A Systematic Literature Review: The Improvement of Students' Cognitive Styles on Mathematical Literacy

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Abstract

This study aims to describe the improvement of mathematical literacy in terms of students' cognitive styles. The research method used is a Systematic Literature Review (SLR) which includes 3 stages: planning, conducting, and reporting. The data collection process is carried out by identifying articles relevant to the research topic based on predetermined criteria. This study reviewed 17 articles based on search results through the Publish or Perish application. Data synthesis in this study is then presented in data tabulation and strengthened with narrative form. The results of this study indicate that the improvement of mathematical literacy at the elementary, junior high school, and senior high school levels is influenced by students' cognitive styles. Based on the results of the analysis of the achievement of students' mathematical literacy indicators, it can be concluded that Field Independent (FI) students are better than Field Dependent (FD) students, Reflective (RE) students are better than Impulsive (IM) students, while Verbalizer (VER) and Visualizer (VIS) students have different ways of solving problems so they cannot be compared.

Keywords: SLR; mathematical literacy; cognitive styles.

1. Introduction

Terms related to mathematical thinking include mathematical thinking ability, mathematical thinking skills, mathematical processes, and mathematical tasks. (Sumarmo in Amalia, 2016).

Mathematical thinking ability is a form of accumulation of mathematical thinking concepts that indicate the development of abilities: 1) mathematical understanding; 2) mathematical problem solving; 3) mathematical reasoning; 4) mathematical connections; and 5) mathematical communication. (Fajri, 2017). Shidqiya & Sukestiyarno (2022) formulated new mathematical thinking competencies that students must master, namely: 1) Reasoning: identifying concepts and problems; 2) Generalization: demonstrating mathematical ideas in writing and using mathematical language to express ideas correctly; 3) Critical thinking: using representations to create mathematical models; 4) Problem solving: planning problem-solving strategies, implementing strategies and checking results; and 5) Communication: expressing problem-solving results—other mathematical thinking abilities according to OECD (2022) namely mathematical literacy and numeracy. Literacy and numeracy are the ability to apply number concepts and related arithmetic operations skills in everyday life, as well as the ability to interpret quantitative information around us (Han et al., 2017).

Based on the previously identified mathematical thinking competencies, this study focuses solely on examining students' mathematical literacy from three different cognitive styles to determine their influence on improving

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mathematical thinking abilities. These cognitive styles include: 1) Field Independent – Field Dependent; 2) Reflective – Impulsive; and 3) Visualizer – Verbalizer.

Based on the above explanation, a systematic study is needed to provide an overview of the improvement in students' mathematical literacy from a cognitive style perspective. This research was conducted by systematically and in detail reviewing the literature using the Systematic Literature Review (SLR) method. The research questions are as follows:

1) What is the trend in improving students' mathematical literacy from a cognitive style perspective over the past eight years?
2) How does cognitive style influence the improvement in students' mathematical literacy?

The researcher reviewed relevant literature in relation to the research objective, which was to describe research findings on improving students' mathematical literacy from a cognitive style perspective. This study is expected to serve as a reference for further research, providing a more comprehensive understanding of efforts to improve students' mathematical literacy.

2. Methodology

The method used in this research is a Systematic Literature Review (SLR). SLR is a research method that reviews a specific topic, emphasizing a single question that has been systematically identified, assessed, selected, and concluded based on predetermined criteria, using evidence from high-quality research relevant to the problem formulation. (Latifah & Ritonga, 2020). There are three stages in SLR, which include planning, conducting, and reporting (Wibowo & Putri, 2021).

The initial stage was planning. The researcher identified a research topic that focused on improving students' mathematical literacy from a cognitive style perspective. The researcher established article search criteria form the keyword collection.

The next stage was conducting. The researcher began searching for articles that met the criteria. The search was performed using the Publish or Perish software from 2018 to 2025. This stage yielded 51 articles on the topic of students' mathematical literacy from a cognitive style perspective.

Furthermore, the inclusion criteria applied in this study include: 1) articles from national journals accredited by SINTA or international journals; 2) articles published in 2018-2025; 3) research subjects are elementary, junior high school, and senior high school levels; 4) articles reviewed from the cognitive style of Field Independent – Field Dependent or Reflective – Impulsive or Visualizer – Verbalizer. While the exclusion criteria are: 1) repository journals, proceedings, or national journals that SINTA does not index; 2) research subjects are college students or prospective teachers; 3) articles reviewed from other than the cognitive style of Field Independent – Field Dependent or Reflective – Impulsive or Visualizer – Verbalizer; 4) students' mathematical literacy reviewed from only one cognitive style so that there is no comparison.

After selecting articles based on inclusion and exclusion criteria, 17 articles on the topic of students' mathematical literacy were reviewed from a cognitive perspective. Following the selection process, the researchers conducted data synthesis to analyze and evaluate the research findings from the various articles. The data synthesis was then presented in a data tabulation and supported by a narrative format.

The final stage is reporting. At this stage, researchers summarize the results of the analysis and data synthesis evaluation in written form, using a predetermined format. The compilation of the analysis results leads to the formulation of the problem.

3. Results and Discussion

The research results, based on the SLR method, examined mathematical literacy and cognitive style by identifying several significant findings. Researchers analyzed 18 accredited articles published between 2018 and 2025, discussing the research topics of mathematics students from the perspectives of field-independent and field-dependent, reflective and impulsive, and verbalizer and visualizer cognitive styles. The titles of the articles analyzed in this study are presented in Table 1.1 below:

Table 1.1 Title of Analysis Article

Authors	Article Title
Sutama et al. (2023)	The Ability of Mathematical Literacy in Elementary School Students Based on Cognitive Style
(Rasyidah & Khatimah, 2024)	Analysis of Mathematical Literacy Abilities on Cognitive Styles in the Era of Independent Learning Implementation
(Pratiwi et al., 2020)	Level Literasi Matematika Siswa dalam Menyelesaikan Soal PISA Konten Change and Relationship Ditinjau dari Gaya Kognitif Field Dependent dan Field Independent
(Safitri & Khotimah, 2023)	Kemampuan Literasi Matematika Peserta Didik dalam Menyelesaikan Soal PISA Konten Space and Shape Ditinjau dari Gaya Kognitif

(Yazidah & Saputra, 2023)	Profil Kemampuan Literasi Matematika Siswa Berdasarkan Gaya Kognitif
(Rofi'i et al., 2023)	Literasi Matematika Siswa Gaya Kognitif Field Dependent dan Field Independent dalam Menyelesaikan Soal Trigonometri
(Rahmawati & Setyaningsih, 2025)	Analisis Kemampuan Literasi Matematis Siswa dalam Menyelesaikan Soal AKM Materi Statistika Ditinjau dari Gaya Kognitif
(Muthofin & Budiman, 2024)	Analisis Kemampuan Literasi Matematika Ditinjau dari Gaya Kognitif Siswa
(Qolbiyah & Sari, 2024)	Analisis Literasi Matematis Siswa SMP dalam Menyelesaikan Soal Aljabar Berorientasi AKM Numerasi Ditinjau dari Gaya Kognitif
(Siddiq et al., 2021)	Profil Kemampuan Literasi Matematika Siswa Berdasarkan Gaya Kognitif dan Gender
(Hammada et al., 2024)	Analisis Kemampuan Literasi Matematis Siswa SMA Kelas XI Ditinjau Dari Gaya Kognitif Reflektif dan Impulsif
(Ainiah et al., 2023)	Analisis Kemampuan Literasi Matematika dalam Menyelesaikan Masalah Trigonometri Ditinjau dari Gaya Kognitif
(Sholihah et al., 2024)	Kemampuan Literasi Matematika Siswa Kelas VIII Ditinjau dari Gaya Kognitif
(Putri & Novaliyosi, 2024)	Analisis Kemampuan Literasi Matematis Siswa dalam Menyelesaikan Soal AKM Ditinjau dari Gaya Kognitif Reflektif Implusif
(Yusmarina et al., 2023)	Literasi Matematis Siswa Bergaya Kognitif Impulsif dalam Menyelesaikan Masalah Model Pisa Ditinjau dari Gender
(Sari & Manoy, 2018)	Literasi Matematika Siswa SMA Kelas X dalam Menyelesaikan Soal Programme for International Student Assessment (PISA) Ditinjau dari Gaya Kognitif Visualizer Dan Verbalizer
(Azka & Budiman, 2023)	Analisis Literasi Matematis PISA Kelas IX SMP Al Mubarok Ditinjau dari Gaya Kognitif Visualizer dan Verbalizer

Indicators tested in the study by Sutama et al. (2023) include: 1) remembering (C1); 2) understanding (C2); 3) applying (C3); 4) analyzing (C4); 5) evaluating (C5); 6) creating (C6).

Indicators tested in the study by Rasyidah & Khatimah (2024) include: 1) Describing known and asked information; 2) Describing the steps for solving; 3) Describing the answers and conclusions.

Indicators tested in the study by Pratiwi et al. (2020), Muthofin & Budiman (2024), dan Siddiq et al. (2021) includes: 1) answering questions in a general context; 2) interpreting and recognizing situations in context; 3) carrying out procedures clearly; 4) operating with specific methods effectively; 5) developing and working with models; 6) conceptualizing, generalizing and using information.

Indicators tested in the study by Safitri & Khotimah (2023), Rahmawati & Setyaningsih (2025), Qolbiyah & Sari (2024) meliputi: 1) communication; 2) mathematization; 3) devising strategies for solving problems; 4) Reasoning and argument; 5) Using symbolic, formal technical language and operation; 6) Representation.

Indicators tested in the study by Yazidah & Saputra (2023) and Sholihah et al. (2024) include 1) writing down relevant information and developing a solution strategy; 2) using a solution strategy; 3) implementing the solution stages and interpreting the situation; 4) connecting the results obtained with real situations.

Indicators tested in the study by Rofi'i et al. (2023), Ainiah et al. (2023), Sari & Manoy (2018), and Azka & Budiman (2023) include: 1) Formulate; 2) employ; 3) interpret.

Indicators tested in the study by Yusmarina et al. (2023) include 1) identifying problems; 2) explaining mathematical models; 3) designing and implementing problem-solving strategies.

The results of the analysis of students' achievement of mathematical literacy indicators in terms of Field Independent and Field Dependent cognitive styles are presented in Table 1.2 below:

Table 1.2 Achievement of Indicators of FI and FD Cognitive Styles

Authors (Year)	**Analysis Results**	
	FI	**FD**
Sutama et al. (2023)	4 indicators	2 indicators
(Rasyidah & Khatimah, 2024)	2 indicators	0 indicators
(Pratiwi et al., 2020)	level 5	level 2
(Safitri & Khotimah, 2023)	4 indicators	2 indicators
(Yazidah & Saputra, 2023)	4 indicators	3 indicators
(Rofi'i et al., 2023)	3 indicators	1 indicators
(Rahmawati & Setyaningsih, 2025)	6 indicators	3 indicators
(Muthofin & Budiman, 2024)	6 indicators	6 indicators
(Qolbiyah & Sari, 2024)	5 indicators	less 5 indicators
(Siddiq et al., 2021)	male 4 level fem 4 level	male 3 level fem 3 level

Based on the analysis of achievement indicators, it can be concluded that Field-Independent (FI) students outperform Field-Dependent (FD) students. This aligns with the opinion of Sutama et al. (2023), who stated that FI students took a

long time to solve problems, their results tended to be accurate, and students were always careful when performing the calculations. FD students took a short time to solve problems, but gave inaccurate answers. Izatul Yazidah & Nanda Saputra (2023) also argued that FI students were able to work effectively with models in concrete but complex situations, representing different information and relating it to real-world situations. Meanwhile, FD students were only able to carry out procedures well and select and apply simple problem-solving strategies. However, Qolbiyah & Sari (2024) stated that FI students also still face challenges in mathematization and representation, especially on non-routine problems. Meanwhile, FD students have advantages in several indicators of mathematical literacy, including communication, use of symbolic language, operations, technical language, formal language, and reasoning, so they require more assistance and explanation to achieve the same good results as FI students.

The results of the analysis of students' achievement of mathematical literacy indicators in terms of reflective and impulsive cognitive styles are presented in Table 1.3 below:

Table 1.3 Achievement Indicators of Reflective and Impulsive Cognitive Styles

Authors (Year)	Analysis Results	
	RE	IM
(Hammada et al., 2024)	6 indicators	5 indicators
(Ainiah et al., 2023)	3 indicators	3 indicators
(Sholihah et al., 2024)	3 indicators	less 3 indicators
(Putri & Novaliyosi, 2024)	mid 61,54%	low 57,14%
(Yusmarina et al., 2023)	3 indicators	1 indicators

Based on the analysis of the achievement indicators of the Reflective (RE) and Impulsive (IM) cognitive styles, it can be concluded that RE students outperform IM students. This aligns with the opinion of Nadiyatush Sholihah et al. (2024), who state that RE students, despite their inability to write down information, can develop solution strategies, use them effectively, carry out the solution stages, and interpret situations effectively. Furthermore, RE students can also relate their results to real-world situations. Meanwhile, IM students are not yet optimal in using mathematical procedures and tend to be less thorough in their calculations. Yusmarina et al. (2023) also stated that RE students can meet all indicators, although it takes more time. Meanwhile, Yusmarina et al. (2023) conducted research with a gender perspective. The achievement of mathematical literacy indicators for male and female students was similar, with female students being slightly more proficient in applying problem-solving steps.

The results of the analysis of students' achievement of mathematical literacy indicators in terms of the Verbalizer and Visualizer cognitive styles are presented in Table 1.4 below:

Table 1.4 Achievement Indicators of Verbalizer and Visualizer Cognitive Styles

Authors (Year)	Analysis Results	
	VER	VIS
(Sari & Manoy, 2018)	3 indicators	2 indicators
(Azka & Budiman, 2023)	3 indicators	3 indicators

Based on the analysis of the achievement of indicators from the Visualizer (VIS) and Verbalizer (VER) cognitive styles, it cannot be concluded which is better, as there are only two articles and no significant difference in the achievement of the indicators. Sari & Manoy (2018) state that VIS students can explain the Reasons why the results or conclusions obtained are in accordance with the context of the problem; however, the explanations provided are less able to justify why the answers obtained make sense in relation to the given situation. Meanwhile, VER students can explain why the results or conclusions obtained align with the context of the given problem, and their explanations can effectively justify why the answers received are sensible in relation to the given situation. Azka & Budiman (2023) also stated that both VIS and VER students were able to fulfill all indicators of mathematical literacy, namely formulating, employing, and interpreting, so that no conclusion could be drawn as to who was better, as they had their own ways of solving problems.

4. Conclusion

Based on the analysis of students' mathematical literacy indicators, it can be concluded that Field-Independent (FI) students outperform Field-Dependent (FD) students, and Reflective (RE) students outperform Impulsive (IM) students. In contrast, Verbalizer (VER) and Visualizer (VIS) students employ different approaches to solving problems, making direct comparison challenging.

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