Effect of verbal creativity on problem solving abilities of junior high school students

I Rosidi1*, Y Hidayati1, and W P Hadi1

1Program Studi Pendidikan IPA, Universitas Trunojoyo Madura, Jalan Raya Telang PO BOX 2 Kamal, Bangkalan, 69162, Indonesia

*Corresponding: irsad.rosidi@gmail.com

Abstract. The purpose of this study was to determine the effect of verbal creativity on the problem-solving ability of junior high school students. TASC framework learning in environmental material applied in 7th grade. The samples taken were 30 students, 11 male students, and 19 female students. Based on the results, there is an effect of verbal creativity on the problem-solving ability with a significance value of 0.000 (< 0.05) with a contribution of 87.5%. Path analysis shows that each indicator of verbal creativity has a significant effect on problem-solving ability. Learning with the TASC Framework encourages students to develop creative thinking skills and student problem-solving.

1. Introduction
Teaching science in junior high school should involve a variety of varied contexts that can be developed, such as critical thinking, creative thinking, problem-solving, and the concept of science itself [1]. Learning involves this mental process referring to the subject of science learning in the 2013 curriculum. The aim of the 2013 curriculum is to provide thinking skills, one of which is problem-solving skills [2]. Importantly, training in problem-solving skills for students early on, teachers must pay attention to problem-solving skills during the learning process. Currently, most science learning still uses a student-centered approach that causes low student problem-solving skills [3,4]. The low ability of students' problem solving; indirectly, it requires a framework that can train students in developing their problem-solving abilities [5].

Problem-solving is a basic ability that must be obtained by students and taught on certain materials. Problem-solving is the thinking process [6][7][8], which involves cognitive processes in finding ways to solve problems [9] to succeed in life [4]. Furthermore, teaching students the ability to solve problems also involves reflective thinking processes so that they can be categorized as complex thinking [10]. Students acquire their knowledge by solving unusual problems, which means students are involved in constructing their knowledge [11]. Nevertheless, the process of giving problems should be non-routine problems [12]. In addition, the problem-solving teaching process involves four indicators from Polya's. Four indicators of Polya's problem solving, namely 1) understanding the problem, 2) making a plan, 3) carry out the plan, and 4) looking back [7,12–15].

The problem-solving process is inseparable from the creative ability (creative thinking) [16]. Furthermore, Torrance stated that creative thinking is the process of feeling difficulties, problems, lack of information, and missing elements in making guesses and formulating hypotheses against lack of information, then evaluating and testing guesses and the hypothesis that allows repairs and testing again and then communicated [16]. Creative ability is cognitive development in thinking logically in finding
solutions to problem-solving. The basis of creative thinking is divergent thinking [17]. Specifically, this thinking process trains students in developing various alternative answers to solving problems [18]. Alternative answers developed by students are mental processes related to students' verbal abilities. Verbal creativity itself is interpreted as a manifestation of students in writing ideas in writing or verbally. Students present with a verbal analogy process through the counterfactual fact premise [19]. They have to solve the analogies as though the counterfactual premises were true. Verbal creativity has four indicators, namely 1) fluency, 2) flexibility, 3) originality and 5) elaboration [18–21].

Therefore, learning is needed that encourages students to solve problems creatively. The learning framework that can teach this is the TASC wheel. TASC-wheel provides opportunities for students to develop creative processes in solving problems [18][22]. The learning process is taught in the learning cycle which includes 8 stages namely 1) Gather/organize; 2) Identify; 3) Generate; 4) Decide; 5) Implement; 6) Evaluate; 7) Communicate; and 8) Learning from experience [13,23,24]. Every learning process in the TASC-wheel framework provides help to develop creative ideas in problem-solving [13]. The advantages of this framework are students are given scaffolding in solving problems related to everyday life. Furthermore, Evans stated that TASC provides meaningful experiences in interpreting problems, finding solutions, and applying them [25]. In addition, when the learning process teaches brainstorming ideas and arranges them in mind maps that will support the process of creativity and problem solving for students.

The learning process allows faster for students to find solutions to problem-solving. In the learning process, students are taught how to analyze problems, find ideas for solving problems, plan problem-solving processes, and evaluate how the problem-solving process has been done. Furthermore, the learning process also provides opportunities for students to choose problems that will be solved by students [18]. If students can find solutions to problem-solving well, students will have an excellent ability to think creatively and originally [26].

The assumption of this study is that students' verbal creativity has a positive effect on problem-solving abilities. Creative thinking will make students discern the "other side" to try different perceptions of the problem so that students can solve the problem well [26]. Plucker states that creative thinking is an essential component that is considered to build problem-solving abilities [27]. Therefore, this study was held to determine the effect of verbal creativity on students' problem-solving abilities.

2. Methods
This study was a pre-experimental study involving one class of samples consisting of 30 students, 11 male, and 19 female, junior high school students in the seventh grade at SMPN 1 Gresik. Tests given to students include 1) verbal creativity test adopted from the creativity test adapted from Munandar which consists of 5 subtests which include four indicators of verbal creativity (see table 1), and 2) problem-solving tests that include 4 Polya's problem-solving indicators (see table 2). The test is given twice, namely pre-test and post-test.

| Verbal Creativity Indicators’ | Definition | Question | Sub-tests |
|--------------------------------|------------|----------|-----------|
| Fluency                        | The ability to generate many ideas | The beginning of the word | 1 |
|                                |            | Arrange word |          | 2 |
| Flexibility                    | The ability to produce varied ideas | Similar properties | 3 |
| Originality                    | The ability to generate new ideas or uncommon ideas | Extraordinary use | 4 |
| Elaboration                    | The ability to develop or grow ideas to create more detailed ideas | What are the consequences | 5 |
Table 2. The Instrument of Problem Solving test

| Indicators’ | Definition | Information |
|-------------|------------|-------------|
| Understanding the problem making a plan | Defining the problem and formulating it Generalize alternative solutions and plan it | The question consists of 5 questions; each question includes the four Polya's problem-solving indicators on the topic of the Environment. |
| Carrying out the plan looking back | Decision making and its application Verification and re-evaluation of ideas completion | |

Tests validated by expert judgment, after repairs. Otherwise, the test can be used in data collection. Data analysis using quantitative analysis with SPPS 18.0 application, which includes descriptive statistics, linear regression, and path analysis. Path diagram (see figure 1) serves to see the relationship between each indicator of verbal creativity with the problem-solving ability.

Figure 1. Path Diagram Analysis of Verbal Creativity (X) and Problem-Solving Ability (Y)

3. Result and Discussion

The results showed that there were positive effects after learning with TASC-wheel framework. This shows that TASC can develop problem-solving abilities and students' thinking abilities [28]. Providing facilitation with TASC, brainstorming, and mind mapping provides opportunities for students to develop alternative ideas for problem-solving [24]. Description of problem-solving skills and verbal creativity can be seen in table 3.

Table 3. The problem-solving ability dan verbal creativity of the students’

|                         | N  | Pre-test | Post-Test |
|-------------------------|----|----------|-----------|
|                         | Mean | STD     | Mean     | STD     |
| Problem Solving Ability | 30  | 51.70    | 94.87     | 12.12   |
| Verbal Creativity       |     |          |           |         |
| Fluency                 | 30  | 22.40    | 40.80     | 17.163  |
| Flexibility             | 30  | 31.80    | 59.80     | 12.726  |
| Originality             | 30  | 34.30    | 65.30     | 11.049  |
| Elaboration             | 30  | 31.80    | 58.80     | 11.460  |

Based on Table 3, there is an increase in students' problem-solving skills and verbal creativity. The improvement of problem-solving skills in students is not only influenced by the factors applying TASC in learning on environmental themes. Creative contributions also have a positive influence on improving students' problem-solving skills. It is in Sternberg's opinion, which states that creativity is part of
decision making in problem-solving [19]. It can be proven from the results of the linear regression test in table 4.

Table 4. Simple Regression Test Results: Verbal Creativity on Students' Problem Solving Abilities

|          | SS     | MS     | R   | R²  | F     | p    |
|----------|--------|--------|-----|-----|-------|------|
| Regression | 3726.292 | 931.573 | 0.936 | 0.875 | 43.845 | .000 |
| Residual  | 531.174  | 21.247  |      |      |       |      |
| Total     | 4257.467 |        |      |      |       |      |

a. Predictors: (Constant), Elaboration, Originality, Fluency, Flexibility
b. Dependent Variable: Problem Solving Ability

Based on Table 4, it shows that there is an influence of verbal creativity on students' problem-solving abilities, which is 87.5%. The relationship between the ability to solve problems and creativity is following Torrance's opinion, which states that contribution to creative thinking supports students in solving problems [16]. Besides that, Table 4 shows that there are still other influences that affect students' problem-solving abilities, amounting to 12.5%. Clearly, one of the influences is the lack of ability of students to solve unfamiliar problems. The problem presented in the problem-solving ability test uses unfamiliar questions [19], so students don't understand. This indicates that when the teacher makes a problem-solving ability test, the teacher must understand the student's ability to define the problem [15]. 7th-grade students are in the phase of transitioning from concrete operations to formal operations. Another factor that influences the problem-solving ability is the cognitive style and learning model [14]. The influence of each indicator of verbal creativity with the ability to solve problems can be seen based on the results of the hypothesis test in table 5.

Table 5. The Hypothesis Test Result

|          | B       | SE    | β     | t     | P    |
|----------|---------|-------|-------|-------|------|
| (Constant) | 15.061  | 6.513 | "     | 2.313 | 0.029|
| Fluency   | 0.260   | 0.054 | 0.368 | 4.767 | 0.000|
| Flexibility | 0.360  | 0.075 | 0.378 | 4.810 | 0.000|
| Originality | 0.374  | 0.084 | 0.341 | 4.457 | 0.000|
| Elaboration | 0.395  | 0.084 | 0.374 | 4.719 | 0.000|

Based on table 5, that indicators of verbal creativity affect students' problem solving abilities (p = 0.000 < 0.05). That can be illustrated in a one-way path diagram (see figure 2).

Figure 2. The Result of Path Diagram Analysis Verbal Creativity (X) and Problem Solving Ability (Y)
Based on Figure 2, it can be said that creativity contributes to the ability to solve problems. Creative contributors will make different decisions in solving problems [19]. Each indicator of verbal creativity reflects how students develop ideas. First, the indicator fluency (X1) shows that the effect on the ability of problem-solving is 0.368. It is in line with the ability to express students’ problem-solving ideas smoothly to the given problem. This process taught by learning the TASC-wheel at the gather/organize and identify stages. This stage trains students in organizing the knowledge previously possessed by students towards the given problem and identifying their remediation ideas. Secondly, the indicator flexibility (X2) shows the effect on students' problem-solving abilities by 0.378. It is in line with the TASC-wheel framework learning (generate and decide stages), where students gain learning experience to develop ideas and determine the best ideas for problem-solving. Third, the originality indicator (X3) encourages students to create original ideas and out of the box. It influences the students' problem-solving process of 0.41. In this process, students will implement their unique ideas in solving problems. Finally, the elaboration indicator (X4) is in line with the evaluation stage (0.374). In this process, students detail their original ideas and ideas, whether they can work well in solving problems. That shows how students express their creativity with TASC-wheel framework. Creative thinking will make students speak “the other side” to try to build different perceptions, self-concepts, and different decision-making to solve problems. Students who have good creativity will use a variety of methods to solve problems [26]. The scientific way that encourages children to think creatively in finding solutions to problems [16]. Therefore, it is essential to train students. Giving experience to students related to creative problem solving will equip students to become independent learners and have the ability to develop concepts and solve problems.

4. Conclusion
It can be concluded that verbal creativity influences students' problem-solving abilities at 87.5% with p-value <0.05 (0.000). Another factor that affects creative verbal toward problem solving abilities taught with TASC-wheel framwork is 12.5 (e1 = 0.125), it means that TASC-wheel framework encourages students to develop thinking skills and problem-solving. Importance, learning that teaches students creativity in solving problems to prepare students for the development of the 21st century.

5. References
[1] Widiasih, Permanasari A, Riandi and Damayanti T 2018 The profile of problem-solving ability of students of distance education in science learning J. Phys. Conf. Ser. 1013 1–6
[2] Gunawan I 2017 Indonesian Curriculum 2013: Instructional Management, Obstacles Faced by Teachers in Implementation and the Way Forward Advances in Social Science, Education, and Humanities Research p 128
[3] Pratiwi N 2014 Perbedaan Hasil Belajar Siswa Berdasarkan Jenis Kelamin Yang Diajar Menggunakan Multimedia Manusia 20 8–15
[4] Rosidi, Irsad; Hidayati Y 2016 Identifikasi Kemampuan Penyelesaian Masalah Mahasiswa Menggunakan Pembelajaran Berbasis Proyek SNPS (Surakarta: Universitas Negeri Sebelas Maret)
[5] Carin A A 1993 Teaching Science Through Discovery (New York: Macmillan Publishing Company)
[6] Dostál J 2015 Theory of problem-solving (Elsevier Ltd)
[7] Polya G 1975 How to solve it (New Jersey: Princeton University Press)
[8] Mayer R E 1983 Thinking, Problem Solving, and Cognition (New York: W. H. Freeman and Company)
[9] Kirkley J 2003 Principle for Teaching Problem Solving (Indiana: Plato Learning, Inc)
[10] Afandi and Sajidan 2017 Stimulasi Keterampilan Berpikir Tingkat Tinggi: Konsep dan Implementasinya dalam Pembelajaran Abad 21 (Surakarta: UNS press)
[11] Slavin R E 2006 Educational Psychology (Boston: Pearson Education, Inc)
[12] Evans B R 2012 Editor ’ s Perspective Article : Problem Solving Abilities and Perceptions in
[13] Moseley D, Baumfield V, Elliott J, Gregson M, Higgins S, Miller J and Newton D 2005 Frameworks for Thinking: A Handbook for Teaching and Learning (New York: Cambridge University Press)

[14] Marwazi M, Made N, and Putra D 2019 Analysis of Problem Solving Ability Based on Field Dependent Cognitive Style in Discovery Learning Models J. Prim. Educ. 8 127–34

[15] Nurkaeti N and Indonesia U P 2018 Polya ’ S Strategy : an Analysis Of Mathematical Problem Solving Difficulty In 5 Th Grade Elementary J. Pendidik. Dasar 10 140–7

[16] Haydon K, Goff K, and Harvey J 2016 Academic Creativity in Your Classroom Torrance J. Appl. Creat. 1 27–31

[17] Sternberg R J 2006 Cognitive Psychology (USA: Thomson Wadsworth)

[18] Rosidi I, Ibrahim M and Tjandrakirana T 2013 Peningkatan kemampuan Bepikir Kreatif Siswa Menggunakan Perangkat Pembelajaran Biologi dengan Pendekatan TASC (Thinking Actively in Social Context) JPPS (Jurnal Penelit. Pendidik. Sains) 2 250–7

[19] Sternberg R J 2006 The Nature of Creativity Creat. Res. J. 18 87–98

[20] Vorobyeva E, Talalaeva L, Pomazkova N, Sokurenko A and Samoilova N 2014 Age Dynamics of Verbal Creativity at Pupils of Multidisciplinary Institution of Additional Education Procedia - Soc. Behav. Sci. 146 483–6

[21] Valantinaitė I 2014 The Information Literacy And Verbal Creativity Of Trainee Teachers Of Technologies Eur. Sci. J. 1 358–68

[22] Rosidi I 2017 Uji Kelayakan Perangkat Pembelajaran Pengelolaan Limbah dengan Pendekatan TASC (Thinking Actively in a Social Context) Sci. Educ. J. 1 7–18

[23] Wallace B 2015 Using the TASC Thinking and Problem -Solving Framework to create a Curriculum of Opportunity across the Full Spectrum of Human Abilities Applied Practice for Educators of Gifted and Able Learners (Rotterdam: Sense Publisher) pp 113–30

[24] Wallace B, Bernardelli A, Molyneux C, and Farrell C 2012 TASC: Thinking Actively in a Social Context. A universal problem-solving process : A powerful tool to promote differentiated learning experiences Gift. Educ. Int. 28 58–83

[25] Evans D 1997 Book Review: TASC: Thinking Actively in a Social Context Gift. Educ. Int. 12 51

[26] Awang H and Ramly I 2008 Through Problem-Based Learning : Pedagogy and Practice in the Engineering Classroom 2 334–9

[27] Shieh R and Chang W 2014 Fostering Student ’ S Creative And Problem- Solving Skills Through A Hands-On Activity J. Balt. Sci. Educ. 13 650–61

[28] Webber M, Riley T, Sylva K and Scobie-jennings E 2018 The Ruamano Project : Raising Expectations, Realising Community Aspirations, and Recognising Gifted Potential in Maori Boys Aust. J. Indig. Educ. 1–12