The Effect of Biocard Assisted Treffinger on Students' Creative Thinking Skills in Excretion System Materials

Shopiah Dhuha Siregar* & Lazuardi

Department of Biology Education, Medan State University, Indonesia

Abstract: This study aims to determine the effect of the Treffinger learning biocard. onstudents' creative thinking skills. This type of research is a quasi-experimental design with Nonquivalent Control Group. The study population was all class XI MIA SMAS PAB 8 Saentis with a sample of class XI MIA 2 as the experimental class taught with the Treffinger assisted by biocards and XI MIA 1 as the control class taught with the problem based learning model. The research instrument was a 20 item essay test of creative thinking skills on the excretory system material. Data analysis used descriptive statistical analysis and inferential statistical.analysis descriptive statistical showed that the average value of creative thinking skills of students who were taught using the Treffinger learning biocards was higher than the problem based learning model. analysis inferential statistical learning model Treffinger assisted by biocards effect on students' creative thinking skills.

Keywords: creative thinking skills, Treffinger learning model, biocard, excretion system material.

Abstrak: Penelitian ini bertujuan untuk mengetahui pengaruh biocard pembelajaran Treffinger. kemampuan berpikir kreatif siswa. Desain penelitian ini adalah kuasi experimen dengan tipe Non-equivalent Control Group. Populasi penelitian ini adalah seluruh kelas XI MIA SMAS PAB 8 Saentis dengan sampel kelas XI MIA 2 sebagai kelas eksperimen yang diajar dengan Treffinger berbantuan biocard dan XI MIA 1 sebagai kelas kontrol yang diajar dengan model problem based learning. Instrumen penelitian berupa tes keterampilan berpikir kreatif esai 20 butir materi sistem ekskresi. Analisis data menggunakan analisis statistik deskriptif dan statistik inferensial. Analisis statistik deskriptif menunjukkan bahwa nilai rata-rata keterampilan berpikir kreatif siswa yang diajar menggunakan biocard pembelajaran Treffinger lebih tinggi dibandingkan dengan model pembelajaran berbasis masalah. analisis statistik inferensial model pembelajaran Treffinger berbantuan biocards berpengaruh terhadap kemampuan berpikir kreatif siswa.

Kata kunci: keterampilan berpikir kreatif, model pembelajaran Treffinger, biocard, materi sistem ekskresi.

▪ INTRODUCTION

The main objective of education including biology education is to achieve higher order thinking skills (HOTS). Higher order thinking skills (HOTS) according to Baker (in Mohamed & Lebar, 2017) are all intellectual activities that are not just remembering information. Miri et al. (2007) stated that critical thinking and creative thinking are included in higher order thinking skills. While Akin et al. (2015) defines High Order Thinking Skill (HOTS) as critical thinking skills and creative thinking skills.

Creative thinking is a way of thinking to find new insights, new approaches, new perspectives and understand new things (Eragamreddy, 2013). According to Aflafo & Offir (2010) creative thinking is a pattern of thinking that tends to lead to creative

results, namely original, sustainable, and harmonious results according to certain field criteria. Meanwhile, according to Wang & Hou (2018) creative thinking refers to the ability of individuals to use known information to produce new and unique products with social value. Creativity is a powerful weapon in dealing with various types of problems because it encourages students to seek deep understanding (Runisah et al., 2016).

According to Yahya (2013), someone who is able to think creatively tends to have an independent personality because he has the freedom, the courage to create and introduce something new, is confident, dares to take risks, is always enthusiastic and has great determination in achieving something. Guilford & Hoepfner (in Iger, 2016) state that creative people are sensitive to the existence of problems and that individuals have few opportunities to show creative traits without problems to solve.

Based on the results of a survey conducted by the Program for International Student Assessment (PISA) in 2018, Indonesia ranks 74th with a total of 79 countries participating (OECD, 2018). The Global Creativity Index (GCI) in 2015 also placed the creative thinking skills of Indonesian students at a low order, namely 115 out of 139 countries with an index of 0.202. The low creative thinking skills are also seen in class XI students of SMAS PAB 8 Saentis, Percut Sei Tuan.

Demirel (in Ersoy & Baser, 2013) states that appropriate strategies, methods and learning models must be used to achieve creative thinking skills. One model that can improve students' creative thinking skills is the Treffinger. This model was first introduced by Donald J. Treffinger in 1980 (Sari & Putra, 2015). This model consists of three main components, namely understanding challenges, generating ideas and preparing for action (Treffinger, 2007). The three components are broken down into six stages, namely developing opportunities, finding data, formulating problems, generating ideas, developing solutions and building acceptance (Huda, 2013).

Syaodih (2015) revealed that the application of the Treffinger is very helpful in improving students' creative thinking skills when compared to the standard model. Furthermore, Wirahayu (2018) states that the application of the Treffinger has an impact on divergent thinking skills in the form of students' critical and creative thinking skills. In addition, Treffinger can be applied at various levels in the world of education from elementary to university (Ndiung et al., 2019). Alfuhaigi (2015) states that the use of the Treffinger has a positive impact on improving students' creative thinking skills. Furthermore, Ridwan et al. (2019) stated that the Treffinger positive contribution to the development of students' creative thinking skills.

In addition to learning models, there are also learning media that can stimulate and improve students' creative thinking skills. According to Kasim & Wahyuni (2017) the use of learning media is expected to regenerate motivation, increase creativity and improve student learning outcomes because the media is one of the communication tools that will be useful in conveying messages in the learning process. Based on the results of structured interviews conducted with biology subject teachers in class XI MIA SMAS PAB 8 Saentis, it was found that the media commonly used in biology learning are learning videos, power points, torsos, diagrams and accompanying books. One of the learning media that influences students' creative thinking skills is biocard. Biocard is the development of visual media in the form of cards, with ideas or sources or even keywords to be taught included in the biocard (Nurfitriyah, 2009). Wibawa and Mukti

(in Wardaya, 2018) state that one of the benefits of visual media is that it is a tool to increase student creativity.

Based on structured interviews conducted with biology subject teachers in class XI MIA SMAS PAB 8 Saentis material The excretory system is usually taught with lecture, discussion, question and answer methods and project based learning models. There is no special learning media that can be used in learning the excretory system material. If the excretory system material is taught using appropriate models and media, learning this material will be able to improve students' creative thinking skills. Based on the description above, this study aims to determine the effect of the Treffinger assisted by biocards on students' creative thinking skills on the excretory system material.

▪ **METHOD**
Participants

The population in this study were all class XI SMAS PAB 8 Saentis, totaling 4 classes with 108 students. Sampling was carried out using purposive sampling technique with the condition that the control and experimental classes had homogeneous cognitive abilities. The two sample classes were selected based on the results of the one way ANOVA. The first sample class is class XI MIA 2 with a total of 22 students as the experimental class taught with the Treffinger assisted by biocards and XI MIA 1 as a control class with a total of 23 students taught using the problem based learning model.

Research Design and Procedures

The research was carried out at SMAS PAB 8 Saentis, Percut Sei Tuan, North Sumatra with a research period of 3 months, namely March-May in the even semester of the 2021/2022 academic year. The type of research used is a quasi-experimental research design with Nonquivalent Control Group. This research has three stages, namely giving pretest, applying treatment and giving posttest. The treatment given to the experimental class was in the form of a Treffinger -assisted biocard while the control class was a problem based learning model. The treatment was given in four meetings for each class.

Table 1. Research design

Class	Pre-test	Treatment	Post-test
Experiment	T1	X1	T2
Control	T1	X2	T2

Description:
T1: skills initial
T2: skills final
X1: Treatment uses the Treffinger assisted by biocard
X2: Treatment uses a model. problem based learning

Instrument

The instrument used in this study is a test instrument in the form of creative thinking skills essay questions with a total of 20 items. The creative thinking skill test indicator refers to the Torrance framework which consists of four indicators, namely

fluency, flexibility, originality and elaboration (Torrenece, 1965). The rubik for assessing creative thinking skills used in this study is an assessment rubik compiled by Purwasih & Sariningsih (2017) using a scale of 0-4. The essay test instrument was validated first by two experts from Medan State University before being used as research data collectors.

Data Analysis

Data were analyzed using descriptive statistical analysis and inferential statistical analysis. Descriptive statistical analysis consisted of the mean (mean), median, standard deviation, variance, highest score and lowest score. Inferential statistical analysis includes the prerequisite test for data analysis, namely the normality test in the form of the Shapiro-Wilk test with the condition that if the significance value is > 0.05 then the data is normally distributed. The homogeneity test used in this study is the Levene with the condition that if the significance value is > 0.05, the data is said to be homogeneous. Then, a hypothesis test was conducted in the form of a t-test (Independent sample t-test) with the condition that if the value of sig. (2-tailed) > 0.05 then Ha was rejected and if the value of sig. (2-tailed) < 0.05 then Ha accepted (Triton, 2006). Overall inferential statistical analysis was performed using IBM SPSS Statistics 20 software. The N-gain also conducted to measure the improvement of students' creative thinking skills.test N-gain further classified based on the following criteria; ($<g>$ <0.3 (low); 0.3 $<g>0.7$ (medium); and $<g>> 0.7$ (high) (Hake, 1998)

▪ **RESULT AND DISSCUSSION**

Homogeneity test and test normality is carried out before hypothesis testing. The results of the normality test in pretest obtained a significance value of 0.060 while pretest obtained a significant value of 0.189. Both pretest had a significance value > 0.05 so it can be concluded that the pretest creative thinking skills are normally distributed. Furthermore, posttest obtained a significance value of 0.055 while posttest obtained a significance value of 0.069. Both data have a significance value > 0.05 so it can be concluded that the posttest creative thinking skills is normally distributed.

In the homogeneity test, the pretest a significance value of 0.055 and the posttest obtained a significance value of 0.069. Both data have a significance value > 0.05 so it can be concluded that the pretest and posttest on creative thinking skills in this study are homogeneous. Because the data has been proven to be homogeneous and normally distributed, then the hypothesis is tested using the Independent Sample T-Test test. In this study, the value of sig. (2-tailed) was 0.049 where $0.049 < 0.050$ so that Ho was rejected and Ha was accepted. It can be concluded that there is an effect of the Treffinger assisted by biocards on creative thinking skills in the excretory system material. Descriptive analysis of data on creative thinking skills of students who are taught with the Treffinger assisted biocards in the experimental class and problem based learning in the control class are presented in table 2.

Table 2. Data on creative thinking skills of students

Data	Pretest		Posttest	
	Experiment	Control	Experiment	Control
N	22	23	22	23

Max	47.50	45.00	87.50	91.25
Min	6.25	10.00	56.25	43.75
$\overline{X}$	26.02	24.72	75.00	68.05
SD	12.12	9.60	9.44	13.14
Variance	146.97	92.22	89.28	172.84

The difference between the pretest and posttest of the experimental class and the control class is also depicted in Figure 1 below.
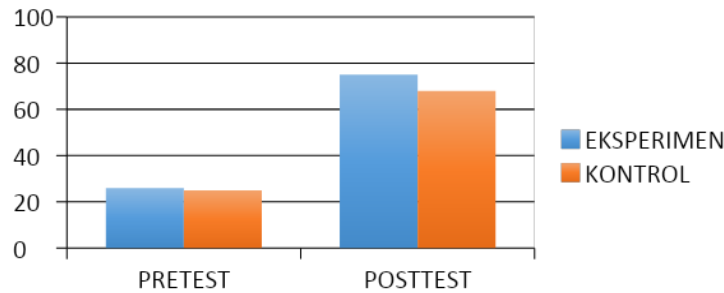

Figure 1. Diagram of pretest and posttest

Figure 1 shows that the experimental class has an average pretest that is not much different from the control class. Average value of posttest creative thinking skills, the experimental class using the Treffinger assisted by biocards has a higher average score than the control class using the problem based learning. Creative thinking skills measured in this study were evaluated from four indicators, namely fluency, flexibility, elaboration and originality. The description of the average pretest of creative thinking skills on each indicator is shown in Figure 2.
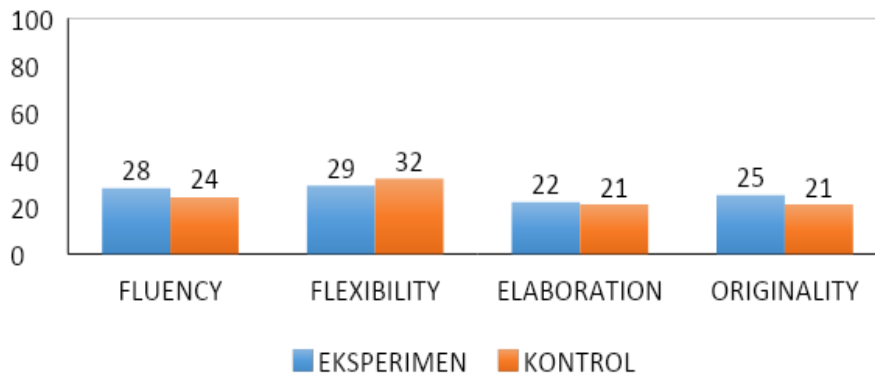

Figure 2. Results pretest of creative thinking skills indicators

Furthermore, the description of the average posttest of creative thinking skills on each indicator is shown in Figure 3.
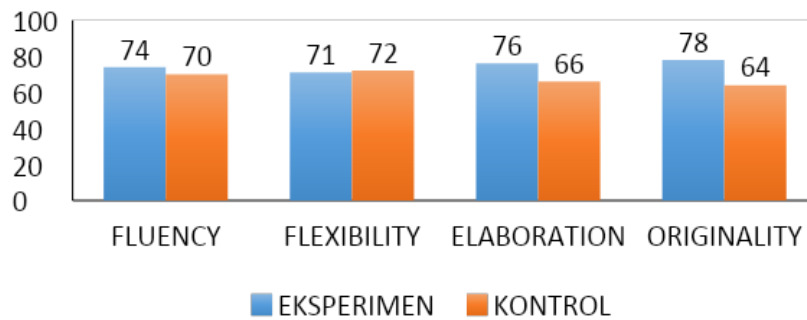
Figure 3. Diagram results of posttest indicators of creative thinking skills

Figure 3 shows that the experimental class has a higher creative thinking skill indicator value than the control class in addition to the flexibility. This can happen because of the implications of using the Treffinger accompanied by a biocard in learning in the experimental class.

learning model Treffinger of 3 main stages which are broken down into 6 learning steps. The first stage is understanding the challenge (understanding the challenge). At this stage the researcher informs the learning objectives to students, then the researcher provides a stimulus by giving open questions based on facts and phenomena presented in the form of power points, at this stage some students look enthusiastic in observing, asking and answering the facts and phenomena presented. This stimulus is given to stimulate students' curiosity and enthusiasm for learning. The next step is to formulate the problem, the researcher conditions and allows students to identify the problem in the biocard which is then given, the problem that has been formulated is written by the student in the LKPD that has been provided. According to Larasati (2020) the process of understanding this challenge plays a role in developing several indicators of creative thinking skills, namely fluency, flexibility, and originality.

The next stage is the stage of generating ideas (generating ideas). At this stage the researcher guides and conditions students to convey their thoughts on the problems that have been identified in advance, at this stage students are seen actively discussing with their group friends. Lestari & Hadi (2022) state that discussion activities can have implications for a complete understanding of the concept and when faced with a problem, students can develop solutions in more detail. The next researcher helps students to agree on various alternative solutions to be tested. The idea generation stage encourages students to see things from a new perspective to generate several alternative ideas from various perspectives. This can have an impact on creative thinking skills, especially on indications of flexible thinking and originality (Larasati, 2020).

The last stage of this model is the stage of preparing for action (preparing for action). This stage is broken down into two stages, the first stage is the development of problem solving, at this stage students collect various information relevant to the idea for solving the problem and then verify the most relevant data to solve the problems that have been formulated. The next stage is to build acceptance, researchers examine the problem solving obtained by students and then provide new problems contained in the LKPD so that students can apply the solutions that have been obtained previously. This stage is able to develop students' abilities in detailed thinking (elaboration) (Larasati, 2020). This stage can also develop students' intellectual abilities in learning various

knowledge with the consideration that the problems given are real problems that are in accordance with the stages of students' cognitive development (Ardana et al., 2017).

The N-gain designed to assess the improvement of students' creative thinking skills before and after after the treatment, namely the Treffinger assisted biocards in the experimental class and the problem based learning in the control class.test N-gain creative thinking skills in this study showed that the experimental class that applied the Treffinger -assisted biocard had N-gain of 0.67 compared to the control class that applied the problem-based learning that had N-gain. of 0.59. Both N-gains are included in the medium category.

The description of the increase in each indicator of creative thinking skills in the experimental class and control class which is calculated by Normalized Gain (N-gain) is shown in the table below.

Table 3. Average N-gain ccreative

Skills Indicator	Experiment		Control	
	N-Gain	Category	*N-Gain*	Category
Fluency	0.63	Medium	0.61	Medium
Flexibility	0.59	Medium	0.58	Medium
Elaboration	0.69	Medium	0.57	Medium
Originality	0.71	High	0.54	Medium

Skill improvement Students' creative thinking in this study is in line with Simangunsong's (2018) findings that the experimental class sample that received treatment in the form of the Treffinger on ecological material obtained higher creative thinking skills than the control class which received treatment in the form of a conventional model. Ndiung et al. (2021) also gave similar results where the creative thinking skills of students who used the Treffinger were better than students who were taught using the conventional model. According to Nisa (2011) Treffinger encourages students to solve challenges imaginatively. This technique helps students understand the principles of the material being taught and allows students to develop potential talents, such as the capacity to think creatively and do problem solving.

learning model Treffinger, the biocard also has an effect on improving students' creative thinking skills. The biocard used in this study is a biocard that contains biological concepts in the form of pictures and facts about the excretory system. The biocard used was designed using the Canva application and printed in color with a creamy white base color and measuring 9 x 6 cm. When biocards are distributed to students, students look curious and more enthusiastic in learning, visualization and the form of biocards trigger students' enthusiasm so that students are encouraged to think more creatively. According to Setyono (in Purwaningsih et al, 2020) interesting objects tend to increase student interest because of the encouragement and tendency to know. Pictures accompanied by explanations also help students to understand the concept of the excretory system that is poorly understood.

The use of biocards learning model Treffinger, the use of biocards is contained in the understanding challenge which is detailed in the steps of extracting data and formulating problems as well as generating ideas (developing ideas). With the help of

biocards, students are more enthusiastic about learning, students have various sources to observe and explore, sources of inspiration and sparks for creative thinking.

▪ **CONCLUSION**

Based on the results of the analysis and discussion of data regarding the effect of the Treffinger assisted by biocards on students' creative thinking skills on the excretory system material, it can be concluded that the average value of creative thinking skills of students taught with the Treffinger assisted by biocards is higher than the problem based learning model. The results of the study also prove that there is an effect of the Treffinger assisted by biocards on students' creative thinking skills on the excretory system material.

The most basic implication of this research is that the Treffinger assisted by biocards can be used as an alternative in improving students' creative thinking skills. The limitations of this study include not measuring the magnitude of the influence given by the Treffinger assisted by biocards on students' creative thinking skills. In addition, the research only focuses on students' creative thinking skills on excretory system material. This study also does not analyze in depth the results of students' creative thinking skills on each indicator of creative thinking.

▪ **REFERENCES**

Aflafo, M., & Offir, B. (2010). Activation of Community Television and its Influence on Students' Creative Thinking Level. Psychology, 1(2), 65-79.

Akin, F., Koray, O., & Tavukcu, K. (2015). How effective is critical reading in the understanding of scientific texts?. Procedia - Social and Behavioral Sciences, 174, 2444-2451.

Alfuhaigi, SS (2015). School environment and creativity development: a review of literature. Journal of Educational and Instructional Studies in the World, 5(2), 33-37.

Ardana, IM, Wisna Ariawan, IP, & Hendra Divayana, DG (2017). Measuring the Effectiveness of BLCS Model (Bruner, Local Culture, Scaffolding) in Mathematics Teaching by using Expert System-Based CSE-UCLA. International Journal of Education and Management Engineering, 7(4), 1–12.

Eragamreddy, N. (2013). Teaching creative thinking skills. International Journal of English Language & Translation Studies, 1(2), 124-145.

Ersoy, E., & Başer, N. (2013). The effects of problem-based learning method in higher education on creative thinking. Procedia-Social and Behavioral Sciences, 116, 3494-3498.

Florida, R., Mellander, C., King, K. (2015). The Global Creativity Index. Toronto, Canada : Martin Prosperity Institute.

Hake, RR (1998). Interactive-Enggegment Versus traditional Methods: A Six-Thousand-Student Survey of Mechanic Test data for Introductory Physics Couses, American Journal of Physics. 66(1), 64-74.

Huda, M. (2013). Teaching and Learning Models: Methodical and Paragdimatic Issues. Yogyakarta, Indonesia: Student Library.

Kasim, A., & Wahyuni, S. (2017). Effect of Learning Media Based on Combination of Mind-Manager and Wonder Share Quiz Creator towards Students' Learning

Outcomes and Creative Thinking Skills. Advances in Social Science, Education and Humanities Research, 174, 486-490.

Larasati, AG (2020). The Influence of the Treffinger Model on Creative Thinking of Elementary School Teacher Education Students Located in the PGSD Study Program, Wijaya Kusuma University. Journal Of Primary Education, 2(2), 130-139.

Lestari, E., & Hadi, S. (2022). Implementation of The Treffinger Model Based STEM Approach to Students' Creative Thinking Skill. Integrative Science Education and Teaching Activity Journal, 3(1), 93-95.

Miri, B., David, BC, & Uri, Z. (2007). Purposely teaching for the promotion of higher-order thinking skills: A case of critical thinking. Research in Science Education, 37(4), 353–369.

Mohamed, R., & Lebar, O. (2017). Authentic Assessment in Assessing Higher Order Thinking Skills. International Journal of Academic Research in Business and Social Sciences, 7(2), 466-476.

Ndiung, S., Dantes, N., Ardana, MI, & Marhaeni, NIAA (2019). Treffinger Creative Learning Model with RME Principles on Creative Thinking Skill by Considering Numerical Ability. International Journal of Instruction, 12 (3), 731-744.

Ndiung, S., Sariyasa., Jehadus, E., Apsari, AR (2021). The Effect of Treffinger Creative Learning Model with the Use RME Principles on Creative Thinking Skills and Mathematics Learning Outcomes. International Journal of Instruction, 4(2), 873-888.

Nisa, T. (2011). Learning Mathematics with Treffinger Model Settings to Develop Student Creativity (Learning Mathematics with Treffinger Model Settings to Develop Student Creativity). Journal Pedagogy, 1(1), 35-50.

Nurfitriyah, A. (2009). The Effect of Using Biocard in Ecosystem Learning on Student Learning Outcomes (Undergraduate's Thesis). UPI, Department of Biology Education, Bandung, Indonesia.

OECD. (2019),PISA 2018 Results (Volume I): What Students Know and Can Do. Paris, France : OECD Publishing.

Purwaningsih, A., Yeni, FL, & Titin. (2020). Application Biocard -Assisted Make A Match Model on Students' Learning Outcomes and Argumentation Skills (Application of Biocard-Assisted Make A Match Model on Students' Learning Outcomes and Argumentation Skills). Journal of Education, 18(1), 61-75.

Purwasih, R., & Sariningsih, R. (2017). Problem Based Learning to Improve Creative Thinking Ability and Self-Concept of Junior High School Students. Journal of Didactic Mathematics, 4(1), 15-24.

Ridwan, R., Ridwan, Supriyadi, E., & Nurmanita, M. (2019). The Effect of Treffinger Learning Model on Critical Thinking Ability of Students in SMK 3 Yogyakarta. Advances in Social Science, Education and Humanities Research, 174, 445–451.

Runisah, Herman, T., & Dahlan, JA (2016). The Enhancement of Students' Creative Thinking Skills in Mathematics through The 5E Learning Cycle with Metacognitive Technique. International Journal of Education and Research, 4(7), 347–360.

Sari, Y, I & Putra, D. (2015). The Influence of Treffinger Learning Model on Critical and Creative Thinking Skills of Kanjuruhan University Students, Malang. Journal of Geography Education, 2 (20), 30–38.

Simangunsong, PG, Lbn. Gaol. D, YA, & Sahnan, M. (2018). The Effectiveness of the Treffinger Learning Model on Learning Outcomes and Creative Thinking Skills of Students on Ecological Materials Located at Dharma Pancasila Private High School Medan). Journal of Pelita Pendidikan, 6(4), 211-217.

Syaodih, E., Akbar, P., & Lisnawati, C. (2015). The Effectiveness of the Treffinger Learning Model to Improve Students' Creative Thinking Ability. JP2EA (Journal of Accounting Economics Education and Learning), 1(1), 33–46.

Torrance, EP (1965). Scientific Views of Creativity and Factors Affecting Its Growth. Daedalus, 94(3). 663-681.

Treffinger, DJ (2007). Creative problem-solving (cps): powerful tools for managing change and developing talent. Gifted and Talented International, 22(2), 8-18.

Triton, P, B. (2006). SPSS 13.0 Applied Parametric Statistical Research. Yogyakarta, Indonesia : CV Andi Offset.

lger, K. (2016). The Relationship between Creative Thinking and Critical Thinking Skills of Students. HU Journal of Education, 31(4), 695-710.

Wang, Y., & Hou, Q. (2018). Insight or Originality: A Spray in the River of Creative Thinking. Open Access Library Journal, 5: e4847.

Wardaya, M. (2018). Visual Media as Assisting Instrument to Improve Students' Listening Ability. Visual Communication Design Journal, 3(1), 1-12.

Wirahayu, YA, & Purwito, H. (2018). Application of the Treffinger Learning Model and Students' Divergent Thinking Skills. Journal of Geographical Education, 23(1), 30–40.

Yahya, M. (2013). Development of Student Creativity in the Learning Process (Development of Student Creativity in the Learning Process). Edu-Islamika, 5(1). 38-75.