Unraveling Mathematical Anxiety: Perspectives from Cognitive Styles

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Abstrak

Penelitian ini bertujuan untuk menganalisis tingkat kecemasan matematika peserta didik berdasarkan gaya kognitif _Field Dependent_ (FD) dan _Field Independent_ (FI), serta mengidentifikasi perbedaan kecemasan antara kedua kelompok tersebut. Dengan pendekatan kualitatif, penelitian ini melibatkan 20 peserta didik kelas VII-A SMP Negeri 2 Babadan yang dikelompokkan berdasarkan gaya kognitif menjadi dua kategori yaitu FD dan FI dengan menggunakan tes GEFT. Setelah diperoleh klasifikasi gaya kognitif, siswa menjalani tes pemecahan masalah matematis. Berdasarkan analisis kesalahan dan kategori kemampuan yang dihasilkan, enam siswa representatif dari berbagai kombinasi gaya kognitif dan kemampuan dipilih untuk wawancara mendalam. Data yang diperoleh kemudian dianalisis melalui tahap reduksi data, penyajian data, dan penarikan kesimpulan. Temuan penelitian menunjukkan bahwa peserta didik dengan gaya kognitif FD cenderung mengalami kecemasan matematika pada kategori berat akibat ketergantungan pada dukungan sosial, rendahnya kepercayaan diri, serta kesulitan dalam memahami konsep. Sebaliknya, peserta didik dengan gaya kognitif FI mengalami kecemasan pada kategori ringan hingga sedang yang dipengaruhi kesulitan mengingat langkah penyelesaian, namun lebih terbantu oleh kontrol diri yang baik. Secara umum, peserta didik FI lebih sistematis dan percaya diri, sehingga terbukti gaya kognitif berpengaruh terhadap kecemasan matematika dan kemampuan pemecahan masalah.
Kata Kunci: Kecemasan matematika; gaya kognitif; _Field Dependent_ (FD); _Field Independent_ (FI); penyelesaian masalah matematis.

Abstract

This study aims to analyze the level and differences in students' mathematics anxiety based on Field Dependent (FD) and Field Independent (FI) cognitive styles, as well as to identify differences in their anxiety. Using a qualitative approach, this study involved 20 seventh-grade students of class VII-A at SMP Negeri 2 Babadan, who were categorized into two cognitive style groups, Field Dependent (FD) and Field Independent (FI) based on the Group Embedded Figures Test (GEFT). After the cognitive style classification was obtained, the students took a mathematical problem-solving test. Based on the error analysis and the resulting ability categories, six representative students from various combinations of cognitive styles and ability levels were selected for in-depth interviews. The data obtained were then analyzed through data reduction, data presentation, and conclusion drawing stages. The research findings show that students with FD cognitive styles tend to experience severe mathematical anxiety due to their dependence on social support, low self-confidence, and difficulty in understanding concepts. Conversely, students with FI cognitive styles experience mild to moderate anxiety influenced by difficulties in remembering solution steps, but are more helped by good self-control. In general, FI students are more systematic and confident, thus proving that cognitive style influences math anxiety and problem-solving abilities.
Keywords: Mathematics anxiety; cognitive style; Field Dependent (FD); Field Independent (FI); mathematical problem solving.

I. INTRODUCTION

Mathematics is an important subject for everyone to learn because it is a key pillar in the development of science. BNSP (2006) states that mathematics is a universal science that underpins modern technological advances and plays a role in various scientific fields. This view is in line with Mualifah and Ekayanti (2022), who emphasize that mathematics is often considered the basis of all science because almost every discipline involves its concepts and applications. In addition, mathematics is not only related to numbers and formulas, but also closely related to various daily activities such as sales transactions, the use of technology, and time management (Af-idah & Suhendar, 2020; Ulkhaq, 2023). Therefore, mastery of mathematical competence is very important for every individual and is one of the indicators of a country's progress.

In the context of education, mathematics learning aims not only to provide conceptual understanding, but also to develop students' thinking skills in facing and solving problems (Ratnasari & Nurhidayah, 2020; Permatasari & Afriansyah, 2022). However, many students still consider mathematics a difficult subject, which hinders them in solving problems. Some students even view mathematics as something frightening, which triggers feelings of tension, discomfort, and worry when faced with mathematical tasks (Gita et al., 2019; Susanti et al., 2023). This condition causes math anxiety, which affects the learning process and outcomes.

Mathematics anxiety is a feeling of fear or anxiety that arises when individuals encounter mathematical situations. Freud (2004) views this anxiety as a reaction to the threat of discomfort that has not yet occurred, but is felt by students because they feel unprepared to face challenges. Ashcraft (2002) explains that math anxiety can interfere with the ability to manipulate numbers and weaken working memory functions that play an important role in mathematical information processing. From an educational psychology perspective, math anxiety is also categorized as an academic emotion that is influenced by students' perceptions of value and control in learning (Pekrun et al., 2007; Putra, Novita, & Usman, 2025).

To a certain extent, math anxiety can have a positive impact because it can motivate students to study harder. However, excessive anxiety actually hinders conceptual understanding and lowers learning achievement (Nurhayati et al., 2019; Sopiatunnisa, Afriansyah, & Mardiani, 2024). Therefore, the ability to recognize and manage math anxiety is an important aspect in supporting the improvement of student learning outcomes (Suren & Kandemir, 2020; Tamba & Bermuli, 2023). Mathematics anxiety can be observed through cognitive, affective, and psychomotor aspects, including confusion, lack of confidence, fear, nervousness, and avoidance of learning (Mulyana et al., 2021; Rahman, 2025). In addition, anxiety levels are categorized as mild, moderate, severe, and panic, each of which has a different impact on learning ability (Townsend, 2010; Zay & Kurniasih, 2023).

Various factors can cause math anxiety, including personal, environmental,

and intellectual factors (Trujillo & Hadfield, 1999; Santoso & Ariyanti, 2023). Milena (2022) found that students with high learning outcomes are generally influenced by environmental pressures and concerns about grades, while students with moderate learning outcomes are influenced by a lack of understanding and self-confidence. Students with low academic achievement tend to experience anxiety due to a lack of understanding and fear during face-to-face learning. In addition, internal factors such as low self-confidence and difficulty in logical thinking, as well as external factors such as teaching style and classroom conditions, can influence and exacerbate student anxiety (Astiati & Ilham, 2023).

Problem-solving skills are one of the important mathematical competencies that students must possess. Polya (1973) emphasized that mathematical problems cannot be solved using routine procedures, but rather require deep understanding and specific strategies through four stages, namely understanding the problem, planning the solution, implementing the plan, and evaluating the results. Similar stages are also mentioned by Krulik and Rudnick (1995), who emphasize the processes of analysis, strategy selection, and reflection as part of problem solving. Thus, problem solving is a higher-order thinking process that requires analysis, creativity, and self-evaluation skills.

In relation to mathematical problem solving, Lyany et al. (2024) revealed that students' mathematical anxiety is influenced by three main factors: cognitive, personality, and social factors. Their findings showed that the highest level of mathematical anxiety was associated with the cognitive factor, accounting for 37.1% of the 16 identified symptoms. The most frequently reported symptoms were forgetting formulas during lessons and feeling overwhelmed when dealing with mathematical tasks that require higher-order thinking skills. This study highlights that the cognitive aspect is a crucial component in understanding mathematical anxiety.

Cognitive style refers to individual differences in receiving, processing, and responding to information (Messick, 1984). According to Witkin et al. (1977), cognitive style is divided into Field Dependent (FD) and Field Independent (FI). FD individuals tend to think globally, are more influenced by context, and prefer group work, while FI individuals are more analytical, independent, and able to separate relevant information well. Research shows that FD individuals are more prone to math anxiety because they have difficulty focusing on important information (Casey et al., 2001). Conversely, FI individuals tend to have lower anxiety levels because they are able to focus their attention and use visual or symbolic representations effectively (Sukmawati et al., 2023).

Based on the description above, it can be seen that math anxiety, problem-solving skills, and cognitive style are interrelated aspects that influence the mathematics learning process. Understanding the relationship between these three aspects is important for improving the effectiveness of learning and student learning outcomes. Researchers are interested in examining

this topic because there are still students who experience anxiety in solving mathematical problems, with apparent differences between Field Dependent and Field Independent cognitive styles. In addition, the limited research examining the relationship between cognitive style and math anxiety in the context of problem solving indicates the need for further study to support the development of more appropriate learning strategies.

II. METHOD

This study uses a descriptive qualitative approach that aims to describe in detail the differences in students' levels of math anxiety in solving mathematical problems based on Field Dependent (FD) and Field Independent (FI) cognitive styles. This approach was chosen because the data collected consisted of narratives, descriptions, and interview results that described the phenomenon of math anxiety in depth.

In the research process, researchers were the main instruments involved fully from the planning stage to data analysis. This research was conducted at SMP Negeri 2 Babadan, located on Jalan Raya Ponorogo–Madiun, Pondok Village, Babadan District, Ponorogo Regency. The research was conducted for approximately one month, namely in April 2025. The selection of subjects was carried out in several stages. All 20 students in class VII-A first took the GEFT test to identify their cognitive styles, which were then classified into FD and FI. Next, the students took a mathematical problem-solving test. The students' answers were then analyzed to identify various types of errors they made.

Based on the degree of errors found, the students were categorized into five ability levels: very poor, poor, fair, good, and very good. Based on the combination of cognitive style and ability results, six students who were considered the most representative were selected as interview subjects.

The research data includes three types of information, namely GEFT test results, mathematical problem-solving test results, and interview data with students. To obtain these data, three data collection techniques were used, namely GEFT, problem-solving tests, and interviews. GEFT was used to determine students' cognitive styles based on the scores obtained. According to Ratumanan's (2003) criteria, students who scored 0-9 were categorized as Field Dependent (FD), while those who scored more than 9-18 were categorized as Field Independent (FI). Next, a mathematical problem-solving test in the form of essay questions was given to observe the students' thinking processes and the quality of their answers. Students who scored 85–100 were categorized as excellent, those who scored 70 to <85 were categorized as good, those who scored 55 to <70 were categorized as fair, those who scored 40 to <55 were categorized as poor, and those who scored <40 were categorized as very poor. After both tests were administered, in-depth interviews were conducted using 17 questions aimed at identifying the level and symptoms of math anxiety and the differences between FD and FI students.

Data analysis in this study used the Miles et al. (2014) model, which consists of three stages: data reduction, data

presentation, and conclusion drawing. In the data reduction stage, information from tests and interviews was selected and simplified to focus on the classification of cognitive styles, problem-solving abilities, and symptoms of math anxiety. The summarized data was then presented in the form of descriptive narratives to show the differences in the characteristics of FD and FI students, both in terms of abilities and experiences of anxiety. Next, conclusions were drawn inductively by examining field findings regarding anxiety levels, dominant symptoms, and factors causing anxiety that distinguished the two groups. This process was complemented by data verification by comparing raw data, analysis results, and supporting theories to ensure that the findings were valid and consistent. The analysis also used a comparative descriptive approach as proposed by Strauss & Corbin (1998). The validity of the data was verified through prolonged engagement and technique triangulation. Prolonged engagement means that the researcher repeatedly examined all data obtained during the study, such as the results of the GEFT, the written test on mathematical problem-solving test, and interview transcripts, to ensure the accuracy of the findings. Technique triangulation was carried out by collecting data from the same sources using different methods, namely tests and interviews. The researcher compared the written test results with the interview data to examine the credibility of the findings by cross-checking information from the same participants through different techniques.

III. RESULT AND DISCUSSION

A. Result

After administering two types of tests, namely cognitive style tests and mathematical problem-solving ability tests, students were grouped based on their respective categories and six students were selected as interview subjects. The interviews were conducted to identify the level of anxiety and differences in anxiety experienced by each subject in each category. The list of subjects who participated in the interviews is presented in Table 1.

Table 1.
Interview Subject

No	Code Name	Gender	Cognitive Style	Ability Category
1	SZFN	Female	FD	Very Poor
2	AR	Female	FD	Poor
3	SAW	Male	FD	Fair
4	MM	Male	FI	Very Poor
5	FMS	Male	FI	Fair
6	ANR	Female	FI	Excellent

1. SZFN Interview Results

The interview results show that SZFN has a strong tendency to feel afraid and dislike mathematics lessons, mainly because he considers the material and calculations to be complicated. He stated, *"I don't really like it, because I think math is complicated, especially the calculations" (SZFN, interview, April 29, 2025).* Even before the lesson began, he already felt unsure about his ability to understand the material. SZFN often experienced headaches when faced with difficult questions and was reluctant to ask the teacher. He also doubted his own answers and always needed validation from his friends.

The habit of memorizing formulas without understanding the concepts makes it easy to forget the steps to solve problems, especially when dealing with word problems. Physical symptoms such as a rapid heartbeat and difficulty concentrating appear both during learning and exams. When asked about his math grades, SZFN showed tense body language, such as clenched fists. He was worried about getting low grades and felt ashamed if his grades were worse than his friends'. The study concluded that SZFN experienced severe math anxiety, characterized by narrow perception, excessive focus on one detail, headaches, and dependence on external motivation.

2. AR Interview Results

AR feels afraid and unmotivated when attending mathematics classes because he often encounters difficult problems and does not understand the teacher's explanations. He admits that he feels more comfortable asking his friends rather than the teacher, as he said: *"Sometimes I try to study on my own but still don't understand... I'm embarrassed to ask the teacher" (AR, interview, April 29, 2025).* AR often experiences palpitations, tension, anxiety, and difficulty concentrating when the classroom atmosphere is not calm. He often feels unsure of his answers and needs to check with his friends.

When working on individual problems, AR also experiences headaches and lacks motivation to study. He prefers group work so he can discuss the problems. AR is very nervous when waiting for his test scores because he is afraid of getting low marks and being scolded by his parents. During the interview, he was seen biting his nails—an

indication of anxiety. Based on these symptoms, AR was classified as having severe math anxiety, which directly impacts his self-confidence and cognitive abilities.

3. SAW Interview Results

From the beginning, SAW stated that he did not like mathematics and considered it boring and a headache. He said, *"I think mathematics is a difficult subject that makes my head spin" (SAW, interview, April 29, 2025).* Nevertheless, he still attended class, but when he got bored, he chose to chat with his friends. SAW often experienced fear, feelings of inadequacy, and difficulty solving problems. He trusted his friends' answers more than his own work. Symptoms such as tension, anxiety, rapid heartbeat, and blanking out during exams made him even more insecure. SAW felt ashamed when he got low grades and was afraid of being scolded by his parents, but these feelings did not motivate him to study harder. He tends to be resigned, and during the interview he repeatedly tugged at his shirt collar as a sign of anxiety. SAW was diagnosed with severe math anxiety, as evidenced by physical symptoms, low motivation to study, and dependence on help from friends.

4. MM Interview Results

MM is quite enthusiastic about learning mathematics but still finds it difficult. He often feels afraid and anxious when faced with problems. However, he tries to solve problems independently before asking his friends for help, as he said: *"I always try to do it myself first" (MM, interview, April 29, 2025).* MM feels he can concentrate when the class is quiet, and he often feels confident about his answers. However, during exams, he experiences heart

palpitations and sometimes forgets formulas because he only memorizes them. He remains motivated to study harder if he receives low grades. During the interview, MM was seen clenching his fists several times—an indication of anxiety. Based on his symptoms, MM experiences moderate anxiety, but this anxiety does not completely hinder his learning process.

5. FMS Interview Results

FMS dislikes mathematics because he finds the material difficult to understand, but he remains enthusiastic about learning and tries to do the problems independently. He can concentrate when the class is quiet, but when the atmosphere is noisy, he has difficulty focusing. He said, *"I can concentrate as long as the atmosphere is quiet. But if the class is noisy, I find it a bit difficult to concentrate" (FMS, interview, April 29, 2025).* When doing problems or taking tests, FMS often feels his heart pounding and becomes confused. He also rarely feels confident about his answers and gets nervous when waiting for test results. However, he is motivated to study harder if his grades are low. During the interview, he exhibited repetitive restless leg movements. Based on these symptoms, FMS was classified as experiencing moderate anxiety.

6. ANR Interview Results

Unlike other subjects, ANR actually likes mathematics and feels enthusiastic about it. He said, *"Mathematics is exciting, like a challenge that makes you curious" (ANR, interview, April 29, 2025).* However, he sometimes feels tense and has difficulty understanding the material. ANR tries to solve problems independently and only asks for help when absolutely necessary. He feels optimistic about his answers, but still experiences forgetting formulas and difficulties with word problems. ANR is a little nervous awaiting the exam results, but remains open-minded about the outcome. ANR appears the calmest in the interview and is classified as having mild math anxiety, which actually motivates him to study harder.

B. Discussion

Each student has a different cognitive style in processing information and solving problems. Field Dependent (FD) and Field Independent (FI) cognitive styles are two main tendencies that influence how students understand, organize, and respond to a situation, including in mathematics learning. Students with an FI cognitive style tend to be more analytical, independent, and able to separate relevant information from the background. Conversely, students with an FD style rely more on external cues and view information holistically without sorting out the details. These differences in cognitive styles not only affect thinking strategies but also students' emotional responses when facing academic challenges, including math anxiety. Thus, this chapter focuses on analyzing the differences in math anxiety between students with FD and FI cognitive styles based on the research data obtained.

The results of the study show that students with FD cognitive styles have varying levels of mathematical problem-solving abilities, but none of them reached the "Good" or "Excellent" categories. Based on interviews with three FD subjects, namely SZFN, AR, and SAW, all three

experienced severe mathematical anxiety. Symptoms of anxiety were evident through emotional, cognitive, and behavioral responses in the form of excessive fear, difficulty concentrating, disturbed thinking, and certain physical reactions. SZFN experienced symptoms such as headaches, fear of being laughed at, and high dependence on help from friends. AR showed severe anxiety through tension, restlessness, and fear of his parents' reactions when he was unable to understand the material. Meanwhile, SAW showed boredom, fear of making mistakes, confusion, and a tendency to experience a blank mind when working on problems. These findings are in line with Townsend's (2010) view that severe anxiety causes a significant narrowing of perception and inhibits rational thinking.

Unlike FD students, subjects with FI cognitive styles showed a wider range of mathematical abilities, even reaching the "Excellent" category. However, FI cognitive style does not always correlate with low mathematical anxiety. Three FI subjects, namely MM, FMS, and ANR, showed varying levels of anxiety, ranging from moderate to mild. MM and FMS showed moderate anxiety, characterized by fear of making mistakes, restlessness, and decreased focus when faced with difficult problems. Meanwhile, ANR experienced mild anxiety, which actually served as motivation to increase focus and perseverance in learning. These findings reinforce Townsend's (2010) theory, which states that low levels of anxiety can increase alertness and motivation to learn, while moderate levels of anxiety begin to interfere with

concentration but still allow students to function academically.

A comparison between FD and FI students shows that FD students tend to experience higher levels of math anxiety. Research by Sukmawati et al. (2023) explains that FD students are more prone to anxiety because they have difficulty separating relevant information from complex contexts. In addition, FD students depend on external support, are easily confused, and often rely on memorization without deep conceptual understanding. In contrast, FI students are more independent, analytical, and able to focus their attention even in less conducive classroom conditions. Nevertheless, FI students still exhibited anxiety at mild to moderate levels. Their strong analytical ability tends to make them engage in deep processing of information. However, when the problems are too complex or involve many steps that must be remembered simultaneously, such intensive analytical processing can overload the capacity of working memory. In this condition, even mild anxiety can exacerbate the situation because anxiety also consumes part of the working memory capacity (Langerock et al., 2025). Consequently, although FI students are capable of good analysis, they may forget the sequence of problem-solving steps since their cognitive resources are divided between analytical processing and anxiety management. Although FI students may experience anxiety, they are generally able to manage their emotions adaptively and use anxiety as a motivation to improve their abilities.

Overall, the findings confirm that differences in cognitive styles influence how students experience and manage math

anxiety. FD students with math abilities ranging from "Very Poor" to "Fair" tend to experience severe anxiety that negatively impacts their motivation and learning outcomes. Meanwhile, FI students with more diverse abilities, ranging from "Very Poor" to "Excellent," are able to manage anxiety more effectively so that it does not hinder the problem-solving process. Therefore, learning strategies need to consider students' cognitive styles, particularly by providing more intensive support for FD students so that they can improve their independence, self-confidence, and conceptual understanding in mathematics learning.

IV. CONCLUSION

Field Dependent (FD) students tend to experience severe math anxiety due to their dependence on external factors and low conceptual understanding and self-confidence. Conversely, Field Independent (FI) students generally experience mild to moderate anxiety, triggered by internal factors such as difficulty remembering solution steps, but aided by good self-control. Overall, FI students are better able to solve mathematical problems because they think more analytically and systematically, while FD students are more dependent on external support and have difficulty managing complex information. Thus, cognitive style has an important influence on students' anxiety levels and mathematical problem-solving abilities.

Considering the research findings regarding differences in mathematics anxiety levels between students with Field Dependent (FD) and Field Independent (FI)

cognitive styles, students are expected to be able to recognize their respective learning styles and apply appropriate strategies to manage anxiety, including deepening their understanding of concepts, thinking systematically, and asking questions when encountering difficulties. Teachers need to understand students' cognitive styles and anxiety characteristics so that they can provide guidance and social support for FD students, as well as design problem-solving tasks that enhance the independence and self-confidence of FI students. Schools need to create a learning environment that is responsive to variations in cognitive styles and provide guidance and counseling services to help students overcome learning anxiety. At the macro level, these findings can serve as a foundation for educational policymakers to develop curricula, evaluation systems, and guidance and counseling services that take into account students' cognitive diversity and psychological well-being. However, the study is limited by the relatively small number of participants and the qualitative nature of the data, which may restrict generalization to broader populations. Future research could expand the sample size, incorporate quantitative measures of anxiety, or explore interventions aimed at reducing math anxiety across different cognitive styles.

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