SPATIAL ABILITY IN MIDDLE SCHOOL MATHEMATICS LEARNING: SYSTEMATIC LITERATURE REVIEW (SLR)

Candra Nugraha [1*], Sufyani Prabawanto [2], Dadang Juandi [3], Rani Sugiarni[4]

[1,2,3,4]Indonesian education university

[1]candnur@gmail.com [2]sufyani_prabawanto@yahoo.com [3]dadang.juandi@upi.edu [4]rani@elemen.ac.id

Corresponding Author: Candra Nugraha

ABSTRAK

Spatial ability is a cognitive process in seeing an object and building a relationship between the object and its environment. This ability is an important element in learning mathematics that can be applied to various problems in life. The data in the form of this article was obtained from the Google Scholar search engine. Furthermore, the data were analyzed using the Systematic Literature Review (SLR) method to obtain information from these articles. The purpose of this study is to analyze published articles about spatial abilities from 2012 to 2022. This study uses the Systematic Literature Review (SLR) method which is used to collect primary data related to spatial abilities published on the Google Scholar search engine. Selection data based on journal index, publication year, education level, sample size, research location, and research materials. From the research results it is known that the most published research was in 2018 and the most widely applied to geometry teaching materials. The results of the study also show that most of the research on spatial abilities is carried out on the island of Java at the junior high school level. From this study it is also recommended that similar research be carried out outside Java and use material for elementary, high school, university levels, and also use material for statistics, algebra, and arithmetic.

ABSTRACT

Kemampuan spasial adalah proses kognitif dalam melihat suatu benda dan membangun hubungan antara benda tersebut dengan lingkungannya. Kemampuan ini merupakan unsur penting dalam pembelajaran matematika yang dapat diterapkan pada berbagai permasalahan dalam kehidupan. Data-data berupa artikel ini didapat dari mesin pencari Google Scholar. Selanjutnya data-data dianalisis dengan metode Systematic Literature Review (SLR) untuk mendapatkan informasi dari artikel-artikel tersebut. Tujuan dari penelitian ini adalah untuk menganalisis artikel yang dipublikasikan tentang kemampuan spasial dari tahun 2012 hingga 2022. Penelitian ini menggunakan metode Systematic Literature Review (SLR) yang digunakan untuk mengumpulkan data primer terkait kemampuan spasial yang dipublikasikan di mesin pencari Google Scholar. Pemilihan data didasarkan pada indeks jurnal, tahun publikasi, tingkat pendidikan, ukuran sampel, lokasi penelitian, dan bahan penelitian. Dari hasil penelitian diketahui bahwa penelitian yang paling banyak dipublikasikan adalah pada tahun 2018 dan paling banyak diterapkan pada bahan ajar geometri. Hasil penelitian juga menunjukkan bahwa sebagian besar penelitian tentang kemampuan spasial dilakukan di Pulau Jawa pada tingkat SMP. Dari penelitian ini juga direkomendasikan agar penelitian serupa dilakukan di luar pulau Jawa dan menggunakan materi tingkat SD, SMA, Universitas, dan juga menggunakan materi statistika, aljabar, dan aritmatika.

Kata kunci: kemampuan Spasial, *Sistematik Literatur Reviu.*

INTRODUCTION

Aiming to develop students' ability to become people of faith and piety to God Almighty, have noble character, be healthy, knowledgeable, capable, creative, independent, and become a democratic and responsible citizen, national education is based on Law No. 2 of 2003. Also, it seeks to develop a respectable national character and civilization. (War-wind & Khayroyah, 2021) According to Law No. 14 of 2005 Concerning Teachers and Lecturers, teachers are

professional educators whose major responsibility is to educate, teach, guide, lead, train, assess, and evaluate their pupils from formal primary and secondary school through early childhood education.

This explanation demonstrates the critical role that teachers play in developing future generations that are academically and morally strong. In this country the teaching profession has many variations, one of which is a mathematics teacher. The role of mathematics is so fundamental in the education of students, that it is not wrong to say "mathematics is the queen of science or mother of science", meaning that mathematics is another source of knowledge.

As a science, mathematics comprises knowledge of shapes and sizes, the use of calculation skills, and most significantly, the ability to think independently by recognizing and applying relationships. Hasratuddin (2014). (2014). Mathematics is used in many fields, inventions, and breakthroughs (Andriani, 2008). According to various research, mathematics is significant since it can raise pupils' intellectual capacity (Mariamah, 2012). According to James & James (Suherman, 2003), mathematics is the discipline that deals with the order of shape, arrangement, amount, and concepts that are connected to one another in enormous numbers. It is separated into three fields: algebra, analysis, and geometry.(Siswanto & Kusumah, 2017)

In learning mathematics there is an important ability to describe, namely spatial ability. In this case the development of spatial skills is important in order to understand the connection and quality of congruence to solve mathematical difficulties and practical applications. According to (NCTM, 2000), one aspect of teaching similarity in schools is to ensure that students can solve problems through visualization, spatial reasoning, and geometric modeling of existing problems. Spatial abilities, according to Subroto (Afriyana & Mampouw, 2018), include storing, remembering, understanding, changing, producing, and communicating spatial structures in the mind. In the classroom, spatial competence is related to geometric content. According to Oktaviana (2016), Spatial ability is a cognitive process of seeing an item and building relationships between that item and its surroundings. The term "spatial ability" can also refer to the capacity to perceive the visual-spatial world accurately, which includes the capacity to accurately identify shapes and objects, to mentally alter an object and recognize those changes, to mentally describe something and transform it into a physical form, and to be sensitive to balance, relation, color, line, shape, and space. (Maemunah, 2015). makes a change to an object in his mind and recognizes the change, describes a thing or object in his mind and changes it. into a real form, as well as sensitivity to balance, relation, color, line, shape, and space (Maemunah, 2015). makes a change to an object in his mind and recognizes the change, describes a thing or object in his mind and changes it. into a real form, as well as sensitivity to balance, relation, color, line, shape, and space (Maemunah, 2015).

According to Maier in Suparno (2013) explains that spatial ability is an abstract concept which includes five elements of spatial ability including: Spatial perception (ability to observe a spatial structure placed in a vertical or horizontal position), spatial visualization (ability to visualize the movement of a figure space or changes in parts of a geometric shape), rotational ability (the ability to quickly and precisely rotate 2-D or 3-D images), spatial relations (the ability to understand the shape of an object or part of that object and the relationship between one part and another), spatial orientation (the ability to orient oneself, either physically or mentally in a space).(AH Putri, 2017)

In this study, a systematic literature review method was used. Systematic literature review is a research method that identifies, interprets, and evaluates findings on a research topic to answer predetermined questions (Kitchenham & Charters, 2007). With this research it is

hoped that it can contribute to the insight of spatial abilities and can bridge existing knowledge for similar research in the future. It is also hoped that this research will become useful information material for educators to make spatial abilities an important element in teaching students.

RESEARCH METHODS

SLR, or systematic literature review, was used to produce this article. A systematic literature review, sometimes referred to as a systematic literature review, is a literature review approach that identifies, reviews, analyzes, and interprets all available research. It is written in Indonesian. Researchers can evaluate and identify journals using this strategy in an organized way, with each stage based on specified processes (Triandini, Jayanatha, Indrawan, Werla Putra, & Iswara, 2019). Journal articles from Google Scholar were gathered for this investigation. The important phrases are systematic and geographical review of literature. (Afsari, Safitri, Harahap, & Munthe, 2021)

A research technique called a systematic literature review collects, examines, and assesses information on a research topic in order to respond to preset questions (Kitchenham & Charters, 2007). Amin Suyitno's Choifah, 2022). A study technique called a systematic review identifies, assesses, and interprets all pertinent research findings pertaining to particular research questions, particular subjects, or problematic occurrences (Kitchenham, 2004). A primary study is an individual's own investigation, whereas a secondary study is a systematic review (secondary study). A systematic review will be very helpful for combining numerous important study findings on the subject, making the information offered to decision-makers more thorough, impartial, and responsible..(Siswanto, 2010)

In another sense, Systematic Literature Review (SLR) is also defined as a review to find out what is already known from pre-existing research on a particular phenomenon, subject or topic (Van Klaveren & De Wolf, 2019). The goals in SLR research include identifying, reviewing, evaluating and interpreting all existing research with existing phenomenal topic areas as well as specific research questions related to the topic (Triandini et al., 2019).Systematic Literature Review (SLR) is also interpreted as a review to find out what is already known from previous research about a particular phenomenon, subject or topic (Van Klaveren & De Wolf, 2019). There are several objectives in SLR research, including identifying, reviewing, evaluating and interpreting all available research with interesting topic areas and relevant research questions (Triandini et al., 2019).(Khairunnisa, Juandi, & Gozali, 2022)

According to (Juandi, 2021), systematic literature review (SLR) is a research methodology that seeks to identify and synthesize exhaustive research that answers particular topics, utilizing an organized, transparent, and repeatable procedure at every stage of the process. A quality SLR takes the necessary precautions to reduce bias and mistakes. This is crucial in research synthesis since bias can appear during original research as well as during publication, dissemination, and review processes, and it can accumulate over time. Bias routinely overstates or understates the effects, which can result in incorrect inferences. A systematic review, like any successful study, adheres to a protocol (detailed plan) that first specifies its primary objectives, ideas, and methodologies.

The stages contained in the SLR method are simplified by Adrian, Abdullah, Atan, & Jusoh (2016) so that they consist of three stages which include planning, implementation, and reporting. The planning stage looks at the protocol which is structured based on the particular research context, defines the review protocol and develops research questions. Then proceed

with carrying out the next stage, namely searching and extracting data to categorize data items as a result. The last stage is the reporting stage which concludes the results of the proposed research and discussion.(Marbawi & Salim, 2019). Inclusion Requirements The following inclusion criteria were used to all study articles found in the initial search to determine which ones should be considered for the meta-analysis: 1. Years of publication range from 2012 to 2022. 2. Articles involving Indonesian authors and published in national journals, Google Scholar, or those that have been indexed SINTA. 3. Research articles on spatial abilities and others are conventional classes or other models as control classes. 4. The study articles report sufficient data for effect size transformations.(Paloloang, Juandi, Tamur, Paloloang, & Adem, 2020).

Spatial ability is the talent to see spatial relationships, present, transform, and communicate back symbolic information, as well as the capacity to articulate and embody mental concepts. Sorby (2009) and Tartre (1990) shown that spatial ability is a mental process that involves the capacity to move items mentally and switch points of view when looking at objects) demonstrated that spatial ability is a mental process.. Meanwhile, Clements (1998) defines spatial ability as a mental operation in building an organization or forming an object or a collection of objects.(Rizky Oktaviana Eko Putri, 2018). Spatial ability is the ability to understand the visual-spatial world and make changes to that perception appropriately involving sensitivity to color, line, shape, space and their relationships among existing elements (Hutagalung and Harahap, 2018).(Isnayanti et al., 2020).This spatial visual is closely related to geometric material. In Indonesia, geometry is a subject that students must learn from elementary school to university.(Fita Fatmawati 1), 2018). This ability can understand the elements or definition of a particular geometric shape or solve problems contained in that geometric shape. The ability to imagine a real shape and then solve various problems related to this ability is what stands out in this type of spatial ability.(Narpila, 2019)

The core of spatial intelligence, according to Gardner (2011: 173), is the capacity to accurately perceive the visual world, change, and adjust one's visual experience, even in the absence of any pertinent physical stimuli. The capacity to visualize and imagine in two and three dimensions is known as spatial intelligence (Femi in Wardhani et al., 2016: 908). (2018) Hodiyanto. According to Tambunan (2006), having strong spatial ability can aid in understanding current mathematical features and concepts. Children can learn arithmetic concepts by using spatial examples, such as creating charts and graphs. Similarly, the spatial experience that came before it affects how we grasp the meaning of the concepts of division and proportion. (Clements in Tambunan, 2006).(Febriana, 2015)

This geometric content that is so familiar with this spatial ability consists of a number of ideas that can be represented by symbols as well as a number of abstract representations that are difficult for students to understand without instruction, help, or mediation from adults. According to Risalah et al., (2019) in geometry, students are required to be able to visualize, manipulate, and compare objects in solving existing problems. For example, if students are asked to find a ratio of the shaded area of a geometry, then students can imagine and manipulate the geometric object as a solution to solving the problem.(Khofifah, Treatise, & Sandie, 2022)

Researchers are interested in performing a thorough literature review study on this spatial skill because of how crucial it is for learning mathematics. The goal of this study is to conduct a literature review on spatial abilities using data from journal indexes, research levels, sample sizes, study sites, and research materials. The range of publications covered the years

2012 through 2022. The inclusion criteria were applied to 31 studies that discussed spatial ability. The researcher then sorts and analyzes the already-published papers.

The author uses the PRISMA Protocol (Preferred Reporting Items for Systematic Reviews and Meta-Analyzes) in which there are four steps in this protocol, namely identification, screening, suitability and final (Liberati, 2009), (D.Juandi, 2021), (Juandi & Tamur, 2020), which is explained as follows: a. Stage 1 (Identification) There are 40 study articles identified related to spatial abilities using the Google Schoolar, Publish or Perish search engine starting in 2012-2022. b. Stage 2 (Screening) From 40 study results there is no duplication of data. c. Stage 3 (appropriateness) After making adjustments to the criteria, there are 31 articles selected d. Stage 4 (Final Articles) There are 32 articles that comply with the provisions regarding spatial abilities to be analyzed.(AA Putri, Juandy, & Indonesia, 2022).

RESULTS AND DISCUSSION
1. Criteria-Based Studies

In this writing, inclusion criteria were applied to existing articles, and categorized based on the journal index, year of publication, level of education, sample size of research location, and research material. We can see in Table 1

Characteristics Study	Criteria	Frequency
Journal Index	S1	0
	S2	3
	S3	7
	S4	12
	S5	5
	S6	1
	Google Scholar	3
Year of Publication	2012	0
	2013	0
	2014	2
	2015	2
	2016	1
	2017	5
	2018	8
	2019	2
	2020	4
	2021	5
	2022	2
Educational level	Elementary School	0
	Junior high school	19
	Senior high school	8
	University	4
Sample size	<30	18
	≥30	13
Research sites	Sumatra	7
	Java	18
	Borneo	3
	Sulawesi	2
	Nusa Tenggara	1
	Papua	0
Research Materials	Geometry	28
	Statistics	0
	Algebra	0

Material not mentioned	3

Table 1. Number of Studies Based on Criteria

2. Studies Based on Journal Indexers

Below is an explanation of the number of articles based on journal indexers, both Sinta and Google Scholar, which can be seen in Figure 1:
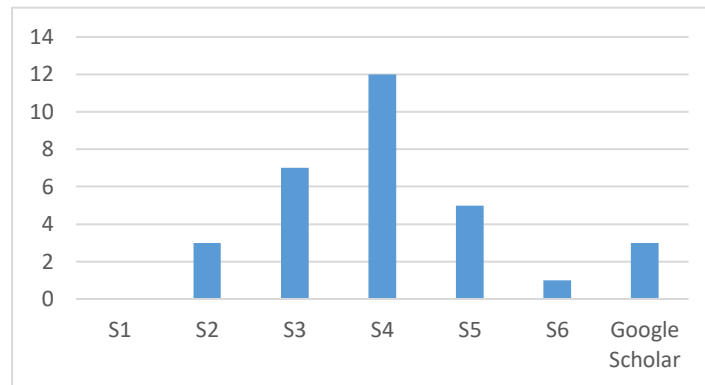

Figure 1. Studies Based on Journal Indexers

Figure 1 shows that scientific articles related to spatial abilities are most widely published in the journal Sinta 4, followed by the journal Sinta 3 in the second position, then the journal Sinta 5 in the third position, then the journal Sinta 2 and Google Scholar in the fourth position, and nothing is found. article on spatial abilities in the journal Sinta 1.

3. Studies by Year of Publication

The number of articles obtained based on the criteria applied resulted in articles published in the 2012 to 2022 range as we can see in Figure 2 below:
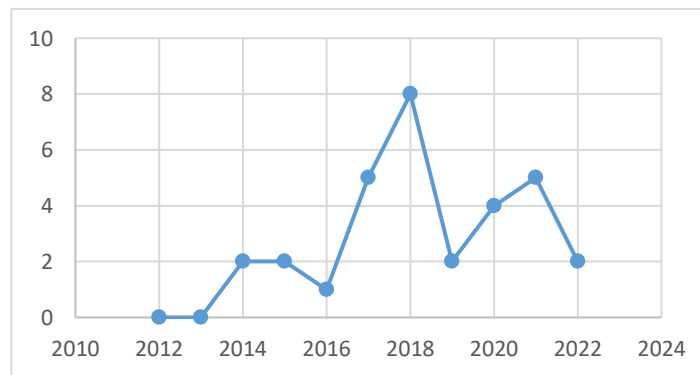

Figure 2. Studies Based on the Year of Publication

In Figure 2. we can see that research on spatial abilities tends to increase in the period 2012 to 2018 and experienced the most published period in 2018. From the graphical form we can see that research on spatial abilities is an important matter.

4. Studies Based on Educational Level

The number of studies on spatial abilities based on educational level can be seen in Figure 3 below:
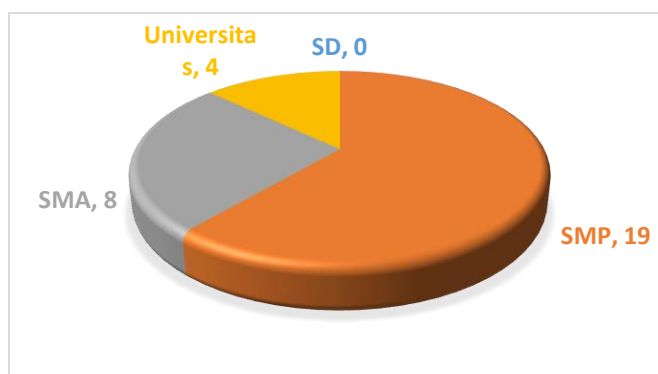

Figure 3. Study Based on Education Level

From Figure 3, we can see that most research on spatial abilities is carried out at the junior high school level and is rarely carried out at the elementary school level. Referring to this we can consider conducting research at the elementary school level.

5. Study Based on Sample Size

For categorizing research, samples with a data size of less than 30 and samples with a data size of more than 30 might be used as the criteria.. We can see this in Figure 4. The following:
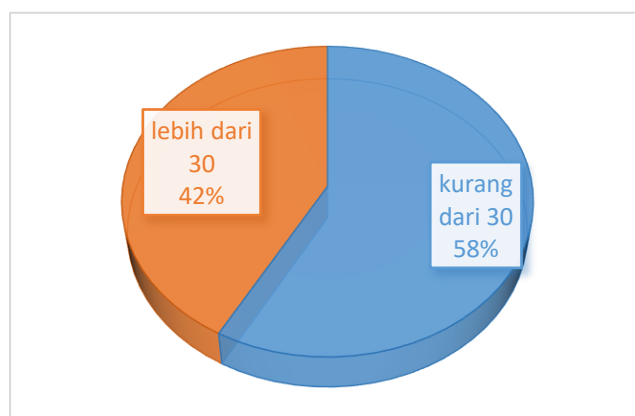

Figure 4. Study based on the number of samples

From the information above, we can see that most of the research on existing article writing uses a sample size below 30 and the rest uses a sample above 30.

6. Studies Based on Research Locations

We can see the distribution of studies based on research locations related to spatial ability articles in Figure 5 below:
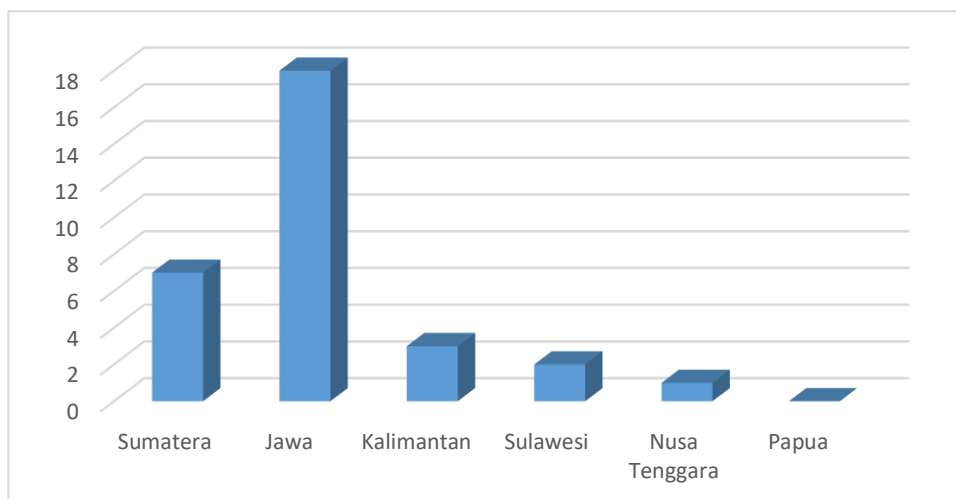
Figure 5. Studies by Research Locations

Based on Figure 5, we can conclude that the largest number of studies related to spatial abilities have been carried out on the island of Java, followed by the islands of Sumatra, Kalimantan, Sulawesi, Nusa Tenggara, and minimally found on the island of Papua. This can be used as material for consideration for further research so that spatial ability research is carried out on the islands of Nusa Tenggara and Papua.

7. Studies Based on ResearchMaterials

In the figure below, the distribution of studies based on research material in spatial abilities is presented in Figure 6 below:

Figure 6. Study Based on Educational Materials

Based on Figure 6, it can be concluded that the research material on spatial abilities is mostly done on Geometry material.

CONCLUSION

Based on the analysis's findings, it can be said that Sinta 4 has published the most research on spatial abilities over the period of 2012 to 2022, with 2018 being the year with the highest number of publications. It was also discovered that less than 30 people were chosen as

the greatest sample size, that junior high school was the academic level where research was conducted the most frequently. The junior high school level was the most frequently found for it's research. And Java Island accounted for the majority of study locations. Geometry is the material that is most frequently employed.

RECOMMENDATION

The author urges that in future research be carried out more outside Java with the use of Algebra and Statistics teaching materials

REFERENCES

Afsari, S., Safitri, I., Harahap, S. K., & Munthe, L. S. (2021). Systematic Literature Review: Efektivitas Pendekatan Pendidikan Matematika Realistik Pada Pembelajaran Matematika. *Indonesian Journal of Intellectual Publication*, *1*(3), 189–197. https://doi.org/10.51577/ijipublication.v1i3.117

Al Hafizin, M., Tendri, M., & Kusumawati, I. (2018). *Analisis Kemampuan Spasial Siswa Pada Geometri Kubus Dan Balok Di Kelas Ix Smp Negeri 03 Pulau Beringin*. *3*(November), 60–65.

Astuti, R. N., Sugiatno, & Bistari. (2016). Kemampuan Penelaran Spasial Matematis Siswa Dalam Geometri Di Sekolah Menengah Pertama. *Jurnal Pendidikan Dan Pembelajaran*, *5*(10), 1–14.

Choifah, Amin Suyitno, E. P. (2022). Systematic Literature Review: Kemampuan Berpikir Kreatif Pada Pembelajaran Matematika. *Didactical Mathematics*, *3*(1), 3158–3166. https://doi.org/10.31949/dm.v3i1.914

Fatmahanik, U. (2021). Penalaran Spasial Geometri Ruang Mahasiswa Calon Guru MI/SD Berkemampuan Awal Tinggi Berdasarkan Gender. *Briliant: Jurnal Riset Dan Konseptual*, Vol. 6, p. 513. Universitas Nahdlatul Ulama Blitar. https://doi.org/10.28926/briliant.v6i3.651

Febriana, E. (2015). Profil Kemampuan Spasial Siswa Menengah Pertama (SMP) dalam Menyelesaikan Masalah Geometri Dimensi Tiga Ditinjau dari Kemampuan Matematika. *Jurnal Elemen*, *1*(1), 13. https://doi.org/10.29408/jel.v1i1.78

Fita Fatmawati1), K. A. H. (2018). Pengaruh Pendekatan Pendidikan Matematika Realistik Terhadap Kemampuan Penalaran Spasial Pada Materi Volume Dan Luas Permukaan. *Jurnal Penelitian Pendidikan Matematika*, *2*, 102–111.

Hodiyanto, H. (2018). Kemampuan spasial sebagai prediktor terhadap prestasi belajar geometri mahasiswa. *Jurnal Mercumatika : Jurnal Penelitian Matematika Dan Pendidikan Matematika*, Vol. 2, p. 59. Universitas Mercu Buana Yogyakarta. https://doi.org/10.26486/jm.v2i2.364

Isnayanti, I., Harahap, M. S., Kunci, K., Penigkatan, :, Spasial, K., & Matematika, P. (2020). Meningkatkankan Kemampuan Spasial Matematika Siswa Di Smp Negeri 3 Padangsidimpuan. *Mathematic Education Journal)MathEdu*, *3*(1), 117–122. Retrieved from http://journal.ipts.ac.id/index.php/

Juandi, D. (2021). Heterogeneity of problem-based learning outcomes for improving mathematical competence: A systematic literature review. *Journal of Physics: Conference Series*, *1722*(1). https://doi.org/10.1088/1742-6596/1722/1/012108

Khairunnisa, A., Juandi, D., & Gozali, S. M. (2022). Systematic Literature Review: Kemampuan Pemahaman Matematis Siswa dalam Menyelesaikan Masalah Matematika.

Jurnal Cendekia : Jurnal Pendidikan Matematika, *6*(2), 1846–1856. https://doi.org/10.31004/cendekia.v6i2.1405

Khofifah, K., Risalah, D., & Sandie, S. (2022). Analisis Kemampuan Spasial Siswa Pada Materi Geometri Kelas VII. *JUPENJI : Jurnal Pendidikan Jompa Indonesia*, Vol. 1, pp. 58–64. Indonesian Society of Applied Science. https://doi.org/10.55784/jupenji.vol1.iss1.150

Marbawi, M. I., & Salim, T. A. (2019). Mempertahankan keaslian arsip elektronik di era digital berdasarkan tinjauan literatur sistematis. *Berkala Ilmu Perpustakaan Dan Informasi*, *15*(2), 149. https://doi.org/10.22146/bip.47370

Narpila, S. D. (2019). PERBEDAAN KECERDASAN SPASIAL ANTARA SISWA LAKI-LAKI DAN SISWA PEREMPUAN KELAS X SMA YPK MEDAN PADA MATERI GEOMETRI. *Jurnal Prinsip Pendidikan Matematika*, Vol. 2, pp. 34–41. Program Studi PGSD FKIP Universitas Riau. https://doi.org/10.33578/prinsip.v2i1.39

Paloloang, M. F. B., Juandi, D., Tamur, M., Paloloang, B., & Adem, A. M. G. (2020). *META ANALISIS : PENGARUH PROBLEM-BASED LEARNING TERHADAP KEMAMPUAN LITERASI MATEMATIS SISWA DI INDONESIA TUJUH TAHUN TERAKHIR Universitas Pendidikan Indonesia , Bandung , Indonesia Universitas Katolik Indonesia Santu Paulus Ruteng , Indonesia Universitas . 9*(4), 851–864.

Perangin-angin, D. S., & Khayroiyah, S. (2021). Analisis Kemampuan Spasial Visualization Siswa Pada Materi Geometri Transformasi Menggunakan Aplikasi Zoom Di Sma Persiapan Stabat T.P.2020/2021. *Maju*, *8*(2), 389–398.

Prastyo, Y. (2017). DESKRIPSI KEMAMPUAN SPASIAL SISWA SMP DITINJAU BERDASARKAN PERBEDAAN GENDER DAN KEMAMPUAN MATEMATIKA. *Jurnal Ilmiah Soulmath : Jurnal Edukasi Pendidikan Matematika*, Vol. 5, pp. 22–30. Dr. Soetomo University. https://doi.org/10.25139/sm.v5i1.454

Putri, A. A., Juandy, D., & Indonesia, U. P. (2022). *Symmetry | Pasundan Journal of Research in Mathematics Learning and Education*. *7*, 135–147. https://doi.org/10.23969/symmetry.v7i2.6493

Putri, A. H. (2017). Pengaruh Kemampuan Spasial Terhadap Kemampuan Geometri Pada Peserta Didik Kelas VIII SMP Swasta Di Kecamatan Kebomas Gresik. *Didaktika*, *23*(2), 114–121.

Rizky Oktaviana Eko Putri, U. N. I. (2018). Studi tentang kemampuan spasial siswa sekolah menengah pertama (smp) di mojokerto. *Majamath*, *1*, 135–141.

Siswanto. (2010). Systematic Review Sebagai Metode Penelitian Untuk Mensintesis Hasil-Hasil Penelitian. *Jurnal Litbang Kementerian Kesehatan*, (i), 326–333.

Siswanto, R. D., & Kusumah, Y. S. (2017). Peningkatan Kemampuan Geometri Spasial Siswa Smp Melalui Pembelajaran Inkuiri Terbimbing Berbantuan Geogebra. *Jurnal Penelitian Dan Pembelajaran Matematika*, *10*(1). https://doi.org/10.30870/jppm.v10i1.1196.

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