



## Interference Thinking Students' to Solve Proportion Problems Based on Cognitive Style

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### ABSTRACT

Thinking interference is defined as a disruption in information processing caused by overlap between old and new knowledge, which can hinder students' problem solving. The purpose of this study is to describe the forms of interference junior high school students thinking in solving ratio problems, as viewed from the cognitive styles of Field Independent (FI) and Field Dependent (FD). This study employs a descriptive qualitative approach, with the research subjects being three seventh-grade junior high school students who are suspected of thinking interference. Research data were collected through the Group Embedded Figures Test (GEFT), a ratio quiz, and interviews. The data analysis techniques used in this study were data reduction, data display, and conclusion. The results showed that FI students experienced retroactive interference characterized by students using the reverse proportion procedure to solve equivalent proportion problems. FD students experienced retroactive interference characterized by students solving problems using the reverse proportion procedure in equivalent proportion problems, and FD students experienced proactive interference characterized by students solving problems using the equivalent proportion procedure in reverse proportion problems. This occurs due to the similarity in solution procedures between equivalent proportion and reverse proportion. This study shows that both cognitive styles contribute to the emergence of thinking errors in solving comparison problems when students do not re-evaluate the appropriateness of the procedure to the problem context.

Keywords: cognitive style; interference; proportion

### INTRODUCTION

Problem solving is a standard mathematical skill classified as mathematical power or mathematical skills that must be possessed by students (NCTM, 2000). Problem solving is considered very important in mathematics learning because it can build knowledge (Cai et al., 2018), thus becoming the main objective in school learning (García et al., 2019). (Nurmutia, 2019) found that students' cognitive styles and problem-solving abilities are positively correlated. Students' cognitive styles significantly influence how they solve mathematical problems (William's, 2023). There are two categories of cognitive styles: field independent (FI) and field dependent (FD), which are related to how someone thinks deeply (Sianturi et al., 2022). Individuals with a field-independent style tend to think analytically and independently when seeking and processing information, while those with a field-dependent style tend to prioritize the big picture and work collaboratively. Therefore, cognitive style can influence how individuals receive and process information in learning activities and problem-solving.

In solving problems, students obtain information by retrieving data from their long-term memory (Panjaitan, 2013). When students retrieve information from long-term

memory, the retrieved information may be mixed with other stored information, or old information may be disrupted by new information. This disruption in information retrieval is called thinking interference. Thinking interference refers to disruptions in information processing caused by overlap between old and new knowledge stored in memory (Stenberg & Stenberg, 2016). Thinking interference is categorized into two types based on the timing of information acquisition: proactive interference and retroactive interference (Stenberg & Stenberg, 2016).

Some issues that can cause interference in mathematics learning are GCF and LCM, permutations and combinations, opposite and complementary angles, and direct and inverse proportions (Subanji, 2015). Students experience difficulties in solving problems involving direct and inverse proportions (Pelen & Artut, 2016). Students still struggle to distinguish between situations involving proportions and those that do not, as well as between direct and inverse proportions (Fathiyah et al., 2024). One of the difficulties students face in solving problems involving direct and inverse proportions is that they do not understand the relationship between variables and their positions (Arıcan & Kıymaz, 2022). One example of previous research on interference is Hidayanto and Budiono (2019) who investigated thinking interference in understanding functions verbally, symbolically, and diagrammatically. Lestari et al. (2021) investigated proactive interference in solving GCF problems. Malik et al. (2025) examined proactive and retroactive interference in solving equivalent and inverse value problems among general students.

The concept of proportion is very important for learning other mathematical concepts, understanding many scientific situations, and is closely related to everyday life (Arıcan, 2024). Previous researchers have not studied student thinking interference when solving problems of equal and reverse proportion based on students' cognitive styles. Furthermore, based on the results of a preliminary study conducted at one junior high school in Malang City, students were found to exhibit interference and during the preliminary study some students were identified as having FI and FD cognitive styles. Therefore, the researcher will conduct a study on students' thinking interference when solving problems involving direct and reverse proportion, examined from the perspective of cognitive style.

## RESEARCH METHODS

This descriptive qualitative study explores and describes thinking interference in students with field-independent (FI) and field-dependent (FD) cognitive styles, based on the results of the Group Embedded Figures Test (GEFT). Next, a quiz was given with questions about equal ratios and reverse ratios. The study involved seventh-grade junior high school students in the second semester of the 2024/2025 academic year. Subjects were selected through purposive sampling after taking the GEFT and completing the quiz, which showed signs of interference. The criteria for grouping students' cognitive styles are based on the opinion of Kepner & Neimark (1984), who stated that students who score 0-9 are classified as having a field-dependent cognitive style, while students with scores of 10-18 are classified as having a field-independent cognitive style.

## RESULTS AND DISCUSSION

The first data collection involved administering the GEFT to 64 seventh-grade junior high school students. The test results showed that six students had an FI cognitive style and 56 students had an FD cognitive style. Next, a quiz consisting of one problem involving equal proportion and one problem involving reverse proportion was administered. The problems on the quiz were as follows. (1) Two water storage tanks have the same shape but different sizes. Tank A can be filled to capacity in 2 hours if filled with a water flow rate of 5 liters/minute. If tank B has twice the volume of tank A, how long will it take to fill tank B to capacity with the same water flow rate? (2) A bridge construction project team consisting of 6 workers can complete the construction in 12 days. Before construction began, a donor provided funds sufficient to hire 3 additional workers. How long will it take the project team to complete the bridge construction?

Based on the quiz results, 7 students answered correctly and 52 students answered incorrectly. Among the incorrect answers, 6 students showed signs of interference. Based on the students' participation in both tests, discussions with the teacher, and the presence of interference indications, one student with an FI cognitive style and retroactive interference was coded as  $S_1$ , one student with an FD cognitive style and retroactive interference was coded as  $S_2$ , and one student with an FD cognitive style and proactive interference was coded as  $S_3$ .

### Interference in Student Thinking with Field Independent Cognitive Style

$S_1$ 's solution does not correctly solve problem 1 about equivalent proportion, but it can correctly solve problem 2 about reverse proportion.  $S_1$  uses a reverse proportion strategy to solve problem 1, even though problem 1 is about equivalent proportion. In other words,  $S_1$  viewed the equivalent proportion problem as an reverse proportion problem. This means that  $S_1$  performed retroactive interference. The following is the result of  $S_1$ 's performance in Figure 1.

Handwritten student work for problem 2. The work shows a proportion equation  $\frac{6}{9} = \frac{d}{12}$ , followed by calculations:  $c = 6 \times 12 = 72$ ,  $d = 72 : 9 = 8 \text{ hari}$ . Then it calculates volume:  $\text{Volume} = \text{Debit} \times \text{Waktu} = 5 \times 120 = 600 \text{ liter/ menit}$ . A red box highlights the reverse proportion equation:  $\frac{1200}{120} = \frac{600}{?}$  followed by calculations:  $= 600 \times 120 : 1200 = 60 \text{ Menit} = 1 \text{ jam}$ .

Figure 1.  $S_1$ 's Answer

Based on Figure 1,  $S_1$  wrote the proportion equation  $\frac{1200}{120} = \frac{600}{?}$  which is a procedure of reverse proportion because if one quantity increases, the other decreases. In other words,

the greater the volume of the water tank, the shorter the time, which is the beginning of retroactive interference. Retroactive interference occurs when prior learning is influenced by new learning (Orban et al., 2022). This indicates that the new knowledge gained about reverse proportion actually disrupts the understanding of the old concept namely direct proportion, which the student had previously mastered. This is highlighted in the following interview transcript.

R : Why did you use the reverse proportional method?

S<sub>1</sub> : Oh yeah, hehe, I forgot because the methods are similar. At that time, I thought that the more volume there was, the less time it would take to equalize, but it turned out that the discharge remained the same, so it didn't matter.

Although FI students are generally able to separate relevant information from complex contexts. In this case, S<sub>1</sub> appears to have failed to re-evaluate the solution strategy used. This indicates that the FI cognitive style does not fully guarantee success in avoiding thinking interference, especially when the concepts being studied have procedural similarities and are presented at the same time. Errors that can occur in students with a FI cognitive style are due to difficulties in accurately describing information from the problem on the answer sheet (Saputra Mahmud, 2023).

### Interference in Student Thinking with Field Dependent Cognitive Style

FD students in this study had two types of thinking interference namely retroactive interference and proactive interference. First, S<sub>2</sub>'s results didn't solve the equivalent and reverse proportion problems correctly, but showed interference in problem 1. S<sub>2</sub> solved problem 1 using the reverse proportion strategy, while problem 1 was about equivalent proportion. In other words, S<sub>2</sub> viewed the equivalent proportion problem as an reverse proportion problem. This means that S<sub>2</sub> experienced retroactive interference. The results of S<sub>2</sub>'s work are shown in Figure 2.

2)  $5 \times 120 = 600$  - bak A  
 $1200 = \text{bak B}$

5	120	600	1200
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~~$600 \times 4 = 2400$~~   
 ~~$120 \times 1200 = 144000$~~   
 ~~$120 \times 1200 = 144000$~~   
 $V = 600 \times 4 = 2400$   
 $w = 114 \text{ menit}$

$\frac{a}{b} = \frac{c}{d} = \frac{600}{120} = \frac{?}{1200}$   
 $= \frac{600 \times 120}{1200}$   
 $= \frac{72000}{1200}$   
 $= 120$

Figure 2. S<sub>2</sub>'s Answer

Based on Figure 2, S<sub>2</sub> wrote  $\frac{600 \times 120}{1200}$ , which is a procedure of reverse proportion because if one value increases, the other value decreases. The explanation of S<sub>2</sub>'s solution is revealed in the following interview transcript.

- R : Why did you use the reverse proportional method?  
 S<sub>2</sub> : This is the formula I used, but I put the known value in the wrong place, so it's like the values are reversed.

Second, the S<sub>3</sub> solution correctly solves the equivalent proportion problem but does not correctly solve the reversal problem and shows interference. The following is the S<sub>3</sub> solution in Figure 3.

1.  $\frac{a}{b} = \frac{c}{d} = \frac{10}{600} = \frac{20}{d}$   
 $20x = 600$      $10d = 20 \times 600$   
 $= \frac{12.000}{10}$   
 $= 1.200 \text{ m} / 4 \text{ jam}$

2.  $\frac{a}{b} = \frac{c}{d} = \frac{12}{6} = \frac{c}{9}$   
 $6c = 12 \times 9$   
 $= \frac{108}{6}$   
 $= 18 \text{ hari}$

Figure 3. S<sub>3</sub>'s Answer

Based on Figure 3, S<sub>3</sub> wrote the ratio equation  $\frac{12}{6} = \frac{c}{9}$ , which is a procedure of equivalent proportion because if one quantity increases, the other quantity also increases. In other words, the more workers there are, the longer the work time will be, which is the beginning of proactive interference. Retroactive interference is the strength of old memories exceeding new stimuli, causing memories to be replaced by stronger stimulus responses (Hu & Chen, 2022) This indicates that prior knowledge about equivalent proportional relationships interferes with the understanding of newly acquired reverse relationships. This is expressed in the following interview transcript.

- R : Why did you use the equivalent proportional method?  
 S<sub>2</sub> : The thing is, suddenly it's like I'm calculating everything from equivalent proportion and reverse proportion, but I can't seem to find the reverse proportion, so I end up using the equivalent proportion.

These two forms of interference reflect that FD students tend to be more resistant to information processing interference, especially due to their tendency to rely on context and difficulty in sorting out relevant information. The process of generalizing strategies without in-depth evaluation causes students to apply inappropriate procedures. This indicates that the high correlation between two mathematical concepts with similar procedures and are presented at the same time can be the primary source of thinking interference, especially for students with FD cognitive styles. Arifin et al. (2015) state that students with FD cognitive styles are less able to analyze a problem based on the information presented. FD students tend to focus on the final result without relating it to the meaning of the problem (Herlina et al., 2024).

## CONCLUSION

The results of the study indicate that thinking interference affects students' errors in solving proportion problems. Students with a field independent (FI) cognitive style experience retroactive interference, which involves using a reverse proportion procedure for equivalent proportion problems. Meanwhile, students with a field dependent (FD) cognitive style experience both retroactive and proactive interference, which involves applying inappropriate procedures due to the overlap of old and new information. This interference is caused by the procedural similarity between the concepts of equivalent and reverse proportion, as well as the lack of re-evaluation of the appropriateness of the strategy in the context of the problem. Cognitive style also influences students' tendencies in selecting and applying problem solving strategies. Therefore, teachers need to explicitly emphasize conceptual differences and train students' metacognitive abilities so they can choose appropriate strategies based on the problem context.

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