

Research Article

Spatial Ability in Learning Mathematics: Systematic Literature Review (SLR)

Nasrul Naufal^{1*} and Dadang Juandi²

Department of Mathematics Education FPMIPA Universitas Pendidikan Indonesia, Jl. Dr. Setiabudi No.229 Bandung 40154, Indonesia

ORCIDNasrul Naufal: <https://orcid.org/0009-0000-9866-7003>Dadang Juandi: <https://orcid.org/0000-0001-6997-1399>**Abstract.**

Spatial ability plays a crucial role in the study of geometry. When related to the context of mathematics, especially geometry, it becomes apparent that having and developing spatial abilities is crucial. Academic achievement, particularly in understanding mathematics and geometry, was closely linked to spatial ability. The researcher conducted a study using the Systematic Literature Review (SLR) method to uncover the latest information on spatial ability in learning mathematics. Summarizing and interpreting a total of 18 accredited journal articles from various databases in the period 2016-2021, the researcher produced a review presented in a graph, including the year of publication, education level, a method used, sample size, and demography. Spatial abilities in mathematics learning have received considerable attention in research. However, the number of studies on spatial abilities in mathematics learning has decreased in the last two years. In addition, spatial abilities in early childhood have not been optimized. This is disappointing because spatial abilities are closely related to children's cognitive development. This literature review recommends conducting research on spatial abilities in various provinces in Indonesia, emphasizing the significance of high spatial abilities for good mathematical performance.

Keywords: learning mathematics, spatial ability, systematic literature review.

Corresponding Author: Nasrul

Naufal; email:

nasrulnaufal@upi.edu

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1. INTRODUCTION

Mathematics has an important role in the world of education, in Indonesia mathematics is studied at every level of education. Starting from elementary school to university, students are expected to be able to master mathematics well so that they can develop their mindset. According to James and James, mathematics is the science of logic, shape, magnitude, arrangement, and concepts related to each other which consists of three major branches, namely algebra, analysis, and geometry [1]. Therefore, mathematics is a subject that demands a systematic, logical, rational, and critical thinking pattern.

One of the branches of mathematics that are considered difficult by students is geometry. Geometry is related to the shape, size, composition, proportion, and properties of

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an object and their relationship to one another [2]. Geometry is the study of points, lines, planes, space objects, and their properties, sizes, and relationships with one another [3]. Geometry is a branch of mathematics that we often encounter in everyday life, this is because geometry exists in almost every visual object. According to Usiskin, the reasons for geometry are important to be taught, namely: 1) Geometry is a field of mathematics that can connect mathematics with the physical form of the real world; 2) Geometry can allow mathematical ideas to be visualized; 3) Geometry can provide more than one example of a mathematical system. The factor that plays an important role in studying geometry is spatial ability [4]. Spatial ability is also important for success in many fields of study such as mathematics, natural sciences, engineering, architecture, etc., all of which involve the use of spatial skills. Many studies have found that high spatial skills are associated with better math performance. This is following what was said by Purborini and Hastari in their research on spatial abilities in polyhedrons in terms of gender differences, saying that students who show that they fulfill the aspect of spatial ability can solve problems using pictures and can see the problem from a different perspective [3].

Spatial ability is the ability to perceive the visual-spatial world accurately and the ability to make changes by sight or by imagining [5]. Meanwhile, according to Clement and Battista, spatial reasoning ability is the ability that involves one's cognitive processes to present and manipulate spatial forms, relationships, and image formation [6]. The spatial ability is the ability to imagine, compare, guess, determine, construct, represent, and find information from visual stimuli in the context of space [7]. Spatial ability is an abstract concept that includes spatial perception involving spatial relationships including orientation to complex abilities involving manipulation and mental rotation [8]. Therefore, in general, spatial abilities require visualization which requires individuals to transform, namely changing the shape of things seen by the eye into other forms, for example observing in the mind and then pouring the recording into a painting or sketch.

If it is related to the context of mathematics, especially geometry, it turns out that spatial abilities are very important to have and develop. Spatial ability is closely related to academic achievement, especially to understand mathematics and geometry [9]. The main emphasis is on drawing three-dimensional shapes into two-dimensional shapes [10]. In solving problems in three dimensions, the spatial ability is very much needed, because in the spatial material many questions cannot be shown in their actual form, so they can only be drawn or visualized in two dimensions. This three-dimensional visualization into two-dimensional form requires the imagination of students, so it often confuses some students.

Based on the description above, the importance of spatial ability in learning, especially learning mathematics. Therefore, researchers are interested in conducting a literature review on spatial abilities in mathematics learning. So that it can be used as a guide for researchers related to spatial abilities in mathematics learning in developing and researching further. The main purpose of this study is to describe the results of research related to spatial ability in mathematics learning based on the year of publication, education level, the method used, sample size, and demography. Therefore, an important stage of SLR is collecting data in the form of research results on spatial abilities in mathematics learning. Through the extracted research data, the researcher asked several relevant questions as follows:

1. How is the description of research results regarding spatial ability in mathematics learning based on the year of publication?
2. How is the description of research results regarding spatial ability in mathematics learning based on education level?
3. How is the description of research results regarding spatial ability in mathematics learning based on the method used?
4. How is the description of research results regarding spatial ability in mathematics learning based on sample size?
5. How is the description of research results regarding spatial ability in mathematics learning based on demography?

2. RESEARCH METHOD

The method used in this study is the SLR (Systematic Literature Review) method. Research is conducted by identifying, reviewing, evaluating, and interpreting all available research. With this method, researchers review and identify journals systematically which in each process follow the steps that have been set [11]. There are five stages in carrying out a literature review, that is: 1) formulating research questions; 2) searching for articles; 3) evaluating articles; 4) summarizing the article; and 5) interpreting article findings [12].

Based on the stages above, the researchers collected journal articles with the keyword spatial ability in learning mathematics. Data collection was carried out by documenting all articles obtained in the 2016-2021 period. The articles used in this study were 18 accredited national journal articles related to the keywords used. Articles obtained

from google scholar, and SINTA. Article data is presented in a graph which includes the year of publication, level of education, the method used, sample size, and demography. The selected articles are articles that have similar research and then the articles are analyzed and summarized. The results of the research are then incorporated into a complete discussion in this article.

3. result and discussion

3.1. Year of Publication

These criteria are grouped into six categories that is the periods 2016, 2017, 2018, 2019, 2020, and 2021. For more details, see Fig.1.

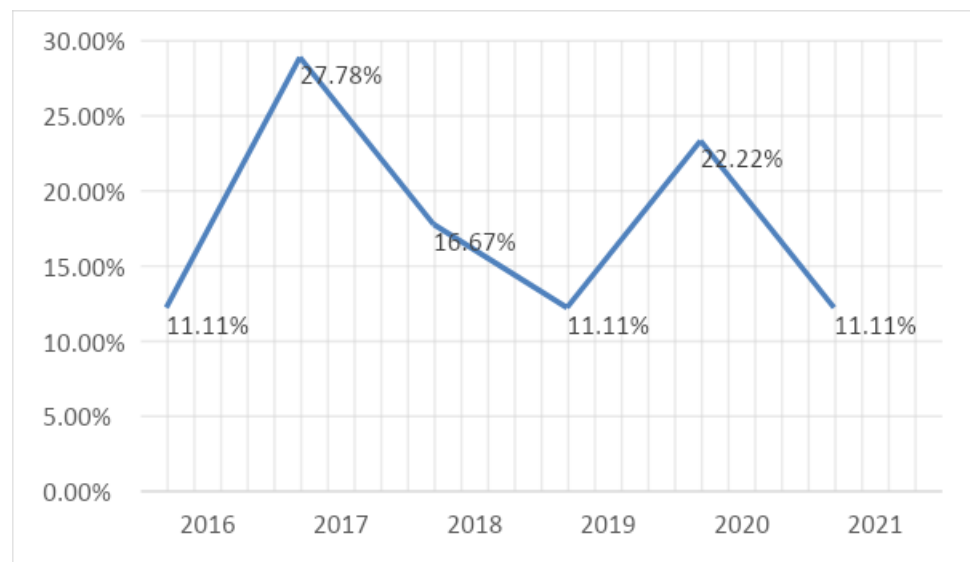


Figure 1: Data by year of publication.

Figure 1 shows that in the period 2016-2021 spatial ability research on mathematics learning was widely published in 2017, which was 27.78%. Meanwhile, in 2016, 2019 and 2021 published research on spatial ability in mathematics learning was the lowest in the last 6-year period. Figure 1 also shows that from 2017 to 2019 research on spatial ability in mathematics learning has decreased. Then it increased again in 2020 but decreased again in 2021.

3.2. Education Level

The criteria for the education level are grouped into three categories, namely: Elementary School (SD), Junior High School (SMP), and Senior High School (SMA). The following is an image for the research level criteria.

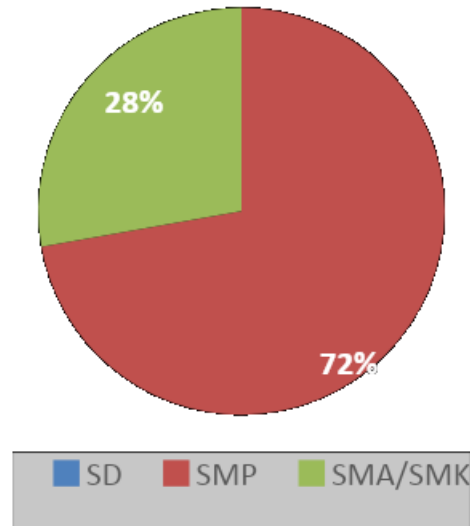


Figure 2: Data by education level.

Based on Fig. 2, shows that research on spatial ability in learning mathematics dominates at the SMP level, which is 72%. While at the SD level, there is no research on spatial ability in mathematics learning, as well as being the lowest compared to other levels. This is a concern because basically spatial abilities should be introduced early so that students are accustomed to mathematics which tends to be abstract. At school age, spatial ability is very important because spatial ability in general is closely related to cognitive aspects [13]. It is very important to optimize spatial abilities from an early age because individuals tend to remember and think about 2D and 3D media more easily at the age of 13 years and under [14]. Therefore, it is better to develop spatial abilities as early as possible since the child is born through stimulation of the five senses.

3.3. The Method Used

The criteria for research methods are grouped into four categories, that is Classroom Action Research, Research and Development (RnD), quantitative, and qualitative. The following is an image of the criteria for the research approach.

Based on Fig. 3, the article on spatial ability in mathematics learning at the 2016-2021 level, the methods often used by researchers are quantitative methods and RnD that is

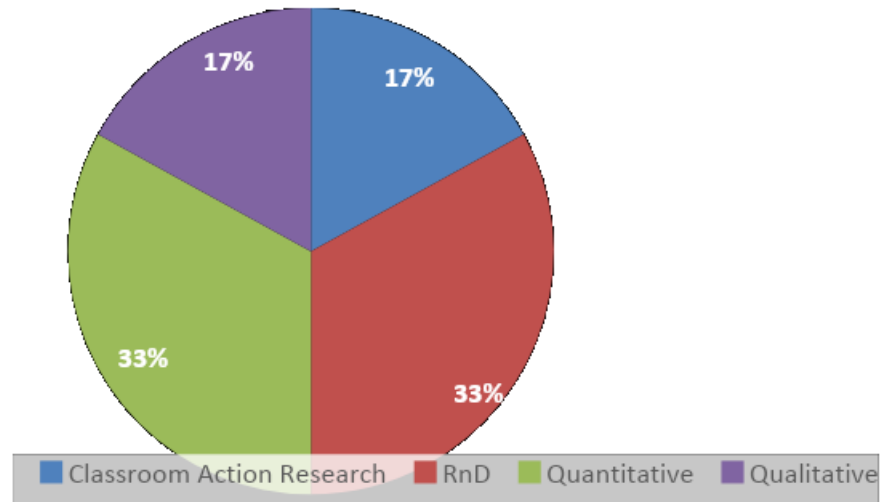


Figure 3: Data by the method used.

six articles or 33%. Meanwhile, research with PTK and qualitative research approaches each contains four articles or 17%.

3.4. Sample Size

In the sample size criteria, they are grouped into two categories that is less than thirty, and more or equal to thirty. The division of these criteria is based on the majority of the number of students in one class of approximately thirty students. The following is an image for the sample size criteria.

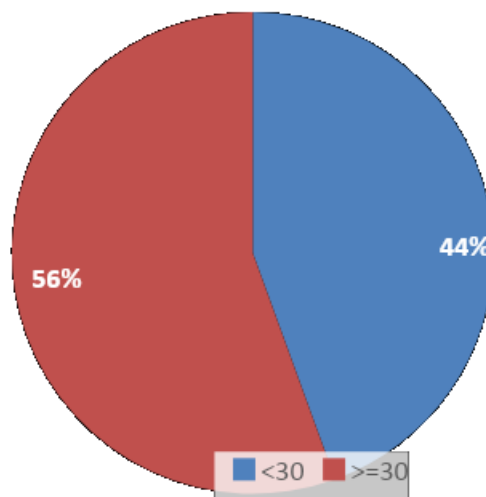


Figure 4: Data by sample size

Figure 4, shows that the majority of articles regarding spatial ability in mathematics learning in the 2016-2021 period are dominated by research with a sample of more than 30 respondents (students) to be studied, which is 56%. This is because the research is dominated by the type of quantitative approach.

3.5. Demography

On the demographic criteria, grouped by province the research was conducted and divided into ten places, namely: Banten, West Java, Central Java, East Java, North Sumatra, Bengkulu, West Nusa Tenggara (NTB), Jakarta, West Kalimantan, and Aceh. Here's a picture of the demographic criteria.

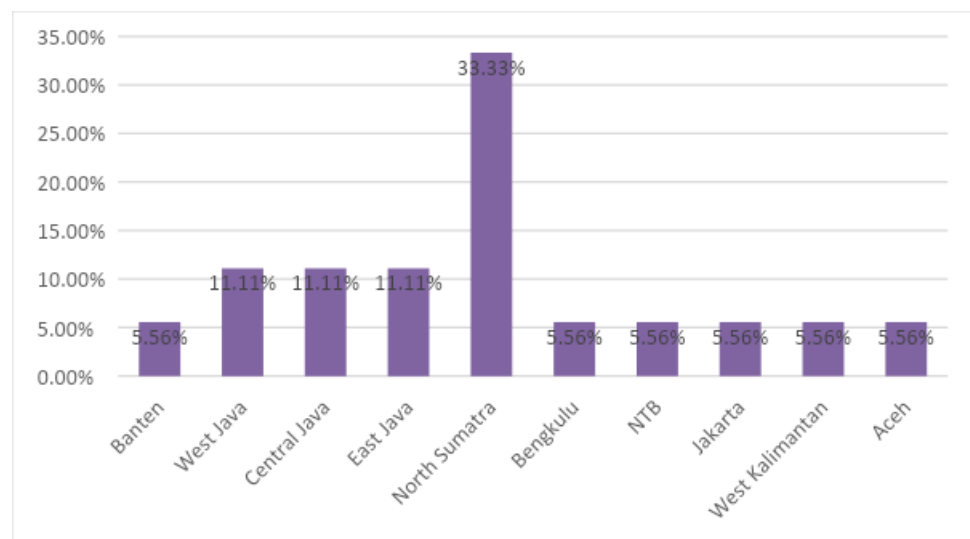


Figure 5: Data by demography

Figure 5 shows that articles on spatial ability in mathematics learning in Indonesia are spread across various provinces. North Sumatra is the province with the most research on spatial ability in mathematics learning in the 2016-2021 period, which is 33.33%. Meanwhile, the provinces of Banten, Bengkulu, NTB, Jakarta, West Kalimantan, and Aceh were the provinces with the least amount of research, which was 5.56%. Of the 34 provinces in Indonesia, only 10 provinces conducted research on spatial abilities in mathematics learning during the 2016-2021 period. Therefore, research on spatial ability in mathematics learning is still not evenly distributed in Indonesia.

4. CONCLUSION

Research on spatial abilities in mathematics learning has received good attention, but the number of studies on spatial abilities in mathematics learning in the last two years continues to decline and research on spatial ability in mathematics learning is still not evenly distributed in Indonesia. In addition, spatial abilities in early childhood have not been optimized, this is disappointing because spatial abilities are closely related to children's cognitive aspects. This literature review recommends conducting research on spatial abilities in various provinces in Indonesia, taking into account the importance of high spatial abilities for good mathematical performance.

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