

Analysis of Correlation Between Understanding to Mathematics Creative Thinking Ability Through E-Learning Assisted Learning

T.S. Hadi¹, S.B. Waluya^{2*}, Mulyono² and A. Suyitno²

¹*Students of Doctoral Department of Mathematics, Faculty of Mathematics and Science Universitas Negeri Semarang*

²*Department of Mathematics, Faculty of Mathematics and Science Universitas Negeri Semarang*

The teaching-learning process can serve as an effective solution for education during a pandemic due to the implementation of distance learning principles. E-learning is facilitated by various platforms, such as Zoom, Youtube, and Spada, to enhance the development of creative thinking abilities. There is a belief that comprehension is a crucial factor that must be present to support it. Based on this, the research aims to examine the impact of comprehension on the ability to think creatively during the learning process, as well as the influence of comprehension on the final exam through the mediation of creative thinking skills. Additionally, the study will explore the relationship between comprehension and creative thinking skills in the learning process. The research methodology employed is quantitative research, which primarily involves the statistical analysis of numerical data and also provides further insights into the questionnaire and interview data. Comprehension has a significantly positive impact on measures of creative thinking capacity; comprehension has a beneficial impact on performance in final examinations. By utilising thinking ability indicators, there is a positive correlation between creative thinking and comprehension with all indicators of creative thinking ability, resulting in an enhanced contribution to favourable learning outcomes.

Keywords: creative thinking skill; pre-service teacher; mathematics; e-learning

I. INTRODUCTION

Creative thinking is a higher-order thinking ability that every student must have in order to get the best results in learning (Serevina *et al.*, 2020). By building creative thinking skills, students will be able to create various kinds of ideas in solving the given problems (Saputri *et al.*, 2022). Creative thinking makes students more independent in finding solutions to any work they will complete. It is caused by creative thinking requires students to find something new, creates creative ideas, and be able to solve problems with several solutions (Sari *et al.*, 2018). In other words, when students have high level creative thinking skill, they will find new things and be able to finish problem by more than one method.

In creative thinking skills, several things are needed as a support in its achievement. They are fluency which includes

varied answers given by students, flexibility which provides many different methods of solving the given problems, novelty, which includes the ability to solve problems before being given background knowledge, and elaboration, which means increasing one's ability in identifying the relationship between concepts and ideas. Considering the supporting factors in creative thinking ability will make a better students' learning abilities (Prastika, 2020). To realise students' creative thinking ability, comprehension is needed to improve students' abilities in learning mathematics. Students' comprehension in learning is important for the basis of finding solutions to the given problems. By understanding the given questions, students are able to create solutions mapping to their problems. In order to determine the solutions, especially in the post-pandemic period, learning process must be designed to support

*Corresponding author's e-mail: budiw@mail.unnes.ac.id

students' creative thinking skills. E-learning is used to support students' creative thinking skills in learning mathematics in the new normal era (Rahmawati *et al.*, 2019). During the pandemic, students join learning process by online methods using e-learning platform as a supporting facility in learning process. It is very helpful, and students can still learn well during the learning process. However, it creates new problems that decrease the quality of education because the platforms used are still limited. That is why hybrid learning method is used when the level of the pandemic has started to decline because not all learning process can be done offline yet. E-learning is only a support system in learning in order to make sure that students get the whole supposed material even though it is in a new normal state. The e-learning platforms used are Zoom, learning management system and educational videos from Youtube (Sya'Roni *et al.*, 2020).

In addition to these indicators, other things are needed as a support to realise students' creative thinking skills. It is

understanding (Nugroho *et al.*, 2020). If students' comprehension becomes prior consideration, it will make a real contribution to creative thinking skills (Nahrowi *et al.*, 2020). The indicators of mathematical comprehension according to (Yudhanegara, 2017) are: (1) Restate a concept, (2) Classify certain objects according to their characteristics, (3) Identify a concept example or not (4) Use, utilise, and choose a procedure or operation. By analogy, if students understand a material, they will easily create new ideas, find solutions in several different ways, find novelty in solving the given problem and be able to identify each problem. Based on this, the urgency of this research is aimed to increase students' skill in creative thinking. To achieve it, the inquiries of this research are:

1. How is the effect of comprehension on creative thinking skills in e-learning?
2. How is the effect of comprehension on the final exam mediated by creative thinking skills in e-learning?
3. How is the correlation between comprehension and creative thinking skills?

II. DESIGN AND METHOD

A. Design Thinking

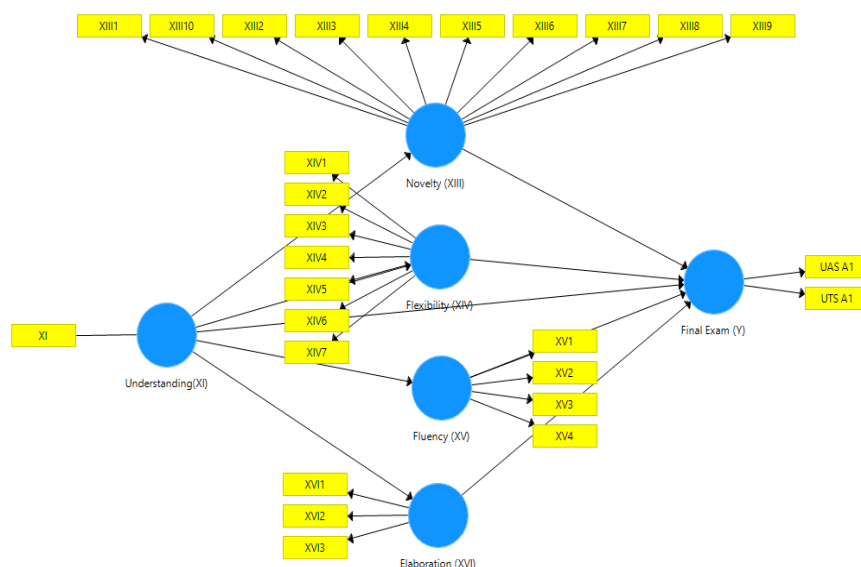


Figure 1. PLS Output
Source: SEM - PLS output

Based on the following research design, it is described as follows:

Q1: Comprehension has an effect on learning outcomes.

Q2: The effect of comprehension is mediated by flexibility on learning outcomes.

Q3: Effect of comprehension is mediated by fluency on learning outcomes.

Q4: Effect of comprehension is mediated by elaboration on learning outcomes.

Q5: The effect of comprehension is mediated by novelty on learning outcomes.

This research applied e-learning assisted learning. It was done by using learning management system, Youtube and Zoom.

B. Methodology

Conducting research quantitatively has been aimed to investigate theories. It is conducted by investigating correlation on some variables. Some instruments are used to measure them and can be conveyed into number then analysed statistically (Cresswell, 1994). Another opinion said that doing research quantitatively means conducting research based on positivism philosophy. It is aimed to investigate some populations or samples. It uses instruments to collect the data and then is statistically analysed to reach the outcome to hypothesis test (Sugiyono, 2017). Based on this opinion, it is concluded that qualitative research is research that is conducted to reveal empirical facts by using statistical analysis to answer research hypotheses. The answer is in the form of conclusions obtained from data that is confirmed based on theory and based on facts. Learning activities conducted in this study used e-learning such as learning videos, learning management systems (LMS) for documenting materials and assignments. The learning video was presented to students, after which it was briefly re-explained about the material. At the end of the learning activities, practice questions were given and at the end of the research activities, final questions were given to measure the success of the research. Instruments in this research are questions and research questionnaires which are based on theory. Questionnaires were given to reveal facts related to students' mathematical understanding and creative

thinking skills in e-learning assisted learning.

This research was aimed to reveal more deeply related to the ability to creative thinking through e-learning assisted learning. This research method was quantitative. It is a study which focus on analysing data of numeric (numbers) which are analysed statistically. Basically, the quantitative approach was conducted in inferential research (hypothesis testing) and relied its results conclusion on a probability of rejection error of the null hypothesis (nil). Based on method of quantitative, how significance of the group comparison or the correlation between the studied variables can be revealed. Normally conducting research quantitatively needs a large amount of sample (Tong *et al.*, 2020).

The research procedure is as follows:

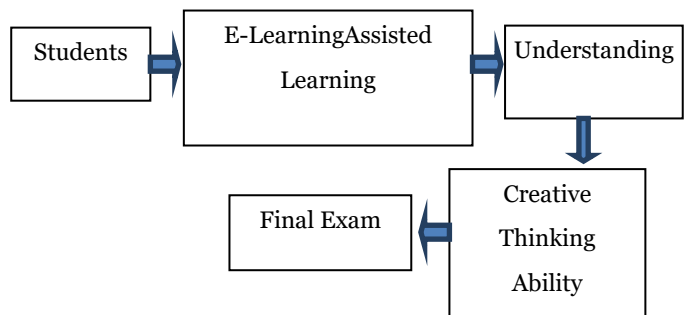


Figure 2. Research Procedure

Source: Researcher (2022)

Based on the research procedure using e-learning to conduct a more in-depth study of students' creative thinking skill by training students' comprehension on the provided mathematical material, the researchers believed that by growing this comprehension, students will become better in solving the given problems. The context of comprehension that is emphasised in this research is the process of understanding the material and understanding the meaning of the questions given by the lecturer to support indicators in creative thinking ability.

III. RESULT AND DISCUSSION

A. Result

1. Analysis Data

Research data which are obtained from the results of questionnaires given to students using the g-form and the

results of the exams are as follows:

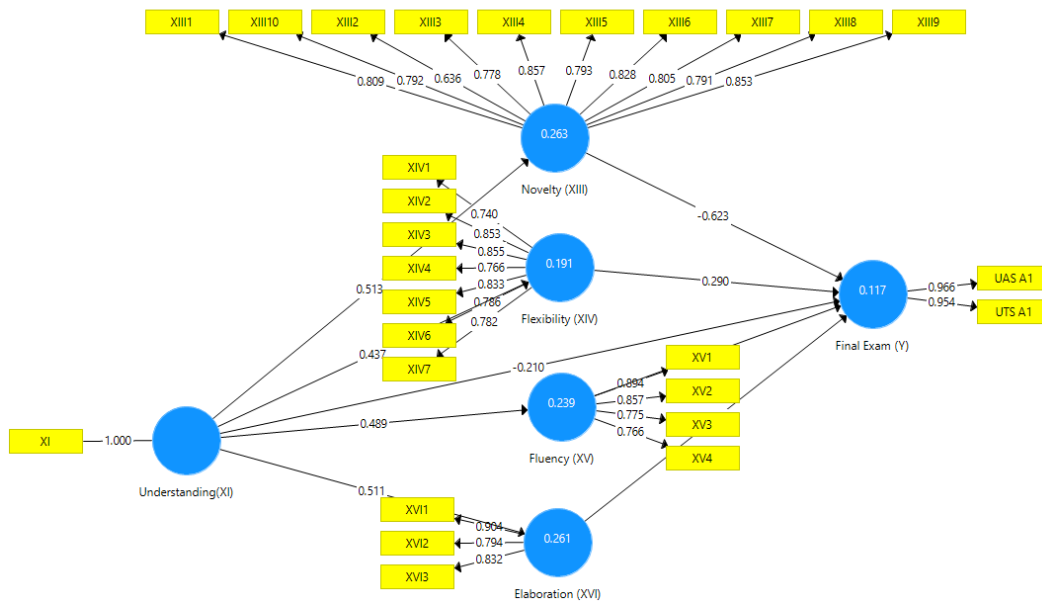


Figure 3. Output of Research Result

Source: PLS software

i. Validity and reliability test

The highest score of the elaboration variable with 3 indicators was 0.904, while the lowest one was 0.794. It is higher than 0.70. which means the data meet validity and reliability. The highest result of the fluency variable with 4 indicators was 0.894 and the lowest one was 0.766. The next variable, flexibility, has 7 indicators with the highest result of 0.855 and the lowest one was 0.740 which is greater than 0.70 and it is concluded that it meets the rules of validity and reliability. The novelty variable has 10 indicators with the highest score of 0.857 and the lowest one was 0.636 but still meeting the conditions of validity and reliability. In other hand, the final exam with 2 indicators has the highest result of 0.966 and the lowest one was 0.954. It is higher than 0.70 so it can be concluded that all research variables have met the prerequisite tests. According to the analysis, the data can be used for the next test.

ii. Analysis of comprehension on creative thinking skills and final exam

The next analysis is aimed to explore the relationship between comprehension on creative thinking skills and final

exam through e-learning assisted learning. Based on the analysis results, the data of comprehension of elaboration had an R-Square score of 0.511 or 51.1%. In other words, it can be said that comprehension has an effect on elaboration of 51.1% in a fairly good category. Secondly, comprehension of fluency had an R-Square value of 0.489 or 48.9%. It means the effect of comprehension on fluency is 48.9%. Next, the comprehension of flexibility had an R-Square score of 0.437 or 43.7% which means the effect of comprehension on flexibility is 43.7. Furthermore, the comprehension of novelty is 0.513 or 51.3%, in other words the effect of understanding on novelty is 51.3%. However, the R-Square score for comprehension on the final exam was -0.210 or -21.0% so it can be concluded that the effect of comprehension to the final exam has a poor score.

iii. Analysis is the effect of comprehension on the final exam by mediation of creative thinking skills??

The next analysis is the effect of comprehension on the final exam by mediation of creative thinking skills. The outcomes show these data: the effect of comprehension on the final exam with elaboration mediation obtained an R-Square score of 0.369 or 36.9% in other words the effect is quite good. Furthermore, the effect of comprehension on the final

exam with fluency mediation was 0.167 or 16.7%. It means, it gives less effect. Meanwhile, comprehension on the final exam with flexibility mediation obtained an R-Square of 0.290 or 29.0% with a good enough category. Lastly, for comprehension on the final exam with novelty mediation, it obtained an R-Square of -0.623 or 62.3% in the good category.

iv. *Descriptive test*

To review the relationship between mathematical understanding and creative thinking skills, a review of descriptive research was conducted with the following results:

Table 1. Descriptive Test

Score	Mean	Deviation Standard
Mid Test	48.10	11.68
Final Exam	61.17	15.22

The learning process is conducted using e-learning to review creative thinking skills related to mathematical comprehension. The average score of the mid test and final exam has increased quite well. By paying attention to the correlation between mathematical comprehension and creative thinking skills in learning using e-learning, the final exam outcome is better than the beginning of the lesson.

The study was continued to analyse the improvement of students' creative thinking skills related to mathematical comprehension; the following results were obtained:

Table 2. N-Gain

Statistic Test	Mean	Deviation Standard
N-Gain	26.31	16.21

Based on the results of N-gain test in determining the learning outcomes, it increases in terms of the correlation between mathematical comprehension and creative thinking skill. It is 26.31 in the category of good enough improvement. So, it can be concluded that if mathematics learning process is also considered to the correlation between mathematical comprehension and creative thinking skills, it will have a positive impact.

2. *Student's Response*

In order to conduct more in-depth analysis, a students' response questionnaire was tested related to students' mathematical comprehension to their creative thinking skill. The results of the students' responses are as follows:

Table 3. Students' Responses

No	Statement	Mean	Percentage (%)
1	Students restudy the material	2.88	73.60
2	Students always read the material	3.25	83.20
3	Students' ways in restudying material	2.94	75.20
4	Students do some classification in finishing the task	3.81	97.60
5	Students feel sure on their answer by classifying	3.13	80.00
6	Students conduct an identification on the test items	3.56	91.20
7	Students do the task based on the procedure given by the lecturer	3.96	99.3
8	Students use different method in finishing the task	2.38	60.80
9	Students do not use different method in doing the task item	2.06	52.80
10	Students do the task easily	3.19	81.60
11	Students recognise the method in finishing the task	2.94	7.50

12	Students are stuck on the concept	3.56	91.20
13	Students use some methods in doing the task	2.94	75.20
14	Students use their original idea in doing the task	3.75	96.00
15	Students conduct an answer crosscheck to their friends'	2.69	68.80
16	Students create new method in doing the task	1.75	44.80
17	Students create new method by identifying	1.75	44.80
18	Students classify the task items	2.56	65.60
19	Students always classify the task items	3.50	89.60
20	Identification is needed to find new method	2.31	59.20
21	Students need to restudy the material to find new thing	3.19	81.60

Based on the results of the analysis using a questionnaire to clarify data about students' responses to the correlation of mathematical comprehension to mathematical creative thinking skills, the result of the indicator of repeating the concept gets score of 77.33% which means good. The next indicators are classification which gets 88.80%, identification indicator gets 91.20%, while for the procedural indicators gets 56.80%. The next analysis to the creative thinking skill of students in terms of responses gets result for 81.60% for the elaboration indicator which can be categorised as "Good". The fluency indicator is 78.40% categorised as "Good". The flexibility indicator is 83.20% in "Good" category, while for the novelty indicator obtains 69.87% with the category of "Good Enough".

The analysis is continued by reviewing the correlation between mathematical understanding and creative thinking skill of students in learning. From the results of the study, a percentage of 68.16% is obtained in the "good enough" category. So, it can be concluded that the ability to understand mathematics is directly related to the ability of creative thinking in face-to-face learning process. In line with (Nahrowi *et al.*, 2020), it is stated that students'

mathematical understanding, if it gets direct attention, will play an important role to creative thinking skill.

3. Result Interview

The results of data analysis show that there is a relationship between mathematical comprehension to students' creative thinking skills in e-learning assisted learning process. The next analysis uses structured interviews to clarify the results of data analysis. The results of interviews are as follows:

Table 4. The result of interview

No	Question	Answer
1	Do you find different method in doing the task?	Yes, it is obtained through online learning and experiment.
2	How do you find the new method?	By watching learning video, trying to solve other task items, and conducting identification.
3	How do you identify?	Reread the material, check the task item and its example thoroughly.
4	How do you do concept repetition?	Reread notes and have practice with another task.
5	How do you do the given task?	Do it based on the given concept and check the formula.
6	Does an example of the question need to be given?	It is indispensable because not all students can catch the material quickly and directly.

Based on the results of the interviews, it is proven that mathematical understanding is closely related to students' creative thinking skill. The process of identifying, repeating, and working the task sequentially can lead to new method of finishing the given questions and can support fluency and flexibility in assistance of e-learning since the learning process is conducted in the post-pandemic period.

B. Discussion

The research was conducted on students' creative thinking skills in learning mathematics by paying attention to students' understanding on the material using e-learning.

E-learning is used to collect assignments, tasks, exams and scores during the learning. Learning activities are conducted by using Zoom meetings to provide an explanation of the material when it is conducted online, as well as using video medias. Materials and questions that have been explained and done are archived into the learning management system. The following is the effect of e-learning assisted learning to review creative thinking skills mediated by comprehension:

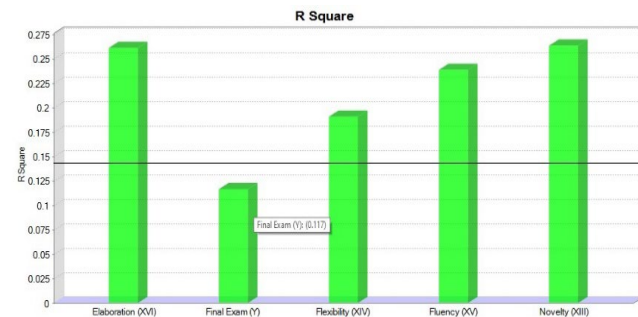


Figure 4. Analysis test

Source: SEM-PLS output

Based on the following bar chart, it is found that when students' comprehension of learning is considered as a significant factor, it has a good effect on students' creative thinking skill. Judging from the diagram that the highest effect is on the elaboration and novelty indicators, it shows that by providing understanding, students can identify the given problems so they can find solutions and can find new things in getting solutions to the problems. Furthermore, the comprehension also has a fairly good effect on the ability to provide ideas and find more than one solution for the answers. However, it has a low effect when the comprehension is constructed directly with the aim of solving the final exam questions. In other words, students' comprehension plays a positive effect on creative thinking skills. It is the process of comprehending the material and the given problem by reading and interpreting to reach their understanding.

In addition, comprehension also has a good effect on some indicators of creative thinking skills. They consist of elaboration, fluency, flexibility, and novelty. The biggest effect of comprehension is on the novelty indicator. In other words, students' understanding can encourage them to find new things in solving the given problems. According to the

data analysis outcomes, it is also statistically proven that comprehension can provide good categories final results with mediation of creative thinking skills.

IV. CONCLUSION

The analysis results of the effect of understanding on the creative thinking ability in e-learning assisted learning draw the following conclusions:

A. The effect of understanding on creative thinking skill in terms of each indicator consists of the effect of comprehension on elaboration is 51.1%, the effect of comprehension on fluency is 48.9%, the effect of comprehension on flexibility is 43.7% and the effect of understanding on novelty is 51.3%.

B. The effects of comprehension on final exam mediated by creative thinking skills are as follow: the effect of comprehension on the final exam by elaboration mediation is 36.9%, the effect of understanding on the final exam by fluency mediation is 16.7%, the effect of understanding on the final exam by flexibility mediation is 29.0% and the effect of comprehension on final exam with novelty mediation is 62.3%.

C. The novelty of this research is that comprehension is highly correlated to all indicators of students' creative thinking skills in e-learning assisted learning which is proven by its contribution on learning outcomes improvement based on N-Gain score.

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