Students’ thinking level based on intrapersonal intelligence

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Abstract. This research aims to determine the students' thinking level based on bloom taxonomy guidance and reviewed from students' Intrapersonal Intelligence. Taxonomy bloom is a taxonomy that classifies the students' thinking level into six, ie the remembering, understanding, applying, analyzing, creating, and evaluating levels. Students' Intrapersonal Intelligence is the intelligence associated with awareness and knowledge of oneself. The type of this research is descriptive research with qualitative approach. The research subject were taken by one student in each Intrapersonal Intelligence category (high, moderate, and low) which then given the problem solving test and the result was triangulated by interview. From this research, it is found that high Intrapersonal Intelligence students can achieve analyzing thinking level, subject with moderate Intrapersonal Intelligence being able to reach the level of applying thinking, and subject with low Intrapersonal Intelligence able to reach understanding level.

1. Introduction
Mathematics is the main source of other knowledge since it has been used importantly in sciences and technologies development [1, 2]. Mathematics is a required learning objective and attached in every class purposively, starting from elementary school, high school, and college, especially in engineering field due to its importance [3, 4]. Mathematics is genuinely related in problem solving [5]. Mathematical knowledge plays an important role in supporting a large number of engineering courses and subsequently, it is vital for engineering students to embrace a strong mathematical problem solving abilities that can keep their motivation for reasonable progress of their engineering programs [6]. According to NCTM, mathematics learning is focus on problem solving [7, 8]. The current emphasis is on problem solving as a means to learn mathematical content and processes [7, 8]. However, mathematics teachers strongly agree if problem solving ability in mathematics is important as well. In teaching and learning process of mathematics, students who are able to solve each problem given to them, they are considered to be able to understand the underlying material.

Materials in mathematics are always related one to another so that students have to master perquisite concepts before jumping into the next material. For instance, the more complex the problem is given, the more perquisite concepts are needed to solve the problem [5]. This problem solving process is correlated to student’s cognitive domain. Metacognition in problem solving helps to recognize the presence of a problem that needs to be solved, to discern what exactly the problem is, and to understand how to reach the goal (solution) [9]. So, student’s ability to solve any problem in learning process is really important. For the successful solution of any complex problem-solving task, a variety of metacognitive processes is necessary; regulatory activities of planning, monitoring, testing, revising, and evaluating throughout problem solving, especially in making the mental representation and selecting and assessing the effectiveness of the strategies employed [9]. Due to
different characters in every mathematics problem, student’s responses are varied as well. Bloom stated that real recitation is actually the lowest level in thinking ability. There were higher levels which have to be mastered in order to achieve student’s competencies. Process antedates the Bloom's taxonomy, wherein the level of difficulty increases gradually from a mere ‘recall’ to an application of mind in ‘evaluation’ [10]. The taxonomy developed by Benjamin S has been revised by a group of educationists [11]. Classification of learning objectives within education that educators set for students use bloom taxonomy. To verify a student's cognitive level educator design cognitive domain within this taxonomy [12]. So, Bloom’s Taxonomy is a hierarchy structure to identify skills, starting from the lowest up to the highest. To be able to achieve the higher level, students have to pass the requirements in the lower level as well. Bloom's taxonomy of educational objectives happens to be one of the most often used models while designing the different training, learning and examination methods [13]. Blooms' Taxonomy cognitive thinking levels define into six domains from simplest to complex, are remembering, understanding, applying, analyzing, creating, and evaluating levels [14]. Those six levels from Bloom’s Taxonomy are described in brief explanation here: 1) Remembering, the lowest level is used for recitation ability in the latest materials which have been studied before. 2) Understanding, in this second level, understanding materials means to be comprehension ability. 3) Applying, in this third level, application directs to implementation ability toward information received by students in new contextual way in real life. 4) Analyzing, this fourth level means to be elaboration ability in order to sort learning objectives out into each aspects. 5) Creating, this level is appeared to be creation ability. 6) Evaluating, the highest level in Bloom’s Taxonomy means to be evaluation ability, making students able to give some sort of values and achievements whether it is good or bad in learning objectives based on indicators given [14]. Nevertheless, one of methods in describing and determining the quality of student’s thinking level in solving mathematics problem is using Bloom’s Taxonomy.

Problem solving ability of students is also influenced by other factors, such as intrapersonal intelligence. Intrapersonal intelligence is an ability to understand self and identity. Intrapersonal intelligence is the ability to understand oneself as well as one's strengths, weaknesses, moods, desires, and intentions [15]. This includes such skills as understanding how you are similar to or different from others, reminding yourself to do something, knowing about yourself as a language learner, and knowing how to handle your feelings [15]. Someone’s ability in understanding themselves would influence their own acts to find out the solution of a problem. The person with Intrapersonal intelligence causes one to distinguish their different feelings [16]. Intrapersonal factor significantly predicted personal goals too [17]. Therefore, it can be seen clearly through how someone tries to solve any problem by looking into their intrapersonal intelligence.

Build Flat Forms is one of materials which are delivered to students in VIII class. This learning objective is one of geometry material. Various questions based on problem solving ability could be created to determine student’s intrapersonal intelligence precisely so that it can be seen how far student’s thinking level is.

Hence, it can be concluded that the research aims to determine how far student’s thinking level to solve multiple problems in mathematics due to Bloom’s Taxonomy based on student’s intrapersonal intelligence in Build Flat Forms learning objective.

2. Method
This study used grounded theory, which is a suitable to analyze large quantities of unstructured or semi-structured data is qualitative [18, 19, 20]. To be able to determine how far student’s thinking level, this research is regarding to Bloom’s Taxonomy and based on student’s intrapersonal intelligence. Subjects are taken from the result of student’s intrapersonal intelligence questionnaire. Questionnaire consists of 40 questions. Based on the result, subjects are classified by high intrapersonal intelligence, moderate intrapersonal intelligence, and low intrapersonal intelligence which represent each level of intrapersonal intelligence. Those three levels of subjects then are given
by 2 questions of problem based test. The results are analyzed by Bloom’s Taxonomy. Triangulation method is used to examine validity of analysis result by using interview to each subject as well [21].

3. Result and discussion

Student’s intrapersonal intelligence questionnaire was used as instrument of determining subjects. The result from questionnaire was used to classify the subjects into three levels of intrapersonal intelligence namely high intrapersonal intelligence (HII), moderate intrapersonal intelligence (MII), and low intrapersonal intelligence (LII). Three students were chosen as representative of each level to do problem based test and give each clarification. The analysis of result showed that HII subject was able to achieve four levels in Bloom’s Taxonomy namely remembering, understanding, applying, and analyzing. MII subject was able to achieve three levels namely remembering, understanding, and applying. Then, LII subject was able to achieve two levels namely remembering and understanding.

3.1. High intrapersonal intelligence (HII)

High intrapersonal intelligence subject (HII) was able to achieve four levels in Bloom’s Taxonomy which are remembering, understanding, applying, and analyzing. The details can be seen in Figure 1 and Figure 2.

Figure 1. HII subject’s answer for number 1

Figure 2. HII subject’s answer for number 2

Figure 1 showed that HII subject was able to describe question scheme and put the size precisely. In this step, HII subject has already achieved the second level, understanding the question. HII subject then was looking for additional information to support the solution using interpretation of the question as well. The student was finding out the triangle’s height of prism’s base. In this step, HII subject has
already achieved analyzing level of information which has not been given by the question to find out the volume of prism. Then, student was applying the formula to determine the volume of prism as a solution of the question. In this step, student was coming back to the lowest level of, remembering the formula and applying it to the question.

Figure 2 showed that HII subject has already achieved in understanding the question, which is finding out the area of surface of stacked cuboids and pyramid. The first step done by HII subject was writing down the formula to determine cuboids area of surface. In this step, student has been remembering and has been applying the formula to solve the problem. Student was writing the area of surface formula of cuboids. Then student subtracted it with the top area of surface in cuboids in order to get it off the solution. The same step was used by HII subject to calculate pyramid’s area of surface. HII subject subtracted with pyramid’s area of base in order to get it off the solution. In this step, HII subject has already achieved analysis level. Subject knew that pyramid’s base and cuboids top were not included to stacked build’s area of surface. HII subject could also analyze additional information which has to be found before applying the formula by finding out the height of triangle as upright side of pyramid.

Based from interview result, HII subject could explain in detail about what he did. From the first question, HII subject explained that he had not solved the prism’s volume directly yet, but he had to find out the base triangle’s height first using Pythagoras theorem. Then, he could find out the prism’s volume. From the second question, HII subject could explain in detail due to surface area of stacked cuboids and pyramid, so that the area of top cuboids and base pyramid would not be calculated as well. Hence, HII subject substracted the total surface area with the area of top cuboids and base pyramid in his answer sheet.

Based on analysis result of student’s answer and interview, it can be obtained that students with high intrapersonal intelligence (HII) could achieve up to fourth level which is analyzing level based on Bloom’s Taxonomy, where student could explain an object learning into its definitive parts in this level [12, 14].

3.2. Moderate intrapersonal intelligence (MII)

Subject with moderate intrapersonal intelligence (MII) was able to achieve three levels in Bloom’s Taxonomy which are remembering, understanding, and applying. The details can be seen in Figure 3 and Figure 4.

![Figure 3. MII subject’s answer for number 1](image-url)
Figure 4. MII subject’s answer for number 2

Figure 3 showed that MII subject was able to describe question scheme and put the size precisely. In this step, MII subject has already achieved the second level, understanding the question. MII subject then wrote down the formula of prism’s volume directly without looking for additional information. In this step, student was coming back to the lowest level of, remembering the formula and applying it to the question. The written formula was right, but MII subject didn’t analyze the additional information, so that MII subject assumed that the hypotenuse of base triangle as the height of triangle as well.

Figure 4 showed that MII subject has already achieved in understanding the question, which is finding out the area of surface of stacked cuboids and pyramid. The first step done by MII subject was writing down the formula to determine cuboids area of surface. In this step, student has been remembering and has been applying the formula to solve the problem. The same step was done by MII subject in determining pyramid’s area of surface, but MII subject didn’t analyze that cuboids top and pyramid base area were not be calculated as well since the builds were stacked.

Based from interview result in the first question, MII subject could explain the direction of the problem in a good way, but MII subject could not analyze the information given and additional informations from the question first to solve the problem. So, MII subject was using the formula to calculate pyramid’s volume directly right after reading the question by using triangle hypotenuse as triangle height. From the second question, MII subject could explain all of the forms incleded in the question. MII subject tried to solve the problem using outlines one by one, starting from the surface area of cuboids and pyramid. But, MII subject did not analyze that the cuboids and pyramid were stacked so those two actually didn’t need to be calculated. MII subject added their surface area directly inorder to solve the problem.

Based on analysis result of student’s answer and interview, it can be obtained that students with moderate intrapersonal intelligence (MII) could achieve up to third level which is applying level based on Bloom’s Taxonomy, where student could use his concept in passing new situation and condition in this level [12, 14].

3.3. Low intrapersonal intelligence (LII)
Subject with low intrapersonal intelligence (LII) was able to achieve two levels in Bloom’s Taxonomy which are reciting and understanding. The details can be seen in Figure 5 and Figure 6 as well.

Figure 5. LII subject’s answer for number 1
Figure 6. LII subject’s answer for number 2

Figure 5 showed that LII subject was not able to describe question scheme. LII subject wrote down the formula of prism’s volume directly. In this step, LII subject has already achieved the second level, understanding the question and remembering the formula of prism’s volume. The written formula was right, but LII subject didn’t analyze the additional information, so that LII subject assumed that the hypotenuse of base triangle as the height of triangle as well.

Figure 6 showed that LII subject has already achieved in understanding the question, which is finding out the area of surface of stacked cuboids and pyramid. The first step done by LII subject was writing down the formula to determine cuboids area of surface. In this step, subject remembers the formula to solve the problem. LII subject was able to write the right formula, but LII subject didn’t analyze that cuboids top was not be calculated as well since the builds were stacked. LII subject wrote down the formula to find pyramid’s area of surface, but LII subject didn’t continue the steps to find the solution.

Based from interview, LII subject seemed still to be in doubt due to his answer. From the first question, LII subject could write the formula of prism’s volume correctly (base multiplied to height of the forms), but LII subject did not understand that difference in prism’s volume could change its formula as well. In his worksheet, LII subject multiplied all of the informations given directly without further analysis of prism’s shape and additional informations from the question. From the second question, LII subject could mention formula of surface area of cuboids and pyramid, but he could not find out the correct answer of pyramid’s surface area. So, LII subject could not solve the problem.

Based on analysis result of student’s answer and interview, it can be obtained that students with low intrapersonal intelligence (LII) could achieve up to second level, understanding level based on Bloom’s Taxonomy, where student could understand the direction of the problem in this level [4, 5, 12, 14].

4. Conclusion
Based on the aim of research and data analysis toward student’s thinking level in solving mathematics problem in Build Flat Forms learning objective using Bloom’s Taxonomy, it can be concluded that students with high intrapersonal intelligence could achieve fourth level of Bloom’s Taxonomy which is analyzing level. Then, students with moderate intrapersonal intelligence could achieve applying level and students with low intrapersonal intelligence could achieve understanding level.

Since each student has their own thinking level, it can be concluded that student’s ability in problem solving is different as well. Teachers are expected to determine student’s intrapersonal intelligence due to its importance as one of essential factors of student’s achievement in learning mathematics. Furthermore, if teachers are well prepared in designing the whole teaching and learning process and determining each student’s intrapersonal intelligence, the achievement in learning mathematics will definitely be optimal.

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6. References

[1] Young J R 2017 Technology integration in mathematics education: Examining the quality of meta-analytic research *International Journal on Emerging Mathematics Education* 1 71

[2] Fathurrohman M, Porter A L, and Worthy A L 2017 Teachers’ real and perceived of ICT supported-situation for mathematics teaching and learning *International Journal on Emerging Mathematics Education* 1 11

[3] Sundayana R, Herman T, Dahlan J A and Prahmana R C I 2017 Using ASSURE learning design to develop students’ mathematical communication ability *World Transactions on Engineering and Technology Education* 15 245

[4] Tanujaya B, Prahmana R C I, and Mumu J 2017 Mathematics instruction, problems, challenges, and opportunities: A case study in Manokwari regency, Indonesia *World Transactions on Engineering and Technology Education* 15 287

[5] Widodo S A, Pumami A S, and Prahmana R C I 2017 Team accelerated instruction, initials and problem-solves ability in junior high school *International Journal on Emerging Mathematics Education* 1 193

[6] Asshaari I, Othman H, Bahaludin H and Ismail N A 2012 Appraisal on bloom’s separation in final examination question of engineering mathematics courses using rasch measurement model *Procedia social and behavioral sciences* 6 172

[7] Bandura A and Adams N E 1997 Analysis of self efficacy theory of behavioral change *Cognitive theory and research* 1 287

[8] Pajares F and Miller M D 1994 Role of self-efficacy and self concept beliefs in mathematical problem solving: a path analysis *Journal of education of psych.* 86 193

[9] Kuzle A 2013 Patterns of metacognitive behavior during mathematics problem-solving in a dynamic geometry environment *International electronic journal mathematics education* 8 20

[10] Bhalerao S 2017 Bloom’s taxonomy reiterates pramana *Journal ayurveda and integrative medicine* 8 56

[11] Bumen N T 2007 Effects of the original versus revised bloom’s taxonomy on lesson planning skills: a turkish study among pre-service teachers *Review of education* 53 439

[12] Omar N, Haris S S, Hassan R, Arshad H, Rahmat M and Zainal N F A 2012 Automated analysis of exam questions according to bloom’s taxonomy *Procedia social and behavioral science* 59 297

[13] Singh D, Tripathi P K and Patwardhan K 2016 What do ayurveda postgraduate entrance examinations actually assess? - results of a five-year period question-paper analysis based on bloom’s taxonomy *Journal ayurveda and integrative medicine* 7 167

[14] Krathwohl D R 2002 A Revision of bloom’s taxonomy: An Overview *Theory into practice* 41 212

[15] Vongkrahchang S 2016 Effects of personal intelligence reading instruction on personal intelligence profiles of thai university students *Kasetsart journal social sciences* 37 7

[16] Behjat F 2012 Interpersonal and intrapersonal intelligences: Do they really work in foreign-language learning? *Procedia social and behavioral sciences* 32 351

[17] Rampullo A, Licciardello O and Castiglione C 2015 Intrapersonal factors effects on professional orientation and environmental representations *Procedia social and behavioral Sciences* 205 422

[18] Lawrence J and Tar U 2014 The use of grounded theory technique as a practical tool for qualitative data collection and analysis *Journal travel & tourism marketing* 31 417

[19] Prahmana R C I and Kusumah Y S 2016 The hypothetical learning trajectory on research in mathematics education using research-based learning *Pedagogika* 123 42-54

[20] Parakash E S, Narayan K A and Sethuraman 2010 Student perceptions regarding the usefulness of explicit discussion of structure of the observed learning outcome taxonomy *Adv. Physiol. Educ.* 34 145

[21] Prahmana R C I, Kusumah Y S, and Darhim 2017 Didactic trajectory of research in mathematics education using research-based learning *J. Phys.: Conf. Ser.* 893 012001