

INDONESIAN STUDENTS' CONCEPTUAL UNDERSTANDING IN MATHEMATICS BASED ON LEARNING STYLE: SYSTEMATIC LITERATURE REVIEW (SLR)

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ABSTRAK

This study aimed to describe the research results related to students' conceptual understanding in mathematics analyzed based on their learning style. The method used in this study was Systematic Literature Review (SLR). The sample consists of 17 articles indexed in SINTA and Google Scholar, published in 2018 until October 2022, and located in Indonesia. The description in this study will be reviewed based on the year of publication, journal indexes, method uses, level of education, number of subjects, subject matters, research locations, and the theory used in learning style. Through the SLR method, it was found that there was an increasing and decreasing in the number of articles, there were dominantly published in Google Scholar, qualitative method was dominant, the research conducted in junior high school dominant, 14 out of 17 researchers used less than 30 subjects, algebra was dominant followed by geometry and measurement, the research was dominant conducted in Java, DePorter and Hernacki theory were dominantly.

Keywords : Conceptual Understanding, Mathematics, Learning Style, SLR

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INTRODUCTION

Learning mathematics can equip students in ways of thinking, reasoning, and logically through certain mental activities so as to form a continuous flow of thinking and lead to the formation of a flow of understanding of mathematics learning materials in the form of facts, concepts, principles, operations, relations, problems, and solutions certain mathematics that are formal to universal (BSKAP, 2022). Based on Appendix II of the Decree of the Head of the Education Standards, Curriculum, and Assessment Agency of the Ministry of Education and Culture, Research and Technology Number 008/KR/2022, it is stated that one of the objectives of mathematics subjects is to equip students to understand mathematics learning materials in the form of facts, concepts, principles, operations, and explanations mathematics and apply it flexibly, accurately, efficiently, and precisely in solving mathematical problems.

One of the things that students must understand to achieve the above learning objectives is the concept of mathematics, so conceptual understanding is needed which is an important provision for students to carry out mathematics learning. Conceptual understanding or understanding of mathematical concepts is one component of mathematical skills. There are five mathematical skills that are interrelated with each other and can make a person successful in learning mathematics, namely conceptual understanding, procedural



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fluency, strategic competence, adaptive reasoning, and productive disposition (Killpatrick, Swafford, and Findell, 2001). Thus, understanding mathematical concepts is an important part that students must have in learning mathematics. This is also in line with the findings of Aini, Hariyani, and Suwanti (2020) that understanding concepts can help students remember and make it easier when working on math problems.

Kilpatrick, Swafford, and Findell (2001:118) define understanding mathematical concepts as referring to an integrated and functional understanding of mathematical ideas. Students with conceptual understanding know more isolated facts and methods. They are able to organize their abilities into a coherent whole and enable them to learn new ideas by relating these ideas to what they already know. While Susanto (2013) explains that concept understanding is the ability to explain a situation with different words and can interpret or draw conclusions from tables, data, graphs, and so on.

The ability of students to understand the material being taught can be influenced by many factors, one of which is learning style. Learning style is a person's way to absorb, organize, and process information or learning materials (Hartati, 2016). Every child is a unique individual so that in participating in learning at school, not all students have a uniform learning style and the same understanding ability (Aini, Hariyani, & Suwanti, 2020). So, it is important for teachers to pay attention to the learning styles of their students. This is in line with what Karunia & Mulyono (2016) said that in addition to paying attention to the use of learning models, an educator is expected to be able to pay attention to the learning styles of students so that the knowledge gained can be absorbed optimally according to their learning styles. Based on this, it is important to reveal learning styles in improving students' understanding of mathematical concepts.

Although many studies on students' conceptual understanding in mathematics based on learning styles have been carried out in many schools, several subject matters, or different locations, there must be some gaps that are of concern and need further study to fill the gaps. Therefore, the author wants to conduct research on students' mathematical literacy based on: learning style and cognitive style using the Systematic Literature Review (SLR) method.

Systematic Literature Review is a method used by a researcher to identify, review, evaluate, and interpret all available research in the topic area of an interesting phenomenon, with research questions that are certainly relevant (Triandini et al., 2019). By reviewing relevant literature, we understand the breadth and depth of the existing body of work and identify gaps to explore (Paré et al., 2015). Then (Aliyah & Mulawarman, 2020) stated that the Systematic Literature Review method is a method used to identify, assess, and interpret findings on a research topic to answer predetermined research questions.

This study's objective is to describe the research results which relate to students' conceptual understanding in mathematics based on learning style. The description in this study will be reviewed based on the year of publication, journal indexes, methods used, level of education, number of subjects, research locations, subject matter, and the theory used in the learning 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' conceptual understanding based on learning style. Through the research data that has been extracted, the researcher asks several relevant questions as follows: (1) How does the description of the research findings relate students' conceptual understanding in mathematics based on learning style in the term of the year of publication?; (2) How does the description of the research findings relate to students' conceptual understanding in mathematics based on learning style in the term of journal indexes?; (3) How does the description of the research findings relate to students' conceptual understanding in mathematics based on learning style in the term of the method used? (4) How does the description of the research findings relate to students'

conceptual understanding in mathematics based on learning style in the term of education level, (5) How does the description of the research findings relate to students' conceptual understanding in mathematics based on learning style in the term of the number of samples?; (6) How does the description of the research findings relate to students' conceptual understanding in mathematics based on learning style in the term of research location?; (7) How does the description of the research findings relate students' conceptual understanding in mathematics based on learning style in the term of subject matter in the research?; and (8) How does the description of the research findings relate to students' conceptual understanding in mathematics based on learning style in the term of its type of theory used the most in the research?

METHOD

Systematic Literature Review

This type of research is a systematic literature review. According to Kitchenham (2007) Systematic literature review, also known as systematic review, is a method for finding, analyzing, and interpreting every study related to the appropriate research question, topic, or phenomenon of interest. The purpose of this study was to compile secondary data collected from the research results about students' conceptual understanding in mathematics based on learning style.

The procedure of this research is to collect data, analyze the data, and draw conclusions. The data collected is primary that has been made into articles or national journals. Data collection was carried out with the help of electronic database resgistered and indexed by Sinta dan Google Scholar. Then, the data collected is sorted, so that only relevant articles to be analyzed in this research.

Inclusion criteria were carried out to filter the articles that had been obtained and choose those that would be used in the research, this was in line with what was stated by (Xiao & Watson, 2019). The inclusion criteria in this study were:

1. Articles of research results in Mathematics Education.
2. Articles published in 2018 until October 2022.
3. Articles indexed by SINTA or Google Scholar.
4. Articles with the research location in Indonesia.
5. Articles that include subject materials.
6. Research on the analysis of students' conceptual understanding in mathematics based on learning style.

Research Instruments

The research instrument is the form of observation sheets or matters relating to the inclusion criteria and exclusion criteria. The criteria are based on the year research, journal index, research location, subject matter, and research related to students' conceptual understanding in mathematics based on learning style.

Population and Sample

The population in this study are all studies on the students' conceptual understanding in mathematics based on learning style having been published in varied publishers. Based on the inclusion criteria, the sample of this study is 17 articles that are relevant and worthy of a systematic review.

Data Collection Technique

The data collection technique used in this study was collecting articles related to students' conceptual understanding in mathematics based on learning style. The search engines used to collect data are Google Scholar, Garuda Portal, and Google. Based on the

search engines identified 20 articles discussed student conceptual understanding in mathematics based on learning style. The articles were sorted and 17 articles are relevant and met the inclusion criteria. The protocol of this study is PRISM (*Preferred Reporting Items for Systematic Reviews and Meta-Analyzes*). The selection process was conducted with 4 steps: identification, screening, eligibility, and included (Liberati et al., 2009; Juandi & Tamur, 2020), explained as follows:

1. Identification
There are 20 articles identified using Google Scholar, Garuda Portal, and Google.
2. Screening
The 20 articles obtained were not duplicated.
3. Eligibility
There are 17 articles after eliminate process (1 article published in 2015, 2 articles are not mentioned subject materials).
4. Included
There are 17 articles about students' conceptual understanding in mathematics that meet inclusion criteria and included in the analysis.

Data Analysis Technique

Descriptive quantitative data analysis was used in this study.

RESULTS AND DISCUSSION

The result presented in eight parts includes the year of publication, journal indexes, research methods, education level, number of samples, research location, subject materials, and learning style theory used. The analysis result based on eight criteria can be seen in Table 1 as follows.

Table 1. The results of the analysis of the articles based on eight criteria

Characteristics Study	Criteria	Frequency
Year of Publication	2018	1
	2019	3
	2020	5
	2021	3
	2022	5
Journal Indexes	Sinta 1	0
	Sinta 2	1
	Sinta 3	4
	Sinta 4	4
	Sinta 5	2
	Sinta 6	0
Research Methods	Google Scholar	6
	Qualitative	14
	Quantitative	1
Education Level	Mix Method	2
	Elementary School	2
	Junior High School	7
	Senior High School	6
Number of Samples	University	2
	< 30	14
Research Location	≥ 30	3
	Sumatera	1
	Java	11
	Kalimantan	2
Subject Materials	Sulawesi	1
	Flores	2
	Numbers	2

	Measurement and Geometry	5
	Algebra	6
	Trigonometri	2
	Calculus	2
	DePorter and Hernacki	14
Learning Style Theory Used	Honey Mumford	1
	Interpersonal	1
	Grasha Riechman	1

Study by Year of Publication

By filtering the collected articles using inclusion criteria, it was obtained 17 articles which are relevant to be analyzed. From those relevant datas, the number of articles published each year was increasing and decreasing can be observed from the Figure 1 below.

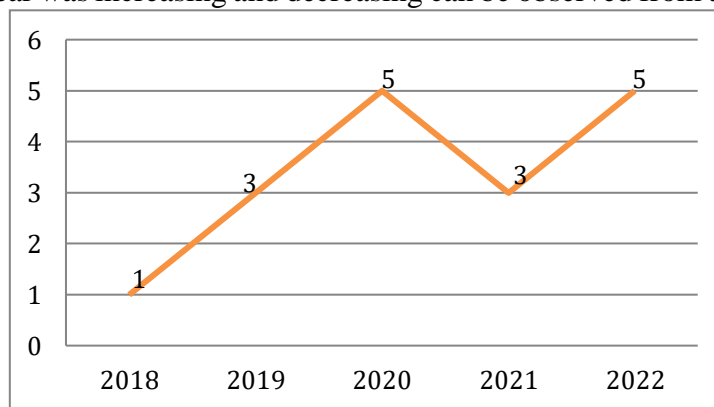


Figure 1. Study by Year of Publication

Based on Figure 1, it can be seen that the research has increased from 2018 to 2020, and then decreased in 2021, but increased again in 2022. Despite of that, the increase of publication shows the research of students' conceptual understanding in mathematics based on learning style still gains a recognition among the researchers. The highest number of publications was both in 2020 and 2022 with 5 articles, while its lowest number of publications was in 2018 with 1 article. This increase is of course due the importance of analyzing students' conceptual understanding in mathematics based on learning style.

Study by Journal Indexes

The number of articles about students' conceptual understanding in mathematics based on learning style indexed in SINTA and Google Scholar can be seen on the Figure 2 below.

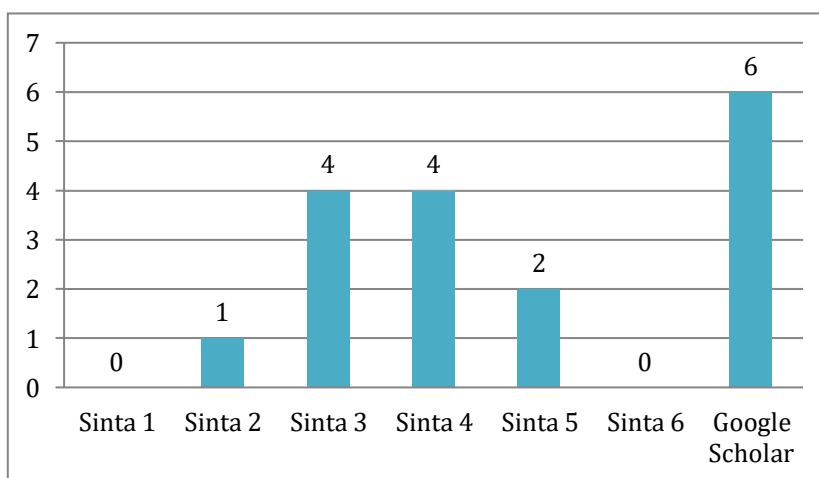


Figure 2. Study by Journal Indexes

Based on Figure 2, it can be seen that the most publication in Google Scholar. But, if it was seen by SINTA Indexes, the most publication in SINTA 3 and SINTA 4, while in SINTA 1 and SINTA 6 there cannot be found any publications of its article. It can be a consideration to the writer or researcher to publish their articles related to student's conceptual understanding in mathematics based on learning style in SINTA 1 and SINTA 6.

Study by Research Methods

In the research there are several research methods can be used such as quantitative, qualitative, or mix method. The method used in the research about students' conceptual understanding in mathematics based on learning style can seen be seen in Figure 3 as follows.

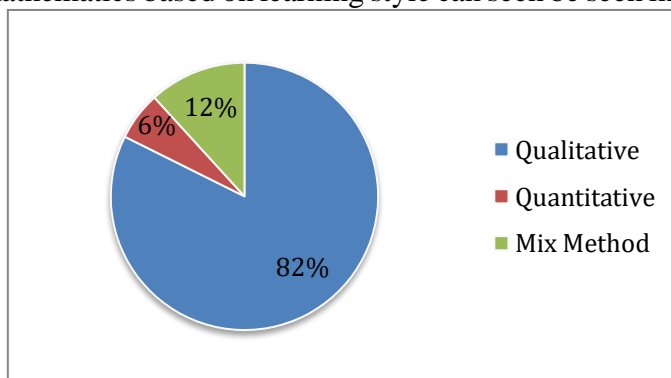


Figure 3. Study by Research Methods

Based on Figure 3, it is seen that in the last 5 years related to research on the students' conceptual understanding in mathematics based on learning style, it is dominated by qualitative method 82% of 17 articles, followed by mix method and quantitative method. It was reasonable because most of the researchers analyzed students' conceptual understanding based on learning style by describing students' answer sheets. This is accordance with the purpose of the qualitative method as an exploratory nature which starts the question with the words and require the discovery of researcher's exploration (Elkatawneh, 2016).

Study by Education Level

The number of articles about students' conceptual understanding in mathematics based on learning style by education level can shown on the Figure 4 below.

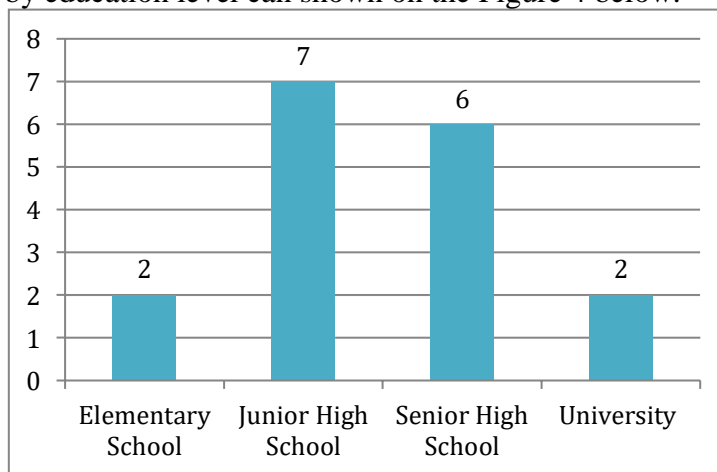


Figure 4. Study by Education Level

Based on Figure 4, it can be concluded that research about students' conceptual understanding in mathematics based on learning style is mostly carried out at the Junior High School level. This could be because conceptual understanding at the junior high school level is very crucial and more needed to understand materials at the next education levels such as senior high school and university. This is in accordance with the statement that every concept

in mathematics is interrelated and a prerequisite for other concepts, so that studying mathematical concepts must be coherent and continuous and if the concept can be understood it will be easier to understand. the next concept is more complex (Hidayat, 2018).

Meanwhile, the least research has been done are at the elementary school level and university level. Even though conceptual understanding in mathematics at elementary school is also important, because elementary school-age children are at the concrete operational stage, that is children are able to think rationally and solve concrete or real problems. Therefore mastery of mathematical concepts can begin at this age, because they can already understand the basic mathematical concepts being taught (Friantini et al., 2020). It can be consideration to the researchers to improve their research about students' conceptual understanding in mathematics based on learning style can research in elementary school.

Study by Number of Samples

The number of samples used in every research is varied. In general, the use of samples in research is categories into two, particularly less than 30 samples and more than/or equals to 30 samples. The number of samples researches about students' conceptual understanding in mathematics based on learning style can be seen in Figure 5 below.

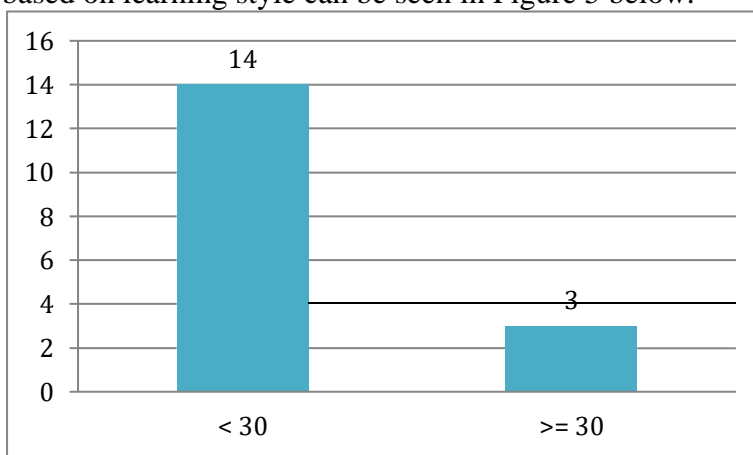


Figure 5. Study by Number of Samples

Based on Figure 5 showed that the researchers most used less than 30 samples reaching 14 articles of 17 articles. This is because this research is dominated by descriptive qualitative research that analyzed students' ability through the description (Aswin & Juandi, 2022).

Study by Research Location

The number of article about students' conceptual understanding in mathematics are spread across several islands in Indonesia, it can be seen on Figure 6 below.

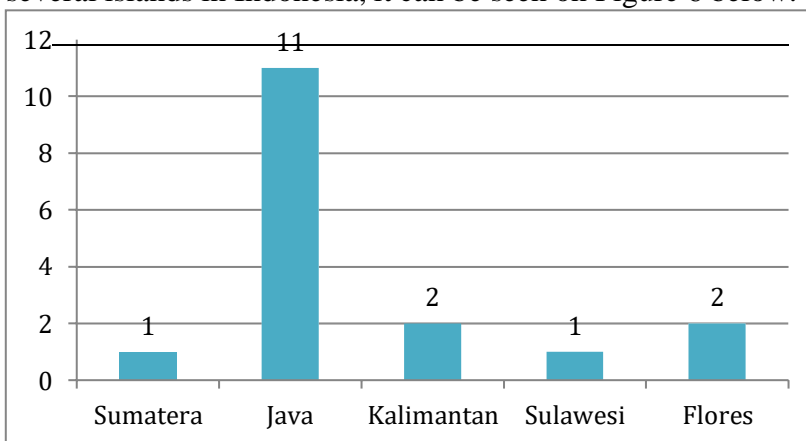


Figure 6. Study by Research Location

Figure 6 explains where the researchers took research data regarding students' conceptual understanding in mathematics based on learning style, dominated by Java which consisted of Jakarta, Banten, East Java, Central Java, and West Java. In addition, it is also seen that the islands of Sumatera and Sulawesi are the islands with the least research about students' conceptual understanding in mathematics based on learning style. The comparison between the number of researchers in Java and the other islands was so contrast.

The research in Java took 11 from 17 samples in this study, this was also found by other researchers about students' mathematics ability was mostly conducted in Java (Khairunnisa et al., 2022; Ariati & Juandi, 2022). This could be because most of Indonesia's population is in Java. Thus the study of students' conceptual understanding in mathematics based on learning style should be conducted in various provinces in Indonesia so that the teachers could use appropriate way to increase students' conceptual understanding in mathematics in the classroom.

Study by Subject Materials

The number of researches about students' conceptual understanding in mathematics by subject matter can be seen on Figure 7 below.

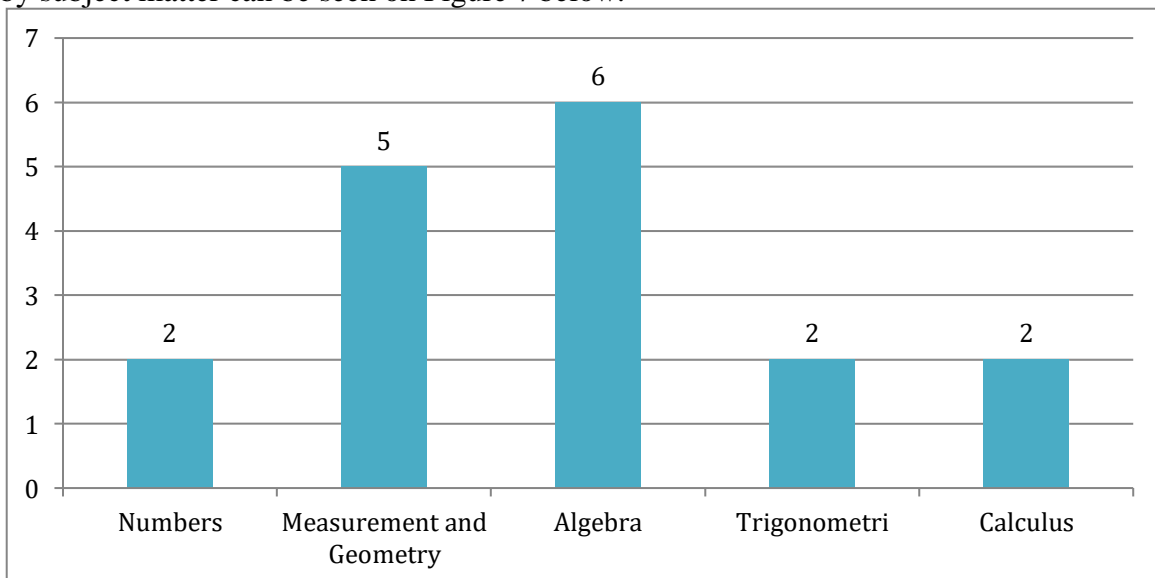


Figure 7. Study by Subject Materials

Based on Figure 7, we can see that the most studied material on algebra is followed by measurement and geometry. The algebraic material studied includes system of linear equations with two variables, functions, systems of three-variable linear equations, and algebraic arithmetic operations. Meanwhile, geometry and measurements include Cartesian coordinates, straight line equations, two-dimentional figure, and three-dimentional figure. Algebra and geometry materials are widely studied because these two materials require many concepts in their learning.

Study by 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 types of learning styles a person uses namely visual, auditory, and kinesthetic (DePorter & Hernacki, 2013). Honey Mumford learning style divides the types of student learning styles into four categories, namely the activist group, pragmatist, reflector, and theorist (Zakirman, 2017). Interpersonal learning style that people are person who enjoy learning in groups or with other people, and aim to work with others as much as possible (Wijayanti, Safitri, and

Raditya, 2018). Grasha Riechman learning has six categories of learning style, namely independent, dependent, collaborative, competitive, contributive, and avoidant (Adawiyah & Kurniasari, 2020). The theory of learning style used in the research about students' conceptual understanding in mathematics based on learning style can be seen in the Figure 8 below.

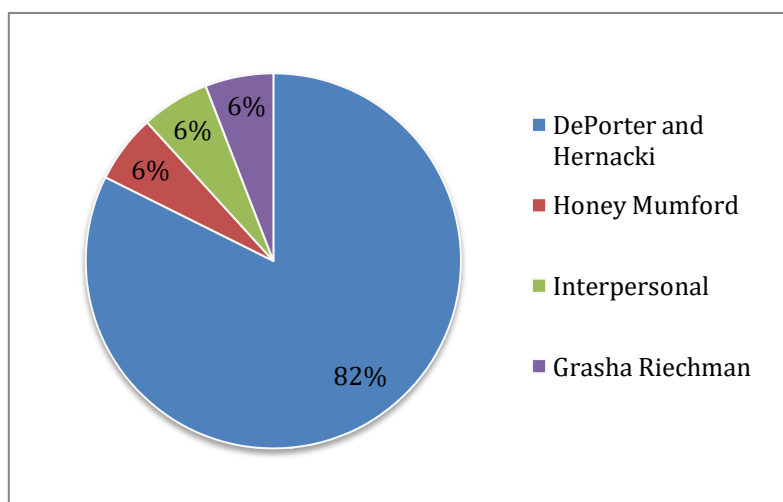


Figure 8. Study by Learning Style Theory Used in The Research

Based on Figure 8, we can conclude that theory De Porter & Hernacki was mostly utilized in the research of students' understanding conceptual in mathematics based on learning style during these past five years with the presentation reaching the number 82% from the total. This could be because Deporter & Hernacki learning style are more effectively used by researcher because this theory based on the sensory modalities involved in retrieving information. As we know, the learning process definitely involves sensory, such as hearing, sight, and touch.

Based on the use of DePorter & Hernacki's learning style theory, it is generally obtained that visual students and auditory students have a fairly good conceptual understanding ability compared to kinesthetic students and meet almost all indicators of understanding mathematical concepts, namely presenting concepts in various mathematical representations, giving examples and non-examples, restating concepts, and applying algorithms (Khoirunnisa & Soro, 2021; Setiana et al., 2019)

Based on a study conducted on students' conceptual understanding in mathematics based on learning styles, it was found that differences in learning styles contributed to students' ability to understand mathematical concepts (Setiana et al., 2019; Virgana, 2019; Khoirunnisa & Soro, 2021). 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 conceptual understanding in mathematics.

CONCLUSION

By the SLR method, it was found the articles of students' conceptual understanding in mathematics based on learning style was gaining a big attention proven by the existence of its articles published each year. This also shows that conceptual understanding in mathematics based on learning style is acknowledge as an important topic to be observed due to its purpose in finding students' level of conceptual understanding in solving mathematical problem based on their learning style. The research of students' conceptual understanding in mathematics based on learning style was dominantly conducted in Java island. In addition, De Porter & Hernacki theory was dominant learning style theory used in this study. Differences in learning styles contributed to students' ability to understand

mathematical concepts, so teachers need to give attention to student learning styles in order to be able to provide appropriate learning designs to improve students' conceptual understanding ability. This research also can help teacher to find the best method, model, learning design, or assignment to the students in the direction of developing, maturing and escalating students' conceptual understanding in mathematics based on their learning style.

RECOMMENDATION

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' conceptual understanding in mathematics based on learning style.

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