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ANALYSIS OF MATHEMATICAL COMMUNICATION ABILITY ON PROBLEM-SOLVING PYTHAGORAS THEOREM VIEWED FROM STUDENTS' COGNITIVE STYLE

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Abstract

This research is motivated by the fact that students' mathematical communication skills still need to be improved. This study aims to describe students' written and oral mathematical communication abilities toward solving the Pythagorean theorem problem in terms of field-dependent and field-independent cognitive styles in class VIII-B at SMP Al-Islam Krian. This type of research is qualitative research with a descriptive method. Subjects in this study were taken using a purposive sampling technique after carrying out the GEFT test in class VIII-B of 2 students, each based on field-independent and field-dependent cognitive styles. The instruments prepared in this study were the GEFT test, a mathematical communication skills test, and an oral examination. Based on the analysis of the answer sheets for the mathematical communication ability test and the oral test, it was concluded that students with field-independent cognitive styles have good written or oral mathematical communication skills. This can be seen from students' ability to write down and convey information, solve problems coherently, systematically, and transparently, and draw conclusions correctly. Students with field-dependent cognitive styles need better mathematical communication skills. This can be seen from the ability of students who need help to correctly write down and convey information, problem-solving ideas coherently, systematically, and clearly, as well as conclusions.

Keywords: Mathematical Communication Skills; Pythagorean Theorem; Cognitive Style.

INTRODUCTION

Mathematics is a science that examines the language of symbols or symbols in the form of numbers and calculations using reasoning and thinking methods (GC Pratama et al., 2023; Safitri et al., 2023). In learning mathematics, students must develop the ability to convey mathematical ideas. This is in line because, with the ability to communicate mathematical ideas, students can coordinate their mathematical reasoning in writing and orally (Mustakim et al., 2023; Segara et al., 2023). Mathematical communication ability is a social activity (talking) as well as a thinking tool (writing) which should continue to be developed among students according to recommendations from experts (Aminah et al., 2018; Faridatul et al., 2023). Mathematical communication skills cancan convey logical information in solving

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mathematical problems, convert explanation forms using mathematical models (BPA Maryanto et al., 2023; Kumar et al., 2021; Wang et al., 2020) and describe mathematical ideas or ideas into contingent explanation forms (Hendriana et al., 2019; Muhammad et al., 2023).

However, the reality in the learning process is that students seem passive in conveying their mathematical ideas and need the opportunity to express them to educators and friends. The teaching method (teacher-centered) is only teacher-centered. As a result, it makes learning conditions dull (Ats-Tsauri et al., 2021). Students tend to need clarification in communicating mathematical ideas orally and writing in simple language; students think math problems are complicated. Due to this, students' mathematical communication skills are still (Fitraini et al., 2021). Improving students' mathematical communication abilities is still necessary, indicating that research focusing on describing mathematical communication abilities is still essential. Mathematics is not only a lesson about arithmetic, such as algebra and arithmetic, but mathematics is also a lesson for developing reasoning abilities, problem-solving, and communication skills (Andriani, 2020).

Pythagorean Theorem material is often found in Trigonometry and Spatial Construct material, so mastery of this material is the basis that needs to be known. It can be shown that the prerequisite material for trigonometry is the Pythagorean theorem(Muktiari et al., 2021). Based on research conducted by (Restianingsih et al., 2020) stated that students the material needed to understand fully, so they required clarification in conveying their explanations, and most students needed to be more capable of implementing the Pythagorean formula.

Students' thinking or reasoning activities are different due to the characteristics of learning styles. A person's way of thinking is also influenced by how a person quickly obtains information which is generally called cognitive style (Mulyo et al., 2019). One type of cognitive style divides humans into two categories, namely Field Dependent and Field Independent (Siahaan et al., 2019). Students with a field-independent cognitive style have logical and critical abilities, are self-motivated, and like independent learning. Conversely, students with a field-dependent cognitive style need more direction in solving problems, like to study or work together, and need motivation or assistance from other people or extrinsic (Amalia et al., 2020).

Based on the description of the problems that have been described, the problem formulated in this study is how mathematical communication skills in solving Pythagorean Theorem problems are based on the cognitive styles of field-dependent and field-independent students. This study aims to describe students' written and oral mathematical communication abilities toward solving the Pythagorean theorem problem in terms of field-dependent and field-independent cognitive styles.

LITERATURE REVIEW

Research conducted by (Malaya et al., 2021) revealed that students with a field-independent cognitive style have good written mathematical communication skills. Has been able to describe problems in the form of pictures and formulate mathematical ideas and descriptions correctly, but it still needs to be corrected. At the same time, students who have a field-dependent cognitive style of mathematical communication skills are pretty good. It still needs to be quite right to describe the problem in the form of pictures and to be able to formulate ideas and mathematical descriptions clearly and perfectly.

Based on research conducted by (Nurmalia et al., 2019) revealed that the mathematical communication abilities of vocational students related to field-independent subjects were better than field-dependent ones. Field-independent issues have the skills to analyze and work individually, while field-dependents work individually and need help.

Based on research conducted by (Prawita et al., 2022) revealed that each individual can communicate different mathematical ideas even though they have the same cognitive style. It was found that students with a field-independent cognitive style have better written mathematical communication skills than those with a field-dependent cognitive style.

Based on research conducted by (Azizah et al., 2022) shows that students with field-independent cognitive style (FI) have better written mathematical communication skills than students with field-dependent cognitive style (FD). Students with independent fields can understand, express, and evaluate their mathematical ideas compared to field dependents.

RESEARCH METHODS

This type of research is qualitative research with a descriptive method. This study describes written and spoken mathematical communication skills regarding field-independent and field-dependent cognitive styles. Qualitative research aims to holistically study phenomena regarding what the research subject is facing, such as behavior, views, drives, activities, etc., and with a descriptive model describing words and language (Nababan, 2020). This research was conducted at Al-Islam Krian Middle School in the even semester of the 2022/2023 academic year. The subjects in this study were four junior high school students. Subject selection was carried out using the GEFT cognitive style test. The results of the test selected students who had a strong inclination towards each cognitive style; 4 subjects were selected to be tested for written and oral mathematical communication abilities. Subjects were taken using a purposive sampling technique. This sampling technique determines specific qualifications (Indriani et al., 2022).

The research procedure consists of the Preparation Stage, the Implementation Stage, and the Final Stage. Data collection techniques in this study were tests and interviews. Two tests were carried out to obtain data from the trials: the GEFT (Group et al. Test) test and description questions to test students' written mathematical communication skills. Data for students' oral mathematical communication abilities were collected through students' results in presenting the answers obtained from the written test and then conducting interviews for each description of the problem solving of the Pythagorean Theorem, used to get more in-depth data on the reasons for students' answers to the questions. The test instrument used in this research is the GEFT (Group et al. Test). The test is in the form of an image which includes three parts, namely the first part consists of 7 pictures, the second and third parts each consist of 9 pictures, and the result has a total of 25 questions. The first part is 15 for practice. As a result, the results need to be addressed as a cognitive style. Each correct answer means that the student can correctly confirm the simple picture form implied in a complex pattern; the correct student gets a score of 1, and the wrong answer gets a score of 0, so the maximum score is 18. In this study, if students get a score of more than 9, they are categorized as FI, and students with a score less than or equal to 9 are classified as FD (Wulandari et al., 2019).

The following test instrument is a written mathematical communication ability test regarding solving Pythagorean theorem problems used in the research. The assessment of the test results is seen from the fulfillment of students' mathematical communication ability indicators. The following instrument was interviews conducted on the description questions given from the execution of the test to obtain data from verbal and mathematical communication skills. The data analysis technique in this study uses the opinion of Miles and Huberman, namely data reduction, data presentation, and conclusion (Aliya et al., 2020). The indicators used for this study were adopted from the research of (Zukhrufurrohmah et al., 2022), namely 1) Write down information from the questions or write down what you are looking

for; 2) State the solution idea coherently, systematically, and clearly; 3) Write down explanations or reasons for confirming the answers found.

RESULTS AND DISCUSSION

Results

The results showed that in a related study using the GEFT test, it was selected based on the inclination of the cognitive style, which can help researchers express students' mathematical communication abilities; the results of the cognitive style test were obtained from 30 students.

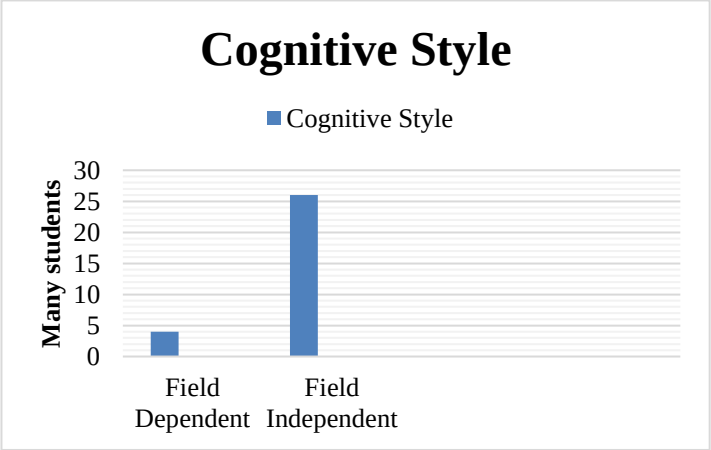

Figure 1. GEFT Test Results

Based on the picture above, four students were randomly taken with two field-dependent students and two field-independent students to be given a mathematical communication ability test (3 essay test questions). The results of students' mathematical communication abilities in 4 subjects based on the results of the description test of mathematical communication abilities are shown in the following figure.

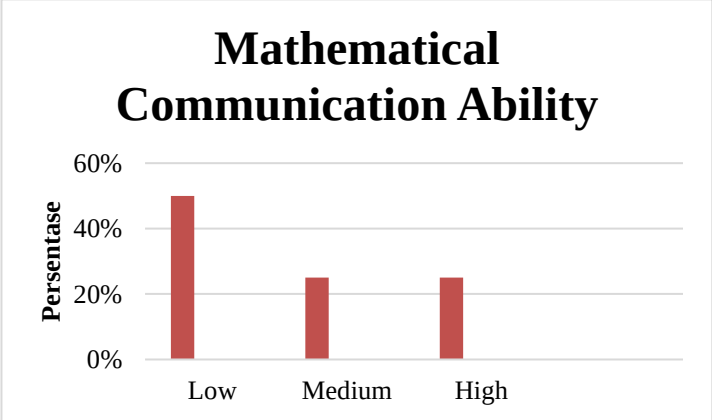

Figure 2. Categorization Results Based on the Level of Mathematical Communication Ability

Based on the picture above, the results of the scoring of the research subjects are shown in Table 1 below.

Table 1. The results of the Mathematical Communication Ability Test

Subject Code	Mathematical Communication Ability	Score
FD1	Low	50

FD2	Low	55
FI1	Moderate	77,8
FI2	High	88,89

In this section, research data are presented, namely the classification of types of students' cognitive styles, field dependent and field independent, and students' mathematical communication abilities in solving trigonometric equation problems, which include indicators (1) Writing down information from questions or writing down what to look for; (2) State the solution idea coherently, systematically and clearly; (3) Write down explanations or reasons for confirming the answers found. Researchers used the results of written tests and interviews to determine students' mathematical communication skills. The following is an analysis of the results of the answers.

a. FD1

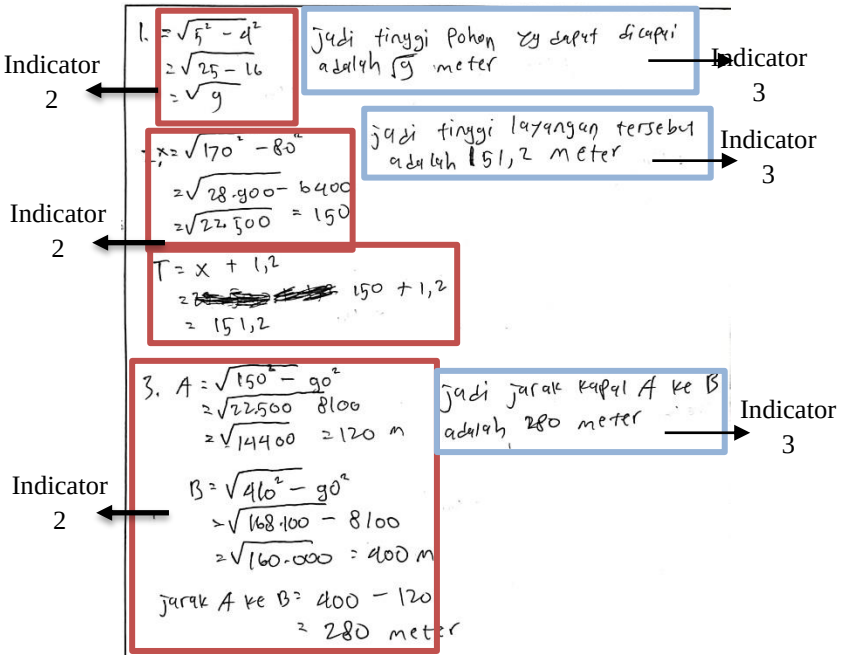

Figure 1. FD1 Mathematical Communication Ability Writing Test Results

When writing down the information from the problem or what to look for, the subject needs to correctly write down the information in the problem. In problems one, two, and three, the subject must write down what was known and what was asked in the questions entirely and precisely. Furthermore, on indicator two, on each question, the subject cannot state the idea of solving coherently, systematically, and clearly; the topic for each question can write down an explanation or reason for confirming the answer found but not correct at number one.

FD1 in all questions can fulfill indicator 3. However, in indicators 1 and 2, FD1 does not fulfill it because it needs to write down or convey the information in the questions and formulas before solving the problems being worked on. FD1 can fulfill indicator three because it can mention and convey conclusions from what is done, but it needs to be corrected and precise.

b. FD2

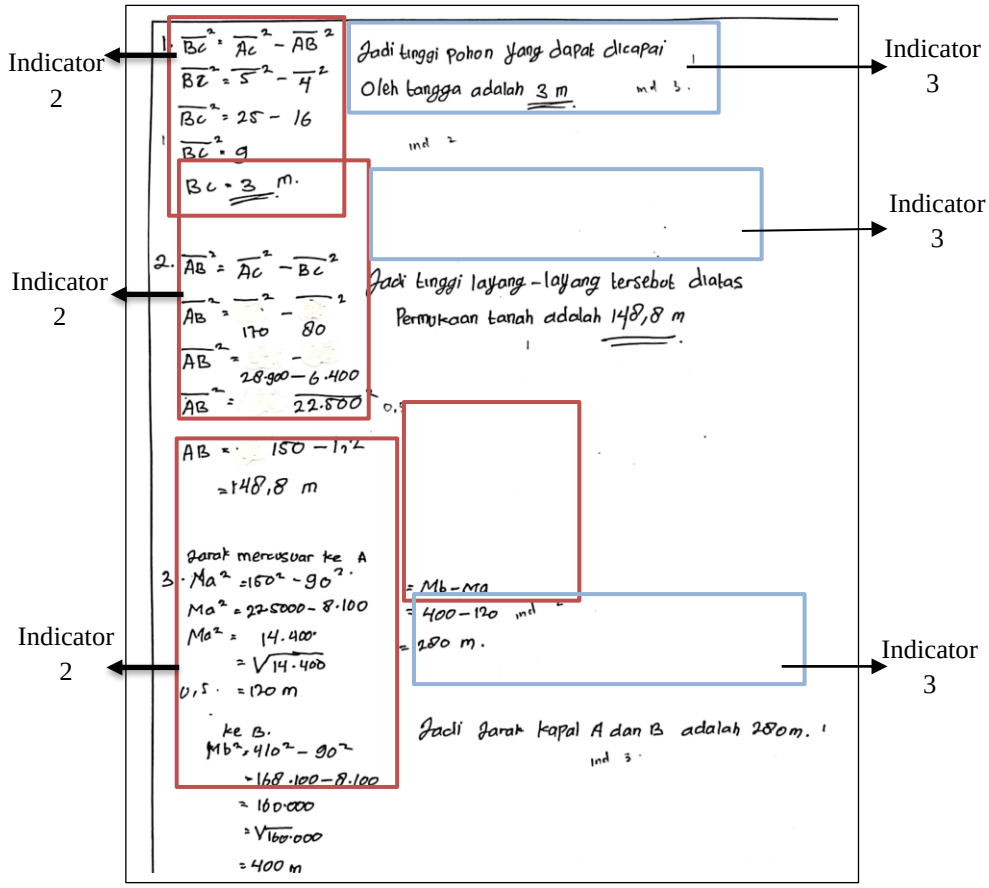

Figure 2. FD2 Mathematical Communication Ability Writing Test Results

When writing down the information from the problem or what to look for, the subject needs to correctly write down the information in the problem. In problems one, two, and three, the subject must write down what was known and what was asked in the questions entirely and precisely. Furthermore, on indicator two, the subject cannot state the idea of solving coherently; the topic for each question can write down explanations or reasons for confirming the answers found.

FD2 fulfilled 2 of the three indicators for questions 1 and 2. However, question 3, only fulfilled one indicator, indicator 3. FD2 did not write down indicator one but could convey indicator one even though it stuttered. FD2 on indicator 2 gives a formula for solving it, but on question number 2, the answer needs to be corrected.

c. FI1

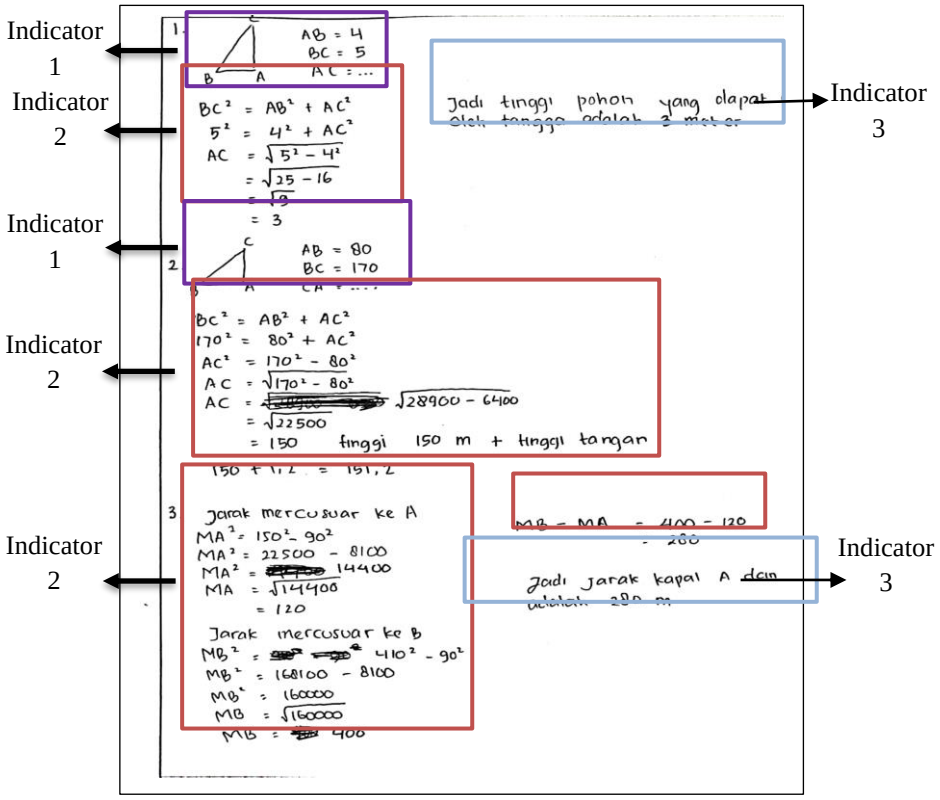

Figure 3. FI1 Mathematical Communication Ability Writing Test Results

In writing down the information from the problem or what to look for, the subject can write down the information in the situation well. In problems one and two, the issue can write down what is known and asked in the questions entirely and precisely. Furthermore, on indicator two, the subject can state the solution idea coherently, systematically, and transparently on each question. Subjects in questions number one and three can write down explanations or reasons for confirming the answers found.

FI1 fulfills all the indicators in question number 1. However, in questions 2 and 3, FI1 completes 2 of the three hands. For question number 2, FI1 did not write down indicator three but was able to convey it well. For number 3, FI1 did not write down hand one and was not precise in conveying information on question number 3

d. FI2

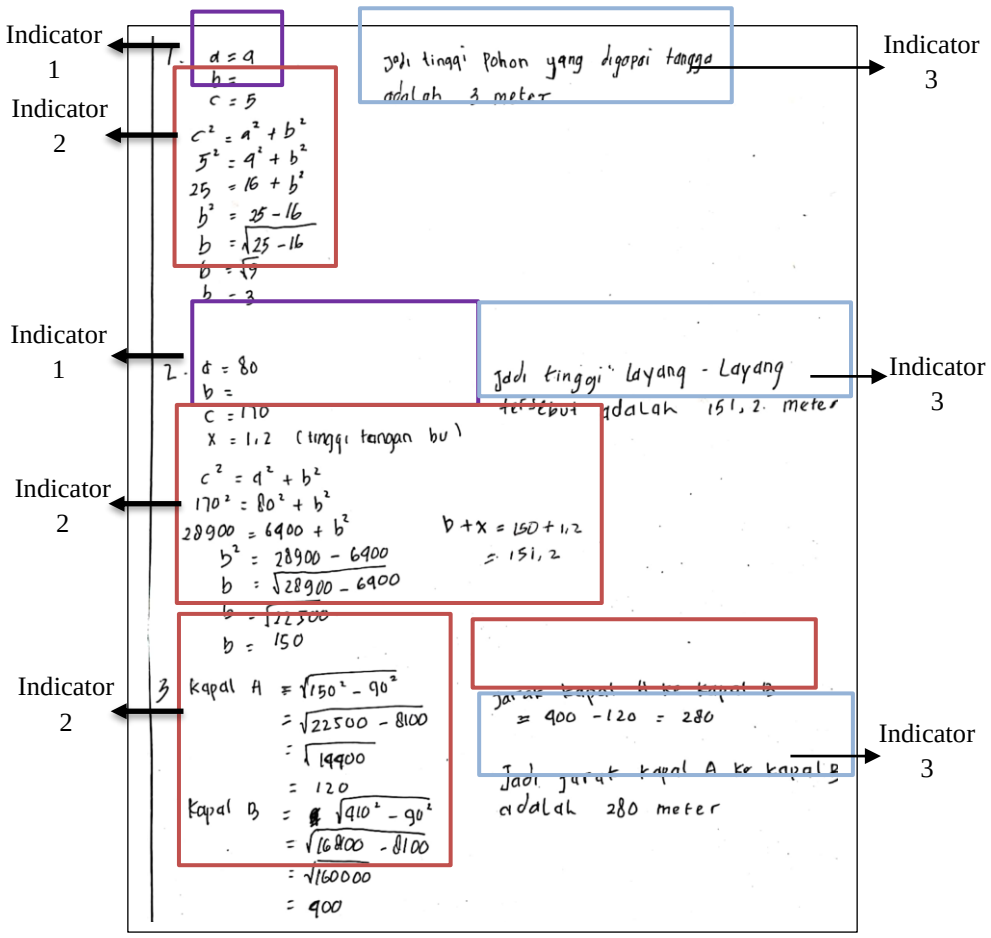

Figure 4. FI2 Mathematical Communication Ability Writing Test Results

In writing down the information from the problem or what to look for, the subject can write down the information in the situation well. In problems one and two, the issue can write down what is known and asked in the questions entirely and precisely. Furthermore, on indicator two, the subject can state the solution idea coherently, systematically, and transparently on each question. Subjects in questions number one, two, and three can write down explanations or reasons for affirming the answers they find.

FI2 can fulfill all the indicators in questions number 1 and 2. However, in question number 3, FI2 does not write down indicator one but can convey it. FI2 can get its solution ideas properly and maximally.

DISCUSSION

Students' mathematical communication abilities in the field-dependent (FD) and field-independent (FI) cognitive styles show that they still need to fulfill all the indicators of mathematical communication ability; it can be seen from FD1 and FD2 that they do not fulfill indicators 1 and 2. Meanwhile, FI1 and FI2 only meet the indicators one on more than one

question. From the results of interviews for FD subjects, the lack of fulfillment of hands is because they rarely solve problems without mentioning the information and the mathematical formula itself. Then for the results of the FI interview, the lack of fulfillment of indicators on one question was caused by a lack of practice questions, such as the questions presented by researchers at school in teaching mathematics in class.

Students with a field-dependent cognitive style tend to have low mathematical communication skills both verbally and in writing. This can be seen from how students with a field-dependent style still need the help of others in working on the problems they are working on. Meanwhile, students with field-independent cognitive techniques tend to have high mathematical communication skills in writing and orally. This can be seen from how students with field-independent cognitive styles can solve problems independently without needing other people's or external help.

Differences in students' cognitive styles will change their mathematical communication abilities and depend on the learning activities (Saputra et al., 2020). Previous research conducted by (Nufus et al., 2021) shows that field-independent mathematical communication skills are superior to field dependent, namely that field-independent style people tend to refer to problem-solving activities and are thinkers than field people. Dependent. Factors influencing students' written mathematical communication abilities include learning methods, attitudes and insights, and adjustments or provision of practice questions that test students' mathematical communication skills (Hikmawati et al., 2019). According to (Sulistiyono et al., 2021), there are differences in student mathematics learning outcomes; this means that cognitive style is involved in mathematics learning outcomes. Therefore in learning mathematics, individual student differences are of particular concern in selecting methods, media, or evaluation.

This shows a relationship between students' mathematical communication skills and cognitive style. Mathematical communication is meaningfully related to the ability to communicate, which is closely associated with activities in the classroom, which includes writing activities, studying, studying, defining, criticizing ideas, symbols, terms, and mathematical information, and when there is a presentation of messages containing related mathematical material (Melinda et al., 2020). According to (Mirlanda et al., 2019), students with a field-independent cognitive style like to compete, are logical, individualistic, goal-centered, and capable of determination. In contrast, students with a field-dependent cognitive style are group-centered, comprehensive, vulnerable to social interaction and criticism, externally motivated, and passive in learning, like getting explanations from others. This aligns with research by (Yuzalia et al., 2021), which shows a relevant link between communication skills and cognitive style.

OPEN PROBLEM

Students with field-independent cognitive styles have good mathematical communication skills. This is seen in the ability of students to write down and convey information and problem-solving ideas in a coherent, systematic, and transparent manner, as well as conclude correctly. Students with field-dependent cognitive styles need better mathematical communication skills. This can be seen from the ability of students who need help to correctly write down and convey information, problem-solving ideas coherently, systematically, and clearly, as well as conclusions.

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