Android-based application to evaluate gender differences in private high schools

F L Usman*, B Budiyono and D Indriati
Postgraduate School of Mathematics, Universitas Sebelas Maret, Jl. Ir. Sutami No.36 A, Surakarta 57126, Indonesia

*faizlatifusman@student.uns.ac.id

Abstract. Whenever a person has an idea in his mind but the idea is intuitively unacceptable, he substitutes his idea which are intuitively more effective and efficient. The substitutes are called intuitive models. The approach used in this study is the qualitative approach with a type of explorative-descriptive. The purpose of this study is to describe the intuition of private vocational students in terms of gender where the students' intuition is an intuitive model of students in solving mathematical problems with the PISA model. The subjects are mechanical engineering student in class XI of vocational high school and included high ability students in their class. This research using task-based interviews and result of student. Based on the result of the research in using intuition models, female student more uses models than male student. Female student uses trial and error to stimulate ideas from understanding problem to finding solution while male student only writes important point for him and not easy to communicate his ideas. It’s found that intuition can occur anywhere in solving problems. The product results from intuition in the form of ideas obtained by intuition models which function as a means to make it easier for someone to understand objects or concepts that are intuitively difficult.

1. Introduction
In the 21st century, education is an integration between knowledge, skills and attitudes, and mastery of information and communication technology. In this digital era, learning is integrated into nine forms of knowledge which are grouped based on three categories including foundational knowledge, humanistic knowledge, and meta knowledge [1]. The latest Indonesian curriculum is curriculum 2013 and has goals making students to develop their skill in challenging the current of globalization. Curriculum 2013 and 21st century learning has similar goals in developing student’s ability especially regarding aspects of meta knowledge (creative thinking) [1,2].

Creative thinking is a combination of several processes to produce an unique or original ideas and intuitive solutions [3]. This is also one of the goals in curriculum of KTSP 2006 that must be achieved even though it has changed to the latest curriculum. One of these goals is to develop creative activities that involve imagination, intuition, making predictions, and trial and error [4]. Based on engineering experts in the current information age, learning creativity methods and problem solving heuristics is more important than acquiring additional discipline knowledge [5]. Vocational high school realized that entrepreneur will be one of their careers and it’s important to have creative abilities that produce unique ideas and intuition solutions in solving a problem [6]. According to that, no genuine creative activity is possible in science and mathematics without intuition [7].
Intuition is frequently defined as immediate cognition, quick exploration of thinking strategies and experience-based [8-10]. Intuition is formed based on experiences or current knowledge because knowledge is fundamental factor to shape intuition. So, the more experience is gather, the more accurate intuition will become. The intuition used in this article is an intuitive model that is assumed to be a bridge between imagined concepts (forms of cognitive processes) with intuitive solutions that are useful for determining steps or strategies. Models represents an essential tool. Whenever a person has an idea in his mind but the idea is intuitively unacceptable, he substitutes his idea which are intuitively more effective and efficient. The substitutes are called intuitive models. So, Intuitive models are interpreted as something or an essential tool to help someone understanding about concepts with more intuitively accessible when the emerging concepts or ideas become difficult to imagine [11].

The intuitive model used by researcher referring to Fischbein's opinion, such as: (a) tacit model is representation, interpretation selected and created implicitly and automatically assumed to help facilitate finding a solution, (b) analogy model is representation, interpretation or manipulation of tool selected and created by other systems concepts that have similarity with specific concepts, (c) paradigmatic model is representation, interpretation or manipulation of objects contained in the class of systems being modeled and (d) diagramatic model is representation, interpretation or manipulation of objects through diagrams, pictures or graphics [12].

Conscious mental process such as logical and analytical thinking in solving mathematical problems and intuition sync with each other. Logical and analytical thinking will filter out intuition (as form of idea or schema), so they will synchronize with each other to point the right solution [13]. The main concern has to be the conversion of cognitive process in long-term memory into intuitive efficient tools (intuitive models). Because of this, intuition is used as bridge to understand a problem and in order to facilitate the finding of solution. Based on the results of the research, one of the factors in engineering students failing to solve a problem is mathematical intuition leading to improper solutions [14], but the student has similarities using intuition which are in the form of intuitive efficient tools (try use symbolic and graphical representations). The research about gender differences in philosophical intuitions, these differences had been almost entirely unrecognized [15]. According to these, researcher try to describe the intuition models of private vocational students in terms of gender in solving mathematical problems.

2. Method
The approach used in this study is the qualitative approach with a type of explorative-descriptive research. The purpose of this study is to describe the intuition of private vocational students in terms of gender where the students’ intuition is an intuitive model of students in solving mathematical problems with the PISA model. The researcher acts as a key instrument because the researcher tries to conduct a careful, in-depth examination (by exploring) of the students about what is done, written, drawn, spoken, body movements, or even what they are thinking. Interviews are used to explore students about what they do which is task-based interviews. The subjects are mechanical engineering student in class XI of vocational high school and included high ability students in their class. The subjects used by researchers are two sample with a male student with the initials VK and female students with the initials LD.

3. Results and discussion
Problem related to mathematics problem with model of PISA about lampung theme. The Problem is taken from article of Putra et al. as follows [16]:

Every year, the height of Mount Anak Krakatoa increases by 20 feet. The increase in the height of the mountain is due to the material coming out of the lava hole. Nowadays, the height of Mount Anak Krakatoa reaches around 230 meters above sea level, while the height of Mount Krakatoa was 813 meters above sea level before Mount Krakatoa erupted. So, in what year will the height of Mount Anak Krakatoa be the same as Mount Krakatoa before it erupted? Explain your answer. (Remarks: 1 foot = 0.3048 m).
Figure 1. VK’s solution about model PISA problem.

Based on figure 1 about VK's answer, the intuitive model used by VK was obtained in solving problems, which is the tacit model and the analogy model. The first aspect, when VK understands the problem begins with writing what is known about the problem but actually without writing it already understands the problem. VK is not too fluent in communicating an idea because VK always explains the results of the calculation after the solution is found by him. Second Aspect, VK uses a similar concept based on its experience when working on problems regarding the application of the concepts of speed and distance.

Next the researcher conducted an interview to summarize the data from the answers to the subject. The interview footage is presented in the following table.

Table 1. Result of activity interview with subject VK.

| Code | Interview Result |
|------|------------------|
| P1   | Do you understand this problem? Try to tell how you solve it. |
| VK1  | Understand, sir, I was trying to read the matter once. Then, I repeated the sentence that I didn't understand. It run out this way (while showing the equivalent sentence of 1 foot to meters) ... 20 feet ... it's like this ... (silent and thinking of composing sentences) |
| P2   | Do you feel confident or doubtful about your solving? |
| VK2  | Actually, sir, I'm doubtful about the calculation, but I feel confident about that method. |
| P3   | Have you worked on the problem before? |
| VK3  | I feel like I've been in elementary school ... it seems ... like about velocity or distance. |
| P4   | Can you explain the relationship between the concept of velocity or distance with the concept of solving this problem? |
| VK4  | It's hard to explain, sir (scratching his hair), yeah, the point is just that hehe... I feel the connection is so... |
| P5   | In your opinion, do you need to write down what is known or asked? |
| VK5  | It depends, sir, sometimes written and sometimes not. I am even happier if I immediately do the calculation. |
| P6   | Why do you immediately calculate the difference between the height of Mount Krakatoa and the Mount Anak Krakatau? Please explain. |
| VK6  | Yeah, like that, sir. Wait, sir ... (thinking of putting together sentences and needing about 5 minutes) |
| P7   | Do you really believe that your solution is correct? |
| VK7  | Sure, sir ... wait, sir (while looking at the answer sheet itself) ... at the moment it means 2019, right.... then sum up ... sir, I am sure that the solution is correct... hehe |
| P8   | Do you think of other ways to solve this problem? |
| VK8  | No, sir.... |
Based on interview footage in table 1, VK solved mathematical problems using the tacit model and analogy model. VK in understanding the problem given has received an overall picture of how to get a solution and is spontaneous but still doubts whether the solution is correct or not (VK believes that the formula used is correct) is seen in section VK2. VK once felt working on a problem that resembled the concept but about the application of distance and speed (doubtful to his memory) was seen in the VK3 section.

![Figure 2. LD’s solution about model PISA problem.](image)

Based on figure 2 about LD answers, the intuitive model used by LD in solving problems which is diagrammatic models, analogy models, tacit models, and paradigmatic models. LD in understanding the problem begins by writing down what is known and what is asked because it has become a habit taught by the teacher. The first aspect, LD drew two mountains. The second aspect, LD tried to calculate the height of Mount Anak Krakatau from 2019 to 2021. The third aspect, LD changed the way by calculating the height difference between Mount Krakatoa and Mount Anak Krakatoa without explaining the usefulness of the calculation of the difference. The fourth aspect, LD made a change of concept from calculating the height of Mount Anak Krakatoa in 2019 to 2021 to the concept of finding the difference between the two mountains.

Furthermore, the researcher conducted an interview to summarize the data from the answers to the subject. The interview footage is presented in the following table.

| Code | Interview Result |
|------|------------------|
| P1   | Why do you need to draw the mountain first? |
| LD1  | Confused about the problem, sir, so that I can compare the two mountains and find out about what is being asked for. |
| P2   | It means that by drawing first it is faster to understand, but if not by drawing can you understand? |
| LD2  | Yes, I can, sir, but it needs long time to understand it. |
Table 2. Cont.

| P3 | When calculating the height of Mount Anak Krakatoa in 2019, 2020 and 2021, why do you immediately calculate the difference in height between the two mountains? |
| LD3 | Yes, sir, after I read the problem again, I immediately thought about the way because it will take a long time if counting one by one, sir. |
| P4 | If the calculation is continued, it can find a solution? |
| LD4 | Yes, I can, sir, but takes so long time. |
| P5 | Previously, when calculating the height in 2019 to 2021, did you ever work on the same problem? |
| LD5 | Yes, sir, but the problem is different because it's been a long time |
| P6 | Did the idea or method emerge after trying to calculate the height in 2019 to 2021? (while pointing at the subject's answer) |
| LD6 | Yes, sir, actually I wanted to continue but it takes long time, sir. Then, I looked at the picture and the idea immediately appeared sir |
| P7 | Ok. Why isn’t it explained why you have to find the difference between the heights of the two mountains? |
| LD7 | No need, sir, because later, it will be clear in the last calculation (while pointing at the final solution to the answer). |

Based on interview footage in table 2, LD resolves mathematical problems using diagrammatic models, analogy models, tacit models and paradigmatic models. In section, LD1 uses images to solve problems in this case to stimulate the first idea. The analogy model occurs in section LD5, which is LD utilizes his experience even though it is only a second stimulus of ideas. The second idea appears suddenly and immediately so that shows in the LD6 section using the tacit model. LD uses the paradigmatic model indirectly when LD uses the concept of calculating the height of Mount Anak Krakatoa in 2019 to 2021 to change to the concept of looking for the difference between the two mountains (e.g., LD5 and LD6).

Based on the results of tests and interviews, subjects with male gender have an intuition models using the tacit model and the analogy model. The tacit model used by male gender subjects when understanding problems. He felt confident about the idea or concept that would be used to solve the problem but the subject still felt doubtful about the calculation. The analogy model is used to reflect concepts based on prior experience or knowledge that affect the idea’s exit and are stored in long-memory. Subjects with female gender have intuition models using diagrammatic models, analogy models, tacit models and paradigmatic models. This diagramatic model is used to help subjects to understand problems and to stimulate ideas with intuitive solutions. The analogy model used by subjects with female gender is the same as male gender. The tacit model used by female gender occurs when solving problems. This model arose after she reflected the result of trial and error so that ideas appeared spontaneously. The idea is the result of intuition that grows from experience or knowledge as a result of reflective thinking [7]. This Paradigmatic model appears only briefly which is then replaced with the idea produced by the tacit model because it is more practical.

4. Conclusion
Based on the research finding and discussion that has been described above it can be concluded that in using intuition models, female student more uses models than male student. Female student uses trial and error to stimulate ideas from understanding problem to finding solution while male student only writes important point for him and not easy to communicate his ideas (take time to write his ideas). Based on these results, it is found that intuition can occur anywhere in solving problems. The product results from intuition in the form of ideas obtained by intuition models which function as a means to make it easier for someone to understand objects or concepts that are intuitively difficult. The suggestion based on this research is to reintroduce intuition that has been lost in mathematics education because according to Albert Einsten intuition is the only most valuable and best gift given to humans.

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