

Students' Mathematical Literacy: Systematic Literature Review (SLR)

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Abstract

The aim of this study was to describe the research results related to students' mathematical literacy analyzed based on their learning style or cognitive style. The method used in this study was Systematic Literature Review (SLR). The sample was 27 articles consisting of 18 and 9 articles about students' mathematical literacy based on: learning style and cognitive style, respectively. The samples were articles indexed in SINTA, published in 2018 until September 2022 and located in Indonesia. The description in this study will be reviewed based on the journal indexes, year of publication, methods used, level of education, number of subjects, research locations, and the theory used both in the learning style and cognitive style. Through the SLR method, it was found the articles were dominantly published in SINTA 4, there were a decreasing and increasing in number of articles published in SINTA, qualitative method was dominant followed by mix method and quantitative method, the research conducted in junior high school was dominant, 18 out of 27 researches used more than 30 subjects, the research was dominantly conducted in Java, De Porter & Hernacki theory and Witkin & Goodenough were dominantly utilized in learning style and cognitive style research, respectively.

Keywords: *learning style, cognitive style, mathematical literacy, SLR*

INTRODUCTION

Students in each level of education learn mathematics at school because it is considered as one of the important subjects to be mastered. One of the vital objectives of the mathematics curriculum is to develop students' abilities to solve problems and make decisions (Tambychik & Meerah, 2010). The capacity to use mathematical knowledge and solve problems are directly tied to mathematical literacy skills (Kurniawati & Mahmudi, 2019). Different from what people usually think, mathematics learning



involves mathematical literacy skills whereas it is not only necessity for using the skills in memorizing and the ability to use procedures (Taufik & Zainab, 2021). According to Sulistiya & Rachmani Dewi (2021) mathematical literacy becomes an important variable in the mathematics learning process. Mathematical literacy is an individual's capacity to formulate, employ and interpret mathematics in a variety of contexts which includes reasoning mathematically and using mathematical concepts, procedures, facts and tools to describe, explain and predict phenomena (OECD, 2019). This leads people understand the importance of mathematics in life and develops the strong judgment and decision-making skills necessary for constructive, thoughtful residents. (Hayati & Kamid, 2019). Those abilities in mathematical literacy can be beneficial in solving varied contexts in daily life effectively (Sakinah & Avip, 2021; Sari & Wijaya, 2017) and making decisions and living a life that has complete purpose (Rizki & Priatna, 2019). Thus, mathematical literacy is essential for a student to utilize their understanding towards mathematics to solve the problem.

Students' mathematical literacy can be influenced by some factors such as learning style and cognitive style. Sukadi states that learning style is a combination of ways someone in absorbing knowledge and how to organize and process information or knowledge obtained (Papilaya et al., 2016). Due to someone's style in absorbing the knowledge, learning style becomes the issue which affects the learning style. This statement is in accord with mathematical literacy skills are impacted by student learning styles (Amaliya & Fathurohman, 2022; Norawati, 2020) and the skills of mathematical literacy is induced by learning style (Sakinah & Avip, 2021). Different learning styles give different effects to students' mathematical literacy. Based on some research, a visual learning style student has better mathematical literacy ability than auditory and kinesthetic learning style students (Anisa et al., 2022; Azizah et al., 2019; Wardono et al., 2018). However, due to numerous kinds of learning styles, each student with different learning style will have different level in mathematical literacy.

Another factor that affects students' mathematical literacy is cognitive style. Miller views cognitive styles are a person's variances in the numerous subcomponents of an information-processing model of perception, memory, and thought which are the three primary categories of cognitive processes (Zhang & Sternberg, 2005). Because of the differences in processing information and cognitive processes, students' mathematical

literacy is influenced by cognitive style (Damayanti et al., 2021; Herliani & Wardono, 2019) so that each student has various mathematical literacy characteristics (Rosyada & Wardono, 2021). Hence, cognitive style is one of the variables that can be used to observe students' mathematical literacy.

Several researches related to students' mathematical literacy based on learning style or cognitive style have become appealing issue to be investigated during these past years due to the needs in developing students' mathematical literacy. Knowing students' learning style can help teacher in managing class room in accordance with students' ways in learning and adsorbing information. A bit different from learning style, cognitive style is considered to be a crucial component of learning style (Tang, 2009). Thus, teacher need to find out students' learning style and cognitive style. Yaju stated that teachers can adapt appropriate teaching methods and strategies in response to their knowledge of the various learning styles of their students, and students can do the same if they are aware of their own cognitive styles, which can foster their independence in a place of helping them grow into successful learners (Yaju, 2008). Inasmuch as those reasons, it is essential to disclose students' learning style and cognitive style in that escalating students' ability in mathematical literacy.

Even though numerous researches about students' mathematical literacy based on learning style or cognitive style have been conducted in many schools, several subjects or different locations, there must be some gap that becomes a concern and need to get the further studies in order to fill the gap. Because of this matter, the writer wants to do a research about students' mathematical literacy based on: learning style and cognitive style using Systematic Literature Review (SLR) Method.

SLR is aimed to contain all information that has been published on the topic and evaluates the quality of this evidence while striving to provide a transparent and reproducible manner to a peculiar research question (Lame, 2019). SLR is a certain process locating prior research, chooses and assesses contributions, analyzes and synthesizes data, and presents the information in a way that permits to legitimately form inferences about what is and is not known. (Denyer & Tranfield, 2009). Hence, researcher could synthesize general conclusion and find the research gap to conduct further studies through SLR.

This study's objective is to describe the research results which relate to students' mathematical literacy that was analyzed according to their learning style or cognitive style. The description in this study will be reviewed based on the journal indexes, year of publication, methods used, level of education, number of subjects, research locations, and the theory used both in the learning style and cognitive style. One of the important steps in SLR called collecting data was conducted to obtain the data in the form of research results about students' mathematical literacy based on: learning style and cognitive style. Through the data that was retrieved, the researcher poses the following pertinent queries: (1) How does the description of the research findings relate to students' mathematical literacy based on: learning style and cognitive style in the term of journal indexes?; (2) How does the description of the research findings relate to students' mathematical literacy based on: learning style and cognitive style in the term of the year of publication?; (3) How does the description of the research findings relate to students' mathematical literacy based on: learning style and cognitive style in the term of the method used? (4) How does the description of the research findings relate to students' mathematical literacy based on: learning style and cognitive style in the term of education level, (5) How does the description of the research findings relate to students' mathematical literacy based on: learning style and cognitive style in the term of the number of subjects?; (6) How does the description of the research findings relate to students' mathematical literacy based on: learning style and cognitive style in the term of research location?; (7) How does the description of the research findings relate to students' mathematical literacy based on learning style in the term of its type of theory used the most in the research?; and (8) How does the description of the research findings relate to students' mathematical literacy based on cognitive style in the term of its type of theory used the most in the research?

METHOD

Systematic Literature Review

This research is a Systematic Literature Review. According to Kitchenham (2007) A systematic literature review, also known as a systematic review, is a method for finding, analyzing, and interpreting every study that is pertinent to a precise research question, topic, or interest phenomenon. The purpose of this study was to compile secondary data collected from the research results about students' mathematical literacy ability based on: learning style and cognitive style.

The procedure of this research is collecting the data, analyzing the data and drawing conclusion. The data collected is primary data having been made into articles or national journals. After collecting the data, the sorting was applied to obtain relevant articles to be analyzed in this research.

The data was sorted using the inclusion criteria which will determine which of these studies to include in the collection of relevant ones and exclusion criteria may be used to eliminate irrelevant studies from the studies that have already been chosen (Stapic et al., 2014). The inclusion criteria in this study were:

1. Articles of research results in Mathematics Education.
2. Articles published in 2018 until September 2022.
3. Articles indexed in SINTA.
4. Articles with the research location in Indonesia.
5. Research on the analysis of students' mathematical literacy based on: learning style and cognitive style.

Research Instruments

The research instrument utilized in this study is observation sheets or matters relating to the inclusion criteria and exclusion criteria. The criteria are based on the year of research, journal index, research location, and research related to students' mathematical literacy based on: learning style and cognitive style.

Population and Sample

The population in this study are all studies on the students' mathematical literacy based on: learning style and cognitive style having been published in varied publishers. Based on the inclusion criteria, it was obtained that the total sample was 27 consisting of 18 articles of students' mathematical literacy based on learning style and 9 articles of mathematical literacy based on cognitive style.

Data Collection Technique

The data collection technique used in this study was collecting the articles related to students' mathematical literacy ability based on: learning style and cognitive style. The search engines used to collect data are Google Scholar, Garuda Portal, and Google.

Data Analysis Technique

Descriptive quantitative data analysis was used in this study.

RESULTS AND DISCUSSION

Study by Number of Articles Indexed in SINTA

The quantity of articles about students' mathematical literacy based on: learning style and cognitive style indexed in SINTA can be seen on the Figure 1 below.

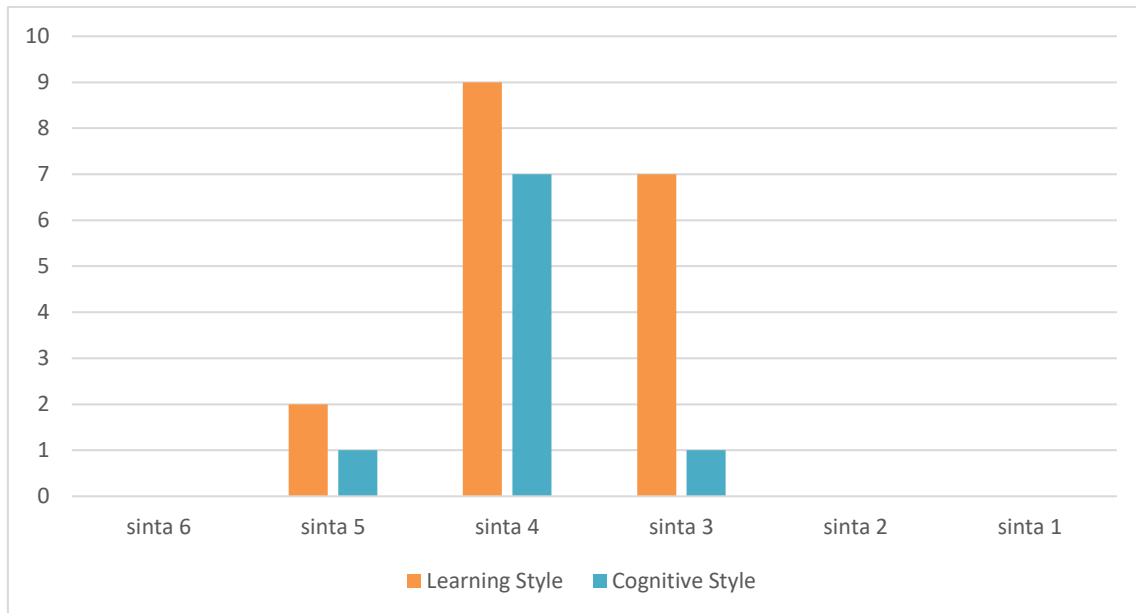


Figure 1. Study by Number of Articles Indexted in Sinta

From the Figure 1 above, it can be seen that publication in SINTA about students' mathematical literacy based on: learning style and cognitive style can be found the most in SINTA 4 followed by SINTA 3 and SINTA 5, while in SINTA 6, SINTA 2 and SINTA 1 there cannot be found any publications of its article. This may be affected by the different variable used in analyzing students' mathematical literacy. Another possibility is mathematical literacy widely studied using the application of other methods (Juandi, 2021). It can be a consideration to the researchers to improve and deepen their research about students' mathematical literacy based on learning style or cognitive style so that its article can be published in SINTA 2 or SINTA 1.

Study by Year of Publication

By filtering the collected articles using inclusion criteria, it was obtained 27 articles which are relevant to be analyzed. From those relevant datas, the number of articles published each year was distinct which can be observed from the Figure 2 below.

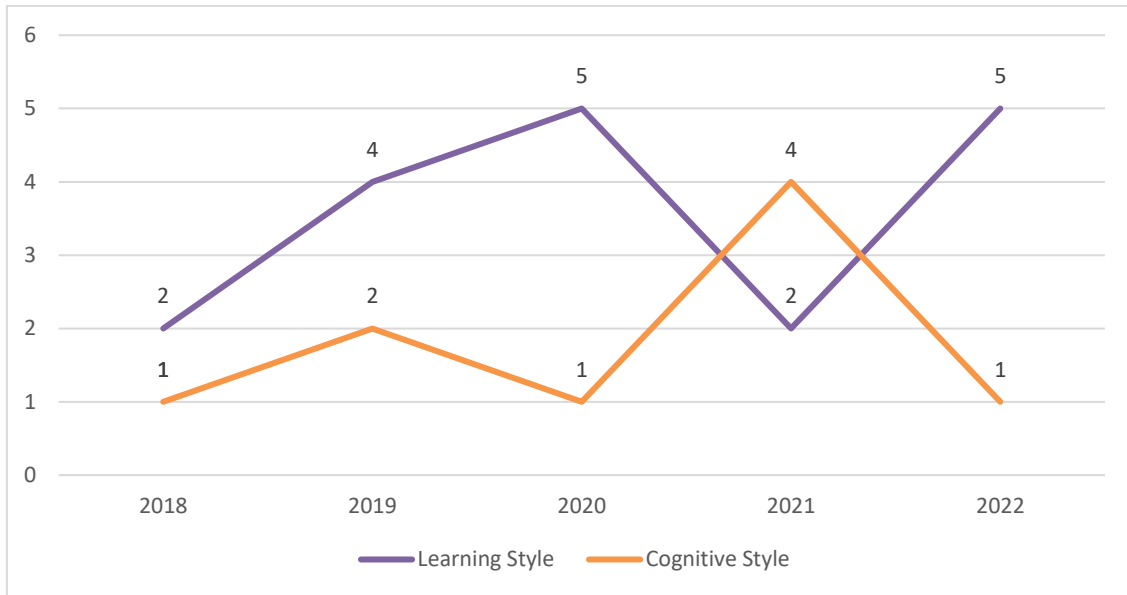


Figure 2. Study by Year of Publication

Based on Figure 2, it can be seen that the number of publications happens to face the increase or decrease in each year. Despite of that, the increase of publication shows the research of students' mathematical literacy still gains a recognition among the researchers.

The highest number of publications for students' mathematical literacy based on learning style was both in 2020 and 2022 with 5 articles for each year while its lowest number of publications was in 2018 and 2021 with 2 articles of each year. The highest number of publications for students' mathematical literacy based on cognitive style was in 2021 with 4 articles in total while its lowest number of publications was in 2018, 2020 and 2022 with only 1 article for each year. In addition, the total number of publications about students' mathematical literacy based on learning style during these past five years is more than the number of publications about students' mathematical literacy based on cognitive style.

Study by Research Methods

There are several research methods can be used in the research such as quantitative, qualitative, or even mix method. The method used in the research about students' mathematical literacy is shown in Figure 3 as follows.

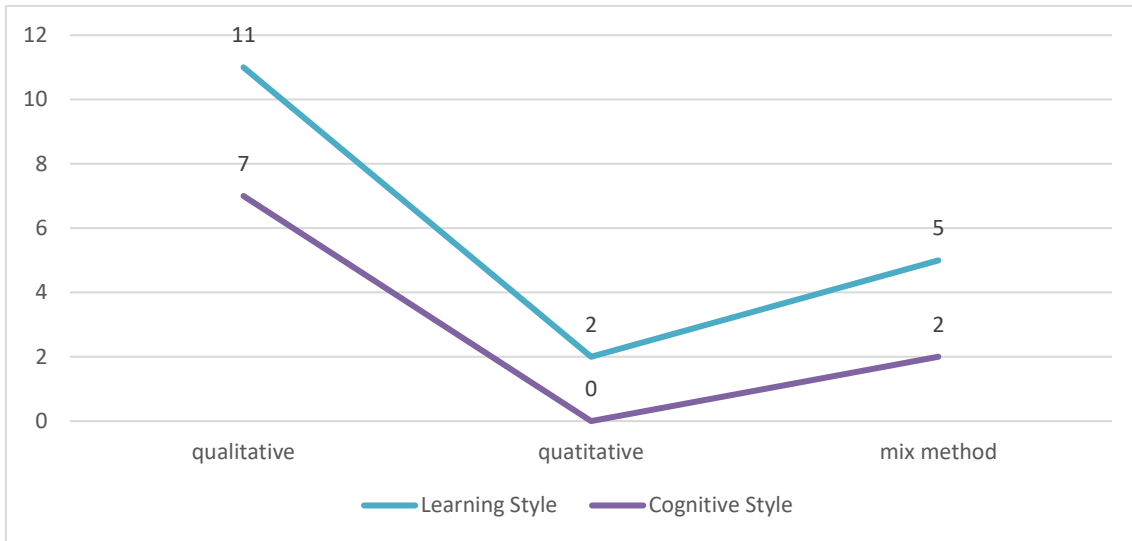


Figure 3. Study by Research Method

From Figure 3 it can be known that during the last five years both of research about students' mathematical literacy based on learning style and students' mathematical literacy based on cognitive style depict the similar graph which means they have the similar result. The research of students' mathematical literacy ability was dominated with the research using qualitative methods. 61,11% research of students' mathematical literacy based on learning style and 77,78% research of students' mathematical literacy based on cognitive style was using qualitative method, followed by mix method, quantitative method, respectively, for both topics. It was reasonable because most of the articles in this study provide the description of students' mathematical literacy explained based on their answer sheets. It is in line with the purpose of qualitative method as an exploratory nature which starts the question with the words, such as WHAT, or HOW and require the discovery of researcher's exploration (Elkatawneh, 2016).

Study by Education Level

Mathematical literacy is one of the abilities which is crucial to be mastered by each student on each level because it influences students to be able analyzing and giving reasons to answer the given problem by linking the concepts, formulas, and mathematical knowledge (Yulianah et al., 2022). The research about students' mathematical literacy based on: learning style and cognitive style were conducted in each level of education to observe students' performance on mathematical literacy ability. The number of its researches in each level of education can be seen in Figure 4 below.

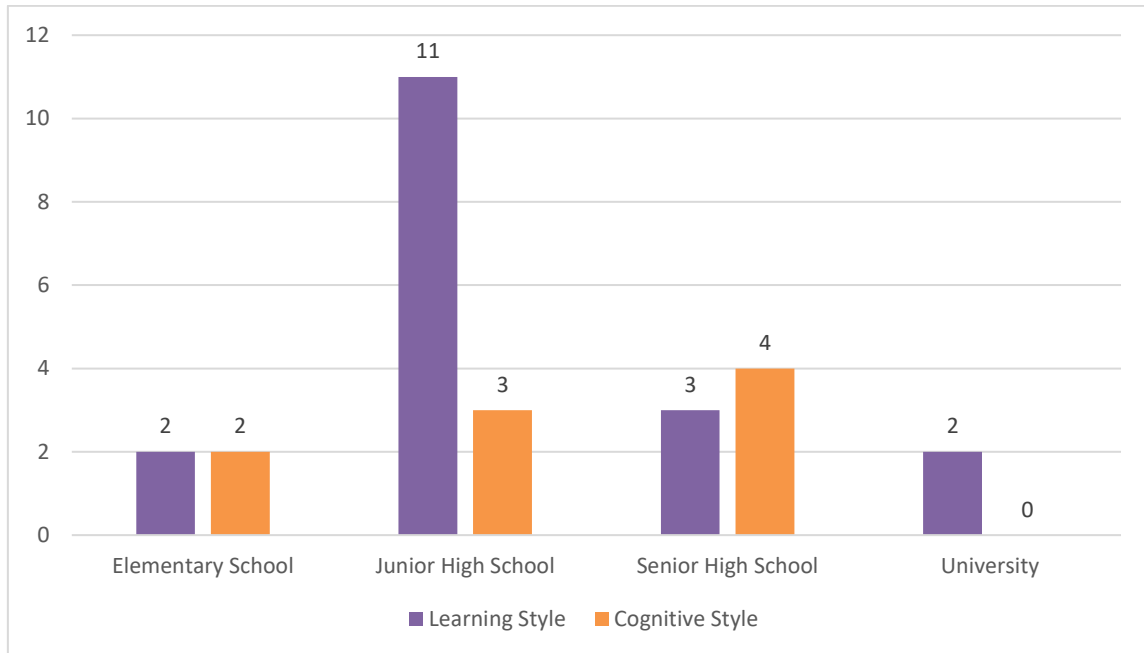


Figure 4. Study by Education Level

Based on the Figure 4 above, the research of student's mathematical literacy based on learning style conducted in junior high school was dominant than the research conducted in the other education level which reached 11 articles out of 27 articles while the study of student's mathematical literacy based on cognitive style was largely conducted in senior high school. It was understandable since the content knowledge to assess mathematical literacy from PISA (Programme for International Student Assessment) is relevant to a 15-year-old student assessment (OECD, 2017). On the other hand, its research in university became the least research among the others.

Even though PISA was made for 15-year-old students, it does not imply students' mathematical literacy in elementary school, senior high school and university students becomes less important to be analyzed. This is in line with the use of elementary school students' mathematical literacy in the solution of word problem is classified low (Simarmata et al., 2020) while literacy is a skill that must be developed from a young age (Juandi, 2021). In addition, Ridzkiyah & Effendi. (2021) also found the same result. She stated that there are many senior high school students struggle to meet all three requirements for mathematical literacy, which are to construct real-world problems mathematically utilizing concepts, facts, methods, and mathematical reasoning, as well as to interpret, apply, and evaluate mathematical conclusions. These expressions show that students' mathematical literacy based on learning style and cognitive style need to be

done in variety level of education in order to find the best method and cure students' mathematical literacy based on its research results in specific level of education.

Study by Number of Samples

The number of samples used in every research is varied. Generally, the utilizing of the sample is divided into two categories particularly less than 30 samples and more than/or equals 30 samples. The number of researches on student's mathematical literacy based on: learning style and cognitive style is shown in the Figure 5 below.

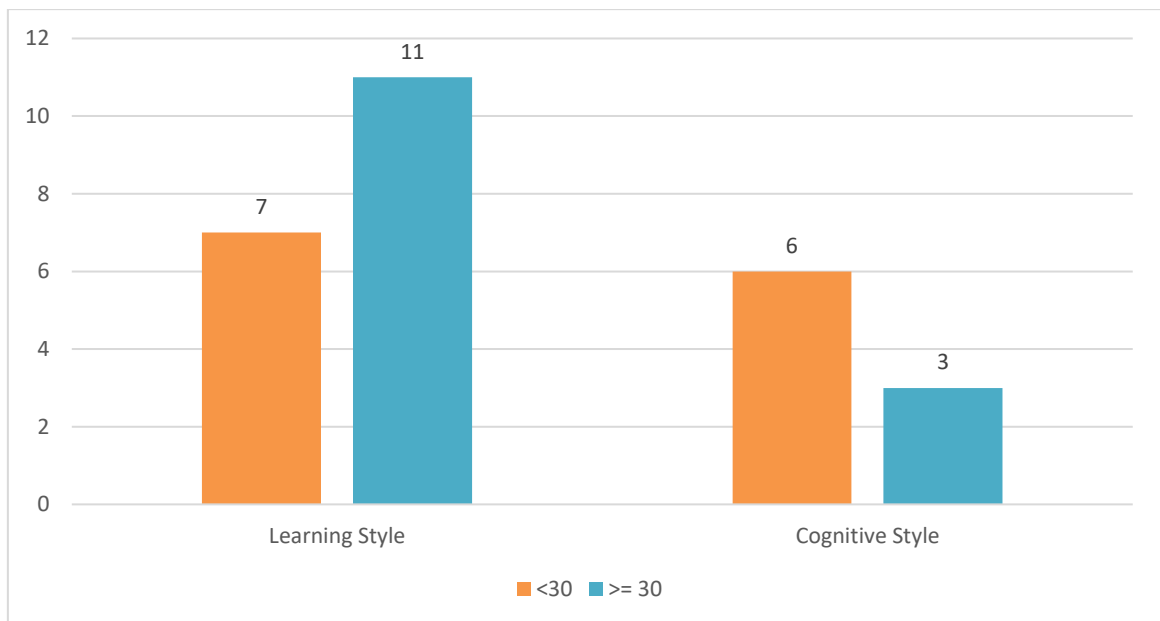


Figure 5. Study by Number of Samples

From Figure 5, it can be said that the researches were largely used more than 30 subjects reaching 18 articles from the total of 27 articles. This is because this research is dominated by descriptive qualitative research (Aswin & Juandi, 2022) which analyzed students' ability through the description.

Study by Research Location

Indonesia has many islands including five biggest islands which are Sumatera, Java, Kalimantan, Sulawesi and Papua. The number of researches about students' mathematical literacy conducted in five biggest islands in Indonesia can be seen in Figure 6 below.

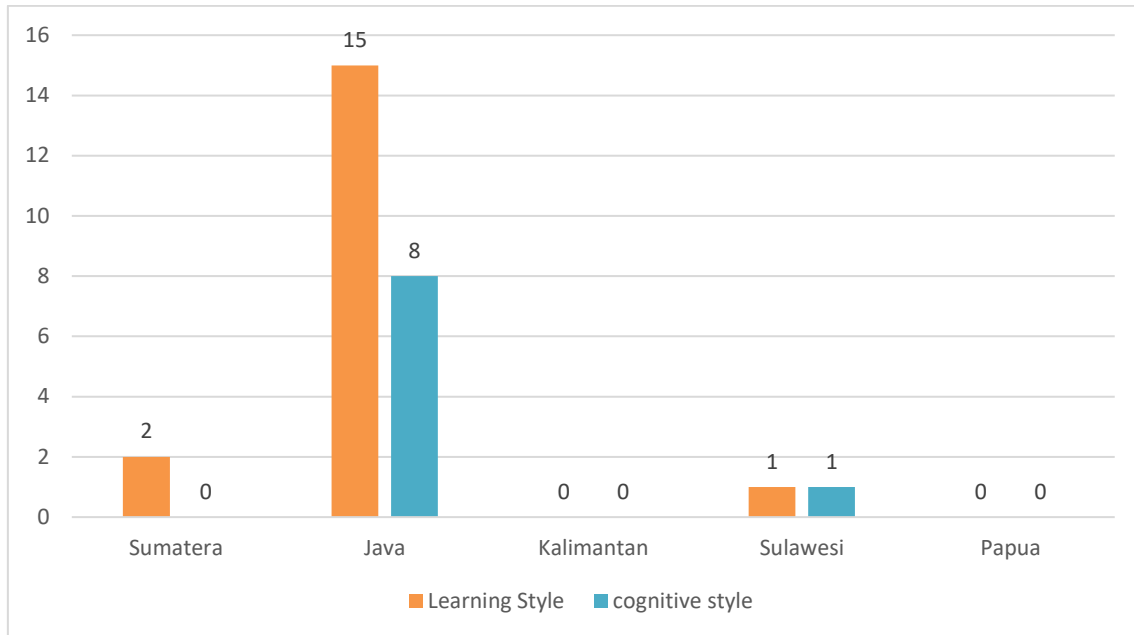


Figure 6. Study by Research Location

From the Figure 6 above, it is known that the research on students' mathematical literacy was mostly executed in Java while in Kalimantan and Papua cannot be found any research of it was conducted there during these past 5 years. The comparison between the number of researchers in Java and the other four islands was so contrast. The research in Java alone took 85,2% from all of the samples in this study. On the other hand, the study on students' mathematical literacy based on: learning style and cognitive style conducted in Sumatera and Kalimantan is considering low because it was a thirteenth of the research conducted in Java. This is in line with the statement the research about students' mathematics ability was mostly conducted in Java while its research in Papua is still in a low number (Ariati & Juandi, 2022; Khairunnisa et al., 2022). Aswin & Juandi (2022) also found similar result which stated the research about students' error was largely conducted in Java. Hence, the study of mathematical literacy based on learning style or cognitive style should be conducted in various provinces in Indonesia so that teachers could use appropriate way to increase students' mathematical literacy in the classroom.

Study Based on Learning Style Theory Used in The Research

Learning style has several theories to be picked by researchers depending on students' type in learning. According to De Porter & Hernacki, there are three learning styles a person uses in learning namely visual, auditory and kinesthetic (Putra et al., 2018). Aside from De Porter & Hernacki, David Kolb divides learning style into four parts namely diverger, assimilator, converger, and accommodator (Nurcahyandi &

Purwaningrum, 2022). The theory used in the research as regards students' mathematical literacy based on learning style can be seen in the Figure 7 below.

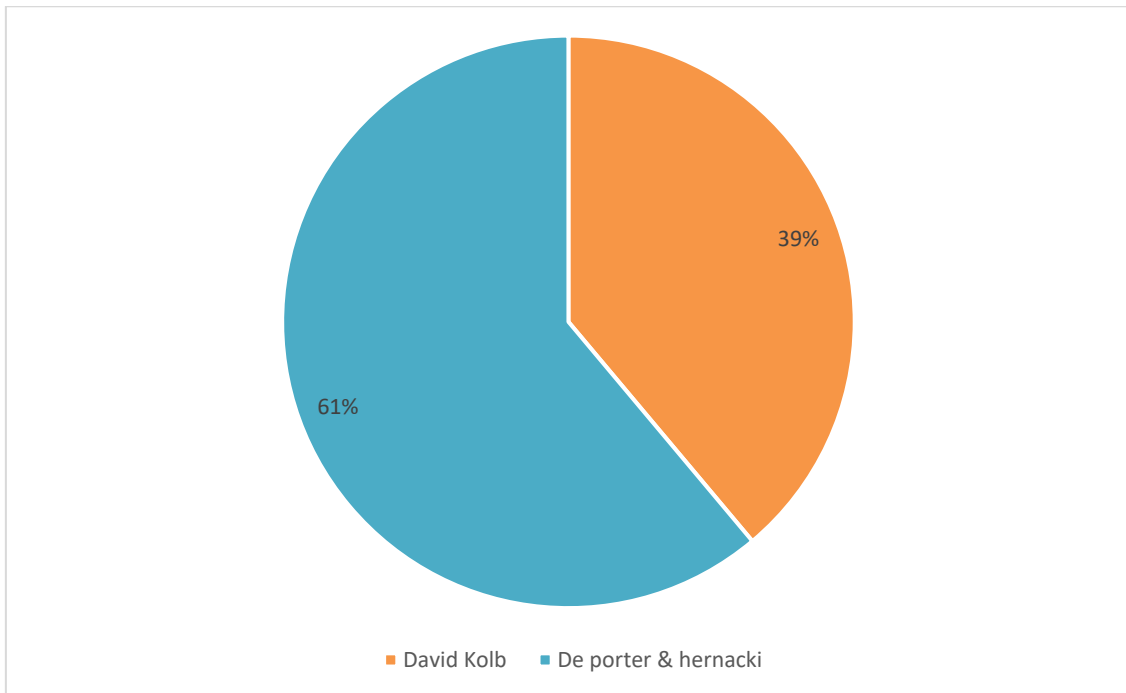


Figure 7. Study by Learning Style Theory Used in The Research

From the Figure 7, it is safe to say the theory of De Porter & Hernacki was mostly utilized in the research regarding students' mathematical literacy based on learning style during these past five years with the presentation reaching the number 61% followed by David Kolb Theory which was used around 39% from the total. Despite of what theory chosen by researcher, knowing student learning style can help teacher to teach effectively in the classroom and help students increase their mathematical literacy. From the use of various different research instruments and contexts concerned, many empirical studies have revealed that learning styles may have a major impact on students' decisions regarding their learning practices (Shi, 2011).

Study Based on Cognitive Style Theory Used in The Research

As well as learning style, cognitive style has several theories related to how a person does the thinking process using their cognitive ability. Kagan et al. introduced impulsivity-reflectivity theory dividing learners into two distinct categories namely cognitively impulsive and cognitively reflective (Mcewan & Reynolds, 1997) classified based on the speed and accuracy in responding (Habibi et al., 2020). The other theory is called field dependence and field independence prescribed by Witkin and Goodenough as a process variable, representing the degree of autonomous functioning in assimilating

information from self and field (Martinsen, 1997). Another theory was first developed by Paivio called verbalizer-visualizer (McEwan & Reynolds, 2007) which is distinguished in the terms of differences in receiving information visually and verbally (Sari & Budiarto, 2016). The number of theories utilized in study of students' mathematical literacy based on cognitive style is presented in Figure 8 below.

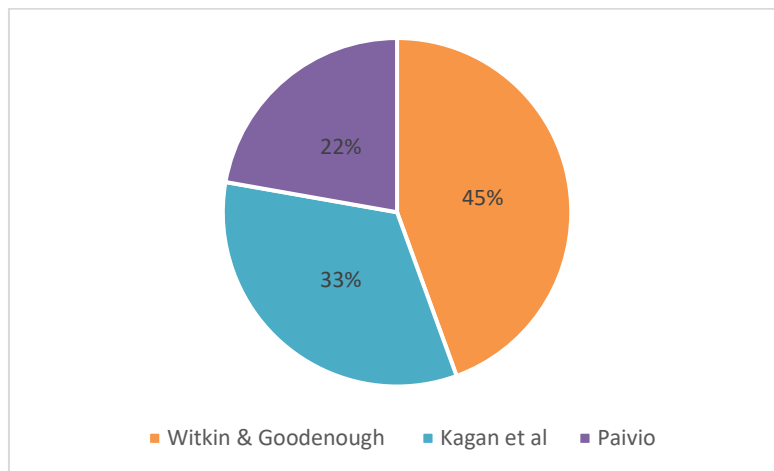


Figure 8. Study Based on Cognitive Style Theory

Based on Figure 8, field dependence and field independence theory by Witkin & Goodenough was mostly used in the research as regards students' mathematical literacy in these past 5 years and hit the number of 45% from the total. Followed by Kagan et al. theory reaching 33% and Paivio theory reaching 22%. Regardless of the cognitive style theory, cognitive styles have a convincing impact on choosing the learning strategies by the learners (Shi, 2011) wherein they are directly linked to the learner's innate learning styles and other personality-related factors (Li & Qin, 2006). This statement implies they do not work on their own. Therefore, it is crucial to know students' cognitive style in developing their mathematical literacy ability.

CONCLUSION

Through the SLR method, it was found the articles of students' mathematical literacy based on: learning style and cognitive style were gaining a big attention proven by the existence of its articles published each year. This also shows mathematical literacy based on learning style or cognitive style is acknowledge as an important topic to be observed due to its purpose in finding students' level of understanding in solving mathematical literacy problem based on their learning style or cognitive style. The research of students' mathematical literacy based on: learning style or cognitive style was

largely using junior high school students as samples and dominantly conducted in Java island. In addition, De Porter & Hernacki theory and Witkin & Goodenough were broadly employed in learning style and cognitive style research, respectively.

Due to the low number of publications about students' mathematical literacy based on cognitive style, further study about it should be done to find out the relation of students' mathematical literacy and students' cognitive style. This research also can help teacher to find the best method, model, or assignment to the students in the direction of developing, maturing and escalating students' mathematical literacy. Additionally, the research outside the Java island should be executed more since the students from other cities in Indonesia also have the urgency to be the subject of research which is beneficial to fill the research gap in the study of students' mathematical literacy.

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