

STUDENTS' STRATEGIES IN SOLVING PROPORTION PROBLEM BASED ON FIELD DEPENDENT AND FIELD INDEPENDENT COGNITIVE STYLES**Augita Silvania Putri**

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email: rooselynaekawati@unesa.ac.id**Abstract**

Strategies are related to how students solve the problem. Students' strategies in solving problem is based on their experience. Cognitive style is one of factor that influence the differenceness of students' strategies. This research is a qualitative descriptive research that aims to describe student's strategies with field dependent and field independent cognitive style in solving proportion problem. This research was conducted to students of grade VIII. The determination of FI and FD were 4 using GEFT (Group Embedded Figure Test) instrument which then will be given proportion problem test and interview. The results showed that FI students, uses multiplicative strategy, SI1 uses cross product algorithm and unit rate strategies and SI2 uses cross product algorithm strategy only. FD students, SD1 does not use multiplicative strategy that is cross division and SD2 uses multiplicative strategy that is cross product algorithm strategy. From this research, it is expected that teachers can teach many strategies so that student can develop their strategies in solving problem.

Keywords: strategy, proportion problem, field dependent, field independent, cognitive style.

INTRODUCTION

Strategy is a way to achieve a goal (Nasution, 2016). According to Nata (2009), strategy is a planned and meaningful, broad-minded steps resulting from a deep thought process and reflection based on certain theories and experience. In this research, strategies related to how students solve the problem. Students' strategies in solving problem is based on their experience. In mathematics education literature, students' strategy are define for proportion problem. These strategies are classified into two as correct and erroneous strategies. The erroneous strategy usually used by student is additive strategy. In this research, the correct strategies is defined as multiplicative strategy, there are unit rate strategy, factor of change strategy, build-up strategy, cross product algorithm strategy, equivalent fraction strategy, and unitizing strategy (Avcu & Avcu, 2010).

Cognitive style is one of factor that influence the differenceness of students' strategy. According to Basir (2015), the differences of student's cognitive style can influencing student's thinking and reasoning skills. Field dependent and field independent cognitive styles are kind of cognitive style. O'brien et al (2001) explain that field dependent (FD) students are more global and holistic in perceptual and information processing, so often called

global thinkers. FD students are tend to receive information as it is presented and rely mostly on how to memorize. Field independent (FI) students have a higher analysis in the reception and information processing, so often called analytical thinkers. FD students tend to organize information into some units that can be managed. Based on cognitive style, FD and FI students are different in processing information. This leads to the differences possibility in students' strategies. Students' propotional strategy in this research is combine with Polya's steps of problem solving, there are understanding problem, devising a plan, carrying out the plan, and looking back.

This research are purposed to describing student's strategies in solving proportion problem based on field dependent and field independent cognitive style. This research is expected to give benefits as follows: (1) give information for teacher about students' strategies in solving proportion problem based on field dependent and field independent cognitive style so teacher can design learning to increase students' skills in solving problem; (2) give information for other researcher as their reference.

METHODOLOGY

This research is a qualitative descriptive research. The subjects of this research were 4 eighth grade students at SMP Negeri 2 Candi Sidoarjo, 2 field dependent and 2 field

independent cognitive style students in equal mathematics ability. Equal mathematics ability based on previous students' score with differences <5 and teacher recommendation. Students' selected are in medium and high mathematics ability.

Group Embedded Figures Test (GEFT)

GEFT were given to 37 students to determining field dependent and field independent cognitive style student. This test consist of 3 session. First session consist of 7 items, second and third consist of 9 items. The score was compute for second and thirs session, since first session for trial. The students with scores >9 were in field independent and the students with scores ≤ 9 were in field dependent.

Test of Proportions Problem

Problem used were proportion problem consist of 2 items. The problems were missing value problem adapted with Kurikulum 2013. The problem that used as follows:

1. A sugar cane machine takes 2 hours to produce 40 liter of sugar cane juice from 5 sugar cane quintals. The price per quintal of sugar cane is Rp50.000,00. A sugar cane juice trader has a capital of Rp400.000,00. If he uses all of that capital to buy sugar cane, calculate:
 - a. how many liters of sugar cane juice can the machine produce ?
 - b. how many hours does the machine works ?
2. The following recipe is used to make a nastar cake.

Nastar Cake Recipe

- 500 grams of butter
- 100 grams of refined sugar
- 4 egg yolks
- 500 grams of wheat flour
- 1 pack of vanilla
- Pineapple jam

For 40 nastar cakes.

Mrs Dewi will make a nastar cake using the recipe above as many as 5 jars with each jars containing 30 nastar cakes. If she has 300 grams of wheat flour, then how many grams of wheat flour does ratna need to make the nastar cake ?

Interview

Subjects selected were interviewed based on interview guidance to gain information of students' strategies. The result of data analysis was done by data reduction, data display, and conclusion.

This research was done in eight-D grade SMPN 2 Candi Sidoarjo on 2nd February 2018 for GEFT and 7th February 2018 for proportions problem test and interview.

Result of GEFT

Based on GEFT (Group Embedded Figure Test), there are 9 students in field independent cognitive style and 28 students in field dependent cognitive style from 37 total students. The subject were selected in the equal mathematics ability based on previous score test and teacher recommendation. The selected subjects as follows.

Table 1. Research Subject

Cognitive Style	Initial	Gender	Previous Score	Subject Code
FI	AGR	M	82	SI1
FI	RW	F	81,5	SI2
FD	RMV	F	82,5	SD1
FD	RA	F	84	SD2

Proportion Problems Test and Interview Result

Based on proportion problem test and interview, analysis of students' are presented in description below.

Field Independent (FI) Students

In solving proportion problems, SI1 uses multiplicative strategy, there are cross product algorithm and unit rate. SI2 uses multiplicative strategy that is cross product algorithm.

Jawab : $\frac{Rp\ 400.000}{Rp\ 50.000} = 8\ \text{quintal}$ → MSI-UR
 $= \frac{5\ \text{quintal}}{8\ \text{quintal}} = \frac{40\ \text{liter}}{x}$
 $= 5x = 8(40)$
 $= x = \frac{320}{5}$ → MSI-CP
 $= x = 64\ \text{liter}$
 Jadi air tebu yang dapat dihasilkan mesin 64 liter

b. Ditanya: Berapa jam mesin bekerja?
 Jawab: $\frac{40L}{64L} = \frac{2\ \text{jam}}{x}$
 $= 40x = 64(2)$
 $= x = \frac{128}{40}$ → MSI-CP
 $= x = 3,2\ \text{jam}$
 Jadi lama mesin bekerja 3,2 jam

Figure 1. Multiplicative strategies of SI1 in Solving Problem 1

RESULT AND DISCUSSION

Jawab: $\frac{300}{30} = \frac{3000}{x}$
 $30x = 72000$
 $x = \frac{12000}{30}$
 $x = 400\ \text{gram}$

$\frac{30}{40} = \frac{x}{500g}$ → MSI-CP
 $40x = 15000$
 $x = \frac{15000}{40}$
 $x = 375 \times 5$
 $= 1875g - 300g$
 $= 1575g$

Students' Strategies in Solving Proportion Problem

Figure 2. Multiplicative Strategy of SI1 in Solving Problem 2

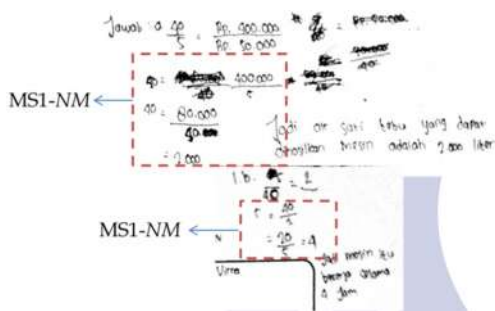


Figure 3. Multiplicative Strategy of SI2 in Solving Problem 1

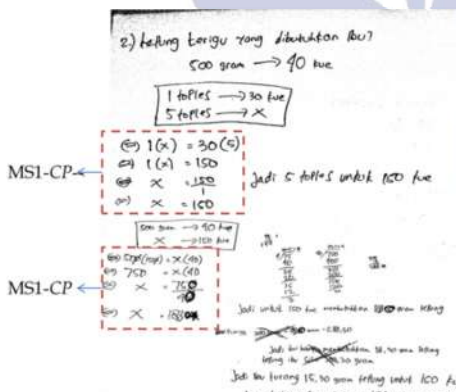


Figure 4. Multiplicative Strategy of SI2 in Solving Problem 2

SI1 uses unit rate strategy to find another quantities that needed by calculate unit value at first then divide other quantities with that unit value. SI2 is used cross product algorithm to find the quantities that needed by setting up proportion then do cross product in proportion and solving the resulting equation by division. When cross product algorithm, SI1 and SI2 setting up a proportion, forming a cross product, and solving the resulting equation by division.

SI1 uses more simple strategy, unit rate strategy in solving problem 1 for determine sugar cane that bought

than SI2 use cross product algorithm strategy. It might influence by FI students' gender. SI1 is male and SI2 is female. Susilowati (2016) explain that male students tend to make a simple thing whereas female students carrying out the plan based on the planned strategy from the given problem until final answered is found when solving problem. According to Sukayasa (2014), male students can make more than one way in solving problem, whereas female students only one way.

Field Dependent (FD) Students

In solving proportion problem, SD1 not use multiplicative strategy, but SD1 uses cross division strategy in both problem. SD2 use multiplicative strategy that is cross product algorithm strategy.

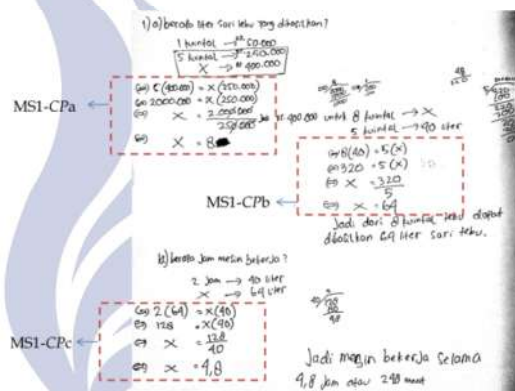


Figure 5. Multiplicative strategy of SD1 in Solving Problem 1

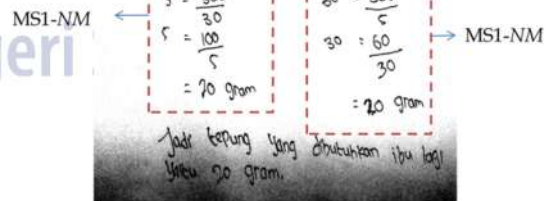


Figure 6. Multiplicative strategy of SD1 in Solving Problem 2

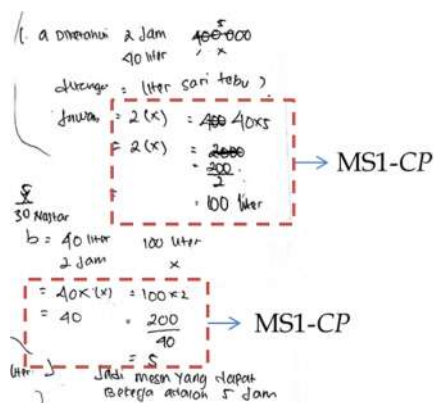


Figure 7. Multiplicative strategies of SD2 in Solving Problem 1

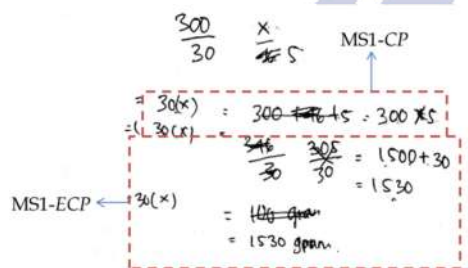


Figure 8. Multiplicative strategies of SD2 in Solving Problem 2

First, SD1 and SD2 setting up a proportion. Then, SD1 do cross division and solving the resulting equation by division again while SD2 do cross product and solving the resulting equation by division. The procedure without a conceptual basic will lead to learning by rote. FD students tend to memorize the way that teachers taught to build proportions and do cross product only.

The Differences of FI and FD Students' Strategies

FI students, SI1 uses multiplicative strategy, there are cross product algorithm and unit rate. SI2 and SD2 using multiplicative strategy that is cross product and SD1 subject does not use multiplicative strategy that is cross division FI students solve the problem correctly, while FD students do some errors. It shows that FI students not only use procedural knowledge, but also conceptual knowledge while FD students only use procedural knowledge. According to Yekti et al (2016), FI students were able to apply the concept that have been learned to construct a new knowledge that use to solving problem. Accordig to Johar (2006), in doing mathematics procedure, students must interpret and understand the reasons of each step used. The procedure without a conceptual basic will lead to learning

by rote. FD students tend to memorize the way that teachers taught to build proportions and do cross product only.

CONCLUSION AND SUGGESTION

Conclusion

Based on the analysis research and discussion, the conclusion of students' strategies in solving proportion problem based on field dependent (FD) and field independent (FI) cognitive style as follows:

1. FI students uses multiplicative strategy, SI1 uses cross product algorithm and unit rate strategies and SI2 uses multiplicative strategy that is cross product algorithm strategy only.
2. FD students that is SD1 does not use multiplicative strategy, cross division and SD2 uses multiplicative strategy, cross product algorithm strategy .

Suggestion

For teacher to teach many strategies so that student can solve any problems using many strategies. For other researcher in research about filed dependent and field independent cognitive style should based on mathematics ability test so that the chosen subject has equal ability.

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