Profile of students’ generated representations and creative thinking skill in problem solving in vocational school

P M Fikri¹, P Sinaga¹, L Hasanah¹ and D Solehat²

¹Sekolah Pasca Sarjana, Universitas Pendidikan Indonesia, Bandung, Indonesia
²Pendidikan Fisika, Fakultas Ilmu Tarbiyah dan Keguruan, UIN Syarif Hidayatullah Jakarta, Indonesia

*Corresponding author’s e-mail: febifikri@gmail.com

Abstract. This study aims to determine profile of students’ generated representations and creative thinking skill on problem solving in vocational school. This research is a descriptive research to get an idea of comprehend students’ generated representations and creative thinking skill on problem solving of vocational school in Bandung. Technique of collecting data is done by test method, observation, and interview. Representation is something that represents, describes or symbolizes an object or process. To evaluate the multi-representation skill used essay test with rubric of scoring was used to assess multi-depressant student skills. While creative thinking skill on problem solving used essay test which contains the components of skills in finding facts, problem finding skills, idea finding skills and solution finding skills. The results showed generated representations is still relatively low, this is proven by average student answers explanation is mathematically correct but there is no explanation verbally or graphically. While creative thinking skill on problem solving is still relatively low, this is proven by average score for skill indicator in finding the student problem is 1.52 including the non-creative category, average score for the skill indicator in finding the student idea is 1.23 including the non-creative category, and the average score of the students skill in finding this solution is 0.72 belongs to a very uncreative category.

1. Introduction

Creative thinking skills in problem solving are very important. This is required because every profession must have his own question to be solved. Without creative thinking skills, someone will use obsolete solutions to solve the problems even the solutions are inconsistent with situation [1]. Therefore, creative thinking skills are needed in the 21st century today. In accordance with the statement of Clegg et al. who stated that, creative thinking skills are no longer as a complement but have become a major factor that must be owned by every individual to survive amid increasingly tight global competition [2]. Therefore, every individual should not only be equipped with problem solving skills but also must be trained in their creative thinking skills so that they can solve problems in creative ways [3].

Based on observation results, one of vocational school in Sumedang obtained information that; (1) Physics learning in schools to be teacher-centered and tends to be knowledge transfer, 2) Physics learning in schools is not based on constructivism which students build their own understanding, 3) teachers rarely invite students to see real-world problems and solve problems creatively as an effort to
improve creative thinking skills in solving student problems. Problems given to students are more likely to the problems that solve directly on the use of existing formulas in the form of closed questions so that students lack the opportunity to develop creative thinking skills, especially the ability to think creatively in solving their problems. This kind of learning is not only happening in this school but also in general in all schools in Indonesia [4].

The facts as described above show that the physics learning process in schools still needs to be improved. This suggests the need for paradigm reform in learning, which is from the role of the teacher as the transfer of knowledge to the role of the teacher as a stimulation of learning. Teachers are required to give students the opportunity to construct their own learned knowledge through learning activities such as discussion and or practicum. The higher activity students do about a concept, the level of mastery of students to the taught concept is also higher [5]. In addition, as an effort to tackle creative thinking skills in solving student problems, then one way that can be taken is a problem-solving approach. Pehkonen et al. argue that ways to improve creative thinking skills especially in problem solving are through problem-solving approaches [6]. Similarly, Mackinon [7] states that the creative process always begins with sight or sensitivity to the problem because the root of creativity lies in someone realizing that something is wrong, lacking, or mysterious [7]. In addition, learning-oriented problem-solving process can also strengthen students’ understanding of the material being taught [8]. The problem-solving process can be individualized and group problem solving, but teamwork will result in better problem-solving than individual problem solving [9]. Similar statements are also expressed by Isaksen [7] which states that problem solving can be done individually, however it will be more effective if solved in groups. Group problem solving demands collaboration among group members, exchange of opinions, complementary and correct solutions so that ultimately the best solution is obtained from the various solutions that the group offers. So in solving a problem will be more effective if it involves interaction between students.

Based on interviews of students, they regard the lessons of physics as a very difficult lesson. One of the reasons physics is said to be a difficult lesson, is that physics requires students to master different representations (experiment, graphics, conceptual/verbal statement, formulas, drawings or diagrams) simultaneously and manage change between this representations [10]. With multiple representation approach in learning, it is expected that students can better understand the concept of physics so that physics is no longer a lesson that is considered difficult by students. Based on this the researcher tries to give static fluid material presented by multiple representation approach. Multiple representations mean re-presenting the same concepts with different formats, including verbal, images, graphics and mathematics [11]. Multi representation has three main functions namely as a complement, limiting interpretation, and understanding builder [12]. First, multiple representations are used to provide representations that contain complementary information or help complete the cognitive process. Second, a representation is used to limit the likelihood of misinterpretation in using another representation. Third, multi-representation can be used to encourage students to build a deep understanding of the situation.

Research on the ability to build representations has been done by Sirait; Huevelen & Xueli [13, 14]. The research concludes that most students (97%) use mathematical equations representations in problem solving, students who are able to make representations of images and graphics are able to solve in the form of mathematical equations correctly. Huevelen & Xueli [13] conducted research on the use of multi-representation approaches in learning on business and energy topics that concluded that the approach can help students understand energy-effort concepts and in problem solving on those concepts. While Kohl & Finkelstein [15]. They conclude that skilled students tend to use non-mathematical representation, while less skilled students tend to directly use mathematical representation in solving physics problems. Kohl and Finkelstein conclude that the success of students in solving physical problems is influenced by the format of representation of those problems [15]. Furthermore they also stated that there is a significant influence of the learning approaches used on students' representation abilities.
Based on vocational physics curriculum and annual plan, the subject chosen in this research is static fluid. The selection of this concept is motivated because the concept of static fluid is found in everyday life so it has potential as an ingredient to enlarge creative thinking skill in solving student physics problem.

Based on the above background, the researcher is interested in conducting research entitled "Profile of Students’ Generated Representations and Creative Thinking Skill in Problem Solving in Vocational School".

2. Methods
This research was conducted on 38 students class XI in one of the vocational school in Sumedang academic year 2016/2017. This research uses descriptive research to find out students’ generated representations and creative thinking skill on problem solving in vocational school on static fluid. The sampling technique used in this research is purposive sampling technique. The flow of research conducted in the study of literature relates to the focus of research, observation, and provides research instruments. To evaluate the multi-representation skill used essay test with rubric of scoring was used to assess multi-depressant student skills. While creative thinking skill on problem solving used essay which contains the components of skills in finding facts, problem finding skills, idea finding skills and solution finding skills.

3. Results and Discussion

3.1. Figure of Profile Students’ Generated Representations
The results of interviews with students, they regard the lessons of physics as a very difficult lesson. One of the reasons physics is said to be a difficult lesson, is that physics requires students to master different representations (experiment, graphics, conceptual / verbal statement, formulas, drawings/diagrams) simultaneously and manage change between representations-This representation [10]. With multiple representation approach in learning is expected the students can better understand the concept of physics so that physics is no longer a lesson that is considered difficult by students. Based on this the researcher tries to give static fluid material presented by multiple representation approach. Multiple representations mean re-presenting the same concepts with different formats, including verbal, images, graphics and mathematics [16]. Multi representation has three main functions namely as a complement, limiting interpretation, and understanding builder [17]. First, multiple representations are used to provide representations that contain complementary information or help complete the cognitive process. Second, a representation is used to limit the likelihood of misinterpretation in using another representation. Third, multi-representation can be used to encourage students to build a deep understanding of the situation.

3.2. Figure the Students’ Creative Thinking Skill in Problem Solving
The result of the research is the percentage of creative thinking skill in problem solving on finding facts, problem finding skills, idea finding skills and solution finding skills. The result of students' argumentation skill assessment on static fluid is presented as follows:
Figure 1 shows that students’ creative thinking skill in problem solving is low. In addition, the results of the preliminary study show that creative thinking skills in solving student problems are also low, especially in the aspects of problem finding skills, idea finding skills, and solution finding skills. This can be seen from the results of a limited trial using a test adapted from the problem of creative thinking skills in problem solving showed that the average score for skill indicators in finding student problems was 1.52. By consulting this acquisition with the criteria shows that the skills in finding such student problems include the non-creative category. In addition, students are also weak in generating ideas of completion of an event. This can be seen from the average score for skill indicators in finding student ideas that is equal to 1.23 including in the category of not creative. So also for aspects of skills in finding solutions. Students are very weak in generating a variety of solutions from a given event. The average score of students related skills in finding this solution is 0.72 including in the category of highly un-creative. This acquisition shows that the average student is not able to find more than one solution even many students who are completely unable to find a solution to the solution of the problem given.

4. Conclusion
The conclusions obtained based on the results of research, show that creative thinking skills in solving student problems are also low. This can be seen from the results of a limited trial using a test adapted from the problem of creative thinking skills in problem solving showed that the average score for skill indicators in finding student problems was 1.52. By consulting this acquisition with the criteria shows that the skills in finding such student problems include the non-creative category. In addition, students are also weak in generating ideas of completion of an event. This can be seen from the average score for skill indicators in finding student ideas that is equal to 1.23 including in the category of not creative. So also for aspects of skills in finding solutions. Students are very weak in generating a variety of solutions from a given event. The average score of students’ related skills in finding this solution is 0.72 including in the category of highly un-creative. This acquisition indicates that the average student is not able to find more than one solution even though many students are completely unable to find a solution to the solution of the given problem. This finding will be the basis for further research on innovative learning models and strategies that can improve students’ understanding and argument.

5. References
[1] Kusuma Y 2010 Creative Problem Solving (Solo: Rumah Pengetahuan)
[2] Clegg B and Brich P 2006 Instan Creativity: 76 Cara Instan Meningkatkan Kreativitas (Jakarta: Erlangga)
[3] Bilal A A 2012 The effect of using brainstorming strategy in developing creative problem solving skills among female students in princess alia university college American International Journal of Contemporary Research 2 10 29-38

[4] Munandar U 2004 Pengembangan Kreativitas Anak Berbakat (Jakarta: Rineka Cipta)

[5] Zaim H, Yaşar M F and Ünal Ö F 2013 Analyzing the effects of individual competencies on performance: A field study in services industries in Turkey Journal of Global Strategic Management 7 2 67-77

[6] Pekkone E 1997 The state-of-art in mathematical creativity ZDM 29 3 63-67

[7] Isaksen S G 2007 An exploratory study of the relationships between an assessment of problem solving style and creative problem solving The Korean Journal of Thingking & Problem Solving 17 1 5–26

[8] Sanjaya W 2006 Strategi Pembelajaran Berorientasi Standar Proses Pendidikan (Jakarta: Kencana)

[9] Helie S and Sun R 2010 incubation, insight, and creative problem solving: a unified theory and a connectionist model American Psychological Association 117 3 994–1024

[10] Angell C, Guttersrud O and Henriksen E K 2007 Multiple representations as a framework for a modelling approach to physics education (Oslo, Norway: Department of Physics, University of Oslo and UK: Per Morten Kind, School of Education, Durham University)

[11] Abdurrahman, Liihasari, Rusli A and Waldrip B 2011 Implementasi pembelajaran berbasis multi representasi untuk peningkatkan penguasaan konsep fisika kuantum (Yogyakarta: Jurnal Pendidikan Cakrawala: LPM UNY)

[12] Ainsworth S 1999 The Functions of Multiple Representations ESRC Centre for Research in Development, Instruction and Training 33 2-3.

[13] Heuvelen A V and Xueli Z 2001 Multiple Representation of Work-energi Processes American Journal of Physics 69 2 184-194

[14] Sirait Judyanto 2010 Multirepresentasi Siswa SMA dalam Pemecahan Masalah Kinematika Gerak Lurus (Pontianak: UNTAN)

[15] Kohl B P and Finkelstein N D 2006 Effect of instructional environment on physics students’ representational skills Physical Review Special TopicsPhysics Education Research 2 1 010102

[16] Prain V and Waldrip B 2007 An exploratory study of teachers’ and students’ use of multimodal representations of concepts in primary science International Journal of Science Education 28 15 1843-186

[17] Ainsworth S 1999 The Function of Multiple Representations Computers and Education 33 2-3 131-152

Acknowledgments
The author would like to thank Dr. Parlindungan Sinaga and Dr. Lilik Hasanah for his guidance and time in making the students’ generated representations and creative thinking skill in problem solving of static fluid. The writer also expressed his willingness to the students of SMKN 1 Sumedang for his willingness to be a sample of this research.