Hierarchy Level of Student's Mathematical Creative Thinking based on IPT Model with Scaffolding

Hevy Risqi Maharani[1,2], YL. Sukestiyarno[1], S.B. Waluya[1], Mulyono[1]

[1]Mathematics Education Department, Semarang State University, Semarang, Indonesia

[2]Mathematics Education Department, Sultan Agung Islamic University, Semarang, Indonesia

[*]Corresponding author: hevyrisqi@unissula.ac.id

Received: 11.03.2020 Revised: 12.04.2020 Accepted: 28.05.2020

Abstract— Developing the quality of creative thinking has always been one of the main goals of education. This study aims to describe the teaching quality of scaffolding learning and to find the hierarchy level of students' creative thinking in mathematics based on the IPT model. The mixed-method design used to carry out this study with the data collection techniques used are validation, questionnaire, test, and interview. The results showed that the classification for developing the learning devices was valid. This learning was also to be practical and effective to develope mathematical creative thinking of students. The findings of the hierarchy of student's levels of the high, medium, and low creative thinking ability groups have shown at the hierarchy level 5, 4, and 3 in solving problems based on the IPT model. The results of this study have shown that each student has different information processing based on the category of their creative thinking abilities. This study implied that teachers need to provide the right scaffolding according to the obstacles experienced by students when processing information to solve problems.

Keywords: creative thinking, scaffolding, information processing taxonomy

1 INTRODUCTION

The era of globalization and technological change that has occurred in the last few years has influenced people to solve complex and diverse problems in everyday life [1]. This is aligned with the most important goal of the educational system stated by Karkockiene [2], Yuniarti [3], and Puspitasari [4], which developing educational programs must help to enhance student's creative thinking. Creative thinking has come to be important thinking as the most valuable human asset to survive. So, creative thinking needs to be given to someone from his early age [5]. The results of the studies indicated that it is possible to teach thinking skills and thinking skills instruction begins in pre-school years [6], [7], [8], [9]. Furthermore, Aizikovitsh-Udi state that instructional support and learning that can develop mathematical creative thinking must be prepared by teachers from preschool until secondary school that needs to emphasize not only the creative ways to solve problems but also the uniqueness of the solutions as done by mathematicians [10]. This can be done by allowing students to complete mathematical processes and structures.

Scaffolding learning is a concept based on Vigotsky regarding the Zone of Proximal Development (ZPD). Vygotsky said that students have two levels of development, namely the level of actual and potential development [11], [12]. Scaffolding is a model of guidance based on students' actual abilities to achieve their potential abilities [13]. With the application of scaffolding in mathematics learning, it can facilitate students in learning and can create effective learning [14]. If learning can run effectively, then the learning objective to develop mathematical creative thinking of students can be achieved. In this study, scaffolding learning was used so that students could achieve their optimal abilities in creative thinking, so that appropriate mathematical thinking abilities of students can be determined.

The taxonomies that have been widely used to evaluate the quality of a student's output are Bloom's and the Structure of Observed Learning Outcomes (SOLO) taxonomy. Although both taxonomies have proven useful in assessing student's abilities, these two taxonomies have some disadvantages in their implementation for developing test items to get the response of students at different levels. It cannot explain of how the processing information in solving problems [15]. Therefore, it is necessary to use the Information Processing Taxonomy (IPT) model in assessing mathematical abilities. The IPT model helps to build a test item that is properly used to assess student's

ISSN- 2394-5125 VOL 7, ISSUE 08, 2020

creative thinking abilities. The ability to design the correct test item is defined at each level contained in the IPT model. Problems can be classified based on information processing carried out by students obtained from the mathematical knowledge they have to solve problems that have certain criteria at each level [16].

The purpose of this study is: (1) to describe the valid and practical learning device of scaffolding and (2) to find out the extent of the hierarchy level of high, medium, and low mathematical creative thinking ability based on the IPT model. By knowing the extent of the hierarchy of students' abilities, the students can be optimized their mathematical creative thinking abilities. Students can also help to overcome obstacles they experience in solving problems.

2 LITERATURE

2.1 Scaffolding Learning

Scaffolding learning is a concept based on Vigotsky regarding the ZPD. Vigotsky said that students have two levels of development, namely the level of actual and potential development [11], [12]. Scaffolding is a model of guidance based on students' actual abilities to achieve their potential abilities [13]. With the application of scaffolding in mathematics learning, it can facilitate students in learning and can create effective learning [14].

Students can solve problem-solving problems well if students can gradually know the information needed to solve the problem. This can be achieved by scaffolding. Scaffolding can work through a hierarchical program where students first solve low-level (simple) problems that can help students solve more difficult problems gradually until they reach high-level problems [17].

Stuyf further said that scaffolding techniques facilitate activities and tasks that (1) motivate students, (2) simplify assignments to make them more easily completed or achieved by students, (3) provide direction in helping students focus on achieving goals, (4) reduce frustration, and (5) provide clear direction about the ultimate goal of the activities carried out [18]. Therefore, scaffolding is considered to reduce the level of difficulty of students in solving problems and become motivated in learning [19].

On the other hand, the provision of scaffolding can develop social interactions between students and teachers and also social interactions between students [20]. This is because in the application of scaffolding there is the role of more capable teachers and friends who can help students in aspects not yet mastered by students [21], [22]. This is following the concept of scaffolding where scaffolding is used to define and explain the role of adults or peers who are more capable in supporting the learning and development of students' thinking processes [23]. With scaffolding given by teachers and friends who are more capable, students can exchange understanding in their social environment so that understanding of concepts can be reached by students and can help them in solving problems [24].

The application of scaffolding can have an effect on students' emotional and cognitive effects that not only affect students' knowledge and skills but can also increase students' confidence and motivation in completing assignments [23]. Scaffolding provides benefits to the teacher and students involved in it. Scaffolding can improve students' creative thinking and divergent thinking skills, increase their freedom of opinion and participate in problem-solving, and increase their confidence in learning mathematics [25].

2.2 Information Processing Taxonomy (IPT) Model

The IPT model includes five levels of hierarchies that consist of two general features (Fong, 1994, 1997; Purwoko et al., 2017): (a) a series of information processing components such as the external source (ES), short- term memory (STM) or working memory (WM) and long-term memory (LTM), and (b) operating system consisting of perception through stimulus, retrieving information from ES, and operations based on primary and secondary productions. The test of mathematical creative thinking can be classified into five levels based on the specific characteristics of information processing in solving problems. Five levels of the IPT model as showed in Table 1.

TABLE 1.
INFORMATION PROCESSING TAXONOMY MODEL

Levels	Characteristic Features				Production System	
	ES	STM/WM	LTM (Type A)	LTM (Type B)	Primary	Secondary
One	V	V	–	–	–	–
Two	V	V	V	–	V	–
Three	V	V	V	V	V	–
Four	V	V	V	–	V	V
Five	V	V	V	V	V	V

ISSN- 2394-5125 VOL 7, ISSUE 08, 2020

Source: [15], [16]

ES is information identified from the problem being asked. Information from ES or LTM processed at STM / WM. There are type A and B information stored in LTM. Type A information as information is related to the latest and often delivered fields of study content, while type B information as information on related topics. Type B information is information that is difficult to remember or retrieve by students compared to type A information [15].

The study results of Purwoko showed that problem-solving problems can confirm the IPT in designing students' assessments on different levels [16]. The higher level of the question will be more hard to solve. The students who have good mathematical abilities have good abilities in information processing. From that analysis, students' thinking processes are still at levels 1 and 2 where students can identify external sources and can complete a problem-solving algorithm on the STM. Based on the study, this study wants to show that creative mathematical thinking questions also can confirm the IPT in designing students' assessments on different levels of hierarchy. By knowing the information processing of students 'creative thinking abilities, the teacher can help students who are still experiencing obstacles or difficulties when doing information processing.

3 METHOD

3.1 Research Design

The research method used in this study was a mixed-method design [26], [27]. Firstly, the quantitative method was used to analyze the expert validation and students' response criteria to describe the teaching quality of scaffolding learning. Secondly, the qualitative method is used to analyze the hierarchy level of students' mathematical creative thinking in scaffolding learning based on IPT models.

3.2 Participants

The research subjects were 8th-grade students at SMPN 18 Semarang. Six students were taken by purposive sampling where each group of mathematical creative thinking abilities categories was represented by two students for triangulation to analyze the extent of their hierarchy level to solve mathematical creative thinking tests based on IPT models. Triangulation techniques were carried out using two different techniques, including tests and interviews.

3.3 Data Collection Methods

The data collection methods used in this study were validation sheets, student response questionnaires, and mathematical creative thinking tests based on the IPT model. To assess the quality of scaffolding begins by validating the syllabus, lesson plans, and tests of mathematical creative thinking abilities based on the IPT model. Validation was carried out by experts in the field of mathematics education consisting of 6 people. After implementing the scaffolding learning, questionnaires were given to get students' responses about the learning and then students get the mathematical creative thinking test. An evaluation of the student's work results in completing the test will be analyzed to what extent their creative thinking abilities are based on the hierarchy level of the IPT model.

4 RESULTS

The quality of scaffolding learning is assessed at the planning and implementation stages of learning. In the planning stage, the average results of the validation assessment by the six experts on the learning tools and research instruments were 4.33 and 4.35 with very good categories. It can be concluded that it is suitable for use in research. At the implementation stage, scaffolding learning is assessed using teacher observation sheets managing student learning and students' responses. The average assessment of a teacher's ability to manage the learning is 4.09 with good criteria. The results of the student response questionnaire on scaffolding learning also obtained an average score of 3.04 is included in the good category. At the evaluation stage, scaffolding learning can reach the proportion of students completeness of more than 75% and the average creative thinking ability of students in the class is more than the average creative thinking ability of students in the control class. This shows that learning with assistance or scaffolding is effective

Analysis of student's mathematical creative thinking was conducted on selected subjects based on the ranking of the test scores. Six research subjects were divided into three groups: upper, middle, and low group. Each group was taken by two students to be analyzed the achievement of the hierarchical level based on the IPT model. The list of subjects in this study as shown in Table 2.

TABLE 2.
LIST OF RESEARCH SUBJECTS

No.	Code	Group Category
1	S11	Upper
2	S12	Upper
3	S21	Middle
4	S22	Middle
5	S31	Low
6	S32	Low

The results of the analysis of creative thinking in solving geometry problems of research subjects from the upper group showed that S11 could solve each question at the hierarchy level 1 to hierarchy level 5 well. Therefore, S11 was at hierarchy level 5. The same result could also be shown in the results of the analysis of creative thinking ability in solving geometry problems of research subjects from the upper group, S12. So it could be concluded that the level of creative thinking ability of upper group research subjects was at the hierarchy level 5.

The results of the analysis of creative thinking ability in solving geometry problems of research subjects from the middle group showed that S21 subjects could not solve the problem at the hierarchical level 5. S21 was able to perceive stimuli by writing down what was known and asked about the problem correctly. However, S21 was not appropriate in applying the concept of comparison, as can be seen in Fig.1. S21 solved the size of the length, width, and height directly by dividing the ratio of each size with the results of the times of the ratio of length, width, and height. As a result, the results of the completion given by S21 were not correct. Therefore, S21 was at the level of hierarchy 4.

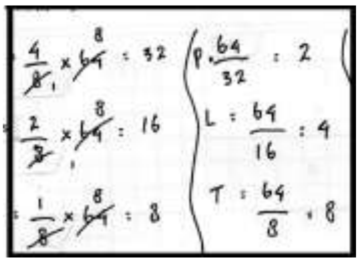

Fig.1. Creative thinking ability of S21 solve the problem at hierarchy level 5

The same result was also done by S22 in solving the problem at hierarchy level 5. S22 divided the size of the ratio of length, width, and height with the results of the ratio of length, width, and height because she assumes that the results of the comparison of length, width, and height were equal to the volume of a cuboid. Therefore, S22 made the same error as S21. This means that the S22 was also at hierarchy level 4. The results of the analysis on S21 and S22 showed that the level of creative thinking ability of the subject of the middle group research based on the IPT of the model was at the hierarchy level 4

The results of creative thinking ability in solving geometry problems from the low group S31 showed

ISSN- 2394-5125 VOL 7, ISSUE 08, 2020

that S31 cannot solve the problem at the hierarchy level 4 and 5. At the hierarchy level 4, S31 could only do the perception of stimulation by writing exactly what is known and asked about the problem. However, S31 was not appropriate in retrieving information from LTM type A in the form of the cuboid volume formula, so that the primary production results experienced an error. Although the mathematical operations carried out by S31 in the secondary production system were correct, but because the primary production results were incorrect, the results of the secondary production system were also incorrect. As a result, the subject S31 did not meet criteria hierarchy level 4. The results of creative thinking ability from S 31 in solving the problem at hierarchy level 4 as explained in Fig.2.

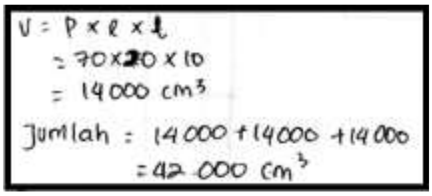

Fig.2. Creative thinking ability of S31 solve the problem at hierarchy level 4

At the hierarchy level 5, S31 has been able to do every stage of starting the perception of stimulation up to getting a second production system. However, S31 made a mistake in the calculation process, which was 4x × 2x × x = 8x, and until the value of x = 2 was obtained, S31 made an error in the calculation process. Although the results obtained were correct, but because she experienced errors in the process in short-term memory, S31 was considered not to meet the hierarchy level 5. Creative thinking ability from S31 in solving the problem at hierarchy level 5 as explained in Fig.3.

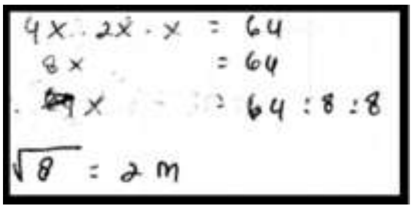

Fig.3. Creative thinking ability of S31 solve the problem at hierarchy level 5

At the hierarchy level 4, S32 misinterprets what was known about the problem. The height of a rectangular prism that was supposed to be high for three rectangular prisms was considered by S32 to be the height of a rectangular prism. This resulted in the primary production system having errors even though the information was taken from LTM type A was correct. Therefore, S32 could not meet hierarchy level 4. The results of creative thinking ability from S32 in solving the problem at hierarchy 4 can be seen in Fig.4.

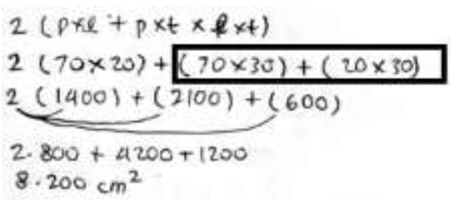

Fig.4. Creative thinking ability of S32 solve the problem at hierarchy level 4

S32 also could not solve the problem at hierarchy level 5 properly. S32 was incorrect in applying the comparison concept when looking for the size of a swimming pool. S32 determined the size of length, width, and height sought by dividing each size comparison to the multiplication of all the sizes of existing comparisons. As a result, the results obtained were wrong. This means that S32 did not meet hierarchy level 5. The results of the analysis on S31 and S32 indicated that at the level of creative thinking ability the subjects of the low-level research subjects were at the hierarchy level 3.

The results of the analysis of students' creative thinking ability in solving problems based on the IPT model show the following points.

1) All students have been able to do information processing well at hierarchy level 1. In solving this problem students don't need to retrieve information from LTM, they just need to solve the problem by drawing cube nets on the paper that has been provided.

2) The question at hierarchy level 2 could be solved well by almost all students. This was due to solving the hierarchy level 2 problem, students needed to take the information from LTM (type A) which has been mastered by students in the matter on solid, namely the volume of the pyramid. Next, the student must process the information in the STM so that a solution could be obtained. However, there were still some students in the middle and low groups who experienced errors in the calculation process and conclusions.

3) In the question at hierarchy level 3, there were still some students in the middle and low groups who have difficulty in retrieving information from the LTM (type B) which is the factorization concept. Even though students could answer the questions correctly, the answers given were done to imagine the answers without the concepts underlying the answers.

4) In the question at hierarchy level 4, only students in the upper and middle groups could complete. This was because, students have difficulty in representing the given picture, which results in student's errors in solving problems.

5) In the question at hierarchy level 5, only students in the upper group can complete. This was because to complete the hierarchy level 5, it was necessary to retrieve information from LTM (types A and B), followed by operating the information in the STM. The majority of students' errors at the hierarchy level 5 were caused by students who did not master the concepts in comparison matter, where students had to make mathematical models of the questions given.

5 DISCUSSIONS

Results of students' responses showed that students like scaffolding learning they have just followed. The initial learning activities with scaffolding begin with the phase of group formation. The formation of groups in learning is done by giving students the initial ability to think creatively first to students who then serve as a reference in forming heterogeneous groups. It is intended that more capable students can help students who are at the level of the category below it to be able to succeed through each process of thinking and can complete the given task or problem well. This is following the concept of scaffolding where scaffolding is used to define and explain the role of adults or peers who are more capable in supporting the learning and development of students' thinking processes [23]. The role of teachers and friends who are more capable can help students in aspects not yet mastered by students [21].

Scaffolding learning can reach the proportion of students completeness of more than 75% and the average creative thinking ability of students in class is more than the average creative thinking ability of students in the control class. This shows that learning with assistance or scaffolding is effective. As stated by Vonna, Mukminatien, & Laksmi, the provision of scaffolding can reduce the level of difficulty of students in solving problems and become motivated in learning [19]. On the other hand, the provision of scaffolding can develop social interactions between students and teachers and also social interactions between students [20]. This is because in the application of scaffolding there is the role of more capable teachers and friends who can help students in aspects not yet mastered by students [21], [22]. The provision of scaffolding is even more integrated with a scientific approach where students can be active to observe, cultivate, reason, try and communicate the results they get. Customizing students to think creatively and actively in solving these problems can have a significant impact on the achievement of students' creative thinking abilities at the end of learning.

The results of the analysis of students' creative thinking ability in solving problems based on the IPT model showed that higher levels of the hierarchy, then the few students who can solve the problems at that level. By the previous study of Fong and Purwoko which showed that the number of students who can be solved problems based on the information processing taxonomy model decreases linearly with the increasing complexity of questions from hierarchy level 1 to level 5 [15], [16]. For example, some operating systems at level four in the information processing taxonomy model require a secondary production system. This causes only students who can complete secondary production systems that can solve problems.

6 CONCLUSIONS

Creative thinking is an important ability to develop early. Developing creative thinking abilities from an early age, students will get used to solving problems by trying various possibilities. In mathematics, teachers and researchers can develop learning to enhance the student's creative thinking abilities. Teachers can provide more opportunities for students to explore the answer or solutions with the aspects of fluency, flexibility, originality, and elaboration. Based on the results of this study, the classification for developed learning devices in scaffolding learning was valid. The scaffolding learning can also improve mathematical creative thinking of students as indicated by the positive response from students. The findings of the hierarchy of students' levels of the high, medium, and low creative mathematical thinking ability groups are at the hierarchy level 5, 4, and 3 in solving problems based on the IPT model.

The majority of students in this study have difficulties in retrieving information derived from LTM (type B). Therefore, in giving questions to students the teacher needs to familiarize students with giving exercises that involve retrieving information from LTM (type B), that is, connecting the material taught today with other materials that have been learned before. The results of this study have shown that each student has different information processing based on the category of their creative thinking abilities. This study implied that teachers need to provide the right scaffolding according to the obstacles experienced by students when processing information to solve problems.

7 REFERENCES

[1] C.-P. Chang, "Relationships Between Playfulness and Creativity Among Students Gifted in Mathematics and Science," *Creat. Educ.*, vol. 4, no. 2, pp. 101–109, 2013.

[2] D. Karkockiene, "Creativity: Can It be Trained? A Scientific Educology of Creativity," *cd-International J. Educol.*, no. Lithuanian special issue, pp. 51–58, 2005.

[3] Y. Yuniarti, Y. S. Kusumah, D. Suryadi, and B. G. Kartasasmita, "The Effectiveness of Open-Ended Problems Based Analytic-Synthetic Learning on the Mathematical Creative Thinking Ability of Pre-Service Elementary School Teachers," *Int. Electron. J. Math. Educ.*, vol. 12, no. 3, pp. 655–666, 2017.

[4] L. Puspitasari, A. In'am, and M. Syaifuddin, "Analysis of Students ' Creative Thinking in Solving Arithmetic Problems," *Int. Electron. J. Math. Educ.*, vol. 14, no. 1, pp. 49–60, 2019.

[5] M. A. Nuha, S. B. Waluya, and I. Junaedi, "Mathematical Creative Process Wallas Model in Students Problem Posing with Lesson Study Approach," *Int. J. Instr.*, vol. 11, no. 2, pp. 527–538, 2018.

[6] O. Akınoğlu and Y. Karsantik, "Pre-Service Teachers' Opinions on Teaching Thinking Skills," *Int. J. Instr.*, vol. 9, no. 2, pp. 61–76, 2016.

[7] E. Chronopoulou and V. Riga, "The Contribution of Music and Movement Activities to Creative Thinking in Pre-School Children," *Creat. Educ.*, vol. 3, no. 2, pp. 196–204, 2012.

[8] A. Craft, "The Limits to Creativity in Education: Dilemmas for the Educator," *Br. J. Educ. Stud.*, vol. 51, no. 2, pp. 113–127, 2003.

[9] K. H. Lee, "The Relationship Between Creative Thinking Ability and Creative Personality of Preschoolers," *Int. Educ. J.*, vol. 6, no. 2, pp. 194–199, 2005.

[10] E. Aizikovitsh-Udi, "The Extent of Mathematical Creativity and Aesthetics in Solving Problems among Students Attending the Mathematically Talented Youth Program," *Creat. Educ.*, vol. 5, no. March, pp. 228–241, 2014.

[11] R. Mamin, "Penerapan Metode Pembelajaran Scaffolding Pada Pokok Bahasan Sistem Periodik Unsur," *J. Chem.*, vol. 10, no. 2, pp. 55–60, 2008.

[12] J. S. Vacca and R. Levitt, "Using Scaffolding Techniques to Teach a Lesson about the Civil War," *Int. J. Humanit. Soc. Sci.*, vol. 1, no. 18, pp. 150–161, 2011.

[13] V. Darmawanti, Sunyono, and T. Efkar, "Pengaruh Scaffolding dalam Pembelajaran SiMaYang untuk Meningkatkan Literasi Kimia dan Self Efficacy," *J. Pendidik. dan Pembelajaran Kim.*, vol. 6, no. 3, pp. 493–505, 2017.

[14] Anwar, I. Yuwono, E. B. Irawan, and A. R. As'ari, "INVESTIGATION OF CONTINGENCY PATTERNS OF TEACHERS' SCAFFOLDING IN TEACHING AND LEARNING MATHEMATICS," *J. Math. Educ.*, vol. 8, no. 1, pp. 65–76, 2017.

[15] H. K. Fong, "Information Processing Taxonomy (IPT): An Alternative Technique for Assessing Mathematical Problem-Solving," *Singapore J. Educ.*, vol. 14, no. 1, pp. 31–45, 1994.

[16] Purwoko, N. S. Saad, and N. M. Tajudin, "Junior High School Students' Cognitive Process in Solving the Developed Algebraic Problems based on Information Processing Taxonomy Model," in *AIP Conference Proceedings*, 2017, no. May, pp. 0300061–0300066.

[17] A. Zurek, J. Torquati, and I. Acar, "Scaffolding as a Tool for Environmental Education in Early Childhood," *Int. J. Early Child. Environ. Educ.*, vol. 2, no. 1, pp. 27–57, 2014.

[18] R. R. Van Der Stuyf, *Scaffolding as a Teaching Strategy*. Adolescent Learning and Development, 2002.

[19] Y. Vonna, N. Mukminatien, and E. D. Laksmi, "The Effect of Scaffolding Techniques on Students' Writing Achievement," *J. Pendidik. Hum.*, vol. 3, no. 1, pp. 227–233, 2015.

[20] Sugiyanti and R. E. Utami, "SCAFFOLDING UNTUK MENINGKATKAN KEMAMPUAN BERPIKIR KREATIF SISWA KELAS VIII D SMP NEGERI 15 SEMARANG," in *Prosiding Seminar Nasional Matematika dan Pendidikan Matematika UMS*, 2015, pp. 407–422.

[21] C. Magno, "The Effect of Scaffolding on Children's Reading Speed, Reading Anxiety, and Reading Proficiency," *TESOL J.*, vol. 3, no. December, pp. 92–98, 2010.

[22] D. F. Noviyanti, "Kajian Teknik Scaffolding dalam Meningkatkan Kemampuan Berpikir Kritis Matematis Siswa," in *Prosiding SNMPM II, Prodi Pendidikan Matematika, Unswagati, Cirebon*, 2018, pp. 93–100.

[23] F. H. Bikmaz, Ö. ÇelebÍ, A. Ata, E. Özer, Ö. Soyak, and H. Reçber, "Scaffolding Strategies Applied by Student Teachers to Teach Mathematics," *Int. J. Res. Teach. Educ.*, vol. 1, no. 3, pp. 25–36, 2010.

[24] A. N. Cahyono, "Vygotskian Perspective : Proses Scaffolding untuk mencapai Zone of Proximal Development (ZPD) Peserta Didik dalam Pembelajaran Matematika," in *Prosiding Seminar Nasional Matematika dan Pendidikan Matematika*, 2010, no. November, pp. 442–448.

[25] N. McCosker and C. Diezmann, "Scaffolding Students' Thinking in Mathematical Investigations," *APMC*, vol. 14, no. 3, pp. 27–32, 2009.

[26] J. W. Creswell, *Educational Research : Planning, Conducting, and Evaluating Quantitative and Qualitative Research*, 4th ed. Boston: Pearson Education, Inc, 2012.

[27] J. W. Creswell, *Research Design : Qualitative, Quantitative, and Mixed Methods Approaches*, 4th ed. United Kingdom: SAGE Publications, Inc., 2014.

[28] Husein, Ismail, YD Prasetyo, S Suwilo "Upper generalized exponents of two-colored primitive extremal ministrong digraphs"AIP Conference Proceedings 1635 (1), 430-439, 2014

[29] I Husein, RF Sari, H Sumardi, M Furqan, 2017, Matriks dan transformasi linear, Jakarta: Prenada Media Group

[30] Husein Ismail, Rahmad Syah, "Model of Increasing Experiences Mathematics Learning with Group Method Project", International Journal of Advanced Science and Technology, pp. 1133-1138, 2020.