Jurnal Kependidikan:
Jurnal Hasil Penelitian dan Kajian Kepustakaan di Bidang Pendidikan, Pengajaran dan Pembelajaran
https://e-journal.undikma.ac.id/index.php/jurnalkependidikan/index

Vol. 10, No. 3 : September 2024
E-ISSN: 2442-7667
pp. 1243-1254
Email: jklppm@undikma.ac.id

Do Habits of Mind and Cognitive Style Affect Critical Thinking Ability of High School Students?

Yohana Dwi Kristiani Sinaga, Elly Arliani
Master of Mathematics Education, Faculty of Mathematics and Natural Sciences
Universitas Negeri Yogyakarta, Indonesia.
*Corresponding Author. Email: yohanadwi.2022@student.uny.ac.id

Abstract: This research aims to analyze the influence of habits of mind and cognitive style (field dependent and field independent) on the critical thinking ability of high school students. This research employs a mixed-method approach with an explanatory sequential design and a QUAN → qual model. The population consists of all 11th-grade high school students in Sintang Regency, West Kalimantan Province, with a sample of 385 students and 19 students serving as interview informants. The instruments used include a critical thinking ability test, habits of mind questionnaire, GEFT, and interview guidelines. The analysis techniques employed are descriptive analysis, inferential analysis, and qualitative analysis based on Miles & Huberman. The results show that habits of mind and cognitive style simultaneously have a significant influence on critical thinking ability. Furthermore, based on the coefficient of determination, it is found that habits of mind and cognitive style together have the power to explain critical thinking ability. The implication is that teachers need to adjust learning strategies based on students' cognitive styles and develop habits of mind to improve their critical thinking skills.

Article History
Received: 21-06-2024
Revised: 28-07-2024
Accepted: 20-08-2024
Published: 18-09-2024

Key Words:
Habits of Mind; Cognitive Style; Field Dependent; Field Independent; Critical Thinking.

How to Cite: Sinaga, Y., & Arliani, E. (2024). Do Habits of Mind and Cognitive Style Affect Critical Thinking Ability of High School Students?. *Jurnal Kependidikan: Jurnal Hasil Penelitian dan Kajian Kepustakaan di Bidang Pendidikan, Pengajaran dan Pembelajaran, 10*(3), 1243-1254. doi:https://doi.org/10.33394/jk.v10i3.12730

https://doi.org/10.33394/jk.v10i3.12730

Introduction

In the world of education, mathematics plays a crucial role (Imanisa & Effendi, 2023). The Ministry of Education, Culture, Research, and Technology Regulation No. 7 of 2022 concerning content standards in early childhood education, basic education, and secondary education levels also clearly states that mathematics is one of the mandatory subjects in schools. Besides being a compulsory subject in schools, mathematics holds an important role for humans that can be applied in daily life (Antasari et al., 2023). Another goal of mathematics education in schools is to equip students with the ability to think logically, systematically, analytically, critically, creatively, and innovatively, as well as the ability to collaborate (Prajono et al., 2022). With these abilities, it is expected that students will be able to process, acquire, and utilize information for application in everyday life.

The importance and mandatory nature of mathematics in education do not necessarily mean that Indonesian students have mastered the subject. This fact is evident from the results of international surveys involving Indonesian students, such as the Trends in International Mathematics and Science Study (TIMSS) and the Program for International Student Assessment (PISA). The results of the 2015 TIMSS showed that the mathematics proficiency of Indonesian students ranked 44th out of 49 participating countries, with an average score of 397, compared to the international average of 500. According to TIMSS criteria, a score below 400 falls into the low international benchmark category. Additionally, in 2022, Indonesia's ranking in PISA improved by 5-6 positions compared to 2018, but the survey

results indicated a decline in several scores, such as reading literacy, mathematical literacy, and scientific literacy. This indicates that the low achievements of Indonesian students are due to their lack of mastery of the mathematics material tested.

Several studies indicate that students' mathematics abilities still need improvement (Agoestanti et al., 2017; Arigawati & Kusnandi, 2023; Hafni et al., 2019). The results of the Minimum Competency Assessment (AKM) in 2021 and 2022 focused on mathematical literacy, specifically numeracy. This assessment evaluates students' abilities to apply mathematical principles to solve everyday problems. The Indonesian Education Report (Ministry of Education and Culture, 2023) reveals that in 2022, national numeracy achievement for high school students was in the medium category at 41.14%, up from 35.16% in 2021. This indicates that most students still do not meet minimum numeracy standards. The same trend is observed in Sintang Regency, one of the regencies in West Kalimantan Province. The AKM results for numeracy in 2022 showed a percentage of 40.36%, also in the medium category. These results underscore the need for improved mathematical literacy, particularly through enhancing students' critical thinking skills to better analyze, evaluate, and solve problems.

Critical thinking is a reflective and logical approach focused on determining what to believe or do (Ennis, 2011), and is recognized as a higher-order thinking skill, or high-order mathematical thinking skill (Nurhikmayati & Gilar, 2019). It involves using existing knowledge and new information to address new situations (Heong et al., 2011) and requires comparing multiple pieces of information (Siswono, 2016). Research indicates that developing critical thinking skills enhances students' math achievement (Chukwuyenum, 2013) and improves problem-solving effectiveness (Peter, 2012). Haryani (2011) also notes that critical thinking is essential in problem-solving processes, from understanding the problem to reviewing the solution, underscoring its importance in mathematical problem-solving.

Developing Critical Thinking Ability in mathematics is a gradual process that requires cultivating intelligent problem-solving habits, known as habits of mind. These habits, defined as automatic and repeated positive behaviors that foster problem-solving intelligence (Handayani et al., 2018; Sumartini, 2022), involve intelligent actions when faced with unclear solutions (Costa & Kallick, 2008). Research shows a significant correlation between improved habits of mind and Critical Thinking Ability, with a 60.98% relationship (Nurdiansyah et al., 2021). Habits of mind positively impact mathematical generalization and problem-solving abilities (Dwirahayu et al., 2018; Nurmala et al., 2018), and are crucial for solving complex mathematical problems (Tyaningsi et al., 2020). A meta-analysis by Alhamlan et al (2018) further confirms that habits of mind contribute to the development of Critical Thinking Ability. Thus, understanding and fostering these thinking habits is essential for students to effectively engage in critical thinking and improve their mathematical problem-solving skills.

In addition to habits of mind, individual differences, particularly cognitive styles, impact how students construct knowledge. Keefe (Oh & Lim, 2005) states that the different ways individuals process information are known as cognitive styles. These styles affect students' abilities to understand and manage information and solve mathematical problems (Pradiarti & Subanji, 2022). Cognitive style, which varies among individuals, serves as a stable indicator of how they perceive and interact with learning environments (Wolfe, 1995). According to Witkin et al (1977), cognitive styles are categorized as field dependent (FD) or field independent (FI). FD individuals rely on their environment and social context, while FI individuals are more independent and less influenced by external factors (Darmono, 2012).

Vol. 10, No. 3 : September 2024
E-ISSN: 2442-7667
pp. 1243-1254
Email: jklppm@undikma.ac.id

Consequently, FD students often need more external support to solve problems, whereas FI students are more self-reliant and less affected by external feedback.

Based on the explanation of the relationship between students' cognitive styles and their problem-solving process, the diverse characteristics of students cannot be generalized, so it is important to understand how they process, store, and communicate information in problem solving. This understanding ensures that students can use critical thinking skills to achieve better understanding in mathematics learning. The novelty of this study lies in the combined analysis of habits of mind and cognitive styles (field dependent and field independent) which simultaneously affect students' critical thinking skills in solving mathematics problems. By focusing on high school students in Sintang, this study provides a unique contribution in exploring the role of cognitive factors and thinking habits in the context of Indonesian education which has rarely been studied before.

Understanding the influence of habits of mind and cognitive styles on students' critical thinking skills is crucial. However, there is a lack of empirical evidence on this topic, particularly concerning high school students in Sintang Regency, West Kalimantan Province.. Therefore, the aim of this research is to determine how habits of mind and the cognitive styles of field-dependent and field-independent students affect the critical thinking abilities of high school students.

Research Method

The type of research used is mixed methods research, which is a procedure for collecting, analyzing, and combining both quantitative and qualitative methods within a single study or series of studies to understand a research problem (Creswell, 2012). The research design used is explanatory sequential with the model QUAN → QUAL. Explanatory sequential is a research design that involves collecting quantitative data first, followed by the collection of qualitative data to help explain or elaborate on the quantitative results (Creswell, 2012). The following are the steps in this research.

Table 1. Research Step

Step 1	**Design and Implementation of Quantitative Research** 1. Develop research instruments, including a critical thinking skills test and a habits of mind questionnaire. 2. Validate and test the reliability of the instruments. 3. Obtain research permission. 4. Collect data (administer tests and distribute questionnaires). 5. Analyze quantitative data.
Step 2	**Design and Implementation of Qualitative Research** 1. Prepare an interview question list. 2. Identify research informants (based on test results and questionnaire outcomes). 3. Conduct interviews. 4. Analyze qualitative data.
Step 3	**Data Interpretation** 1. Interpret the quantitative research data. 2. Interpret the qualitative research data. 3. Discuss how well the qualitative data supports the quantitative data.

The population for this research consists of all 11th-grade high school students in Sintang Regency, West Kalimantan Province, for the 2023/2024 academic year, totaling 3265 students. The sampling technique used in this study is stratified proportional random sampling, which combines proportional sampling with stratified sampling before applying random sampling (Creswell, 2012). Getting a proportionate sample from each stratum is the

aim of this sampling strategy. Based on their accreditation, schools are categorized into three strata: high, medium, and low strata are represented by schools with accreditations A, B, and C, respectively. School accreditation was selected as the basis for the strata in this study due to its easy accessibility and availability of data, which the researcher could obtain with ease. Furthermore, grouping schools according to assessments carried out by official agencies using the same evaluation standards for every school circumvents researcher bias in school grouping by providing uniformity and a standard. Through the sampling steps, the sample for this research consists of 385 students from 13 high schools in Sintang Regency.

Table 2. Research Sample

Strata	School Name	Research Sample
A	SMA Negeri 1 Sintang	35
	SMA Negeri 3 Sintang	36
	SMA Negeri 4 Sintang	30
	SMA Swasta Panca Setya Sintang	30
	SMA Muhammadiyah Sintang	20
	SMA Negeri 1 Kelam Permai	34
B	SMA Nusantara Indah	28
	SMA Joseph Khatulistiwa	20
	SMA Negeri 1 Tebelian	36
	SMA Negeri 1 Binjai Hulu	30
	SMA Negeri 2 Kelam Permai	25
	SMA Swasta Sinar Kasih	25
C	SMA Negeri 2 Dedai	36
Total		**385**

In addition, data sources, also known as informants, are participants in the quantitative study chosen through purposive sampling. The selection of informants is based on specific considerations and criteria determined by the researcher, including: 1) having completed the critical thinking skills test, filled out the habits of mind questionnaire, and finished the GEFT; 2) being students from various strata, with each habits of mind criterion represented by two students-one exhibiting a field-dependent cognitive style and the other a field-independent cognitive style. This study employs three instruments for quantitative data collection: a critical thinking ability test, a habits of mind questionnaire, and the GEFT. These instruments have undergone content validation through expert consideration and the use of expert agreement indices recommended by Gregory (Retnawati, 2016).

Table 3. Expert Agreement Index Results

Instrumeni	Index	Category
Critical Thinking Ability Test	1.0	High
Habits of Mind Questionnaire	0.84	High

This research also performs Confirmatory Factor Analysis (CFA) to test the construct validity of an instrument. The indices used to determine model fit are an RMSEA value of less than 0.08 and a probability greater than 0.05 (Retnawati, 2017). The instrument to be validated for construct validity is the habits of mind questionnaire.

Table 4. Model Fit Index Result

Index	Result	Category
RMSEA	0.06	Fit
P-Value	0.09168	Fit

A test is considered reliable if the observed test scores are highly correlated with the true scores (Allen & Yen, 1979). This means that the instrument is deemed reliable if its measurements are close to what is actually happening. However, obtaining pure scores in a

measurement is very difficult, so the reliability of an instrument can only be estimated. Reliability estimation is obtained using Cronbach's alpha (Allen & Yen, 1979), with the criterion for an instrument to be considered reliable if the estimate is at least 0.65. The estimated reliability for the critical thinking skills test is 0.96 (>0.65) and for the habits of mind questionnaire is 0.85 (>0.65), indicating that both instruments are reliable.

For qualitative data collection, this study employs semi-structured interviews, which are guided by predefined topics and questions but allow flexibility in wording and sequence for each informant (Harahap, 2020). These interviews aim to explore how informants approach and solve critical thinking test questions, providing insight into their critical thinking skills based on habits of mind and cognitive styles. To ensure the data's validity, the study applies triangulation, specifically technique or multiple method triangulation, which involves validating data from the same source using different techniques, such as critical thinking tests and interviews (Harahap, 2020).

Quantitative data analysis employs both descriptive and inferential statistics. Descriptive statistics categorize students according to their critical thinking skills, mental habits, and cognitive styles. Inferential statistics utilize multiple linear regression to examine the relationships and effects between critical thinking skills, mental habits, and cognitive styles. For qualitative data, the study uses the interactive model by Miles & Huberman (Miles et al., 2014), which consists of three analytical stages: data reduction, data presentation, and conclusion drawing/verification.

Results and Discussion

The study involved 385 students as samples. Then to measure students' critical thinking skills, the researcher used a test consisting of five descriptive questions containing indicators of critical thinking skills. Questions 1 and 2 contain indicators of critical thinking skills with cognitive level C4, questions 3 and 4 contain indicators of critical thinking skills with cognitive level C5, and question 5 contains indicators of critical thinking skills with cognitive level C6. In general, the average critical thinking skills of high school students in Sintang Regency are 67.92 with a moderate category. While the percentage distribution shows that the critical thinking skills of high school students are generally dominated by students with a low category (31.16%). The description of the data on the results of the students' critical thinking skills test in general is presented in the following table.

Table 5. Description of Students' Critical Thinking Abilities in General

Description	Score
Number of Respondents	385
Highest Ideal Value	100
Highest Value	93.3
Lowest Ideal Value	0
Lowest Value	35.0
Average	67.92
Standard Deviation	10.79

Although the overall critical thinking ability of high school students in Sintang Regency is moderate, significant differences emerge based on school accreditation levels. Students from schools with higher accreditation levels demonstrate better critical thinking skills, with top scores and averages coming from high-level schools, followed by medium-level and lower-level schools. High-level schools, accredited with an A rating, meet national quality standards and contribute to this higher performance. The National Education Standards regulated in *Government Regulation of the Republic of Indonesia Number 57 of 2021 concerning National*

Education Standards (2021) cover various aspects, including adequate facilities, a structured curriculum, and the quality and professionalism of teachers. Accreditation A indicates that the school has met various strict assessment indicators, including the effectiveness of learning carried out by teachers. The better the scores and accreditation obtained by a school, the better its quality (Khotimah et al., 2021). Thus, higher school accreditation and more effective teaching and learning processes in high-level schools provide a more conducive environment for the development of students' critical thinking skills. Based on the interview results, several things were found as follows:

1) High Strata (A): Students in the high stratum (A) generally excel in problem formulation and drawing conclusions, particularly those with very high (HoMST) or high (HoMT) habits of mind. However, those with moderate (HoMS) or low (HoMR) habits of mind struggle more with questions at cognitive levels C5 and C6.
2) Medium Strata (B): Students in the medium stratum show a pattern similar to the high stratum, but with more limitations, especially in terms of diverse practice questions. They also tend to have difficulty with more complex questions (C5 and C6).
3) Low Strata (C): Students in the low stratum generally show greater difficulties in all aspects, especially in understanding and solving questions with higher cognitive levels (C5 and C6).

To assess habits of mind, this study used a non-test instrument: a 32-statement questionnaire with 16 positive and 16 negative items, rated on a Likert scale from 1 to 4. The average score for high school students in Sintang Regency was 89.97, indicating generally high habits of mind, with 47.02% of students falling into the high category and none in the very low category. Analysis by school strata showed that students in high and medium strata had high habits of mind, with average scores of 90.77 and 90.70, respectively, while students in the low strata had medium habits of mind with an average score of 82.64. The description of the general habits of mind questionnaire data is presented in the following table.

Table 6. Description of Students' Habits of Mind in General

Description	Score
Number of Respondents	385
Highest Ideal Value	128
Highest Value	117
Lowest Ideal Value	32
Lowest Value	57
Average	89,97
Standard Deviation	10,33

To classify students' cognitive styles, the GEFT was used, which includes 25 questions divided into three sections: 7 practice questions and 9 questions each in the second and third sections. The results revealed that 79.48% of high school students in Sintang Regency are field dependent, with 306 out of 385 students showing this style. The remaining 20.52% are field independent. Across different school strata, field dependence is prevalent: 138 students in high strata, 139 in medium strata, and 29 in low strata, while field-independent students number 46 in high strata, 26 in medium strata, and 7 in low strata.

The hypothesis of this study is that "habits of mind and cognitive style affect students' critical thinking skills," which is tested using multiple linear regression. Assumption tests are crucial for this analysis, including the residual normality test, heteroscedasticity test, and multicollinearity test. The results indicate that the residuals are approximately normally distributed with a p-value of 0.079 (> 0.05), no heteroscedasticity is present with a p-value of 0.7966 (> 0.05), and no multicollinearity is detected, as all VIF values are below 10 and

Jurnal Kependidikan:
Jurnal Hasil Penelitian dan Kajian Kepustakaan di Bidang Pendidikan, Pengajaran dan Pembelajaran
https://e-journal.undikma.ac.id/index.php/jurnalkependidikan/index
Vol. 10, No. 3 : September 2024
E-ISSN: 2442-7667
pp. 1243-1254
Email: jklppm@undikma.ac.id

tolerance values exceed 0.1. With these assumptions met, a multiple linear regression test will be conducted to address the hypothesis.

Table 7. Multiple Linear Regression Test

Coefficients			
Variabel	**Estimate**	**Std. Error**	**p-value**
(Intercept)	52,704	1,997	< 0,000
Very High HoM	28,033	3,354	0,000
High HoM	17,389	2,180	0,000
Medium HoM	9,853	2,136	0,000
GK FI	3,400	1,365	0,013

In multiple linear regression involving categorical variables, one level of each categorical variable is selected as the reference or baseline category. This reference level is not explicitly included in the model because the coefficient for the reference level is assumed to be zero, and all other levels are interpreted as a comparison to that reference level. This process is usually called the formation of dummy variables (Matloff, 2017). In this study, "low HoM" and "GK FD" (field dependent) act as reference categories for each categorical variable. Therefore, these two variables do not have coefficients in the model because all coefficients for other levels are measured relative to this reference level.

Based on Table 7, it is observed that students with "very high" habits of mind score significantly higher on average compared to those with "low" habits of mind, with results being highly statistically significant. Similarly, students with "high" and "medium" habits of mind also score notably higher than those with "low" habits of mind, and these results are statistically significant as well. Additionally, students with a "field independent" cognitive style achieve higher scores compared to those with a "field dependent" style, with this finding also being statistically significant. The multiple linear regression equation in this study can be written as $Y = 52,704 + 28,033X_1 + 17,389X_2 + 9,853X_3 + 3,400X_4$.

Description:
Y = Critical thinking ability
X_1 = Very high habits of mind
X_2 = High habits of mind
X_3 = Medium habits of mind
X_4 = Field independent cognitive style

In addition, the test results also show a p-value of 2.2e-16 which is smaller than 0.05. Therefore, it can be said that habits of mind and cognitive style simultaneously have a significant influence on critical thinking skills. The coefficient of determination (Adjusted R-squared) shows a value of 0.2843, which means that habits of mind and cognitive style together have the power to explain critical thinking skills of 28.43%.

From the results of the research analysis, it is also known that students with very high habits of mind criteria have the highest average critical thinking skills compared to students with other habits of mind criteria. The results of this study are in line with research conducted by Hafni et al (2019) which shows that habits of mind have a positive effect on mathematical critical thinking skills of around 50%. In addition, there are also research results from Alhamlan et al (2018) which explore the formation of habits of mind to improve students' thinking in class through a systematic review with meta-analysis, and confirm that habits of mind are related to the development of critical thinking skills, although the effects vary from one habit to another and require in-depth investigation for various disciplines. Based on the interview results, differences in critical thinking skills are observed among students with varying levels of habits of mind:

1) Very High Habits of Mind (HoMST): Students with very high habits of mind generally perform best in all areas but may have minor issues, particularly in accurately reading questions if they have a field dependent (FD) cognitive style.
2) High Habits of Mind (HoMT): These students perform well but start to struggle with more complex questions and may make calculation errors (FI) or misread questions (FD).
3) Medium and Low Habits of Mind (HoMS and HoMR): Students with medium or low habits of mind showed weaker performance overall, with many difficulties in validating information, solving problems, and making conclusions, especially on high-cognitive questions.

According to Costa & Kallick (2000), habits of mind are cognitive tendencies used when confronting problems with no immediate solutions. These habits encompass skills such as critical, creative, and independent thinking (Marzano et al., 1997). This study shows that students with strong habits of mind generally excel in critical thinking. Additionally, these habits aid students in constructing knowledge, aligning with Piaget's theory that knowledge is built through assimilation and accommodation (Ginsburg & Opper, 2016). Habits of mind, including reflection and metacognition, help students assess their thinking and learning processes, which is essential for refining their understanding. They also encourage active exploration and discovery, facilitating the integration of new information. Overall, the study supports existing research and theories that developing habits of mind, especially in fields like mathematics, enhances critical thinking skills.

The study reveals that field independent students generally exhibit higher critical thinking abilities than field dependent students, aligning with findings from (Agoestanti et al (2017) and Arigawati & Kusnandi (2023). This difference can be attributed to the characteristics of field independent cognitive styles, as described by Witkin et al (1977), which include analytical thinking, independence, and intrinsic motivation, all of which enhance their ability to critically evaluate information, make accurate inferences, and assess arguments. Additionally, cognitive styles influence preferences in information processing and learning strategies, leading to varied learning outcomes (Zhang & Tian, 2019). Interviews further highlight these differences in critical thinking skills between field dependent and field independent students.

1) Field Dependent (FD): Students with a field dependent (FD) cognitive style often struggle with accuracy and validating information, and find complex or lengthy questions challenging. They are also more prone to errors in reading questions.
2) Field Independent (FI): Students with a field independent (FI) cognitive style excel at validating information and drawing conclusions but may occasionally make calculation errors or solve problems without reaching a final answer.

The study, along with previous research and theories, highlights that cognitive style significantly impacts students' critical thinking skills. Understanding cognitive styles better is crucial. The findings indicate that students with very high or high habits of mind and a field-independent cognitive style exhibit the strongest critical thinking skills, excelling in validating information, solving problems, and drawing conclusions. In contrast, students with low habits of mind and a field-dependent cognitive style demonstrate weaker critical thinking skills, struggling with complex questions and showing lower accuracy.

Habits of mind involve the approaches individuals use to tackle problems and challenges. Students with strong habits of mind are typically more thorough and analytical, enhancing their critical thinking skills. According to Dwirahayu et al (2018), improving these habits fosters a more adaptive and reflective mindset, aiding in overcoming academic challenges. This indicates that habits of mind not only aid in mathematical understanding but

also bolster critical thinking across various complex problems. Supporting literature also shows that cognitive style significantly affects how students approach tasks and problem-solving. Arigawati & Kusnandi (2023) found that students' critical thinking skills are closely linked to their cognitive style, particularly in algebra. In this study, students with a field-independent cognitive style and very high habits of mind exhibit superior critical thinking abilities. This is likely because a field-independent style promotes independence in thinking and problem-solving, crucial for grasping complex mathematical concepts. Conversely, students with field-dependent styles and low habits of mind tend to have weaker critical thinking skills, as they rely more on external support and guidance, which limits their development of independent critical thinking.

Atabaki et al (2015) argue that critical thinking skills can be developed through direct instruction, philosophical and psychological approaches, social and communication skills, a supportive educational environment, and relevant knowledge and experience. Habits of mind like persistence, applying knowledge in new contexts, and metacognitive thinking are crucial in this process. Integrating these habits into teaching can enhance students' critical thinking by presenting challenging situations and promoting self-reflection. Additionally, cognitive styles, such as field dependent and field independent, influence how students process information and solve problems. Effective critical thinking requires skills in interpretation, analysis, inference, and explanation, which vary based on cognitive style. Thus, combining habits of mind with cognitive styles in teaching strategies can significantly boost students' critical thinking skills, supporting the hypothesis that these factors impact high school students' critical thinking abilities in Sintang Regency.

Conclusion

Based on the results of the research and discussion, it can be concluded that the critical thinking ability of high school students in grade XI in Sintang Regency is in the moderate category with an average of 67.92 and a standard deviation of 10.79. In addition, based on the results of the multiple linear regression test, it was written $Y = 52.704 + 28.033X_1 + 17.389X_2 + 9.853X_3 + 3.400X_4$. The p-value of 0.000 is smaller than 0.05 with a determinant coefficient value of 0.2843, based on the decision criteria, the hypothesis is accepted. Thus, habits of mind and cognitive style together have the power to explain critical thinking ability by 28.34%. The results of this study have important implications in education, especially in developing students' critical thinking skills. Theoretically, this study strengthens the relationship between habits of mind and cognitive styles with critical thinking skills. Practically, teachers can adjust teaching strategies based on students' cognitive styles and encourage the development of habits of mind through more reflective and contextual learning. Educators and policymakers can also design curricula and teacher training programs that focus on improving critical thinking, while education policies can better support critical skills-based learning and more comprehensive assessments.

Recommendation

Based on the research findings, it is suggested that mathematics teachers create varied learning designs tailored to different mathematical content and cognitive levels to enhance students' critical thinking skills. Teachers should consider students' cognitive styles and habits of mind, as these factors influence critical thinking. Field-dependent students might benefit from additional examples and contextual explanations, while field-independent students could be encouraged to work more independently and analytically. Students should also cultivate habits of mind such as reflective thinking, thoroughness, and perseverance to

better handle mathematical challenges. Additionally, further research should investigate how specific habits of mind affect critical thinking across various subjects and explore the development of teaching materials and strategies that cater to different cognitive styles to improve students' critical thinking abilities.

References

Agoestanti, A., Sukestiyarno, Y. L., & Rochmad. (2017). Analysis of Mathematics Critical Thinking Students in Junior High School Based on Cognitive Style Analysis of Mathematics Critical Thinking Students in Junior High School Based on Cognitive Style. *Journal of Physics: Conference Series*. https://doi.org/10.1088/1742-6596/755/1/011001

Alhamlan, S., Aljasser, H., Almajed, A., Almansour, H., & Alahmad, N. (2018). A Systematic Review : Using Habits of Mind to Improve Student ‟ s thinking in Class. *Higher Education Studies*, *8*(1), 25–35. https://doi.org/10.5539/hes.v8n1p25

Allen, M. J., & Yen, W. M. (1979). Introduction to Measurement Theory. In *Handbook of Complementary Methods in Education Research*. Wadsworth, Inc. https://doi.org/10.4324/9780203874769-27

Antasari, M., Hanifah, Susanta, A., & Andriani, I. (2023). Penerapan Pendekatan Realistic Mathematics Education Melalui Model APOS Berbantuan Geogebra Untuk Meningkatkan Hasil Belajar Matematika. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *12*(2), 2468–2478.

Arigawati, N. H., & Kusnandi. (2023). Berpikir Kritis Siswa Ditinjau dari Gender dan Gaya Kognitif Field Dependent dan Field Independent. *JIIP (Jurnal Ilmiah Ilmu Pendidikan)*, *6*(8), 6125–6133.

Atabaki, A. M. S., Keshtiaray, N., & Yarmohammadian, M. H. (2015). Scrutiny of Critical Thinking Concept. *International Education Studies*, *8*(3), 93–102. https://doi.org/10.5539/ies.v8n3p93

Chukwuyenum, A. N. (2013). Impact of Critical thinking on Performance in Mathematics among Senior Secondary School Students in Lagos State. *Journal of Research & Method in Education*, *3*(5), 18–25.

Costa, A. L., & Kallick, B. (2000). *Habits of mind*. Alexandria, VA: Association for Supervision and Curriculum Development. https://doi.org/10.1016/j.cursur.2003.09.009

Costa, A. L., & Kallick, B. (2008). *Learning and Leading with Habits of Mind, 16 Essential Characteristics for Success*. Alexandria, VA: Association for Supervision and Curriculum Development.

Creswell, J. W. (2012). *Educational Research: Planning, Conducting, and Evaluating Quantitative and Qualitative Research* (Fourth Edi). Pearson.

Darmono, A. (2012). Identifikasi Gaya KOgnitif (Cognitive style) Peserta Didik dalam Belajar. *Jurnal Studi Islam Dan Sosial*, *3*(1). https://doi.org/https://doi.org/10.56997/almabsut.v3i1.39

Dwirahayu, G., Kustiawati, D., & Bidari, I. (2018). Pengaruh Habits of Mind Terhadap Kemampuan Generalisasi Matematis. *Jurnal Penelitian Dan Pembelajaran Matematika*, *11*(2). https://doi.org/10.30870/jppm.v11i2.3757

Ennis, R. H. (2011). The Nature of Critical Thinking: An Outline of Critical Thinking Dispositions and Abilities. *University of Illinois*. https://doi.org/10.22329/il.v6i2.2729

Ginsburg, H. P., & Opper, S. (2016). *Piaget's Theory of Intellectual Development* (3rd Ed). International Psychotherapy Institute.

Hafni, R. N., Sari, D. M., & Nurlaelah, E. (2019). Analyzing theeffect of students ' habits of mind to mathematical critical thinking skill. *Journal of Physics: Conference Series. Series*, *1211*(012074). https://doi.org/10.1088/1742-6596/1211/1/012074

Handayani, A. D., Herman, T., Fatimah, S., Setyowidodo, I., & Katminingsih, Y. (2018). Inquiry based learning: A student centered learning to develop mathematical habits of mind. *Journal of Physics: Conference Series*, *1013*(1). https://doi.org/10.1088/1742-6596/1013/1/012115

Harahap, N. (2020). *Penelitian Kualitatif* (H. Sazali (Ed.)). Wal Ashri Publishing.

Haryani, D. (2011). Pembelajaran Matematika dengan pemecahan masalah untuk menumbuhkembangkan kemampuan berpikir kritis siswa. *Prosiding Seminar Nasional Penelitian, Pendidikan Dan Penerapan MIPA, Fakultas MIPA, Universitas Negeri Yogyakarta*, 121–126.

Heong, Y. M., Othman, W. B., Yunos, J. B. M., Kiong, T. T., Hassan, R. Bin, & Mohamad, M. B. (2011). The Level of Marzano Higher Order Thinking Skills among Technical Education Students. *International Journal of Social Science and Humanity*, *1*(2), 121–125.

Imanisa, N., & Effendi, K. N. S. (2023). Kemampuan Komunikasi Matematis Siswa SMP Pada Materi Segitiga. *Jurnal Pembelajaran Matematika Inovatif*, *6*(2), 773–784. https://doi.org/10.22460/jpmi.v6i2.16010

Kemdikbud. (2023). Rapor Pendidikan Indonesia Tahun 2023. *Merdeka Belajar*, 2023. https://raporpendidikan.kemdikbud.go.id/login

Khotimah, H., Harapan, E., & Kesumawati, N. (2021). Kualitas Guru Mengajar Sebagai Salah Satu Upaya Meningkatkan Status Akreditasi Sekolah. *JMKSP: Jurnal Manajemen, Kepemimpinan, Dan Supervisi Pendidikan*, *6*(1), 124–131.

Marzano, R. J., Pickering, D. J., Arredondo, D., Blackburn, G. J., Brandt, R. S., Moffett, C., Paynter, D. E., Pollock, J. E., & Whisler, J. S. (1997). *Dimensions of Learning: Teacher's Manual* (B. B. Gaddy (Ed.); 2nd Editio). ASCD: Alexandria, Virginia USA.

Matloff, N. (2017). Statistical Regression and Classification From Linear Models to Machine Learning. In *Chapman & Hall/CRC*. Chapman & Hall/CRC. https://doi.org/10.1201/9781315119588

Miles, M. B., Huberman, M. A., & Saldana, J. (2014). *Qualitative Data Analysis, A Methods Sourcebook* (3rd Editio, Issue 112). Arizona State University, SAGE.

Nurdiansyah, S., Sundayana, R., & Sritresna, T. (2021). Kemampuan Berpikir Kritis Matematis serta Habits Of Mind Menggunakan Model Inquiry Learning dan Model Creative Problem Solving Mathematic Critical Thinking Ability And Habits Of Mind Using Inquiry Learning Model And Creative Problem Solving Model Abstract. *Mosharafa*, *10*(1), 95–106. http://journal.institutpendidikan.ac.id/index.php/mosharafa

Nurhikmayati, I., & Gilar, M. (2019). Pengembangan Bahan Ajar Matematika Berbasis Scientific yang Berorientasi pada Kemampuan Berpikir Kritis Matematis Siswa. *Mosharafa : Jurnal Pendidikan Matematika*, *8*(1).

Nurmala, N., Rohaeti, E. E., & Sariningsih, R. (2018). Pengaruh Habits of Mind (Kebiasaan Berpikir) Terhadap Pemecahan Masalah Matematik Siswa Smp. *Journal on Education*, *1*(2), 163–168. https://www.jonedu.org/index.php/joe/article/view/41

Oh, E., & Lim, D. (2005). Cross relationships between cognitive styles and learner variables in online learning environment. *Journal of Interactive Online Learning*, *4*(1), 53–66.

Peraturan Pemerintah Republik Indonesia Nomor 57 Tahun 2021 Tentang Standar Nasional Pendidikan. (2021).

Peter, E. E. (2012). Critical thinking: Essence for teaching mathematics and mathematics problem solving skills. *African Journal of Mathematics and Computer Science Research*, *5*(3), 39–43. https://doi.org/10.5897/ajmcsr11.161

Pradiarti, R. A., & Subanji. (2022). Kemampuan Pemecahan Masalah Matematis Siswa SMP ditinjau dari Gaya Kognitif. *Mosharafa : Jurnal Pendidikan Matematika*, *11*(3), 379–390.

Prajono, R., Gunarti, D. Y., & Anggo, M. (2022). Analisis Kemampuan Berpikir Kritis Matematis Peserta Didik SMP Ditinjau dari Self Efficacy. *Mosharafa: Jurnal Pendidikan Matematika*, *11*(1), 143–154.

Retnawati, H. (2016). *Analisis Kuantitatif Instrumen Penelitian*. Parama Publishing.

Retnawati, H. (2017). Analisis Jalur, Analisis Faktor Konfirmatori dan Pemodelan Persamaan Struktural. *Workshop Teknik Analisis Data Fakultas Ekonomi Dan Bisnis IAIN Batusangkar*.

Siswono, T. Y. E. (2016). Berpikir Kritis dan Berpikir Kreatif sebagai Fokus Pembelajaran Matematika. *Seminar Nasional Matematika Dan Pendidikan Matematika*, 11–26.

Sumartini, T. S. (2022). Pengaruh Habit of Mind terhadap Kemampuan Berpikir Kreatif Matematis melalui Metode Pembelajaran Improve. *Mosharafa: Jurnal Pendidikan Matematika*, *11*(1), 167–178. https://doi.org/10.31980/mosharafa.v11i1.1253

Tyaningsi, R. Y., Triutami, T. W., Novitasari, D., Wulandari, N. P., & Cholily, Y. M. (2020). The Relationship Between Habits of Mind and Metacognition In Solving Real Analysis Problems. *Journal of Physics: Conference Series*. https://doi.org/10.1088/1742-6596/1663/1/012053

Witkin, H. A., Moore, C. A., Goodenough, D., & Cox, P. W. (1977). Field-Dependent and Field-Independent Cognitive Styles and Their Educational Implications. *Review of Educational Research*, *47*(1), 1–64. https://doi.org/10.3102/00346543047001001

Wolfe, R. N. (1995). Personality As A Predictor Of College Performance. *Educational and Psychological Measurement*, *55*(2), 177–185. https://doi.org/https://doi.org/10.1177/0013164495055002002

Zhang, J., & Tian, Y. (2019). The Influence of Field Independent-Dependent Cognitive Styles on Students ' Learning Performance under Different Teaching Modes. *ICIET 2019: Proceedings of the 2019 7th International Conference on Information and Education Technology*, 230–237.