Intuition characteristics of junior high school students with rational personality types in solving HOTS mathematical problems

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Abstract. Mathematics has a vital role in development in all aspects of life. Through mathematical modeling, students can be trained to think critically and creatively in solving problems related to everyday life. The habit of critical thinking using intuition can help determine the initial steps and bring up creative ideas in solving the problems they face. This study aims to describe the characteristics of the intuitive reasoning model of students of rational personality types in solving HOTS problems in mathematics. The subjects in this study were grade VIII students of Junior High School Daha 1 Pawyatan Kediri, who had been selected based on rational personality types through Kiersey's personality test. The intuition data used by the subjects in this study were collected using task-based interviews. The results of this study are that the subjects did not rewrite the critical things on question when answering, such as, what is known and what is asked by arguing that this is usually true. In general, the subjects in this study used an implicit intuitive reasoning model and diagrammatic model to solve the HOTS problem given.

1. Introduction
Human awareness of the importance of the continuity of humans and the universe was marked by the convening of the United Nations Conference on the "Human Environment" (Stockholm) in Stockholm, Sweden in 1972. This conference became a driving force for humans to focus their attention on environmental issues (Policy Research Center, 2012). The same thing applies to development carried out by the government and the people in Indonesia in the form of physical development and non-physical development. Such as physical facilities and infrastructure (buildings, bridges) needed to support the mastery of science and technology. Likewise, the development of non-physical development, such as building systems and improving the quality of resources that are no less important, will be used for management. This development cannot be separated from the development of science and technology. There are always positive and negative impacts in every development. The concept of sustainable development is considered as an answer to overcome the negative impacts of development. Education can accelerate sustainable development, because through this way perceptions, behaviors and attitudes will change. The concept of Education for Sustainable Development (ESD) emerged as an answer to achieving the desired development [1].

Through Permendikbud No.20 of 2016, Creative, productive, critical, independent, collaborative, and communicative thinking and acting skills are skills that must be possessed by junior high school graduates. [2]. Thinking skills like these are very important for students to deal with ongoing problems. De Bono defines that creative thinking is a combination of analytical and intuitive thinking. De Bono
noticed that the two hemispheres work synergistically and together or not separately. One of the compulsory subjects in school is mathematics. Mathematics is knowledge that originated from the induction of facts in the world and has certain characteristics from other knowledge. Its characteristic is that mathematics has research objects that are abstract, deductive, and consistent [3]. Because mathematics has abstract studies, it requires a good learning process from students.

In mathematics, no matter how appropriate and good the mathematics teaching material is applied, it does not guarantee the achievement of the desired mathematics learning goals [4]. In terms of learning mathematics all elements are interconnected, namely the teacher and students are required to carry out the process of thinking to solve problems related to mathematics. The human mindset in developing knowledge has two ways, namely the analytic method which is divided into two types of reasoning, namely inductive and deductive reasoning, and in non-analytic ways in the form of intuition [3]. Solving mathematical problems requires many solutions to get the desired results. Math questions have different levels of difficulty. Questions that require deeper thinking are about Higher Level Thinking Skills (HOTS).

Higher-Order Thinking Skills are students' thinking processes at a higher cognitive level developed from various cognitive and learning concepts and taxonomy methods such as problem solving methods, blooming taxonomies, and learning, teaching and assessment taxonomies [5]. These higher-order thinking skills include problem solving skills, creative thinking skills, critical thinking, argumentation skills, and decision making skills. According to King, higher-order thinking skills include critical, logical, reflective, metacognitive, and creative thinking, while according to Newman and Wehlage [6] with high-level thinking students will be able to distinguish ideas or ideas clearly, think well, be able to solve problems, be able to build explanations, be able to make hypotheses and understand complex things more clearly.

According to Sumarmo [7], mathematical mindset has an important role in various aspects of life. Because in reality, through mathematics someone in this case the community can always think logically, critically, practically, be positive, and be creative and consistent. So, the ability to imagine, create, innovate must also be a measure of educational success today. In this case Bruner proposes a theory called free discovery learning [8]. According to this theory, the learning process will run well and creatively provide opportunities for students to find rules (including concepts, theories, definitions, etc.) This learning process is certainly not independent of the cognitive processes that take place during the learning process in class [9]. The cognitive processes according to Fischbein are formal cognition, algorithmic cognition, and intuitive cognition [10]. Intuitive cognition is defined as Fischbein as direct cognition with the characteristics of self-proof, intrinsic certainty, perseverance, coercivity, extrapolativeness, and globality. Intuitive cognition plays a role in providing informal meaning or interpretation of certain definitions and theorems (formal cognition), giving informal meanings or interpretations to certain formulas and procedures (algorithmic cognition), and contributing to making assumptions or claims in solving mathematical problems. Fischbein, E in his article divides the intuitive model into 4 models: implicit models, analogical and paradigmatic models, and diagram models.

The behavior of students in the class shows different responses when the teacher is teaching. There are students who always look active, want to be number one and calm when working on problems, but also seen some students who always look passive and do not want to pay attention to the delivery of material provided by the teacher. It can be concluded that each individual has a different behavior when participating in mathematics teaching and learning activities in class.

Some theorists and psychologists argue, the difference in the behavior of students in the classroom is the impact of their different personalities. [11] Some experts try to classify people into certain types, as in 1984 in his book Please Understand Me I and II, David Keirsey, classifying personality into 4 types, namely Idealist, Rational, Artisan and Guardian. There are students who are more introspective when receiving material, they put their brains above all else, and are more abstract in looking at the world. Because it is introspective, it is very important for him, to form a concept in him. The concept that he formed, can come from objective reasoning and not based on emotions (Thinking), as well as concepts formed based on feelings or emotions (Feeling)[12,13]. Keirsey called this introspective
student Rational. Students with a rational personality are individuals who are individual in everything from birth, always looking for reasons for each event they experience. They want to learn how things work. They begin their logical investigation early on and continue throughout life. Then do students who put their brains above all use their intuition? If he uses intuition, what intuition does he use when solving HOTS problems?

2. Methods
In this study, the research approach used was a qualitative approach, qualitative approach means that the data collected is not numbers, but in the form of interviews, documentation, field notes, etc. This type of research is descriptive research qualitative. To achieve this goal, the researcher took the subject of a student from Junior high school Pawyatan Daha 1 Kediri who was predicated on Pacasila-Integrated School. Determination of the subject to be observed was not random, but was taken based on the results of personality tests using Kiersey's personality questionnaire.

Tests are essay questions that are given to them to be done thoroughly. Each student is asked to work individually. After all students complete the assignment given, the researcher checks the work of students which leads to intuitive reasoning and classifies student work. Work results are grouped according to guardian, artisan, idealist, and rational personality types. Then the researchers conducted interviews with student who represented members of the rational personality type. The interview used is structured and unstructured interviews.

3. Result and Discussion
After the researchers found students with rational personality types, then the researchers offered math problems as well as task-based interviews.

**Problem:**
If you have 4 sticks of 5 cm, 10 cm, 12 cm and 13 cm each. How many triangles can you make using the stick? Also calculate the circumference of the triangle you made! (may work with the stick provided may also by drawing lines instead of sticks). The following are the results of the settlement made by the RB subject and the results of the interview

![Figure 1. Model diagrammatic](image)

Based on the RB answers that appear in the picture above it appears that the intuitive reasoning model used by RB in solving mathematical problems is a diagramatic model. This model feels easier to solve the problems faced if it begins with drawing.

![Figure 2. Model tacit/implicit](image)
In figure 2 it appears that the subject of RB uses the tacit / implicit intuitive reasoning model. This is seen when the subject does not rewrite important things such as what is known, what is asked, and the unit.

To conduct the triangulation step, researchers conducted interviews with RB. here I will show footage of the interview that has been done.

O: Alright, why did you start working on drawing?
RB: So it's easier, sir.
O: Is it difficult to use the available stick media?
RB: Maybe not sir, but I'm not sure.
O: Did the images help you find answers?
RB: Yes sir, the thing is I can do a direct check, what is my formula use fit to calculate this problem.
O: You did not write down what is known and what was asked, as well as the unit, why?
RB: You already have it in the picture, sir.
O: So you don't need to write it down?
RB: No sir. Enough here. (the subject points to the problem).

Based on the interview excerpt above, RB wrote the intentions of the problem implicitly, as if only RB understood the point, as written in the picture he made.

4. Conclusion
Mathematics in school is considered difficult and boring by some students. this assumption has been tried to be overcome by several experts by conducting studies related to learning methods. Another problem that is also influential is the problem of learning difficulties experienced by students originating from within and outside the student's self. by using a non-analytic piir pattern in the form of intuition, researchers try to dig up as much information as possible from class VII students of Pawyan Daha 1 Kediri as research subjects selected based on rational personality types. This study provides results that show that the subject did not rewrite important things in the question when answering, such as what is known and what was asked on the grounds that this is usually true.. In general the subjects in this study used an implicit intuitive reasoning model and diagrammatic model to solve the HOTS problem given.

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