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# Cognitive Reasoning and Style: do Differences of Cognitive Style Result Differences in Reasoning Ability?

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## ABSTRAK

Sebuah penelitian kualitatif yang bertujuan untuk mendeskripsikan perbedaan kemampuan penalaran matematika antara siswa field independent dengan field dependent dalam memecahkan masalah program linear pada kelas X SMK Baramuli Pinrang. Pengambilan subjek penelitian menggunakan tes GEFT. Metode pengumpulan data menggunakan tes tertulis pemecahan masalah dan wawancara. Analisis data menggunakan analisis data model Miles dan Huberman. Hasil penelitian menunjukkan bahwa ada perbedaan kemampuan penalaran matematika siswa dalam memecahkan masalah antara gaya kognitif FI dengan FD pada setiap indikator penalaran matematika menunjukkan bahwa siswa FI dapat melakukan penalaran matematika dalam memecahkan masalah dengan lebih baik daripada siswa FD.

**Kata Kunci**: kemampuan penalaran matematika, pemecahan masalah, masalah program linear, gaya kognitif

## ABSTRACT

The study is a qualitative research. The study aims at describing the differences of reasoning ability of students in solving linear program problems based on cognitive styles between FI and FD in class X at SMK Baramuli Pinrang. Subjects of the study were taken by employing test GEFT. Data were collected through written test of problem solving ond interview. Data were obtained through the result of written test and interview which were analyzed using Miles and Huberman model. The results of the study indicate that the differences of reasoning ability of students in solving problem based on cognitive styles between FI and FD in each of reasoning math indicator indicate that FI students can do reasoning and math communication better than FD students.

**Keywords:** reasoning math ability, problem solving, linear program problems, and cognitive style

## 1. INTRODUCTION

Mathematics as a vehicle for education can not only be used to achieve one goal, for example educating students but can also shape students' personalities and develop certain abilities and skills. Seeing this reality, mathematics education provided for the future should pay attention to two goals, namely the first formal goals, and the second material goals. Formal goals are in the form of structuring reasoning and personal formation of students, and material goals in the form of applying mathematics and mathematical skills (Soedjadi, 2000: 138).

This is stated in the core competencies of mathematics subjects for the 2013 curriculum Senior High School (SMA/SMK), namely students can process, reason, present, and create in the concrete and abstract realms related to the development of what they learn in school independently, and can use appropriate methods. scientific rules (Kemendikbud, 2013). The results of the TIMMS study indicate that Indonesian students are ranked very low in the abilities of (1) understanding complex information, (2) theory, analysis, and problem-solving, and (3) using tools, procedures, and problem-solving and conducting investigations. (Husamah dan Yanur, 2013: 2).

This also happens at the school level, based on the author's experience during teaching and based on the results of interviews with mathematics teachers in class X SMK Baramuli Pinrang, stating that there are still many students who have difficulty solving mathematical problems that require mathematical reasoning and communication skills. This is evidenced in the average percentage of daily test results for class X students in the odd semester of the 2016/2017 academic year which only achieved completeness of 40% on the subject of systems of linear and quadratic equations and inequalities which also require mathematical reasoning and communication skills.

Tayler (Haryani, 2012: 148) states that every individual is different from one another, the dimensions of individual differences include intelligence, logical thinking ability, creativity, cognitive style, personality, values, attitudes, and interests. Cognitive style as part of the dimension of individual differences refers to the characteristics of a person in responding, processing, storing, thinking, and using the information to respond to a task or respond to various types of environmental situations.

Individuals with *field independence* differ from individuals with field-dependent in many characteristics, among others, in information processing, learning power, way of thinking, and so on. The differences are that individuals with independent fields tend to be reflective in thinking, are more creative, develop creativity based on rationality, tend to subject matter that is abstract, impersonal, factual, analytical, have left brainpower, tend to think divergently, and are less able to socialize well. more individualistic.

While individuals with field dependents tend to be impulsive in thinking, less creative, creativity develops based on imagination (lateral thinking), tends to the human subject matter, social content, and fantasy has right brain power, tend to lack divergent thinking, and can establish social relationships. well. The subject of linear programming at the SMK level is one of the subjects considered difficult by students because it places more emphasis on mathematical reasoning and communication skills.

Based on the description above, researchers are interested in knowing how the description of mathematical reasoning and communication skills in solving linear programming problems based on the cognitive style of class X SMK Baramuli Pinrang students.

This study aims to describe the differences in mathematical reasoning and communication skills between field-independent and *field-dependent* students in solving linear programming problems in class X SMK Baramuli Pinrang.

a. Mathematical Reasoning Ability

Keraf in Sadiq (2004: 2) explains reasoning (thoughts or reasoning) as: "The process of thinking that tries to connect facts or known evidence to a conclusion". Furthermore, Sadiq defines reasoning as an activity, a process, or a thinking activity to draw conclusions or make a new statement that is true based on several statements whose truth has been proven or assumed previously.

b. Troubleshooting

Polya (Saedi, 2004: 64) defines problem-solving as an attempt to find a way out of a difficulty to achieve a goal that is not so easily achievable. Furthermore, he proposed several steps related to this, including 1) Understanding the problem, 2) Devising a plan, 3)

Carrying out the plan, and 4) Re-examining the process and results. (Looking back).

c. Indicators of Mathematical Reasoning and Communication Ability

The indicators of mathematical reasoning and communication skills used in solving linear programming problems in this study are as follows:

1. Indicators of mathematical reasoning ability include:
   a. make allegations;
   b. Perform mathematical manipulations;
   c. find patterns to establish generalizations;
   d. check the validity of the argument;
   e. Conclude.

2. Indicators of mathematical communication skills include:
   a. Connect pictures into mathematical ideas;
   b. Expressing mathematical ideas or situations with pictures, tables, and algebraic forms (mathematical models).

d. Cognitive style *Field Independent* (FI) and *Field Dependent* (FD)

Since 1948, Witkin has begun to develop measuring tools to distinguish types of students based on cognitive style (Witkin in Rufi'i, 2011: 70). Witkin states that analytical individuals are individuals who perceive the environment into its components, and are less dependent on the environment or less influenced by the environment. This individual is said to belong to the field-independent cognitive style (FI). While global individuals are individuals who focus on the environment as a whole, are dominated or influenced by the environment. The individual is said to be a field-dependent cognitive style (FD).

e. Linear Program Material

In general, there are three important steps that must be taken in solving two-variable linear programming problems related to everyday life, namely: (1) translating story problems into a mathematical model (system of inequalities), (2) determining the set of solutions, and ( 3) determine some points that give the optimal value.

## 2. RESEARCH METHODS

The type of research used in this study is included in the type of qualitative research. This research was conducted in class X LG SMK Baramuli Pinrang even the semester 2016/2017 academic year with a total of 27 students.

The technique of taking the subject in this research is purposive sampling. Many subjects in this study were four people consisting of two field independent students and two field-dependent students representing high and low scores. Based on the results of the GEFT test and the considerations of the mathematics teacher, the research subjects can be seen in Table 1.

Table 1. List of Research Subjects

| No | Subjek | Skor | Gaya Kognitif |
|---|---|---|---|
| 1 | HZ | 18 | FI |
| 2 | MI | 16 | FI |
| 3 | RK | 6 | FD |
| 4 | ED | 4 | FD |

The instruments used in this study are divided into two, namely the main instrument and the supporting instrument. As for this research, the main instrument is the researcher himself. Meanwhile, the supporting instruments are as follows:

1. GEFT Instrument

GEFT (*Group Embagged Figure Test*) is a measuring tool developed to classify a person whether it is a field independent (FI) or field-dependent (FD) cognitive style? This instrument was adapted from the instrument developed by Witkin, et al (1971). Determine the group of students who have field-independent and field-dependent cognitive styles, is based on the rules of Dyer and Osborne (1996) in Irawan, et al (2012: 5). Scores 0 – 8 are field dependent (FD), 9 – 10 are field neutral (FN), and 11 – 18 are field independent (FI).

2. Problem Solving Test Questions (TPM)

The diagnostic test used to obtain data on mathematical reasoning and communication skills in solving linear programming problems is a problem-solving test consisting of TPM 1 and TPM 2.

3. Interview Guidelines

The interview guide in this study is an interview guide based on the results of giving problem-solving tests that guide researchers in conducting interviews that aim to reveal students' mathematical reasoning and communication skills and to clarify the results of giving problem-solving tests.

The focus of this research is to reveal students' mathematical reasoning and communication skills in solving linear programming problems. based on the troubleshooting steps according to Polya.

The data collection technique used by the researcher in this study was giving tests and interviews.

The data analysis technique in this study is the data analysis of the Miles and Huberman Model (1984). According to Miles and Huberman (Sugiyono, 2013: 334) activities in data analysis in qualitative research include data reduction (data reduction), data presentation (data display), and conclusions/verification (conclusion/verification).

To test the validity of the data in this study, a data credibility test or a trust test on the research data was carried out. The credibility of the data was tested by using the triangulation technique. The triangulation used in this research is time triangulation. In this study, tests and interviews were conducted twice with a two-week interval

## 3. RESULT

a. Description of Students' Mathematical Reasoning Ability with Cognitive Style *Field Independent* and *Field Dependent*

1. Make a Conjecture

FI1 subjects make assumptions by stating the completion steps completely and sequentially while FI2 subjects can formulate problem-solving strategies by first making a mathematical model stating the constraint function and its objective function and then making a graph to determine the area of completion correctly so that it will lead to problem-solving. correct.

The subject of FD1 can state the steps of completion, but sometimes it is incomplete and in order and formulates the solution strategy used but leads to the wrong solution, while the subject of FD2 can make a conjecture by being able to state the steps of completion but it is not complete because it is not able to mention all the steps of completion and cannot mention the method used. The description of the ability to submit allegations of FI and FD subjects that has been described above is in line with Witkin's opinion (Pratiwi, 2013: 536) which states that FI students can organize unorganized objects while FD students are less able to organize unorganized objects so they have not been able to formulate a proper problem-solving strategy.

2. Perform Mathematical Manipulation

FI1 subjects use the right solution method and can perform calculations using mathematical equations very well. FI2 subjects perform mathematical manipulations using the right method and can perform calculations using mathematical equations well. The subject of FD1 is performing mathematical manipulation using the appropriate method but wrong in the solution and writing the wrong mathematical symbol and can perform calculations using mathematical equations well. The subject of FD2 uses an inaccurate solution method and can perform calculations using mathematical equations quite well. The description of the ability to perform mathematical manipulation of the four subjects described above is in line with the opinion of Witkin and Goodenough (Andreas, 2013: 74) which states that FI is a student who can analyze and separate objects from the surrounding environment so that the subject of FI can perform calculations using the same method. precise and can separate the concepts of equations and inequalities by using the right symbols in the elimination and substitution method while FD is less or unable to separate a part of a unit and tends to immediately accept the dominant part or context and is less able to perform analysis.

3. Finding Patterns To Establish Generalizations

FI1 and FI2 subjects have similarities in setting generalizations where both subjects can determine the final result based on the pattern of answers obtained correctly. FD1 subjects in determining generalizations are sometimes based on an inaccurate analysis, while FD2 subjects in determining generalizations do not the first test the optimum point so that they determine generalizations based on incorrect analysis and are unable to explain the supporting arguments correctly.

The description of the ability to find patterns to establish generalizations described above is Desmita's opinion (2012: 148) which states that the characteristics of the FI cognitive style can show separate parts of the overall pattern and can analyze the pattern into its components while the characteristics of the FD cognitive style difficult to focus on one aspect and analyze the pattern into different parts.

4. Checking the validity of the argument

Subjects FI1 and FI2 have similarities in checking the validity of arguments where Subjects FI1 and FI2 check the validity of arguments by re-checking the results obtained by examining the results of calculations and completion steps so that subjects FI1 and FI2 can believe the truth of the results of their work. While the subject of FD2 did not check the final results obtained so they did not believe in the truth of their work.

## 4. DISCUSSION

Based on the research results, subjects FI1 and FI2 can draw conclusions based on the results of their work that are relevant to the problem, while subjects FD1 and FD2 can conclude from the results of their work, but they are not clear and less relevant to the problem. The description of the ability to conclude is in line with Ardana's opinion (Andreas, 2013: 78) which states that FI tends to respond to stimuli using their perceptions, while the characteristics of FD cognitive style use environmental cues as the basis for their perceptions.

## 5. CONCLUSIONS AND SUGGESTIONS

a.Conclusion

Based on the results of the research analysis and discussion, it can be concluded that the differences in students' mathematical reasoning abilities in solving problems between field-independent and field-dependent students include the following indicators: (1) in proposing the FI subject conjecture can state the completion steps completely and clearly while the subject of FD submits allegations in an unclear and unordered manner; (2) in mathematical manipulation the FI can use the right method and solve it well, while the FD can use the appropriate method but is wrong in the solution; (3) in determining the generalization, the FI can determine based on the analysis of the pattern of answers obtained correctly while the FI is not based on the analysis of the pattern of the correct answers; (4) in checking the validity of the argument, the FI checks again so that it believes in the correctness of the answer, while the FD does not re-check so that it does not believe in the answer; (5) in concluding FI draws conclusions clearly and relevant to the problem while FD makes conclusions but is less clear and less relevant to the problem;

b. Suggestion

1. Based on the conclusions above, the suggestions that can be put forward by the researchers are:
2. Students' cognitive style greatly influences students' mathematical reasoning and communication abilities in solving mathematical problems so special consideration is needed from the teacher in determining strategies, models, and learning methods that are following the characteristics of each student's cognitive style to provide positive learning outcomes for students with field-independent and field-dependent cognitive styles.
3. Students should know the type of cognitive style they have so that they can use learning methods that are following the characteristics of their cognitive style.
4. Other researchers who want to do the same research can conduct research on different students and materials or by examining different cognitive styles.

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