The development role of mathematic intuition principles in mathematical problem-solving

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Abstract. This research is descriptive explorative with a qualitative approach, aim to know the role of student intuition development in solving a math problem. Data collection methods triangulate data through tests, interviews, and documentation. The subject of the research is a mathematics education student of the Muhammadiyah University of Cirebon. The population of the subjects was 70 students and then selected who had the initial ability of mathematics in a number of 35 people, after which selected 1 female student whose TPMM and TPA is medium and has good mathematical delivery. The results of this study indicate that the role of the development of student intuition in solving mathematical problems is: First. Subjection using intuition is self-evident intuition, ie, statement, representation, or interpretation is considered the subject right by itself, the subject feels no need to show/prove formally the truth of the statement, its representation, or its interpretation. Second. Subjects use certainty's intrinsic intuition, ie the subject assumes a statement, its representation, or its interpretation, a certainty, no external support (formal or empirical to obtain it). Third. Subjects use the intuition of globality, that is, the subject sees it as a whole in carrying out its plan or global, whether object, concept, or knowledge of its parts. fourth. Subjects use extrapolative ness intuition, ie the subject views certain interpretations, decisions or conclusions based on insufficient information or data. It is proved that the subject is not intact in making problem-solving plans.

1. Introduction
Mathematics is a science that can provide a bridge of knowledge to other sciences, conceptual integrity and the need for mathematical disciplines largely contribute to the advancement of science and technology during this milenial era. In the development of the world of mathematics education also contains elements of intuition that can be developed for scientific contributions in the field of mathematics education. The intuition referred to in this study is immediate cognition, namely a concept without going through the rigorous process and without using procedures or strategies in mathematics. The meaning of intuition in the Wikipedia online dictionary, intuition is receiving input and ideas without knowing exactly how and where you got them from. This means that intuition works to obtain input and ideas/ideas without knowing clearly how and where to get them. Jung also stated that intuition is one of the cognitive functions among three other functions, namely: thought, feeling, and sensation [1]. Bunge, Zeev, and Star [2] states that intuition is reasoning (reason), which has characteristics catalytic inference, synthesis strength, and common sense. The catalytic inference is a shortcut from proposition to other propositions, namely by combining the premise and intermediate.
The power of synthesis is the ability to clamp heterogeneity or elements that are scattered into the room overall harmony or harmony and common sense is a consideration supported by general knowledge. In the Oxford English Dictionary echoes that intuition is knowledge or mental perception which, in direct fear without interference from any process of reasoning, there is no intuition that is knowledge or mental understanding that happens just like that (instant fear) without the intervention of the thought process or punishment.

Westcott and Ranzani state that Intuition is also the best creative process needed [3]. In this case, the individual naturally does extrapolation or generalization with the help of intuition to reach conclusions. Fischbein [4] reveals that intuition as a predictive cognitive tool is used to effectively find the most pragmatic strategy when performing a particular task, intuition as a tool used to build mind / theory and is very effective in finding the right strategy to deal with or doing special tasks (including when facing and finding strategies in mathematical problems). Wild [1] said that intuition is an idea to reach a conclusion, a synthesis process, a formulation process, or problem-solving without awareness of the process so that conclusions or synthesis are achieved. Fischbein [6] suggested that in analyzing students' mathematical behavior, there are three aspects that must be taken into account, namely the formal aspects (definitions, theorems, etc.), algorithmic aspects (standardized solving and strategy techniques), and intuitive aspects (subjective acceptance of concepts, theorem, or mathematical solution).

Fujita, et al [7] said that the notion of intuition "It might be difficult to define" intuition "appropriately, we think of it as a skill to 'see' space figures and geometry, create and manipulate them in mind to solve problems in geometry". Brunner [8] defines intuition as intuition implies an act of capturing the meaning, meaning or structure of a problem or situation without explicit belief in one's analytical skills. The truth or mistake of intuition is ultimately decided not by intuition itself but by the usual method of evidence [9]. Furthermore, Bruner stated that in mathematics, intuition is used with two rather different meanings. On the one hand, an individual is said to think intuitively when he has worked for a long time on a problem, rather he suddenly reaches a solution, before giving formal evidence. On the other hand, an individual is said to be a mathematician with good intuitiveness if, when other people come to him with questions, he can make guesses quickly and very well, or from several approaches to a problem his decision will prove useful.

The notion of problem-solving is the process of applying various skills and cognitive actions to a problem, which is intended to get the right solution from solving the problem. And also said that problem solving is a set of actions taken to find a way out of a problem. This was revealed by Shumway [10] who defines problem-solving as "the set of actions taken to perform the task (i, e., Solve the problem). Cognitive psychologists like Solso [11] define problem-solving as directed thinking in solving a particular problem that involves both the formation of responses and the choice between possible responses.

Looking at the theoretical basis and the problems described above, it is necessary to know how the intuition characteristics of students of mathematics students in using their intuition at the stage of making a plan for solving mathematical problems, when they try to solve mathematical problems with basic mathematical discussion through the problem-solving steps. Polya [12] developed a problem-solving procedure in four steps, namely: (1) analyzing and understanding problem, (2) designing and planing a solution, (3) exporting solutions to difficult problems, (4) verifying a solution. Therefore, it is important to do very interesting research with the title "the role of developing the principle of mathematical intuition in solving mathematical problems"

2. Method
This research method is explorative descriptive with a qualitative approach, aims to determine the characteristics of student intuition in making mathematical problem-solving plans. Data collection methods are data triangulation through tests, interviews, and documentation. The research subject was a student of mathematics education at the Muhammadiyah University of Cirebon. Subject population amounted to 70 students and then were selected who had an initial mathematical ability amounting to
35 students after that 1 student was chosen whose TPMM and TPA were being and had good mathematical delivery. The results of this study indicate that the role of developing student intuition in solving mathematical problems.

3. Result and discussion

3.1. Question mathematic problem solving

A Hexos candy company has three sales stores in the city of Cirebon. Each shop provides 100 boxes of candy. One box consists of 15 large packs. One large pack contains 12 small packs. The price of one small pack of candy is Rp. 7,500. The Hexos candy company, costs from each store for the following purposes:

- a. 25% to pay employee salaries
- b. 20% for capital and raw materials
- c. 10% for store operating costs

Asked:
1) If all Hexos are sold out, how much is the sale of one store?
2) What is the net profit of the Hexos candy company from the 3 stores?

Subject Answer Results In accordance with the data exposure of students' mathematics education intuition in solving mathematical problems, female subjects at the stage of understanding the problem are:

- 1 city = 3 shops, 1 shop = 100 boxes of candy
- 1 box of candy = 15 large packs of candy
- Price of 1 small package = Rp. 7,500

The question is if all the HEXOS candy is sold out, what is the sale of one store, and what is the net profit of the Hexos candy company from the 3 stores. Here it is clear that the price of 1 pack of large candy with a capacity (12 small bugs) is Rp. 7,500, × 12 = Rp. 90.000.

- Price of 1 carton (15 large packs) = Rp. 90.000, × 15 = Rp. 1.350.000.
- Sales of 1 store = Rp. 1.350.000 × 100 = Rp. 135.000.000.
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- Price of 1 box of candy with capacity (15 large packs) = Rp. 90.000 × 15 = Rp. 1.350.000,-
- and sales proceeds for 1 shop Rp. 1.350.000,- × 100 = Rp. 135.000.000,-
- So the result of 1 store is Rp. 135,000,000.
- As for sales results from 3 stores are Rp. 135,000,000,- × 3 = Rp. 405,000,000,-

3.2 Discussion of the results of this research interview shows that the role of developing student intuition in solving mathematical problems. Can lead to the role of intuition including the following:

![Figure 1. TPMM 1 Students’ answer for number 1](image-url)
Figure 2. TPMM 1. Students answer for number 2

Figure 3. TPMM 2. Students’ answer for number 1

Figure 4. TPMM 2. Students’ answer for number 2
Discussion of questions and answers to interview results

Figure 1. Answer for number 1 From the results of the interview above, it can produce that the role of intuition produced is four subjects in developing the role of intuition development, including The subject uses the role of developing self-evident intuition, that is, the statement, representation or interpretation is considered to be true by itself, the subject feels unnecessary show/formally prove the truth of the statement, representation, or interpretation.

The results of the interview with the subject, that the subject understands the question is about what was asked from the question, that is, if all Hexos candies are sold out, then what is the sale of one shop, then what is the net profit from the Hexos candy company from 3 stores is that? according to Fischbein if the subject understands the problem in a sudden manner then this can be called intuition. What the subject knew about the matter was that there were companies that had 3 shops, from each store could provide 100 boxes of hexos, one box of candy consisted of 15 large candy packs, 1 large packet containing 12 small packs and 1 packet sold at a price Rp 7,500,-

As according to the subject that was asked was if all hexos candy sold out, what was the sale result from that one shop, and what was the result of the net profit of the hexos candy company from the 3 stores. Here it is clear that the price of 1 large candy pack with capacity (12 small bugs) is Rp.7,500, \times 12 = Rp. 90,000. Price of 1 box of candy with a capacity (15 large packs) Rp. 90,000, \times 15 = Rp. 1,350,000. and the proceeds of sale for 1 shop Rp. 1,350,000, \times 100 Rp. 135,000,000. So the results of 1 shop are IDR 135,000,000, - for the proceeds from the sale of 3 stores, IDR 135,000,000 - 3 = IDR = 405,000,000.

While the proceeds from sales of 3 bakeries are Rp. 347,500,000, - with details of the sale of 1 bakery Rp. 150,000,000 x 3. Rp. 450,000,000, - reduced spending 1 store 675,500,000, - x 3. Rp. 202,500,000, - so the sale of 3 shops is spent on spending 3 stores Rp. 450,000,000 - 202,500,000, - = 247,500,000, -

According to the subject matter, the problem is easy to understand because the problem is about life that is often encountered every day, the subject understands that this question relates to how much profit from one shop and how much the net yield is from the 3 Hexos candy stores. and the subject immediately understood the point of this matter, the point was to ask what was the sale of one shop if all Hexos candies were sold and also what was the profit of the Hexos candy company from 3 stores, with expenses already set at 25% for employee salaries, 20% for capital and raw materials and 10% for store operational costs. If you see the income from one of these stores is IDR 135,000,000, and also income from 3 stores is IDR = 405,000,000, - from here the subject sees the store as having an expense of 25% for employee salaries, 20% for capital and raw materials and 10% for store operational costs. Whereas for bakeries the expenditure is 20% for employee salaries, 15% for capital and raw materials, and 10% for store operations.

3.3 Discussion of the results of the first discussion
From the results of the interview presentation above it can be concluded that the role of intuition produced by the subject in developing the role of intuition development, including the subject uses the role of self-evident intuition development, namely, statements, representations, or interpretations are considered true subjects by themselves / formally prove the truth of the statement, representation or interpretation. then the subject uses the role of certainty intrinsic intuition development, namely the subject in making plans to solve mathematical problems assuming statements, representations, or interpretations, a determination (certainty), there is no need for external support (formal or empirical to obtain it), evidenced by describing that the subject's cognition is accepted as an individual feeling without requiring further checking and verification. And this is cognition whose statement of truth is received directly. It was proven by the statement from the subject that in the process of understanding the mathematical problems of TPMM1 and TPMM2 the subject felt that what he believed was correct, there was no need to use an external support role in understanding the problem-solving the problem.
As for making a plan to solve a subject problem that has been planned in answering the question, it is correct and does not change the answer.

3.4 Discussion of the results of the second discussion

From the results of the interview presentation above it can be concluded that the role of intuition produced by the subject in developing the role of intuition development, including the subject uses the role of developing intuition globalization, namely the subject as a whole in carrying out the plan or globally, both objects, concepts or knowledge - part of it. then the subject uses the role of extrapolative intuition development, namely the subject in making plans to solve mathematical problems by looking at certain interpretations, decisions or conclusions based on insufficient information or data. It was proven that the subject was not intact in making a problem-solving plan based on the Polya stage [12]. It was proven by a statement from the subject that in the process of carrying out the plan globally, when the subject saw the mathematical problems of TPMM 1 and TPMM 2, the subject feels that what he is doing in a global way is in its entirety in carrying out the completion plan correctly, so sometimes the subject views a content matter only at a glance and not enough information about the parts of the question. As for checking the answer again by not using intuition because the answer is checked again by matching the answer with the initial idea repeatedly in answering the problem.

4. Conclusion

The conclusion of this study can show that the results of intuition by students is to produce several roles for developing student intuition in solving mathematical problems. The first subject uses the role of developing intuition by using the intuition of self-evident interpretations. The second subject uses the role of developing intrinsic certainty intuition. The third subject used the role of developing an intuition of globalization intuition, the subject used the role of developing an intuition of globalization intuition. The three subjects used the role of developing extrapolative ness intuition.

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