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Creative Thinking Dispositions of Truth-Seeking Students in Solving Higher-Order Thinking Skills Questions

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ABSTRACT

This study intended to investigate the creative thinking dispositions of students who can perform truth-seeking in solving mathematical problems. Truth-seeking behavior tends to show students' thinking disposition when they need to solve math problems. This behavior is very much needed by students in solving math problems, especially HOTS-type questions. This study is qualitative and employs a phenomenological approach. Three students from the Integrated Islamic Junior High School (SMP IT) in Manokwari who sought the truth served as research subjects. Their answers on the answer sheets encouraged the determination of the subjects' tendencies in truth-seeking and creative thinking. The results of thought-based and task-based interviews were then incorporated into the analysis to determine the creative thinking dispositions of truth-seeking students and the relationship between truth-seeking and creative thinking dispositions. The findings of this study indicate that all research subjects have diverse creative thinking dispositions; the more truth-seeker indicators that are met, the more creative thinking dispositions they possess. When solving mathematical problems, students tend to show how they think by how hard they try to find the truth. This result implies that it needs more research on the level of creative thinking disposition and how to increase students' true search.

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A. INTRODUCTION

Creativity or creative thinking is the ability to think of new ideas and unusual ways and produce unique solutions to solve problems (Santrock, 2018). Creativity is required to tackle unforeseen issues encountered in daily life. Creative thinking disposition describes the capacity or aptitude of students to think creatively. Álvarez-Huerta et al. (2022) said that creative thinking is one of two complementary cognitive processes that are very important in dealing with complex problems. It is now recognized as being crucial to students' ability to deal with contemporary challenges Akkari & Maleq (2020). According to Sumarmo *et al.* (2011), the disposition for creative thinking is a strong desire, awareness, tendency, and commitment for learners to think and act positively.

Facts demonstrate the purported lack of a creative disposition among students. According to Herlina (2013), both high school and college students exhibit a slight disposition toward creative thinking. For instance, pupils are disinterested in solving math problems. They lack curiosity, are less imaginative, lack the courage to take risks, and are unwilling to ask questions

when something is unclear. One of the dimensions of the assessment framework in TIMSS 2019 is the cognitive dimension, which is focused on assessing thinking processes. According to the Trends in International Mathematics and Science Study (TIMSS) results, Indonesian students are rated 44th out of 49 nations in mathematics. According to the 2015 International Creativity Index assessment, Indonesia was ranked 115th out of 139 countries (Florida, Mellander, & King, 2015:57). This suggests that the scientific thinking ability of Indonesian students is comparatively low. This demonstrates that Indonesian pupils have limited creative thinking dispositions and inadequate problem-solving skills.

The creative thinking disposition can influence students' problem-solving abilities. This disposition can be followed by creative process and product, also creative thinking ability (Sukarso et al., 2019). When students tend to think creatively, they do not quickly answer difficulties but investigate the truth behind the problem and categorize aspects relevant to it. This condition was known as truth-seeking (Ardiansyah et al., 2022; Kurniati, Purwanto, As'ari, & Dwiyana, 2019). Truth-seeking behavior is the behavior when someone always tries to find the truth when facing a problem (Kurniati et al., 2018, 2020; Rohmah et al., 2022). Someone who exhibits this behavior is called a truth-seeker. A person's truth-seeker ability can be known when students are faced with contradictory and nonroutine (Kurniati, et al., 2019; Rohmah et al., 2022). Truth-seeking is a crucial component of the creative-thinking mindset. This is because truth-seekers always seek the truth when confronted with issues (Kurniati *et al.,* 2018:312). Through truth-seeking, students will investigate a specific issue. The truth-seeker always thinks open-mindedly (Kurniati, Purwanto, As'ari, & Dwiyana, 2019), while being open-minded is one of the characteristics of creative thinking (Abdillah et al., 2022; Yanuarto & Hapsari, 2022). So that students' ability to solve Higher Order Thinking Skills (HOTS) questions highly depends on their disposition toward creative thinking.

According to Sani (2019), HOTS questions are complicated problems that cannot be answered by simple memorizing, but rather involve the application of specific strategies and processes. One indicator of pupils' higher-order thinking skills (HOTS) is their disposition for creative thinking. Therefore, we are interested in exploring the creative thinking dispositions of truth-seeking students and seeking to characterize their thinking behavior when answering HOTS questions. The indicators that used to identify truth seekers students in this study were emphasizing evidence an reasoning (TS1), checking all the questions in the given problem (TS2), checking the truth behind the information in the question (TS3), trying to find the best information (TS4), and remembering the original problem (TS5). In TS1, students emphasize the proof of the answers given and use their mathematical reasoning. In TS2, students re-examine the problems given to them. In TS3, students re-examine the truth behind the information obtained from the questions. In TS4, students try to find the best information. While in TS5, students recall the original problem. This study focused specifically on the Two-Variable Linear Equation System (SPLDV).

Integrated Islamic Junior High School (SMP IT) Insan Mulia Manokwari as one of the driving schools in the City of Manokwari that implements an independent curriculum, prioritizes high-level thinking skills of its students and continues to be concerned in improving the HOTS of its students. One of the things that can improve students' HOTS ability is the students' critical thinking disposition and students' ability to seek the truth of the problems and answers given.

Based on the results of a preliminary study conducted at SMP IT Insan Mulia Manokwari, it is known that some students show a disposition to think creatively, and some show their ability to seek truth. Therefore, this research aims to investigate the creative thinking dispositions of students who can perform truth-seeking in solving mathematical problems.

B. METHODS

This study employed a qualitative research method with a phenomenological approach, which generated descriptive data, to describe the creative thinking dispositions of students during the truth-seeking process when solving mathematical problems. The study was conducted in the Integrated Islamic Junior High School (SMP IT) Insan Mulia Manokwari in West Papua, Indonesia. Twenty-five ninth-grade students who had learned the Two-Variable Linear Equation System (SPLDV) volunteered to participate. The research data were gathered using mathematical problems and interviews. The following are the mathematical problems utilized in this study.

> My sister owns square and triangle-shaped playing cards. The triangle card has two chickens and one bird, whereas the square card contains one chicken and four birds. How many square and triangle cards are required to accommodate 25 images of chickens and 51 images of other birds?
>
> a. Create a mathematical model to determine the required quantity of square and triangle playing cards.
> b. Count the number of square and triangle playing cards that must be supplied in multiple ways.
> c. Recalculate the required quantity of square and triangle playing cards using your own method.
> d. Create another mathematical question based on the data, then answer the question.
>
> (Source: Wardani, 2009)

Twenty-five pupils received the test individually online. Then, we rectified student test results and conducted interviews with potential research participants to find the truth seeker students. Furthermore, all respondents were interviewed to find out their truth-seeker behavior. Three students showed truth-seeker behavior. Then they were interviewed again to explore deeper their creative thinking disposition. The snippet of the creative thinking disposition that shown by the truth-seeker students is presented in this paper based on the truth seeker indicators shown by the students.

The questions asked during the interview were designed to dig deeper into the truth-seeking tendencies of the subjects and to analyze some of the possible conditions behind the offered information. The questions are: (a) what is known based on the given information? What are the questions asking? Additional questions that might be asked to assist pupils in comprehending the task include; (b) what mathematical principles are involved in the problem?; (c) what is your understanding of the concept?; (d) have you ever addressed an issue like this?; and (e) what is the solution to this problem?. The interview questions used to expose the truth-seeking behavior of the students are: (a) what steps have you taken to solve the problem?; (b) is there an alternative solution to the problem?; (c) how do you evaluate your answers?; and (d) are you sure about your answer?.

Furthermore, to ensure the validity and reliability of the research data, data analysis was carried out by triangulation. In this study, triangulation was accomplished by displaying the problem-solving findings of the participants and comparing them to the interview results. The

triangulation data were evaluated to determine the students' creative thinking dispositions and their truth-seeking behavior when solving the task.

C. RESULT AND DISCUSSION

Analysis of data on "having a disposition to always seek the truth when confronted with mathematical problems" indicates that truth-seeking behavior influences the creative thinking disposition of pupils. In this section, we present some pieces of the work of the truth-seeker students and their creative thinking dispositions. First, on the fluency component of creative thinking, students could comprehend the provided questions and develop possible solutions to them. The result of the subject's work showing the fluency can be seen in Figure 1. Based on the result of student answers during test and interviews, this student was identified as carrying out the TS2 and TS4 criteria from the truth-seeking indicator. From the result of the interview analysis, it was revealed that he re-read over and over all the entire question. This is done to check what to expect from the given problem. He also tries to gather the best information from the given problem, as shown in Figure 1.

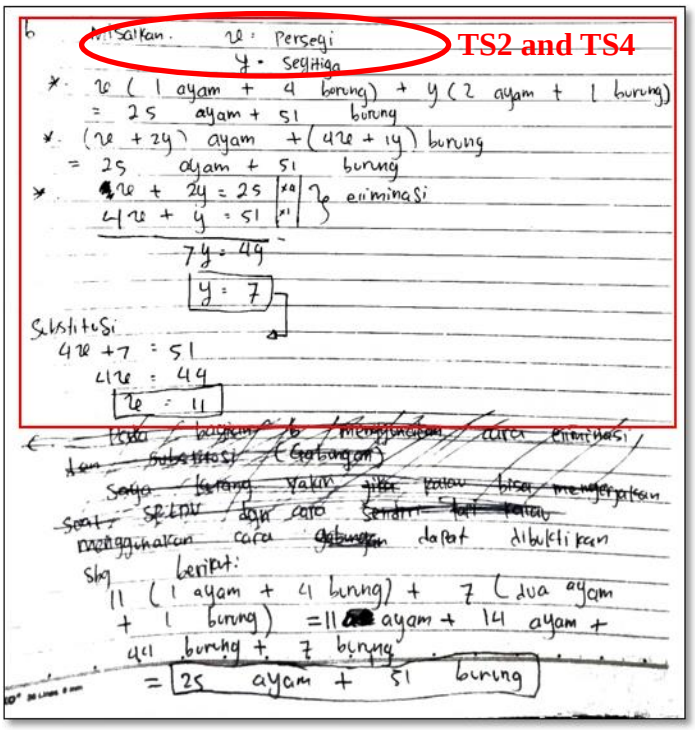

Figure 1. Student Test Result, Question 1b

Figure 1 demonstrates that one of the research subjects solved the problems using the way often taught by mathematics teachers, namely the combined method (elimination-substitution). The student wrote $x = square$ and $y = triangle$, then eliminated the equation $x + 2y = 25$ and $4x + y = 51$, without writing what was known or asked by the test. Although the student did not write down what was known and asked, the student was able to complete the answer during the interview. The following is an excerpt from the student's interview findings.

I : I saw your friends wrote down what was known or asked by the question. Why don't you include them in your answer? What is your reason?

S : I am too lazy to do it.
I : Is it the reason?
S : Yes, too lazy to write. I just wanted to do the math right away.

The student answered in the interview why he did not write down what was known and asked by the test question. The student believed he was too lazy to write it and that it would take too much time. This finding suggests that the student imagined the problem-related information in his head. Therefore, despite not writing down what was known and asked by the question, the student was able to provide a thorough response during the interview.

In addition to fluency, research participants who exhibit truth-seeker behavior also exhibited cognitive flexibility. From the results of interview analysis of truth seeker students, he also revealed that he always double-checked to prove that what he got was true. Besides, he also draws conclusions based on the facts and evidence provided. This shows that respondents place great emphasis on proof and reasoning when solving math problems (Hasanah et al., 2019; Sundstorm, 2020). In the exam, students were permitted to express divergent thoughts, even if they were presented in the same format, for instance by noting distinct procedures for determining the values of x and y. To answer Question 1b (Figure 1), a student must first determine the value of y, whereas to answer Question 1c (Figure 2), a student must first calculate x. This demonstrates that pupils demonstrated another facet of creative thinking, namely flexibility because it allows for multiple methods of determining x and y's values. The following interview excerpt provides support for this claim:

I : In your opinion, how many ways can be used to solve Question no 1b?
S : Elimination, substitution, the combined method, and graphs.
I : What method did you use here?
S : The combined method
I : Can you do the task differently?
S : Sure

The following are the Student Test Results for Question 1c, as shown in Figure 2.

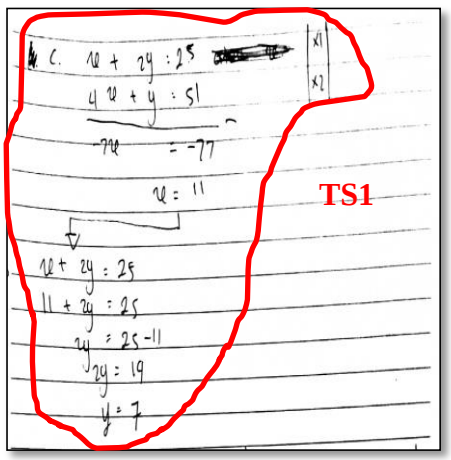

Figure 2. Student Test Result, Question 1c

The interview excerpt above shows that students can use other ways to solve Question 1c, such as elimination, substitution (see Figure 3. Student Test Result, Question 1d) or a combination of elimination and substitution, and graphs. The description above shows that the respondent knows more than one alternative problem solving and can see the problem from a different perspectives based on previous experience. This is characterized as a flexibility profile in solving mathematical problems. As stated by Nadjafikhah et al. (2012) and Sriraman (2009) that new ideas are usually generated from individual interactions with other people and previous experiences. Thirdly, in terms of originality in creative thinking, students could generate new math questions based on existing facts and deliver answers. For instance, one student identified the subject of the inquiry as "Mikoro's sister", as shown in Figure 3.

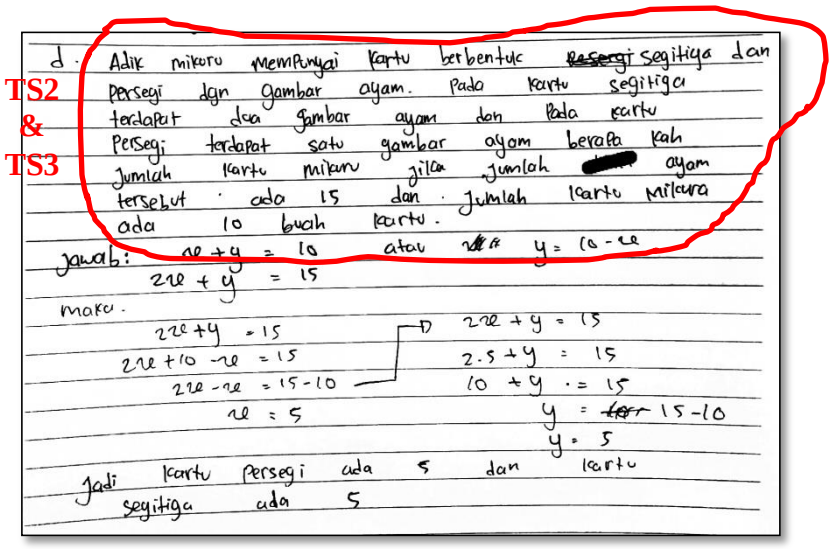

Figure 3. Student Test Result, Question 1d

We identified that what students were doing was uniquely and unusual. This is in line with what was stated by Da Costa et al. (2015) that creativity is an original novelty. In this situation, the student who created question said, "Mikoro's sister has triangle and square cards." The square card features one chicken image, whereas the triangle card contains two. The question is, "How many triangle cards and square cards does Mikoro's sister have if there are 15 chickens and ten cards?" In the test question, the square cards and triangle cards have images of chickens and birds; however in the question the student just prepared, these cards solely feature images of chickens. In other words, the student only utilized the chicken image on the triangular and square cards. The student then added a sentence indicating that there were ten triangle cards and square cards. This demonstrates that the student had met the originality requirement for creative thinking, as his question was never imagined by anyone else. The following is an excerpt from the interviews conducted with this student.

I : Question 1 d says, "Create another mathematical question based on the data, then answer the question." Can you explain it?

S_1 : Explain the question?

I : Yes

S_1 : The writer's little sister has a card in the shape of a triangle and a square with a picture of a chicken. There are two chicken images on the triangular card, whereas the square card

only has one chicken image. How many square and triangular cards does she have if she had ten playing cards and 15 images of chickens?

I : Have you solved a similar problem?

S_1 : Never

I : Do you think this question is difficult?

S_1 : I think this question is difficult. I have never seen a question like this before.

Based on the result of an analysis of student work (as shown in Figure 3) and the interviews, it can be seen that the respondents rechecked the questions and the truth behind the information contained in the questions. Fourth, a research subject was seen writing the outcomes of the math $y = 7$ and $x = 11$ in a red box, illustrating the elaboration part of creative thinking, as shown in Figure 4.

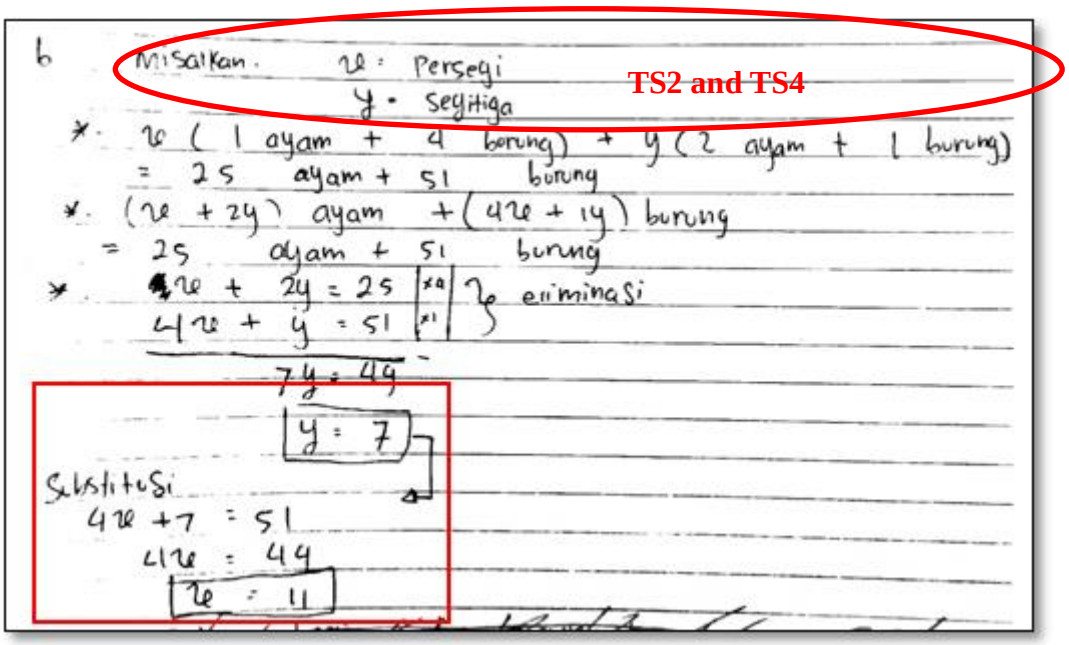

Figure 4. Student Test Result, Question 1b

Figure 4 shows that S_1 answered the question with the combined method (elimination-substitution) and wrote the calculation in a red box. This indicates the elaboration aspect of creative thinking, where the student highlighted important details in his answer. This finding is supported by the result of the interview with the student.

I : Why are $y = 7$ and $x = 11$ written in a box?

S_1 : It helps to emphasize the calculation result.

The following is the Student Test Results for Question 1b, as shown in Figure 5.

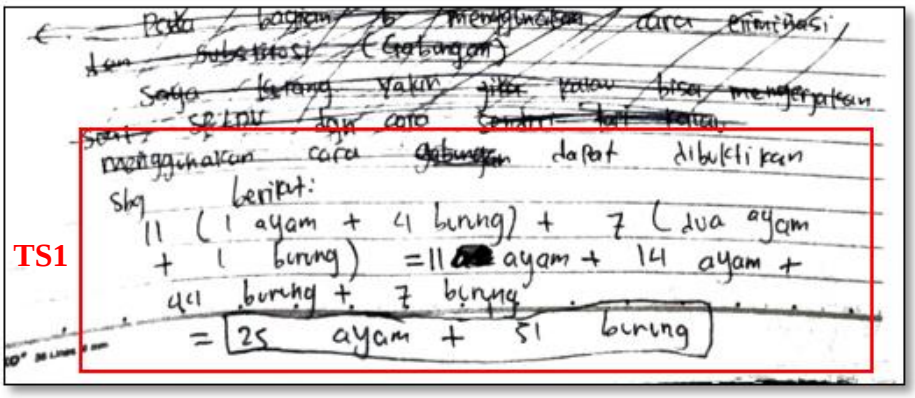

Figure 5. Student Test Result, Question 1b

Fifth, on the evaluation aspect of a creative thinking disposition, one participant supported his answer with evidence to check the accuracy of the calculations he had done (Figure 5). The student multiplied the results of a triangular card (y) = seven and a square card (x)=11 with a charge of 1 chicken and four birds on a square card and two chickens and one bird on a triangle card. Finally, the student answered that the square card contains 25 chickens, and the triangle card contains 51 birds. The following is an excerpt of the interview conducted with S_1.

I : "This can be proven as follows." What does this statement mean?

S_1 : Just my initiative, so that (my answer) can be proven and the answer is the same as stated in the question.

Based on the results of data analysis conducted on subjects who have a tendency to search for truth when facing mathematical problems, it is known that S1 meets five truth-seekers indicators and five aspects of creative thinking disposition, S2 meets three truth-seekers indicators (TS1, TS2, and TS4) and four aspects of creative thinking disposition (fluency, flexibility, originality, and elaboration), and S3 fulfills two truth-seekers indicators (TS1 and TS4) and three aspects of creative thinking disposition (fluency, originality, and evaluation). Based on the results of the data analysis, it shows that truth-seeking behavior has an impact on students' creative thinking disposition. It can be seen that the more truth-seeking indicators that are met by students, the aspects of the disposition of creative thinking that students have will increase. As'ari *et al.* (2019) said that truth-seeking behavior tends to show students' thinking dispositions when they need to solve math problems. As'ari *et al.* (2019) added that their mathematics achievement also outperformed students who never informed truth-seeking behavior. So it can be said that truth-seeking behavior greatly affects students' creative thinking disposition. The more truth-seeker indicators that are met, the more creative thinking dispositions they possess.

D. CONCLUSION AND SUGGESTIONS

The results of this study imply that truth-seeking students' creative thinking dispositions alter when answering HOTS questions on SPLDV material. The first subject includes five aspects of the creative thinking disposition, namely fluency, flexibility, originality, elaboration, and evaluation. The second subject has four aspects of the creative thinking disposition, namely fluency, flexibility, originality, and elaboration. The third subject has three aspects of the

creative thinking disposition, namely fluency, originality, and evaluation. This study demonstrates that truth-seeking behavior influences the creative thinking dispositions of students. The more truth-seeking indicators that students meet, the more creative thinking dispositions that students have will increase. When solving mathematical problems, students tend to show how they think by how hard they try to find the truth. For further research, it is necessary to conduct further studies regarding the level of disposition of creative thinking and how to improve students' true seeking.

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