

Metaphorical Thinking of Students in Solving Algebraic Problems based on Their Cognitive Styles

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Abstract. *One of thinking concepts which connects real life to mathematics is called metaphorical thinking. Metaphor and modelling are two closely related concepts. Besides, each individual performs different cognitive styles, such as field independent (FI) and field dependent (FD) cognitive styles. This factor possibly leads to different metaphorical thinking in solving algebraic problems. The participants of this qualitative research consist of two students at grade 7 of one of junior high school in Banda Aceh, Indonesia, with FI and FD as their cognitive styles. Based on the findings, it is found that: 1) Metaphorical thinking of the student with FI cognitive style in solving the algebraic problem in the stage of understanding the problem, devising a plan, carrying out the plan, and looking back is considered to achieve the target for each criteria of CREATE; 2) Metaphorical thinking of the student with FD cognitive style in solving the problem in the all four stages but could not reveal all criteria mentioned in CREATE. This happens as the student is unable to find the appropriate metaphor to the algebraic problem. Therefore, the student does not need to explain the suitability of the metaphor to the algebraic problem.*

Keywords: *metaphorical thinking, problem solving, field independent, field dependent*

Introduction

Algebra is constituted to be the core component of mathematics curriculum to all students (Ahmad & Shahrill, 2014; National Council of Teachers of Mathematics, 2006; Pungut & Shahrill, 2014; Sarwadi & Shahrill, 2014). This topic is a part of the fundamental mathematical concepts which needs intensive abstract thoughts (Star, Caronongan, Foegon, Furgeson, Keating, Larson, & Zbiek, 2015). Basically, algebra concept does not only discuss procedures to manipulate symbols, but also focuses on the use of symbols to represent numbers and express mathematical relationships. In other words, algebra tends to put emphasis on the activity to analyse and represent the concepts and mathematical ideas (NCTM, 2000).

The importance of mastering algebra does not always equal to the real existing problems. Based on the preliminary study, it shows that students' understanding of algebra seems to be low. Balgamis (2011) mentions that students of grade 6-8 are likely to experience misconception in the algebraic topic.

One of thinking concepts connecting between phenomenon or real life and mathematics is metaphorical thinking. It applies metaphors as a basic concept in thinking. The abstract concepts in metaphorical thinking are metaphorized to be the real objects in the real life. Metaphor and

modelling are two closely related concepts. As mentioned by Lai (2003) that the metaphor helps students construct the abstract mathematical concepts and complex procedures without a concrete analogy. Carreira (2001) adds that the metaphor connects two conceptual domains, known as basic and target domains. It is stated that the basic domain is likely to be more concrete while the target domain is much more abstract.

Each individual has their own approach and different style in solving math problems. It is because not all people tend to have the same thinking ability. Perceptual and intellectual aspects reveal that each person has distinctive ways to other individuals. Based on the analysis of this aspect, it is found that individual differences can be revealed by cognitive types which is recognized as cognitive style. Cognitive style is likely to be one of the prominent factors that can influence learning process and students' performance (Niroomand & Rostampour, 2014). Cognitive style relates to individual's way in processing, saving or using the information to respond a certain task or different types of environment. Susanto (2008) mentions that individual's process of thinking is influenced by the characteristics one possesses. One of those characteristics is cognitive style. This statement leads the researchers to hypothesize that metaphorical thinking is influenced by cognitive style.

Woolfolk (1993), Danili and Reid (2006), Altun and Cakan (2006), and Lin and Davidson-Shivers (1996) assert that the students with field independent (FI) cognitive style has a characteristic in which they do not include the environment as a sign in responding to a stimulus given. Students with field independent cognitive style are likely to be more analytical. They could choose the stimuli based on the situation. Therefore, it can be said that only a small percentage of individuals with this style who are influenced when a changing situation happens and are able to solve the problems without the needs of any assistance. The individuals with field independent cognitive style are able to restate their understanding regarding the components that is found in the problem they face. In the learning process, students with this style tend to be more independent as they prioritize their analytical and systematic thinking. Besides, in solving the problem, they are more independent and are not influenced by critics and motivations either from friends or teachers. According to Mailili (2008), a student with field independent (FI) cognitive style has higher learning output compared to the field-dependent (FD) student in solving problems related to the theory of Pythagoras. In other words, cognitive style contributes significantly to student learning outcome. Different from previous research, this research focuses on the analysis of students' metaphorical thinking on algebra based on field independent and dependent cognitive styles.

This research aims to provide a comprehensive description on metaphorical thinking of students with field independent and dependent cognitive styles in solving algebraic problems.

Therefore, this research is expected to ease teachers in explaining how to solve problems using an appropriate metaphor. It is also expected to help students in understanding multiple ways to solve the problems. It happens as the metaphor relates the problems that the students face to the case that the students are more familiar with. In mathematics, the use of metaphors by students could be an alternative way to connect the mathematical concepts that the students have previously understood in their daily life. It takes place when they employ mathematical concepts by using their own words and showing their understanding to the concepts. In this research, metaphorical thinking is used by students to understand and explain the abstract concepts to be more concrete by visualizing them and comparing two objects with different meaning or more, either they are related or not.

Metaphorical thinking can be illustrated by using the acronym of *CREATE* which means “*Connect-Relate-Explore-Analyze-Transform-Experience*”. According to Sunito, Sukardjo, Masribi, Syukur, Latifah, Fakhruddin, Chudori, Komarudin, and Syarif (2013), the approach includes: 1) *Connect* refers to the idea of connecting two or more things or ideas ; 2) *Relate* means that connecting two or more things or ideas which have been previously recognized, started by observing their similarity; 3) *Explore* refers to the process of analysing their similarity, drawing the ideas, developing a model, role playing, and drawing the model; 4) *Analyse* refers to the analysis related to things that have been previously thought about; 5) *Transform* refers to the process of recognizing or finding something new based on the connection, exploration, and analysis; 6) *Experience* refers to the process of employing a picture, a model or invention as new contexts as much as possible.

Based on the above-mentioned factors, the question that arises in this study relates to how students’ metaphorical thinking in solving algebraic problems analyzed based on field independent and dependent cognitive styles.

Method

This research is categorised into a qualitative research that aims to provide an illustration of students’ metaphorical thinking with field independent and dependent cognitive styles in solving algebraic problems. The subjects of this research were students of grade 7 of junior high school in Banda Aceh, Indonesia. To obtain the research subjects, GEFT (Group Embedded Figure Test) test was applied. This test was designed and developed by Witkin, Moore, Goodenough, and Cox (1975) in which its validity and reliability have been tested previously. Based on the GEFT test result, a student with field independent cognitive style and a student with field dependent cognitive style who obtained the highest results on the algebraic problems in the class had been selected.

The instrument in this research is categorised into main and supporting instruments. The main instrument consists of the researchers while the supporting instrument includes *Group Embedded Figures Test* (GEFT), mathematical ability test, problem solving test, and interview guidelines. Mathematical ability test, problem solving test, and interview guidelines were designed by the researchers and have been validated by several lecturers of Mathematics Education and some of the teachers where this research was conducted. The validation result shows that all of the instruments have been considered valid. The problem solving test used in this research can be seen in Figure 1.

Aisyah and Zahra gets an assignment to make some cookies from their Art class. Aisyah is successful to make 5 boxes of cookies. Meanwhile, Zahra is successful to make 2 boxes of cookies. The number of cookies in the baking tray is the same. Then, Aisyah gets additional of 3 pieces of cookies from her sister and Zahra gets additional of 18 pieces of cookies from her mother. If the entire number of cookies between Aisyah and Zahra is known to be the same, then:

- Draw or describe the above case into a more understandable form!
- Find how many pieces of cookies in a box!
- Write a new problem based on what has been done previously

Figure 1. Problem solving test

Metaphorical thinking process is formulated by using the indicators suggested by Sunito et al. (2013), as illustrated in Table 1.

Table 1. Indicators of metaphorical thinking process

No	Metaphorical Thinking Process	Indicator
1	Connect	Analyze a suitable and appropriate metaphor from the given algebraic problems
2	Relate	Connect the relationship between algebraic problems and other concepts (either in mathematics or other fields). Arrange a metaphor statement that is related to the algebraic problem.
3	Explore	Design the model based on the algebraic problems
4	Analyze	Analyze the metaphor, its relationship with the problem and the mathematical model which has been made
5	Transform	Solve the problem by using the strategy (mathematical knowledge) of problem solving Create a new problem from the model which has been made before.
6	Experience	Create a picture or a model that is related to other problems in daily life. Interpret the final result from the completion of the algebraic problem

The data analysis was done by reducing the data, serving the data, and making the conclusion (Miles & Huberman, 2009). The data reduction in this research was conducted to select, simplify, categorize, and focus on important aspects, and to formulate all data obtained from problem solving test results and interviews. All of the data were selected based on the needs of answering the research question. To assure the validity of data, credibility test by using triangulation was conducted. Students were interviewed a week after the problem solving test

given. The interview was conducted several times until the researchers found appropriate answers.

Results dan Discussion

Students' metaphorical thinking can be illustrated by using the acronym *CREATE* which means "*Connect-Relate-Explore-Analyze Transfrom-Experience*". These criteria can be seen on each step suggested by Polya (1973) which includes: understanding the problem, devising a plan, carrying out the plan, and looking back. Students follow Polya's steps when answering the questions given by the researchers. Based on the answers, the characteristics of subjects with field independent (FI) and field dependent (FD) cognitive styles can be identified.

Metaphorical Thinking of the Student with Field Independent (FI) Cognitive Style in Solving Algebraic Problems.

Metaphorical thinking process of the student with field independent (FI) cognitive style starts from the *connect* stage. At this stage, the student is able to state the problem using a metaphor which illustrates the problem. Additionally, the student is able to create an example by using small cubes to illustrate a mathematical problem for Problem 1. This can be seen in Figure 2, such answer was given by the student with field independent cognitive style.

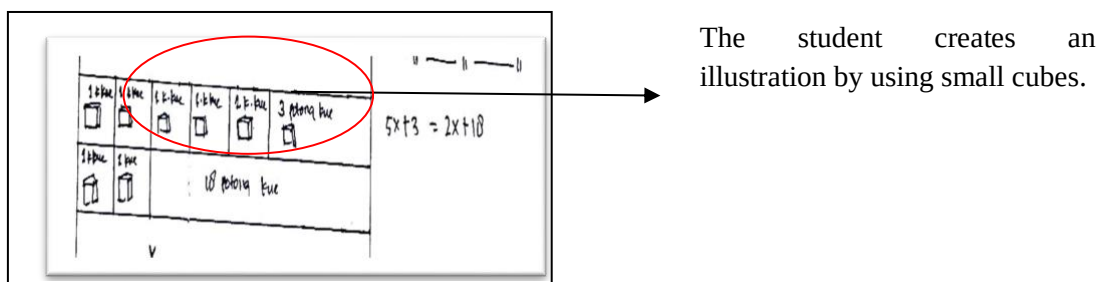


Figure 2. The answer given by the FI student at stage C (connect)

Then the student is able to explain the metaphor that is found in the algebraic problem. In this case, the student gives an example related to her daily life, such as a seesaw, in which it must be equal in the left and the right sides to achieve balance. It can be related to algebraic problems, when the addition is done in the left side, the same thing has to be done on the right side. It applies in the reverse ways.

At the *relate* stage, the student is able to make a relationship between the metaphor and the given algebraic problem, in which the student connects the example to the algebraic problem. The student uses the same rules to the example for the side above and the side under. For example, the student reduces or adds the cubes at the above part and the similar way is also done in the side under. Also, the student is able to explain the characteristics of the metaphor toward the algebraic problem and also to connect them to her prior knowledge. The student

states that it requires an assumption for the objects mentioned in the problem by x , y and so on. In this case, the student assumes boxes of cookies as cubes which will be represented as an x .

At the *explore* stage, the student makes a model based on the problem solving test given. At this stage, the student is able to explain what is known and what is asked in the stated problem. In this case, the student is only able to explain question (b); that is, the student explains the number of cookies in a box. It can be seen on the given answer of the student with field independent cognitive style (Figure 3).

Pernyataan	
Dik : Aisyah = 5 kotak kue + 3 potong kue = $5x+3$ Zahra = 2 kotak kue + 18 potong kue = $2x+18$ Jika dik jumlah keduanya sama maka Dit : a. Perumpamaan menurut Gambar 1. b. Tentukan berapa banyak kue dlm 1 kotak c. Tuliskan sebuah permasalahan baru dan mengambil model matematika di atas }	Given: Aisyah = 5 boxes of cookies + 3 cookies = $5x+3$ Zahra = 2 boxes of cookies + 18 cookies = $2x+18$ If the total of cookies they have is the same, then Find: a. Description using figures b. Find the number of cookies in a box c. Write a new problem using the mathematical model above

Figure 3. The answer provided by the FI student at stage E (explore)

Furthermore, the student is also able to design or create a mathematical model from the problem also explain or retell it based on the mathematical model and the problem given, as highlighted in the following excerpt:

- Researcher : Anyway, you mentioned that the problem will be made into a mathematical form. Do you mean it is a mathematical model?
- F1 student : Oh yes, mathematical model, ma'am.
- Researcher : Could you please mention the mathematical model?
- F1 student : The model is $5x + 3 = 2x + 18$

At the *analyse* stage, the student learns the steps that she did previously. She explains how she illustrates the small cubes in which she then supposes them as an x , y , and so on. The student also explains in detail how she chooses the operation and the strategy used to solve the mathematical model and also re-explains each step from the process that has been done previously.

At the *transform* stage, the student is able to draw a conclusion regarding the problem and also is able to explain the step plan that will be done in solving the problem and describe the results in mathematical symbols. This statement is supported by the following excerpt:

- Researcher : Could you please explain the problem in your own language?
- F1 student : So Aisyah was able to make 5 boxes of cookies and then she got the addition of 3 pieces of cookies from her sister. While Zahra was able to make 2 boxes of cookies and then she also got the addition of 18 pieces of cookies from her mother. The total number of Aisyah's and Zahra's cookies are the same.

It is said that the student fulfils the criteria of T (Transform) if the student is able to write the steps in solving the problem and the result using mathematical symbols. This can be seen on

the answer given by the student with field independent cognitive style which is illustrated in Figure 4.

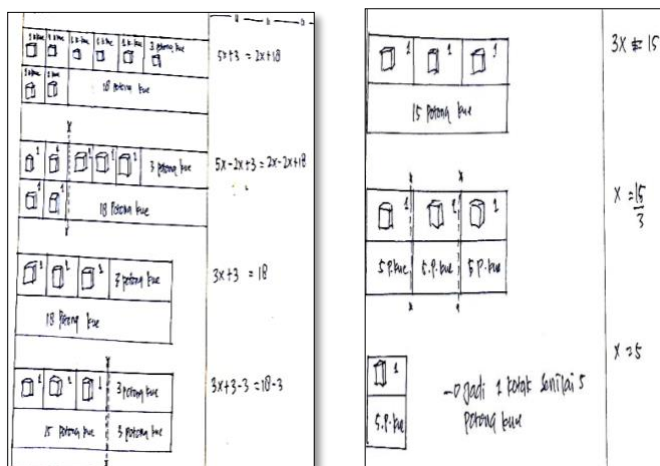


Figure 4. The answer of the FI student at stage T (transform)

Moreover, the student is able to check and assure the final solution that she obtained. On the answer sheet, it can be seen that this criterion is not included because the student forgets to write the way to check and assure the solution that she has obtained. Meanwhile, during the interview, the FI student is able to explain how to check the answer that she obtained.

At the *experience* stage, the student has applied the results she has obtained to solve the problem. The student can do substitution, addition, and subtraction from the equation she found. In that way, she can determine the number of cookies in the boxes that belong to Aisyah and Zahra such that the total of cookies that they have must be similar. Furthermore, the student is able to describe the idea of the final solution that she will obtain. It is confirmed during the interview, as presented in the the following excerpt:

- Researcher* : How is the final solution for question (b)?
F1 student : It will be a number, ma'am.
Researcher : What does the number represent?
F1 student : The number represents the number of cookies in a box.
Researcher : To whom do the cookies belong?
F1 student : They belong to Aisyah and Zahra
Researcher : Okay, then for question (c), how is the solution?
F1 student : It will be the same. We assume the number as a variable, and then find the value of the variable.

The student is also able to write and express a new problem based on the model that has been devised, as revealed in the following interview excerpt:

- Researcher* : From that model, could you please create a new problem based on what you have done?
F1 student : Yes, I can
Researcher : Could you explain it?
F1 student : Lisa has 4 boxes that consist of paper clips and Doni has 2 boxes of

paper clips. If mother gives 4 clips to Lisa and 6 clips to Doni and given that the total of all paper clips that belong to Doni and Lisa is the same, then:

- Describe the problem using pictures
- Find the number of paper clips in a box

Metaphorical Thinking of the Student with Field Dependent (FD) Cognitive Style in Solving Algebraic Problems.

The metaphorical thinking process of the student with the field dependent (FD) cognitive style begins with the *connect* stage. At this stage, the student is able to state a problem in a metaphor that describes the problem. The student is also able to explain the metaphor found while solving an algebraic problem and determine a suitable metaphor for the given algebraic problem.

At the *relate* stage, the student is able to make a relationship between the metaphor and the given algebraic problem. The student creates a simple form of metaphor to describe the mathematical problem, specifically Problem 1. The student represents small squares as cookie boxes but does not describe the problem in any other way or link it to everyday life. It can be seen from the answer provided by the field-dependent student, as given in Figure 5.

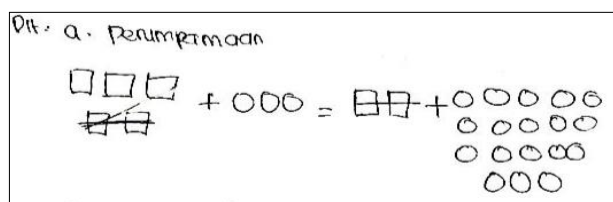


Figure 5. The FD student writes Information given in the problem

Moreover, the student is also able to explain the characteristics of a metaphor toward the algebraic problem. This is supported by the interview results, that the student explains the metaphor used for Problem 1. The student only expresses a simple illustration which is made for an algebraic problem. The student has not yet planned to describe the problem using a metaphor. The student does not explain the characteristics of the metaphor for the algebraic problem. Furthermore, the student does not determine a suitable metaphor for the given algebraic problem and does not explain the metaphor from the given algebraic problem.

At the *explore* stage, the student is able to explain what is known and what is asked in the problem. She explains the information given and asked in the problem orally but writes down only the information known on her answer sheet, without providing the information asked from the problem. It can be seen from the answers given by the field-dependent student, as illustrated in Figure 6.

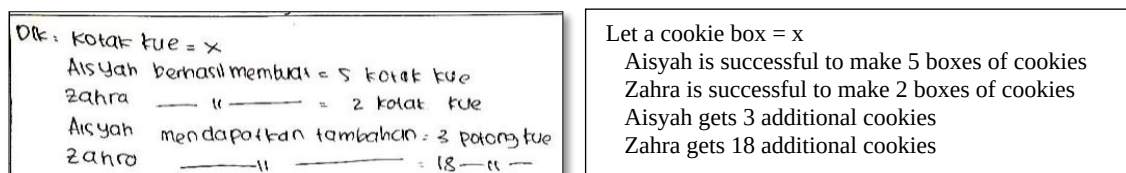


Figure 6. The FD student's answer in understanding mathematical problems

Further, the student is able to explain a mathematical model that will be devised. This finding is supported by the following interview excerpt:

- Researcher : How did you plan to solve this problem?
 FD student : At first, from the problem, I drew several boxes. From those pictures I made a mathematical model.
 Researcher : How did you do that?
 FD student : I read and tried to understand the problem first. After that, I wrote down what is known by drawing boxes of cookies. Then, I made a mathematical model.
 Researcher : What was your plan next?
 FD student : From that model, I solved the problem to find how many cookies are in a box.
 Researcher : You said that you modeled the problem first into a mathematical model. Could you please show me your mathematical model?
 FD student : $5x + 3 = 2x + 18$

Then, the student is able to explain or retell the suitability of the mathematical model with the problem, as confirmed in the interview excerpt below:

- Researcher : Could you please re-explain the solution steps that you did from the beginning?
 FD student : I read the problem first. After that, I drew the cookie boxes, then made a mathematical model and solved it.

At the *analyze* stage, the student is able to restate the metaphor related to the algebraic problem, where she checks the information obtained from the problem and mentions the math topic embedded in the problem. The student is able to choose operations and strategies that will be used in solving the mathematical model. In this case, she can re-explain the steps that she takes. As confirmed during the interview that the student is able to name each step used to solve Problem 1, as in the following excerpt:

- Researcher : What is x ?
 FD student : x is a variable which I suppose as the number of cookies in a box.
 Researcher : Could you please explain your mathematical model again?
 FD student : Aisyah has 5 boxes of cookies, such that it is $5x$. Then, she has 3 additional cookies, so that, it will be $5x + 3$. Zahra has 2 boxes of cookies, such that it is $2x$. She then has 18 additional cookies, so it becomes $2x + 18$.
 Researcher : What operation do you use to solve the problem?
 FD student : Addition, subtraction, and division.

At the *transform* stage, the student is able to demonstrate a new idea she found. This is evident from the interview results, where the student is able to explain the new idea related to Problem 1 although it is presented in a simple form, as depicted in the following excerpt:

- Researcher* : Could you please describe the problem in another form? Linking it to everyday life, for example.
FD student : Yes, I can. I make squares as cookie boxes and these small circles as cookies (pointing the figures).

Furthermore, the student is able to explain the steps that she has devised to solve the problem. This finding is confirmed by the student during the interview, that she is able to explain the solution steps related to Problem 1, as shown in the excerpt below:

- Researcher* : Could you please explain the problem in your own words?
FD student : So... Aisyah has 5 boxes of cookies, then she gets 2 additional cookies. Then, Zahra has 2 boxes of cookies, then she gets 18 additional cookies. So, the number of their cookies is the same.
Researcher : From your explanation, could you describe the problem in another way, or you may want to relate it to daily-life situation to solve the problem?
FD student : I draw squares for cookie boxes and circles for cookies.
Researcher : Is there any other way?
FD student : I do not know, ma'am.

Subsequently, the field-dependent student is able to write the problem solving steps and solutions using mathematical symbols. It is obvious from the answers provided by the student presented in Figure 7 as follows.

$$\begin{aligned}
 5x + 3 &= 2x + 18 \\
 5x - 2x + 3 &= 2x - 2x + 18 \\
 3x + 3 &= 18 \\
 3x + 3 - 3 &= 18 - 3 \\
 3x &= 15 \\
 x &= \frac{15}{3} \\
 x &= 5
 \end{aligned}$$

Figure 7. The FD student's answer at the *transform* stage

In addition, the student is able to check and confirm the final solution she has obtained. On her answer sheet, these criteria are not evident because the student forgets to jot down how to check and ensure the final solution she has found. However, during the interview, this field-dependent student is able to explain how to check her answers, as described in the excerpt below:

- Researcher* : Are you sure with your answer? How do you ensure it?
FD student : Yes, I am. I check it by substituting each value of x into each equation. So that, the number of cookies Aisyah has is the same as the number of cookies Zahra has.
Researcher : Okay, then... regarding the new problem you have made, does it accord with the mathematical model you have made before?
FD student : I made the new problem that accords with the story in the problem, but I used another mathematical model. So, I get $3x = 15$ dan $x = 5$.

At the *experience* stage, the student is able to demonstrate the notion of the algebraic problem. It is verified by the student from the interview that she is able to explain new ideas related to Problem 1, as shown below:

- Researcher* : Is that the way you illustrate it?
FD student : Yes, ma'am.
Researcher : Why do you make such illustrations?
FD student : To easily understand the problem, I make squares like these.
Researcher : Hmm, what if this problem is solved in another way, linking it with daily life for example, can you do that?
FD student : Hmm, I have no idea about that, ma'am.

Further, the student is able to predict the final solution that will be obtained, as seen in the following interview excerpt:

- Researcher* : Hmm, what about question (b), do you have any idea for the final solution that you will get?
FD student : The final solution will be a number represented as an x .
Researcher : What about question (c)?
FD student : The new problem is created based on the model I have made before.

The student is also able to write and demonstrate another problem aligned with the model that has been created, as illustrated in the interview excerpt below:

- Researcher* : From the previous mathematical model, can you create a new problem aligned with the model?
FD student : Yes, sure.
Researcher : Could you please mention it?
FD student : Dina and Dinar get an assignment to make pencil cases from their Art class. Dina makes 9 pencil cases while Dinar makes 3 pencil cases. The number of pencils in each case is the same. Then, Dina gets 2 additional pencils from her brother and Dinar gets 7 additional pencils from her father. Given that the number of pencils that Dina and Dinar have is the same.

Finally, the student is able to explain the application of the model in a new problem, as described in the following excerpt:

- Researcher* : For question (c), how is the solution for the new problem you have made?
FD student : The solution steps are the same as the previous problem, ma'am.

The results showed that the student with the field independent cognitive style is able to perform the CREATE criteria. It can be seen from each step of problem solving she has done. The student performs the *connect* and *relate* criteria. She can explore metaphors that match the algebraic problems. Moreover, the field-independent student reveals the *explore* criteria at the stage of understanding the problem, where she only explains one question out of the three questions given. The field-independent student also performs the *transform* criteria at the stage

of looking back. She does not write the checking process on her answer sheet. This student with the field independent cognitive style seems meticulous and thorough when solving problems. However, the student writes the results of her work on the answer sheet less neatly. At the stage of looking back, the student only checks the results of her work orally and does not write down what she has done on the answer sheet. Aligned with the basic characteristics of field-independent students, it appears that the student is likely not a monotonous person and seems to have a good competency in communication. Thus, there is an agreement between the theory and the study findings.

The aforementioned explanation points out that in solving mathematical problems, the field-independent student prioritizes individual work and prefers to try new things without teacher's assistance. In addition, the student has a fairly good ability in communication. It seems obvious when the student explains the solutions she has made based on the questions posed by the researchers. The results of this study are in line with the results of previous research (Abidin, 2012; Prihatiningsih & Ratu, 2020; Yunus, Hulukati, & Djakaria, 2020) revealing that the field-independent students, in solving problems, tend to think in general and use strategies different from what they have learned. They are also able to perform indicators of novelty and flexibility in solving problems.

Furthermore, the findings revealed that the student with the field dependent cognitive style cannot demonstrate all criteria of metaphorical thinking (i.e., CREATE) for mathematical problems, especially in Problem 1. The student does not perform the *connect* and *relate* criteria since she does not find a metaphor compatible with the algebraic statement and was unable to explain the suitability of the metaphor to the algebraic problem. The results also indicated that the field-independent student is superior to the field-dependent student in terms of learning achievement. As found by O'Brien, Butler, & Bernold (2001) in his study that students with the field independent cognitive style obtain higher scores than those with the field dependent cognitive style. It is supported by Prihatiningsih and Ratu (2020) stating that the field-dependent students are less creative in solving problems. Finally, as a concluding remark, it is worth noting that each cognitive style has its own advantages and disadvantages.

Conclusion

Based on data analysis, it can be concluded that the metaphorical thinking of the student with the field independent cognitive style in solving algebraic problems at the stages of understanding the problems, devising a plan, carrying out the plan, and looking back, demonstrates the CREATE criteria. The student can find the metaphor of the problem and discover a suitable metaphor to the problem in the *connect* criteria. It also relates to the *relate*

criteria; as such, it can reveal the *relate* criteria at the four stages. At the stage of understanding the problem, the student also performs the *explore* criteria. However, the student only explains what is known and describes the information given only for question (b). At the devising a plan stage, the student expresses the *experience* criteria and describes the ideas of solution only for question (b). At the stage of looking back, the student does not show the *transform* criteria; she merely checks the final solution orally, without writing down the checking process over the solution on the answer sheet.

The metaphorical thinking of the student with a field dependent cognitive style in solving algebraic problems at the stage of understanding the problems, devising a plan, carrying out the plan, and looking back does not show all of the CREATE criteria. At the stage of looking back, in terms of the *explore* criteria, the field-dependent student re-explains the alignment of the mathematical model with the problem. In the *analysis* criteria, the student elaborates the process she has been carried out. In the *transform* criteria, the student checks the final solution she has obtained and records the process of checking on the answer sheet. In the *experience* criteria, the student describes the application of the model in a new problem. At the stage of looking back, the field-dependent student does not indicate *connect* and *relate* criteria since she does not find a metaphor that matches the algebraic expression; consequently, she does not need to explain the suitability of the metaphor to the algebraic problem.

Finally, the implication of the study suggests that teachers should help students develop their metaphorical thinking. Students should be given the opportunities to be more active to participate in their learning and to frequently express their ideas to the class. The teachers also should provide them more opportunities to find some unique and various answers and apply their knowledge and mathematical abilities comprehensively. Checking and choosing various strategies and approaches to find different solutions possibly increase the use of their knowledge application and develop their mathematical abilities. Last, students are expected to be able to suggest various solutions in finding possible answers by comparing their friends' answers and discuss the differences with them.

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