	Total
Pre-test	9	21	6	36
Pos-test	0	16	20	36

From Table 2, there was an increase in Kb-iM from the study sample, this can be seen from the change in frequency in each category group. In the pre-test score there were 9 (2.5%) people in the low category and apparently in the post-test there were no more sample units in this category. The same thing, there were 21 people (58.3%) in the medium category and it turned out that in the post-test there were 16 people (44.4%) or reduced by 5 people (23.8%). While 6 people (16.6) for the high category in the post-test changed to 20 people (55.5%) or increased by 14 people (233.3%). These data show that the applied realistic mathematics learning approach has a positive role to improve students' mathematical intuitive thinking skills. The visual picture of the comparison between frequencies for the three categories is presented in Figure 1.

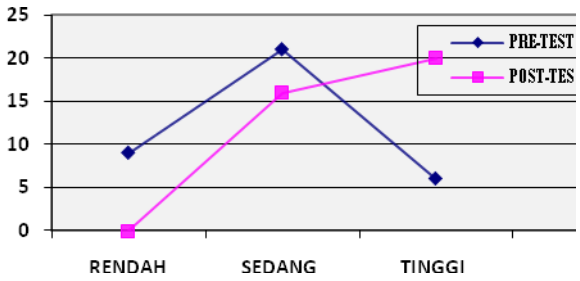


Figure 1. Changes in the Pattern of Frequency of Kb-iM

The graph shows that the highest frequency of students who achieved the Kb-iM "moderate category" was higher than the posttest. At the end of the study it turned out that the level of intuitive thinking ability was at least at a moderate level.

This description also supports the role of realistic mathematical approaches to support the development of mathematical intuitive thinking skills that are very important for mathematics learning, both at the school and college level. Mathematical conclusions are not always fully supported by the basics of the theory, such as the existence of an understanding of the base that is accepted or agreed upon as something truth. Basically, intuition as an action to get a meaning, significance, structure or situation from a problem without dependence explicitly on analytic tools owned by an expert, has worked a lot on a problem over a long period of time, and can immediately provide several alternative approaches to resolve the problem.

Based on the theoretical foundation and the concept of intuitive thinking ability mathematically wasformulated 4 indicators as the basis for developing instruments. The frequency data obtained from the Kb-iM post-test scores from 36 samples through the test instrument based on the 4 indicators are presented in Table 3.

Table 3. Test Instrument Based on the 4 Indicators

Category / Indicator	Low *(x ≤ 2.9)*	Middle *(2.9 <x <3.5)*	High *(x ≥ 3.5)*	Total
Indicator-1	7	17	12	36
Indicator-2	0	4	32	36
Indicator-3	8	8	20	36
Indicator-4	15	9	12	36
Total	30	38	76	144
Percentage (%)	20.8	26.4	52,8	-

From Table 3, there were 20.8% of students whose mathematical intuitive thinking ability was in the low category for all 4 indicators; 26.4% in the medium category and 52.8% in the high category (Figure 2)

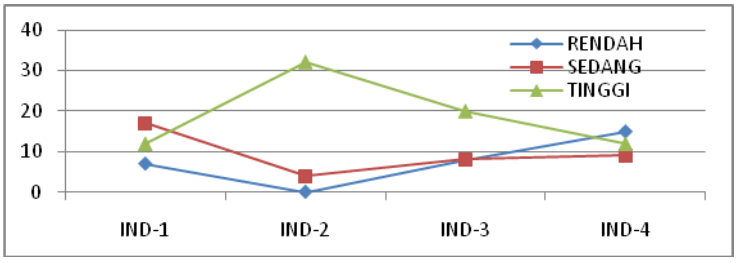


Figure 2. Frequency Based on Kb-iM Categories and Indicators

In indicator 1 the highest frequencies is Kb-iM in the category of "moderate", on indicators 2 and 3 are

in the category of "high", on indicator 4 is the category of "low" from Kb-iM.

From some of the descriptions and data analysis carried out above, it shows a relatively similar phenomenon, namely supporting the theory of the influence of the application of realistic mathematical approaches to the improvement of students' mathematical intuitive thinking skills. Data analysis in general or based on indicators, or the comparison between the pretest and posttest results Kb-iM supports this conclusion. This result was relevant to Hirza's research, that there were differences in the increase in intuitive abilities of the student groups taught with realistic mathematics with conventional methods, where the increase in realistic mathematics learning was higher than conventional learning. That intuitive thinking ability can play a role in developing mathematics itself, including the formal structure of mathematics, geometry and checking the truth of formal evidence in mathematics, even that intuition makes us suspect that there is an error in "evidence".

Based on some of the sources of the above-mentioned errors, the mistakes made by some students were the tendency of students not to get used to solving problems quickly and intuitively. In the case of a realistic mathematical approach is an approach that was able to build constructive activities, build informal mathematical knowledge towards formal, reflection of an independent mindset, and refract self constructing knowledge and skills towards structured forms.

In general, learning learners at the school level only take place based on algorithms and routine formulas that are remembered and applied to solve problems. As a result, they lose some aspects to support mathematical intuitive thinking, namely: (1) losing feeling in the form of ideas in the mind to get spontaneous answers, (2) losing intrinsic power, namely ideas in strategic thoughts to make decisions produce spontaneous answers, and (3) losing the power of the intervention that is the idea of thinking of linking previous knowledge to make strategic decisions produces spontaneous answers.

4. Conclusion and Suggestions

4.1 Conclusion

1) The application of realistic mathematics learning approaches can improve students' intuitive mathematical thinking skills,

2) The effectiveness of the use of mathematical approaches in learning can improve the ability of students to think intuitively mathematically and there are no more students who have the ability to think intuitively in the low category,

3) The source of errors in solving problems is caused by the habit of algorithmic thinking and the use of routine formulas that become learning habits at the school level.

4.2 Suggestion

1) It is necessary to cultivate the application of a realistic learning approach to materials that have relevant characteristics, especially those that require mathematical intuitive thinking skills.

2) Need to design forms of student / student task questions that can foster mathematical intuitive thinking skills early on at the school or college level.

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References

Abiding, Z. (2015). *LenteraIlmuCendikia, Jakarta*.

Bell. (1981). *Teaching and Learning Mathematics* (In Scondary). Wm. CBromm Co. Iowa: USA.

Bonita, H., & Yaya. (n.d.). *Intuition in Mathematics Learning*.

Burke, & Milner. (1999). *Taking the Mystery Out Of Intuitive Decession Making*. https://doi.org/10.5465/ame.1999.2570557

Dane, & Pratt, M. G. (n.d.). *Exploring Intuition and its Role in Managerial*. London: Academy of Management Review.

Dow, M. A. (1990). *A Unified Approach to Developing Intuition in Mathematics*. Maharishi International University, Fairfield, Iowa.

Gie, L. (1999). *Mathematic Philosophy*. Yogyakarta: Pusat Belajar Ilmu Berguna.

Hudojo, H. (2000). *An Effort to Improve Students' Capabilities in Learning Mathematics*. Universitas Negeri Malang.

Kusuma, dan S. (2012). *Optimizing Mathematical Thinking Ability through Mathematical Problem Solving*.

Kusumah, S., & Zulkardi. (2014). *Improving Intuition Skill With Realistic Mathematics Education* (Vol. 5, No. 1). Indo MS-JME. https://doi.org/10.22342/jme.5.1.1446.27-34

Meier, H. (1985). *Didactic Mathematics Compedium*. Bandung: Remaja Karya CV. Yogyakarta: UNY.