

# Students' Creative Thinking in Solving Numeracy Problems Based on Cognitive Style

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## Students' Creative Thinking in Solving Numeracy Problems Based on Cognitive Style

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### ABSTRACT

The research aims to describe the character of solving numeracy problems based on students' cognitive styles. Research instruments include teacher questionnaires, cognitive style test instruments, numeracy problem-solving test instruments, interview guides, and documentation. Data from cognitive style tests and interviews are explained descriptively to select research subjects. The subjects of this research were 32 students in class VIII of state junior high schools in Jombang. Data from numeracy tests, interviews, and documentation were analyzed to describe the subject's creative thinking abilities. The results of the research show that field-independent students think of more than one answer in a variety of ways and succeed in breaking down the details of an idea object into different ways or methods. It also fulfills the creative thinking indicators of novelty and provides a new art in solving numeracy problems that is pure. Meanwhile, field-dependent students have not provided different ideas or ideas as a form of process for solving numeracy problems in different ways. Even though the field-dependent student provided a correct solution to the problem, it did not meet the novelty indicator.

**Keywords:** creative, numeracy, cognitive style

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### INTRODUCTION

The ability to think creatively fosters students' development of ideas to solve problems appropriately, solve problems with various ideas, and solve problems in new ways that are different from existing methods (Silver, 1997). Thinking creatively is essential for students and needs to be taught to students (Faturahman & Afriansyah, 2020). This indicates the need for efforts to develop creative thinking abilities, primarily through learning mathematics. The mathematical skills of students in Indonesia are of particular concern to the government to realize national education goals. Based on this data, in 2020, a new policy emerged, namely that the National Examination had been abolished. In 2021, the National Examination was changed to a Minimum Competency Assessment and character survey. The assessment includes the ability to reason using language (literacy), the ability to maintain using mathematics (numeracy), and character assessment.

This policy is one of the Indonesian government's reactions to the results of the 2018 PISA analysis showing that Indonesia is in the bottom 10 of 79 participating countries regarding student abilities which can be divided into minimum level competency or above and below. In percentage terms, approximately only 25% of Indonesian students have a minimum level of reading competency or more, only 24% have a minimum level of mathematics competency or more, and around 34% of Indonesian students have a minimum level of science competency or more (OECD, [2019a](#)). Based on the PISA results also released by the OECD, Indonesia's numeracy literacy level is ranked 62nd out of 70 countries, this shows that students are still low in solving numeracy problems. This numeracy ability is influenced by many things, such as the ability to solve mathematical problems and students' literacy skills. This means that the ability to think creatively in solving numeracy problems must be considered and developed so that they can develop students' abilities in solving mathematical problems to the maximum.

Existing problems (1) In learning, teachers have not fostered creative thinking in students, placing more emphasis on completing target material rather than mastering competencies with creative thinking. (2) Teachers are less responsive in including numeracy problems in mathematics learning to foster creative thinking. (3) The level of creative thinking ability of students in Indonesia is relatively low, because only 2% of Indonesian students can work on high and advanced category questions which require creative thinking skills to solve them (Mullis, 2012).

Creative thinking is a mental activity to increase purity (originality) and sharpness of understanding (insight) in developing something (generating)". The ability to think creatively is related to the ability to produce or build something new, namely something unusual that is different from the ideas made by most people (Sukmadinata, [2004](#)). Students' ability to think creatively allows them to obtain many ways or alternative solutions to a problem. Although sometimes too many ways will make it difficult to get to the result, having many choices will enable students to get to their goal compared to students who don't have a way to get to the solution to the problem (de Bono, E. [2007](#)). That is why creative thinking is critical for a student. Creative thinking is the key to thinking to design, solve problems, to make changes and improvements, to obtain new ideas.

The results of Puspitasari et al ([2019](#)) in analyzing creative thinking abilities in students with high, medium, and low skills in mathematics show that the increased ability category in mathematics does not show any problems. Students with moderate and low abilities in mathematics still have difficulty solving problems, they are not structured, detailed, and systematic, their calculation processes are not careful, and trial and error strategies are adopted in solving them. Based on the results of this research, it was concluded that someone who does not have the ability to think creatively is not able to solve non-routine problems but is also unable to see various alternatives for solving those problems.

Leikin & Lev (2007) conducted research using several problem solving tasks to explore the mathematical creativity of students from three groups of students, each identified as students with high IQ and having high achievement in Mathematics, students who are proficient in mathematics, as indicated by high levels of performance, and regular students who have high scores in mathematics. It was found that differences between groups depended on the problem-solving task. Final scores indicated differences between groups in the combination of novelty and flexibility. Research by Puspitasari and Leikin & Lev shows that there is no research that describes students' creative thinking in solving numeracy problems.

Another focus of teachers in the learning process is paying attention to student character. Everyone has different characteristics from other individuals when solving problems. According to Suharman (2005), differences in characteristics can include differences in how to receive, organize and process the information received. This is what is called cognitive style. In mathematics learning, students are found to respond quickly to mathematical problems given without thinking deeply so that answers tend to be wrong (Rahmatina et al, 2014). Apart from that, there are also students who are slow to respond to the mathematical problems given, and their answers tend to be correct.

Cognitive Style is a typical way of learning that is inherent in students, both in terms of receiving, managing and attitudes toward information, as well as study habits (Alvani, 2016). Cognitive styles can be classified into two, namely field-independent cognitive styles and field-dependent cognitive styles. Field independent cognitive style is a way of learning for individuals who tend to be independent, prioritize analytical and systematic thinking skills, and are not influenced by environmental and social situations. Meanwhile, the field-dependent cognitive style is an individual's way of learning that tends to depend on the environment and society, thinks in a holistic way so that it is easy to follow other people's suggestions and criticism, and does not require analytical and systematic thinking (Aldamono, 2012).

Putra's (2013) research on the relationship between cognitive style and learning achievement shows that there is a positive and statistically significant correlation between cognitive style and learning achievement. Cognitive style is part of a learning style that describes a person's relatively fixed behavioral habits in receiving, thinking, solving problems, and storing information. One cognitive style that specifically needs to be considered in education is the field-dependent and Field Independent cognitive styles (Witkin et al, 1975). The primary difference between the two cognitive styles is in terms of how to look at a problem. The primary characteristics of these two cognitive styles are very suitable for application in research that involves thinking processes in solving mathematical questions and issues. This cognitive style is a type of cognitive style that reflects a person's analytical way of interacting with their environment.

Based on the description above, it is fascinating for researchers to conduct research, researchers are encouraged to conduct research related to analyzing creative thinking abilities in solving numeracy problems based on cognitive style. The researcher chose the numeracy problem material because the character of a numeracy problem requires solutions from students who can think creatively, one of which is the aspect of fluency. Students' fluency in solving numeration is such that students will have many ideas to solve the problem. In this way, the researcher took the research title "Analysis of Students' Creative Thinking in Solving Numeracy Problems Based on Cognitive Style".

## **METHOD**

### ***Participants***

The participants in this research were class VIII SMP/equivalent students in Jombang, East Java. Students were grouped based on cognitive style, then the researcher chose one student from each Field Independent cognitive style and Field Dependent cognitive style to be the research subject. Determining research subjects uses the following criteria:

1. The students who were research subjects were class VIII SMP/equivalent students from schools selected by researchers in Jombang, East Java. Several junior high schools/equivalents in Jombang Regency that are accredited A were surveyed first by providing a questionnaire on mathematics learning activities, the mathematics teachers at these schools filled in each question in the questionnaire. The questionnaire provides an overview of mathematics teachers delivering numeracy material or not offering numeracy material. Thus, based on the results of the questionnaire, researchers can select subjects from schools that provide numeracy material. Schools that are used as prospective research locations are schools that have the highest scores from 15 questions in the mathematics learning questionnaire or have superior classes/special class programs. If there are similarities in the teacher questionnaire results, the researcher chooses schools that have a high percentage in terms of the number of subjects that support the numeracy literacy program and the number of teachers who have been certified and/or the number of driving teachers.
2. The students who were the research subjects were students from class VIII who were taught by teachers who participated in filling out questionnaires or recommendations for mathematics teachers from schools selected by the researcher. Students from this class were given the Group Embedded Figure Test (GEFT). The GEFT test results will group students into two groups, namely the Field Independent cognitive style group and the Field Dependent cognitive style group. The students who were the research subjects were 2 students consisting of 1 student who had a Field Independent cognitive style and one student who had a Field Dependent cognitive style. Students from selected classes are given several simple geometric shapes and several complex geometric shapes. Students are asked to find simple shapes that are in the complex geometric shape according

to the instructions in the test. The test consists of 3 parts: the first part consists of 7 question items, the second part consists of 9 question items and the third part consists of 9 question items. The first part of the test is prepared for test takers' practice, while the second and third parts are the core of the test. Data obtained from GEFT is used to group cognitive styles into two types, namely field-independent (FI) and field-dependent (FD). The score calculation for an item is worth one if it is correct and 0 if it is wrong so that the student's maximum score is converted into a percentage. To group students into the FI cognitive style, the benchmark test score is 50% greater than the maximum score, namely  $9 < \text{score} \leq 18$ , and the highest score from the FI group is chosen by the researcher as the FI-type research subject. Meanwhile, students who get a test score less than or equal to 50% of the maximum score, namely  $0 \leq \text{score} \leq 9$ , then these students are grouped into the FD cognitive style, and the highest score from the FD group is selected by the researcher as the FD type research subject.

3. If more than 1 subject is found in each learning style group, purposive sampling will be used, the researcher will conduct interviews to collect data on prospective subjects who have good communication and can explain the GEFT test directly correctly.

#### ***Research design***

This research is descriptive qualitative research with the aim of describing the creative thinking process in solving problems in terms of students' cognitive styles by providing an overview of the subject's situation according to the facts and characteristics they experience.

#### ***Instrument***

Research instruments include questionnaires, GEFT, numeracy problem sheets, interview guides, and documentation. Questionnaire, in the form of questions that describe learning activities that contain numeracy. Group Embedded Figure Test (GEFT), in the form of several questions given to students to help researchers differentiate between subjects who have a Field Independent cognitive style and subjects who have a Field Dependent cognitive style. The material in this test is in the form of geometric shapes. Numeracy problem sheets, numeration problems were created by the researchers themselves by developing HOTS-based mathematics problems and fulfilling numeracy indicators, namely skills in number concepts and arithmetic operations, ability to use symbols and numbers, and analyzing tables. Figure 1 shows the numerical problems solved by the subject.

The results obtained from solving the 40 questions provided by the five finalist participants in the Mathematics Olympiad in East Java, namely Yudistira did 20 questions and got P correct, Werkudara answered 12 questions and got 10 correct, Arjuna did 10 questions and got 8 correct, Nakula did 20 questions and got 15 correct, Sadewa did 15 questions and got N correct. The percentage of errors by Arjuna and Sadewa is the same, and the percentage of Yudistira's errors is smaller than Werkudara's. If the Olympiad scoring rules correctly get 4 points, incorrectly get -1 point, then the chance or possibility of the highest total score is . . .

**Figure 1.** Numeracy problem sheet

The interview guide, in this research, was used to collect data on students' creative thinking abilities, which were not recorded in written results after the subjects worked on the sheet to solve numeracy problems. Documentation, in this research, is in the form of photos of student test sheet results, videos of subjects solving numeracy problems, and recorded interviews.

**Data analysis**

The data analysis techniques used in this research are data reduction, data display, and conclusion. In the data reduction technique, researchers summarize, select, and record essential data obtained from the field. The data obtained came from the results of problem-solving tests and interview tests with subjects. In data display, the researcher presents data originating from the results of interviews, which have been reduced to narrative text. Data is presented in a description of the data and research findings. Drawing conclusions is the result of research that answers the research focus based on the results of data analysis. Conclusions are presented in the form of descriptive research objects guided by research studies. The initial findings found are still temporary and will change if strong supporting evidence is not found at the next stage of data collection. However, if the conclusions put forward at the initial stage are supported by valid and consistent evidence when the researcher returns to the field to collect data, then the conclusions put forward are credible conclusions.

**RESULTS & DISCUSSION**

**Result**

On August 13, 2023, researchers visited class VIII of junior high schools in Jombang and gave the students the GEFT test. The GEFT Test results are presented in Table 1.

**Table 1.** Summary of GEFT Test Results

No	Information	0 < score ≤ 9	9 < score ≤ 18
1	The number of students	17	15
2	Maximum score	9	18
3	Minimum score	5	10
4	Number of students maximum score	1	1
5	Number of students minimum score	4	4
6	Cognitive Style Types	FD	FI

Based on the research subject selection criteria in research methods that have been determined by the researcher, the recapitulation information on GEFT test results from Table 1 above can be concluded by the researcher that there is one FI type subject with the highest score of 18 and one FD type subject with the highest score of 9. This shows that students' ability to solve mathematical problems is influenced by several factors. These factors arise because everyone is different. Dimensions of individual differences include intelligence, logical thinking ability, creativity, cognitive style, personality, values, attitudes, and interests (Chrysostomou, [2011](#))

#### ***Data Analysis Creative Thinking Subject FI***

FI-type subjects wrote answers using two different patterns, and the first pattern was that FI-type subjects used the same percentage of errors for Arjuna and Sadewa to get the percentage of errors for Arjuna and Sadewa. Through Sadewa's error percentage, FI type subjects wrote answers to the number of Sadewa errors. Next, the FI type subjects successively wrote down answers to scores for Arjuna, Sadewa, Werkudara, Nakula and 3 possible scores for Yudistira. At the end of the completion process, FI type subjects draw conclusions from solving numeracy problems. Figure 2 is subject FI's answer.

The answer to the second pattern at the beginning of the process written by the FI type subject is different from the first pattern. The first thing that is done in the second pattern is to determine the percentage of Werkudara error and determine the Werkudara score. Next, the FI type subject utilizes the inequality of Yudistira's and Werkudara's error percentages, to create a correct analogue for Yudistira's possible percentage. The analogous results obtained by FI type subjects show the highest possible score for Yudistira. Thus, until the end of the FI type subject solving process, conclusions are drawn from solving the numeracy problem. Most students rely on technical algorithms to solve problems. Although gifted students can overcome thinking challenges well, most of them operate at a basic level of creativity. One of the implications drawn from this research is the need to expand and develop mathematical-logical thinking both as an extraordinary learning and as an integral part of other learning in the program (Chamberlain & Moon, [2005](#)). This shows that the results of the subject's thinking provide a new perspective or capture new opportunities, giving rise to new ideas that have never existed (Ismienar et al, [2009](#)).



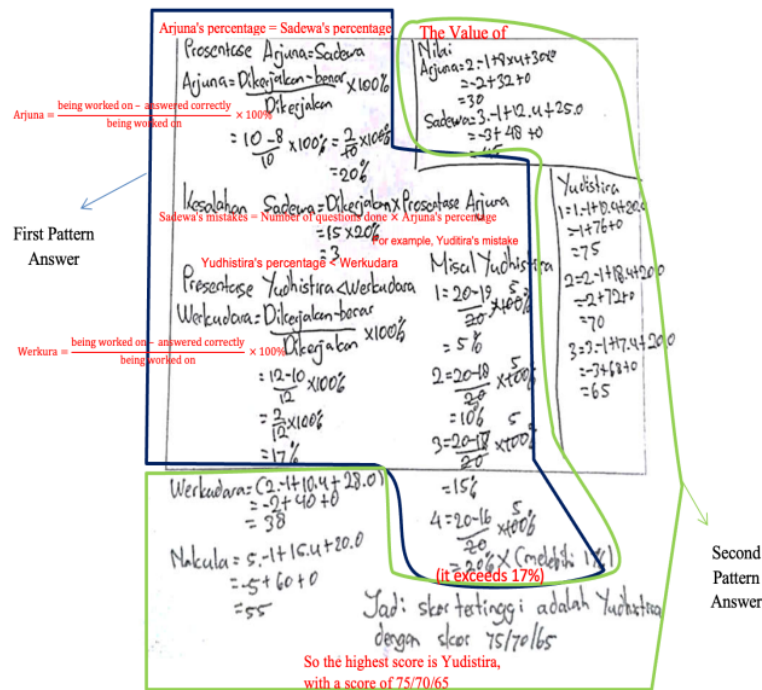


Figure 2. Subject FI's answer

The interview results showed that FI type subjects connected the mathematical concepts they chose with the problems presented. FI type subjects with their learning experiences explained in detail the written problem-solving process to the researchers. Based on the data presented, it shows that FI lancer type subjects produce more than one correct answer. In other words, FI type subjects show the first indicator, namely creative thinking fluency in solving problems. The following are the results of the researcher's interview with Subject FI:

- Researcher : Mention the result of solving the problem that you worked on?  
 Subject FI : The result of this problem is that the highest score obtained by Yudistira is 75, 70 or 65  
 Researcher : Are you sure that the problem solution you are working on is correct?  
 Subject FI : God willing, I'm sure  
 Researcher : Explain the method you used to solve this problem?  
 Subject FI : It is known that Yudistira's percentage is smaller than Werkudara's, so we have to find Werkudara's percentage by means.

$$\frac{\text{the problem being worked on} - \text{questions answered correctly}}{\text{lots of questions to work on}} \times 100\%$$

$$\text{Werkudara error percentage} = \frac{12 - 10}{12} \times 100\% = \frac{2}{12} \times 100\% = 17\%$$

So Werkudara's error percentage is 17%, and what is known in the problem is that Yudistira's percentage is smaller than Werkudara's, so the error percentage cannot exceed more than 17%. So, we use the method by assuming, for example Yudistira is wrong 1, we try

if Yudistira makes a mistake of 1 then the percentage of error is  $\frac{20 - 19}{20} \times 100 = 5\%$

if Yudistira makes a mistake of 2 then the percentage of error is  $= \frac{20 - 18}{20} \times 100$   
 $= 10\%$

if Yudistira makes a mistake of 1 then the percentage of error is  $= \frac{20 - 17}{20} \times 100$   
 $= 15\%$

if Yudistira makes a mistake of 4 then the percentage of error is  $= \frac{20 - 16}{20} \times 100$   
 $= 20\%$

(this is not possible because it exceeds 17%)

So the possibility of Yudhistira's error is 1, 2, or 3

Next, I calculated the highest score from the possible scores obtained.

if wrong 1 then the score is  $= 1 (-1) + 19 (4) = 75$

if wrong 2 then the score is  $= 2 (-1) + 18 (4) = 70$

if 3 are wrong then the score is  $= 3 (-1) + 17 (4) = 65$

So the highest possible score from Yudistira is 75, 70, or 65

Researcher : How do you check that the results of solving the problem you are working on are correct?  
 Subject FI : I also checked it by counting again and again but the result was still the same. However, I also calculated it in another way by paying attention to the next clue in the problem, namely that the percentage of errors by Arjuna and Sadewa was the same. From here, Arjuna's error percentage = Sadewa's error percentage

$$\frac{15 - n}{15} \times 100\% = 20\%$$

So the n value obtained is 12 (n = the correct number of Sadewa) After that I calculated each person's score

For Werkudara, the questions 12 are correct, 10 are wrong, 2 of  $12 - 10 = 2$ , then the score is  $= 2 (-1) + 10 (4) = 38$

For Nakula, the questions that were done were 20 correct, 15, then 5 wrong, so the score was  $= 5 (-1) + 15 (4) = 55$

For Arjuna, the questions he worked on were 10 correct, 8, then 2 incorrect, so the score was  $= 2 (-1) + 8 (4) = 30$

For Sadewa, the questions he worked on were 15 correct, 12, then 3 incorrect, so the score was  $= 3 (-1) + 12 (4) = 45$

From the scores obtained by Werkudara, Arjuna, Nakula, Sadewa, and in the same way, the highest possible score for Yudistira is 75, 70, or 65

### ***Creative Thinking Data Analysis Subject FD***

Solving the FD subject problem provides one correct value method with the highest possible score for Yudistira. The first thing the FD subject does in solving the problem is to determine the percentage of error for each object. The subject, by utilizing the error percentage for each object obtained and the inequality of error percentages between Yudistira and Werkudara, can construct an analogy that Yudistira's error percentage is  $< 17\%$ . Next, the subject determines the highest possible scores for Yudistira as the final result of solving the problem. Figure 3 is subject FD's answer.

Persentase Kesalahan =  $\frac{\text{Jl. salah}}{\text{Jl. soal}} \times 100\%$

- Salah Yudistira:  $\rightarrow$  Soal - Benar =  $\frac{20 - P}{20} \times 100\%$
- Salah Werdukura:  $\frac{12 - 10}{2} \times 100\% = 17\%$
- Salah Arjuna:  $\frac{10 - 8}{10} \times 100\% = 20\%$
- Salah Nakula:  $\frac{20 - 15}{20} \times 100\% = 25\%$
- Salah Sadewa:  $\frac{15 - N}{15} \times 100\%$

\* Perumpamaan persentase kesalahan Arjuna dan Sadewa adalah sama

\* Persentase kesalahan Yudistira < Werdukura, yang berarti harus dibawah < 17%

- Jika Salah 1 maka persentase kesalahan adalah  $\frac{1}{20} \times 100\% = 5\%$
- Jika Salah 2 maka persentase kesalahan adalah  $\frac{2}{20} \times 100\% = 10\%$
- Jika Salah 3 maka persentase kesalahan adalah  $\frac{3}{20} \times 100\% = 15\%$
- Jika Salah 4 maka persentase kesalahan adalah  $\frac{4}{20} \times 100\% = 20\%$

\* Jika kemungkinan 2 yudistira ~~salah~~ tertinggi adalah 1, 2 dan 3 karena < 17%

Amiran:  $13 = 4$  | mana kemungkinan skornya adalah

1) Jika salah 1 = 13 (diambil dari jumlah soal yudistira)

Skor:  $1 \cdot (-1) + 19 \cdot 4$   
 $\cdot -1 + 76$   
 $\cdot 75$

2) Jika salah 2 = 17

Skor:  $2 \cdot (-1) + 18 \cdot 4$   
 $\cdot -2 + 72$   
 $\cdot 70$

3) Jika salah 3 = 15

Skor:  $3 \cdot (-1) + 17 \cdot 4$   
 $\cdot -3 + 68$   
 $\cdot 65$

Figure 3. Subject FI's answer

Direct translation

$$\text{Wrong Yudistira} = \frac{\text{many questions} - \text{correct answers}}{\text{many questions}} = \frac{20 - P}{P} \times 100\%$$

$$\text{Wrong Werdukura} = \frac{12 - 10}{2} \times 100\% = 17\%$$

$$\text{Wrong Arjuna} = \frac{10 - 8}{10} \times 100\% = 20\%$$

$$\text{Wrong Nakula} = \frac{20 - 15}{20} \times 100\% = 25\%$$

$$\text{Wrong Sadewa} = \frac{15 - N}{15} \times 100$$

The clue is that the percentage of errors for Arjuna and Sadewa is the same

Yudistira's error percentage < Werdukura, which means it must be less than 17%

if false 1, then the error percentage is  $\frac{1}{20} \times 100\% = 5\%$

if false 2, then the error percentage is  $\frac{2}{20} \times 100\% = 10\%$

if false 3, then the error percentage is  $\frac{3}{20} \times 100\% = 15\%$

if false 4, then the error percentage is  $\frac{4}{20} \times 100\% = 20\%$

So the possibility that Yudhisthira is wrong is 1, 2,3, I don't take it wrong

4 because if 4 is wrong the percentage of error is more than 17%.

Rule: True = 4, false = -1, then the possible scores are:

So the score if false 1 is  $1(-1) + 19(4) = -1 + 76 = 75$

The score if false 2 is  $2(-1) + 18(4) = -2 + 72 = 70$

The score if false 3 is  $3(-1) + 17(4) = -3 + 68 = 65$  which means Yudistira's highest score is 75, 70 and 65

The subject fluently explained from the beginning of the process to the end of solving problem 1, based on the results of the interview the subject explained in detail such as writing the answer to solving the problem. However, the subject does not fulfill creative thinking fluency in providing various answers, and the subject does not show different ways of solving the same problem. The subject believes that the answer made is correct by examining it again from the beginning of the process to the end of solving the problem that has been created. The following are the results of Subject FD's interview.

- Researcher : Mention the result of solving the problem that you worked on?  
 Subject : The result is that the highest possible total scores are 75, 70 and 65
- Researcher : Are you sure that the problem solution you are working on is correct?  
 Subject : I am sure because I have followed the instructions, namely that Yudistira's error percentage is smaller than Wekudara's. Which means the Yudistira value must be below 17%.
- Researcher : Explain the method you used to solve this problem?  
 Subject : The method I use is that the percentage of errors is the number of errors compared to the number of questions multiplied by 100%, then I count them all. After the results were found, I followed the instructions, namely that Yudistira had to be smaller than Werkudara, which meant that Yudistira's value had to be below 17%. Then I used error percentage
- if 1 is wrong, then the error percentage is  $\frac{1}{20} \times 100\% = 5\%$
- if 2 is wrong, then the error percentage is  $\frac{2}{20} \times 100\% = 10\%$
- if 3 is wrong, then the error percentage is  $\frac{3}{20} \times 100\% = 15\%$
- if 4 is wrong, then the error percentage is  $\frac{4}{20} \times 100\% = 20\%$
- So, the possibility that Yudhisthira is wrong is 1, 2,3, I don't take it wrong  
 4 because if 4 is wrong the percentage of error is more than 17%.
- So, the possible score is if 1 is wrong then 10 is correct (taken from the number of questions done)
- So the score if one is 1 is  $1(-1) + 19(4) = -1 + 76 = 75$
- The score if one is 2 is  $2(-1) + 18(4) = -2 + 72 = 70$
- The score if 3 is wrong is  $3(-1) + 17(4) = -3 + 68 = 65$  which means Yudistira's highest score is 75, 70 and 65
- Researcher : Are you sure that the method you used to solve the problem is correct?  
 Subject : Yes, I'm sure because I followed the instructions
- Researcher : How do you check that the method you use to solve the problem is correct?

Subject : I checked it by following the instructions, which means Yudistira is less than Werkudara, which means it must be below 17%, which means the possibility that Yudistira is wrong is 1, wrong 2 or wrong 3 because everything is below 17%.

Researcher : How do you check that the results of solving the problem you are working on are correct?

Subject : by following the instructions must be less than Werkudara and the error rate must be less than 17%

### ***Discussion***

#### ***Creative Thinking Subject FI***

Subject FI found two different answers correctly to the numeracy problem. FI subjects use the concept of percentage numbers and arithmetic operations correctly. FI subjects fluently and correctly wrote down solutions to numeracy problems. Thus, FI subjects show creative thinking fluency in solving numeracy problems. This is in accordance with the results of research by Prihatiningsih & Ratu (2020) which explains that students with high mathematical abilities with FI style provide a variety of answers or solutions. Thinking FI subjects demonstrate an original cognitive ability and problem-solving process that allows individuals to use their intelligence in a unique and directed way towards a result. This original cognitive ability emphasizes a person's cognitive ability to create something unique that is different from what other people have (Potur & Barkul, 2009)

The two different patterns written by FI subjects include understanding numeracy problems and solving given numeracy problems. In the second indicator, subjects were asked to solve problems regarding numeration in two different ways. FI subjects by providing these two patterns can be said to be showing indicators of creative thinking flexibility. FI subjects include students who have high-level thinking abilities. The scope of higher order thinking abilities includes critical, logical, creative, reflective, and metacognitive thinking (King et al, 2009). This is in accordance with the opinion of Krulik & Rudnick (1999) who define creative thinking as thinking that is original and produces complex results, which includes formulating ideas, generating new ideas, and determining their effectiveness.

FI subjects with their learning experience solve numeration problems using analog methods or by registering percentage results. The ability to conceptualize percentage numbers, arithmetic operations, and the ability to understand problems, FI subjects use two different ways to solve the same problem. Thus, the FI subject can be said to fulfill creative thinking flexibility in solving numeracy problems. This is in accordance with the research results of Aminah (2020) which explains that students with the FI type have two ideas for how to solve it, and can solve it correctly when using these ideas.

To solve problems regarding numeration, people generally use the method of making tables and registering and calculating scores in order starting from 1st, 2nd, ....., wrong to n which is possible for each object. However, it is different from the problem-solving answers given by FI subjects. The subject gets two concepts in the problem (percentage equality and percentage inequality) which are then used as the initial key to solving. This accuracy in understanding the problem is such that the subject has unique and new ways of solving problems. The correct analogy when making the percentage ratio

between Yudistira and Werkudara provides extraordinary accuracy in believing that the first answer pattern written is correct. Thus, a learning experience like this can be said to mean that the subject has shown the third indicator, namely novelty creative thinking.

The experience of learning about number concepts, arithmetic operations, the ability to use symbols and numbers possessed by FI subjects is such that FI subjects can solve numeracy problems in a new way and are purely the result of their own discovery. The strategy combines two different ways that FI subjects make it interesting and unique. The combination of these two methods has two functions, the first is that the two methods are carried out but in the end the solution leads to the same settlement process, the second is that the two methods are carried out to check each other's settlement processes. The method found is rarely used by other people. This is different from the research results of Prihatiningsih & Ratu (2020) which explains that students with high mathematical abilities with the FI style are only able to show two indicators of creative thinking, namely the fluency and flexibility indicators, not the novelty indicator. Mathematical creativity in the school context is a process level that produces new solutions that can be given to problems and/or makes old approaches new (Aizikovitsh, 2014)

Finding new methods, strategies, and methods in the cognitive realm. Bloom's Taxonomy is the highest cognitive level, namely creating, or what we often call C6 in formulating learning objectives. C6 cognitive abilities that students have are certainly different from each other, even though the students are at the same level of ability or cognitive style. This is in accordance with the research results of Rifqiyana (2016) that students with the same cognitive style do not always have the same thinking abilities. Based on the description above, it can be concluded that the FI subject meets the novelty (new) creative thinking indicators in solving numeracy problems.

#### ***Creative Thinking Subject FI***

FD students have experience learning about number concepts and arithmetic operations so that FD students can write down the process of solving numeracy problems in detail and correctly. However, FD students did not find a variety of answers. This is in accordance with the research results of Prihatiningsih & Ratu (2020) explaining that two FD students with moderate and low mathematics abilities were unable to show indicators of creative thinking fluency (fluency) in solving problems.

FD students have experience learning about the concept of numbers and arithmetic operations so that FD students can fluently write down ways to solve numeracy problems in detail and correctly. However, it can be said that FD students, based on their learning experience, do not solve numeracy problems in different ways, either by analog methods, by registering percentage results or by other means. Thus, FD students have not been able to show indicators of creative thinking flexibility in solving numeracy problems. This is in accordance with the research results of Aminah (2020) which explains that students with the FD type only have one solution method. Sriraman (2004) said that creativity is the

ability to produce new or original work, regarding mathematical creativity as a process that results in unusual and insightful solutions to certain problems, regardless of the level of complexity. This understanding shows that creative thinking is a process used to generate or give rise to new, useful ideas that have never previously existed.

The FD subject did not solve the numeracy problem in a new way because the solution given was only one method without a diagram and the method used was commonly used by others. This is in accordance with the research results of Aminah (2020) which explains that FD subjects only have one way to solve HOTS questions and do not have a new way. In contrast to the research findings of Prihatiningsih & Ratu (2020), it was explained that two FD students with moderate and low mathematics abilities were able to produce indicators of creative thinking novelty (novelty) and creative thinking flexibility (flexibility) in solving problems but these students were not fluent in explaining the solution.

Based on the research results, FI subjects met the creative thinking indicators of fluency, flexibility, and novelty. Meanwhile, the FD subject did not meet the three indicators of creative thinking. However, it is not correct to say that FI students always fulfill the three indicators of creative thinking while FD students do not fulfill the three indicators of creative thinking. It is very possible that FI students do not meet the three creative thinking indicators, whereas FD students meet the creative thinking indicators. Success in solving mathematical problems from the beginning of the process to the end of the solution in detail and correctly does not necessarily meet the indicators of creative thinking. But success in solving mathematical problems is closely related to cognitive style. This is in accordance with the results of research by Ulya (2015) showing that there is a high level of positive relationship between cognitive style and the ability to solve mathematical problems.

FI subjects are very careful in understanding numeracy problems, so that FI subjects utilize all sources of information available on the problem as clues to solving them. The experience of learning about number concepts, strong number operations and the skill of combining two different methods, FI subjects are able to show all three indicators of creative thinking. Meanwhile, FD subjects tend to monotonously complete things in one common way like the others. In other words, FI subjects are more careful than FD subjects in utilizing existing information sources and in using their mathematical knowledge. This is in accordance with the results of research by Masriyah (2016) that FI students are more sensitive than FD students to the use of numbers and relationships between numbers, operations and relationships between whole number counting operations and their properties as well as using the concept of numbers and their operations in making estimates) calculation. Research results of Prabawa and Zaenuri (2017) also stated that students with the FI cognitive style tend to have better problem-solving abilities than students with the FD cognitive style. Therefore, to improve creative thinking, teachers can use portfolios (Barak, & Doppelt, 2000). Teachers can also use a liberal approach to improve students' creative thinking abilities (Chiu, 2009). The reason that the FD subject only raises one

solution idea is possible the difficulties experienced by students, namely difficulty understanding the problem; lack of student understanding of prerequisite material; difficulty building a resolution strategy; and difficulty in drawing conclusions (Mahmud, 2019).

Students' creative thinking can be improved through media-assisted learning. Effective use of learning media or teaching aids has been proven to help students understand concepts better and can also increase student interest and motivation in the learning process (Purwandari et al., 2020; Trisanti & Iffah, 2022; Trisanti et al., 2021a ;Trisanti et al., 2021b). This effort is directed at improving the overall quality of education.

Based on the research results, a description of student creativity based on cognitive style was obtained as in Table 2.

**Table 2.** Describes Student Creativity Based on Cognitive Style

Characteristics of Cognitive Style	Creative Thinking Indicators	Description of student creativity based on cognitive style
(Characteristics of Cognitive Style in the Independent Field: Completing analytical tasks well	Fluency: smoothly producing more than one correct answer	Subjects find two or three possible correct answers to numeracy problems related to the concept of numbers and arithmetic operations, the ability to use symbols and numbers, and analyze tables.
	Flexibility: providing more than one relevant way of solving the same problem	Subjects with their learning experience solve numeracy problems related to the concept of numbers and arithmetic operations, the ability to use symbols and numbers, and analyze tables in different ways both by analog and by registering percentage results.
	Novelty: providing an answer or way of solving a problem in a way that is new and not usual for other students	Subjects solve numeracy problems related to the concept of numbers and arithmetic operations, the ability to use symbols and numbers, and analyze tables in a new way and are purely the result of their own discovery.
Cognitive Style Character Field dependent: less able to complete analytical tasks	Fluency: smoothly producing more than one correct answer	The subject is less able to find two or three possibilities. correct answers to numeracy problems related to concepts. numbers and arithmetic operations, ability to use symbols and numbers, and analyze tables.
	Flexibility: providing more than one relevant way of solving the same problem	Subjects with less learning experience can solve numeracy problems related to the concept of numbers and arithmetic operations, the ability to use symbols and numbers, and analyze tables in different ways, either by analog method or by registering percentage results.



Characteristics of Cognitive Style	Creative Thinking Indicators	Description of student creativity based on cognitive style
	Novelty: providing an answer or way of solving a problem in a way that is new and not usual for other students	Subjects are less able to solve numeracy problems related to number concepts and arithmetic operations, the ability to use symbols and numbers, and analyze tables in new ways

## CONCLUSION

Field Independent students think more than one answer in a variety of ways, for indicators of creative thinking flexibility (flexibility) Field Independent students succeed in achieving details of an idea, object into different ways or methods. It is more interesting that Field Independent students fulfill the creative thinking indicators of novelty (novelty) and provide new art in solving numeracy problems that are pure on their own. Meanwhile, Field Dependent students have not been able to provide two different ideas or thoughts as a form of process for solving numeracy problems in different ways. Even though Field Dependent students provide a correct solution to a problem, this does not meet the indicators of creative thinking of novelty (novelty), because the solution method used is not purely his own, in other words the method used is commonly used by others.

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