Mathematical Logical Intelligence Of Junior High School Students In Natural Sciences: Systematic Literature Review

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Abstract. Mathematical logical intelligence is one of the important things in supporting natural science learning. The purpose of this research is to identify and analyze studies relevant to the mathematical logical intelligence of junior high school students in natural science learning. This research was conducted using the systematic literature review method by reviewing various previous studies that are relevant and in accordance with the issues discussed. Based on the results of the systematic literature review research that has been carried out, it can be concluded that mathematical logical intelligence has a close relationship with science learning outcomes of junior high school students. The mathematical logical intelligence of junior high school students in learning natural sciences is mostly found in class VIII with a percentage of 50%. The relationship between mathematical logical intelligence in natural sciences is highest with the field of physics, namely 43%. The highest aspect of mathematical logical intelligence is mathematical ability, namely 28%. The factor most commonly found in supporting the mathematical logical intelligence of junior high school students in learning natural sciences is the learning achievement factor, namely 41%.

Keywords: *Mathematical logical intelligence; Junior high school; Natural science*

INTRODUCTION

Science education has often been accepted as an integral and very important part of comprehensive schools (Lamanauskas, 2013). Natural science is very important to study to train critical and objective thinking and foster students' curiosity (Ariawati et al., 2021). In addition, natural sciences make an important contribution to the development of global knowledge. In natural sciences, students are encouraged to discover their own material and to be able to convey the material in a complex way (Usmeldi & Amini, 2019).

Mathematical logical intelligence is a high-level thinking ability that is closely related to the characteristics of mathematics which involves reasoning to understand it (Anriani et al., 2019). Logical-mathematical intelligence is one of the eight types of intelligence cited in Gardner's Theory of Multiple Intelligences (Shirawia et al., 2023). Gardner has emphasized that every individual has eight intelligences which are summarized in multiple intelligences, namely linguistic, mathematical, spatial, musical, kinesthetic, interpersonal, intrapersonal and naturalist intelligence (Murni et al., 2020).

People who have high logical/mathematical intelligence are skilled in deductive reasoning, detecting patterns, and thinking logically (Šafranj, 2016). Science teaching generally focuses on integrating thinking processes in learning the basics of mathematics, which facilitates the learning of scientific topics, and improves students' abilities in solving problems in life (Shirawia et al., 2023). Students who are mathematically and logically gifted can choose careers such as in computer programming, database design, systems analysis, network analysis, computer technician, and engineering whether chemical, electronic or mechanical. Apart from that, they are also involved in various other career options such as designing, architecture, physics, astronomy, and other scientific fields (Sheoran et al., 2019).

Furner and Kumar (Furner & Kumar, 2007) prove the need to use mathematics widely for natural science. The success of each student in this area of knowledge depends on the degree to which mathematics is integrated by motivating and engaging students in deep learning of this subject. Mathematical abilities increase the motivation of natural science students and their understanding of the relevance of mathematical knowledge

and skills, should represent natural science problems that can be solved with mathematical tools (Kostrova, 2019).

Several studies regarding the mathematical logical intelligence of junior high school students in learning natural sciences have been carried out to improve the understanding of junior high school students in learning natural sciences (science). This systematic literature review aims to develop a stronger concept, based on previous empirical research. In this study, researchers will identify and analyze studies that are relevant to the mathematical logical intelligence of junior high school students in science learning.

LITERATURE REVIEW

Mathematical Logical Intelligence

Mathematical logical intelligence is one of the main elements of multiple intelligence in mathematics learning because it can be applied in various mathematics topics (Azinar et al., 2020). Mathematical logical intelligence is intelligence that includes aspects of logical and mathematical organization in subjects or students' scientific skills, especially in terms of visual-spatial intelligence (Pérez et al., 2018).

Indicators that show mathematical logical intelligence according to (Boumediene & Nacera, 2022): the ability to use reason, logic and numbers, curiosity, asking questions, finding relationships between information. Meanwhile, indicators of mathematical logical intelligence according to (Widiastuti, 2012) are 1) Able to carry out a series of mathematical operations; 2) Have an understanding of patterns and relationships; 3) Understand quantitative principles; 4) Able to carry out logical reasoning well.

Individuals with mathematical intelligence have a variety of characteristics, including sequential tendencies, accuracy and methodology, interest in mathematics and programming, follow-through in scientific development, the ability to think about abstract concepts, and ease in using numbers, shapes, and models to understand problems. and use available information to solve it (Boumediene & Nacera, 2022).

Natural Science

Natural sciences are sciences that attempt to explain the rules that govern nature through scientific methods, the basis of which is measured by quantitative data (Kaur et al., 2022). Meanwhile, according to (Vohland et al., 2021) natural science is a combination of life sciences, which include the study of living organisms, and physical sciences, which focus on non-living objects such as celestial bodies and their structure and composition.

Learning Natural Sciences has its own scope, namely relating to living things and the natural surroundings (Susanti & Apriani, 2020). There are five branches of natural science according to Barr and Simhony in (R. Guo, 2018), namely 1) Astronomy; 2) Biology; 3) Chemistry; 4) Earth sciences and; 5) Physics. Over the last five centuries or so, natural science has changed the way we live and think at a much greater rate than in the early periods of human civilization.

Natural science guides students to study cause-and-effect relationships and the interrelationships between events and processes that occur in the living and non-living environment, including the stages of development that occur in nature (S.Sh.Karimova, 2022). This in accordance with the essence of Natural Science (IPA), namely about nature and all its phenomena, including behavior and properties, which are then organized into a collection of theories and concepts through the process of scientific research carried out by humans (Mariana & Praginda, 2009).

METHODS

This study was conducted using a systematic literature review method by following the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-analyses) guidelines. This method focuses on reviewing clearly formulated questions, using systematic and explicit methods to identify, select, and critically appraise relevant research, and to collect and analyze data from existing studies included in the review (Fitriyani, 2021; Moher et al., 2010).

In the context of this systematic review, the authors obtained articles from Sciencedirect, SpringerLink, Research Gate, Sage Journal, Moraref, Education Resources Information Center and Google Schoolar as search sources. A research paper that is relevant to the research topic, namely "Logical Mathematical Intelligence in Science Learning of Junior High School Students", in March 2024. After the

search, the author listed these articles based on the research topic, so that the author found a total of 20 research articles to be included in the meta-analysis.

In the first instance, the selection of articles to be included or analyzed in a literature review requires inclusion and exclusion criteria (Hidayat & Hayati, 2019). The results of the data search with the inclusion criteria are used by the writer to analyze the article. The inclusion and exclusion criteria in this paper are shown in Table 1.

Table 1. Inclusion and Exclusion

Inclusion Criteria	1) Research articles published in 2014 - 2024 2) Research topics include mathematical logical intelligence and science learning 3) Research subjects in general in junior high school students
Exclusion Criteria	1) Research articles that cannot be accessed in full 2) Literature in the form of thesis / dissertation

After identifying the inclusion and exclusion criteria, the next step is to select the articles to be reviewed (Hadi et al., 2020). This is a chart of the process of selecting an article.

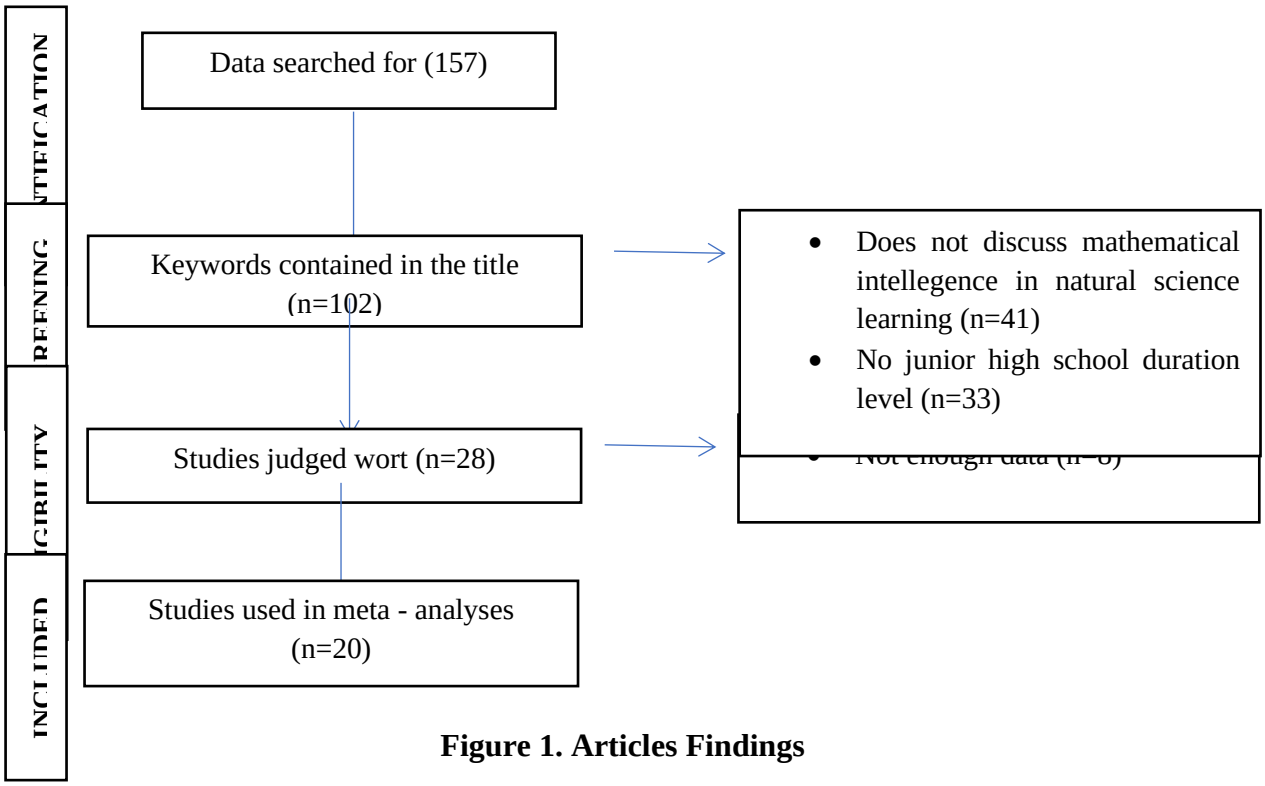

Figure 1. Articles Findings

RESULTS AND DISCUSSION

After searching for scientific articles, 20 relevant articles were found and published between 2014 and 2024, as follows:

Table 2. Articles Synthesis

Author & Year	Class	Fields in Science	Materials or Theme	Aspect of Mathematical Logical Intellegence	Supporting factors
(Isam et al., 2021)	VII	Natural Sciences (IPA)	Flat building concepts	Numeracy skills and understanding concepts	Learning achievement

(Arini, 2018)	VII	Physics	-	Numeracy skills, reasoning skills	Student participation
(Chusni, 2017)	VIII	Physics.	-	Basic mathematical skills, reasoning skills	Learning achievement
(Mufida, 2018)	VIII	Biology	Living and non-living things	Mathematical skills, analytical skills	-
(Roisah Nurbaiti, 2016)	VIII	Naturals Science	My light and sight	Process skills	Analytical abilities
(Mardiyatmi & Abdullah, 2018)	VIII	Physics	-	Basic mathematical skills	Learning creativity
(Probowening et al., 2014)	VIII	Physics	-	Process skills, analytical skills	Motivation to learn
(Maimunah, 2021)	VIII	Naturals Science	Caloric (heat)	Understanding concepts	-
(Wijayanti et al., 2015)	VIII	Naturals Science	Energy and health	-	Learning Creativity
(Nufus et al., 2017)	VIII	Biology	Photosynthesis and Plant Movement	Experiment	-
(Wiladatika et al., 2017)	VIII	Physics	Force	Mathematical skills	-
(Trihono, 2022)	VIII	Naturals science	-	Understanding concepts	-
(N. K. D. Geria Putri et al., 2014)	IX	Naturals science	-	Mathematical skills	Achievement motivation
(Hakim, 2023)	IX	Naturals science	-	Mathematical skills	Learning achievement
(Oktaviani et al., 2021)	1X	Physics	Dynamic electricity	Understanding concepts	Learning achievement
(Anwar et al., 2021)	-	Naturals science	-	Numeracy skills	
(Rahim & Rafiun, 2017)	-	Naturals science	-	Understanding concepts, mathematical skills, analytical skills, problem solving skills	-
(Lamanauskas et al., 2016)	-	Naturals science	Context of science.	Understanding concepts	-
(Cahyaningtiyas, 2019)	-	Biology	Objects and observations	Mathematical skills	Learning achievement
(Nakakoji & Wilson, 2018)	-	Physics	Context of physics	Mathematical skills	Transfer of learning

Logical-mathematical intelligence is one type of intelligence according to Howard Gardner's multiple intelligence theory. This intelligence involves the ability to organize ideas logistically, identify patterns, and carry out mathematical reasoning. In the context of science (Natural Science) learning in junior high school, logistical-mathematical intelligence has an important role.

Furthermore, research (Isam et al., 2021) which shows a positive relationship between numerical intelligence, understanding the concept of flat shapes, and learning achievement in science, especially in pressure material, both when evaluated individually and when linked together. This research states that there is a positive relationship between the level of numerical intelligence and learning achievement in science, as

well as between understanding the concept of plane shapes and learning achievement in science, and both have a positive correlation with learning outcomes in science. Students with good numerical intelligence tend to be more adept at applying mathematical concepts in science. Understanding the concept of flat shapes, as part of mathematical logical intelligence, also supports understanding geometry in science, including interpreting diagrams, measuring and modeling natural phenomena.

(Arini, 2018) in his research discusses studies that obtain information about how the correlation between mathematical logical intelligence and the level of involvement in the learning process influences student achievement in science subjects (Physics) at the junior high school level. The results showed that there was a significant correlation between mathematical logical intelligence and learning achievement in natural science (Physics) subjects, as well as between the level of involvement in the learning process and natural science (Physics) learning achievement, as well as a significant correlation between mathematical logical intelligence, learning participation, and science (Physics) learning outcomes when linked together. This is related to the relationship between mathematical logical intelligence and science learning outcomes, especially physics.

(Chusni, 2017) in his research which aims to determine the impact of basic mathematics abilities and reasoning abilities on learning achievement in science subjects, especially Physics. The results of his study stated that basic mathematical abilities and reasoning abilities had a significant influence on learning achievement in science subjects, including Physics. Students with good mathematical logical intelligence tend to be better able to understand and apply mathematical concepts and use appropriate reasoning in solving problems in the science context, including in physics lessons.

Furthermore, according to (Mufida, 2018) who investigated the correlation between mathematical abilities, case analysis abilities, and graphic analysis abilities of class VIII SMP students in understanding the material of motion in living and non-living creatures. The results of his research stated that there was a significant correlation between mathematical competence and the case analysis ability and graphic analysis ability of class VIII SMP students in studying motion material, both in living and non-living things. Mathematical competence provides a strong foundation for analyzing data and graphs in science, including motion material. Students with good mathematical logical intelligence are better able to interpret graphic data and apply mathematical concepts in complex case analysis.

(Roisah Nurbaiti, 2016) research aimed at developing appropriate Multiple Intelligences-based science worksheet, and knowing the improvement in science process skills, as well as students' responses after using the development worksheet. The results of the research are that it can develop a step-by-step guide for students, including data collection instructions and discussion answers, in accordance with students' logical-mathematical intelligence, as well as helping understanding experiments. Students with intelligence tendencies prefer to answer questions that require logical reasoning or the application of mathematical concepts in answering experimental problems.

Furthermore, (Mardiyatmi & Abdullah, 2018) analyzed the simultaneous and partial impact of basic mathematics skills and learning creativity on physics learning competence in state junior high school students in Tangerang City. This study states that basic mathematics skills have a significant influence on the physics learning competence of state junior high school students in Tangerang City. Basic mathematical abilities, as part of mathematical logical intelligence, are important for understanding and applying mathematical concepts in physics. So, students who have good mathematical logical intelligence tend to be superior in mathematics in science learning, especially in Physics.

Then research by (Probowening et al., 2014) built a physics learning strategy based on the theory of multiple intelligences, especially mathematical intelligence, with the aim of increasing student motivation and learning outcomes. This research states that the application of learning strategies that refer to the theory of multiple intelligences can provide encouragement to student motivation and improve student physics learning outcomes. Mathematical logical intelligence, as part of multiple intelligences, involves understanding mathematical concepts, logical analysis, and problem solving. Applying strategies that take intelligence into account can help students understand physics concepts that require logical analysis and mathematical problem solving more easily.

According to (Maimunah, 2021), his study aims to collect empirical data relating to the correlation between understanding the concept of fractional number operations and science learning outcomes in heat material in class VIII of Al Ihsan Islamic Middle School, Babelan. The interpretation is that students who have

a good understanding of the concept of fractional number operations tend to achieve good learning outcomes in science, especially in heat material. On the other hand, students who have a poor understanding of these concepts tend to have less than optimal learning outcomes in the science of heat material. Understanding the concept of fractional number operations involves aspects of mathematical logical intelligence, where students need to apply mathematical principles to understand this concept.

Furthermore, (Wijayanti et al., 2015) researched things aimed at gaining an understanding of the characteristics, feasibility and effectiveness of Science Student Worksheets (LKS) which are based on multiple intelligences in improving students' creative thinking abilities. This research produces Science Student Worksheets (LKS) based on multiple intelligences that are feasible and successful in improving students' creative thinking abilities. Science worksheets are designed according to multiple intelligences, students can be directed to develop creative thinking abilities, including in terms of logical analysis, solving mathematical problems, and applying scientific concepts in science.

Furthermore, research conducted by (Wiladatika et al., 2017) aims to analyze the correlation between mathematics skills and students' abilities in solving physics problems. The results of his research stated that there was a positive correlation between mathematics skills and students' ability to solve problems, which means that the better the students' mathematics skills, the better the students' ability to solve physics problems, and vice versa. Mathematical logical intelligence, which involves the ability to solve problems, logical analysis, and the application of mathematical concepts in the context of reality, is an important aspect in understanding and solving physics problems which often require calculations and mathematical problem solving.

Finally, (Trihono, 2022) in his study analyzed the correlation between: (1) science process skills and understanding of science concepts, (2) mathematics abilities and understanding of science concepts, and (3) science process skills and mathematics abilities with understanding of science concepts. The result is that addition, subtraction, multiplication, division and simple arithmetic concepts in mathematics play an important role in solving physics problems, from simple to complex. Students' ability to analyze problems, use mathematical logic to develop formulas or solving strategies, and carry out precise calculations allows them to successfully solve physics problems well.

In this case, there are several relevant articles that have been identified discussing this topic. (NKD Geria Putri et al., 2014) discusses a study that analyzes the direct and indirect impact of Indonesian language grades, mathematics grades, and achievement motivation on academic achievement in Natural Sciences (Science) of State Middle School students in Denpasar City. This study states that there is a significant direct or indirect relationship between Indonesian language scores, mathematics scores, and achievement motivation with academic achievement in Natural Sciences (Science). The relationship between junior high school students' mathematical logical intelligence in science learning is reflected in the relationship between mathematics scores and academic achievement in science. Apart from that, the value of the Indonesian language and achievement motivation also influence students' academic achievement in science.

Furthermore, (Hakim, 2023) reviewing the correlation between learning achievement in mathematics and Natural Sciences (IPA) at SMP Negeri 1 Teluk Jambe Timur. In his research, there was a significant correlation and impact between mathematics learning achievement and Natural Sciences (Science) learning achievement, and vice versa. Students who are proficient in mathematics are better able to apply these concepts in science, including calculations, data analysis, and solving physics problems. On the other hand, understanding science can strengthen understanding of mathematics, because the two often complement each other. This reflects the relationship between junior high school students' mathematical logical intelligence in science learning, with mathematics and science achievements influencing each other.

In research (Oktaviani et al., 2021) which obtained empirical data and reliable facts regarding whether there is a correlation between understanding the concept of fractional numbers and learning achievement in electrical science at SMP Negeri 4 Setu. The results obtained are that understanding the concept of fractions significantly influences the learning outcomes of dynamic electrical science material; The deeper the understanding of the concept of fractions, the more optimal the learning outcomes of dynamic electrical science material will be achieved. In this context, understanding the concept of fractions requires strong mathematical logistical thinking because it involves mathematical operations such as addition, subtraction, multiplication and division.

According to (Anwar et al., 2021) in his study which theoretically evaluated the integration of numeracy literacy skills into Natural Sciences (IPA) modules for junior high school (SMP) level. The integration of numeracy literacy with Natural Science (IPA) content for Junior High Schools (SMP) in a module can support each other and form a comprehensive teaching material. Thus, the integration of numeracy literacy with science content not only enriches understanding of science concepts, but also strengthens students' mathematics skills.

According to (Rahim & Rafiun, 2017) who discussed the role of mathematics in learning Natural Sciences (IPA), English and Indonesian subjects, as well as its impact on understanding and applying concepts in each of these subjects. The results of his research stated that mathematics plays an important and significant role in learning Natural Sciences (Science). Mathematical skills help students to understand and apply scientific concepts, carry out measurements, analyze data, and solve problems in a scientific context. This is the connection between mathematics as part of mathematical logical intelligence in learning.

Then (Lamanauskas et al., 2016) which integrates science and mathematics lessons to increase understanding in science and mathematics. The result of the research is to create learning materials that are believed to be able to support students and teachers in presenting mathematical concepts in a way that is more relevant and related to the real world in the context of science. Material that integrates mathematics with science allows students to see real applications of mathematical concepts in science. Students with good mathematical logical intelligence tend to recognize mathematical patterns in natural phenomena, apply mathematical concepts in solving scientific problems, and understand the relationship between the two.

According to (Cahyaningtiyas, 2019) in his study which aims to analyze whether there is a correlation between the results of learning integers and the results of learning science in object material and observations. The results of this study state that student learning achievement in mathematics, especially in integer material, is an important factor influencing the achievement of science learning outcomes in object and observation material. Students' ability to use mathematical logic and apply mathematical concepts in a scientific context greatly influences student achievement in science learning.

Meanwhile (Nakakoji & Wilson, 2018) in their research stated that the transfer of learning from mathematics to science is considered important for progress in the educational and industrial sectors of society. The result is that in the context of physics, achievement in mathematics has a significant and positive influence, directly influencing student performance in this subject. In addition, learning transfer also provides a direct and additional impact in mediating student performance in physics.

(Hatami et al., 2017) conducted research aimed at analyzing the impact of multiple intelligences-based learning on students' metacognitive awareness and Biology science learning outcomes. His research states that learning that focuses on multiple intelligences has a more positive impact on students' metacognitive awareness and learning achievement in Biology Science. The material taught is photosynthesis and movement in plants involving mathematical logical intelligence, namely experimentation. Students are directed to plan, carry out and analyze experimental results logically and mathematically.

Based on the result above, researchers get class percentage data from the articles searched shown in Figure 2.

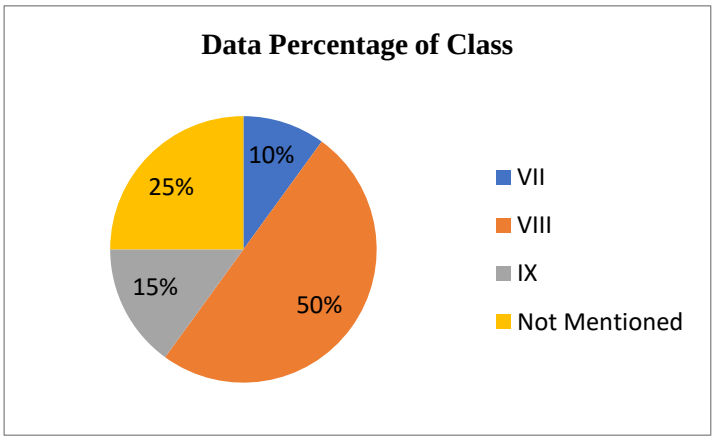

Figure 2. Data Percentage of Class

Figure 2 states that research related to the mathematical logical intelligence of junior high school students in learning natural science is mostly in class VIII with a percentage of 50%. The second highest percentage is in research that does not mention the class, which is 25%. Furthermore, the third highest percentage is in class IX, which is 15%. And the least percentage is in class VII, which is 10%.

After analyzing the following is the relationship of mathematical logical intelligence in the field of natural science in junior high school shown in figure 3.

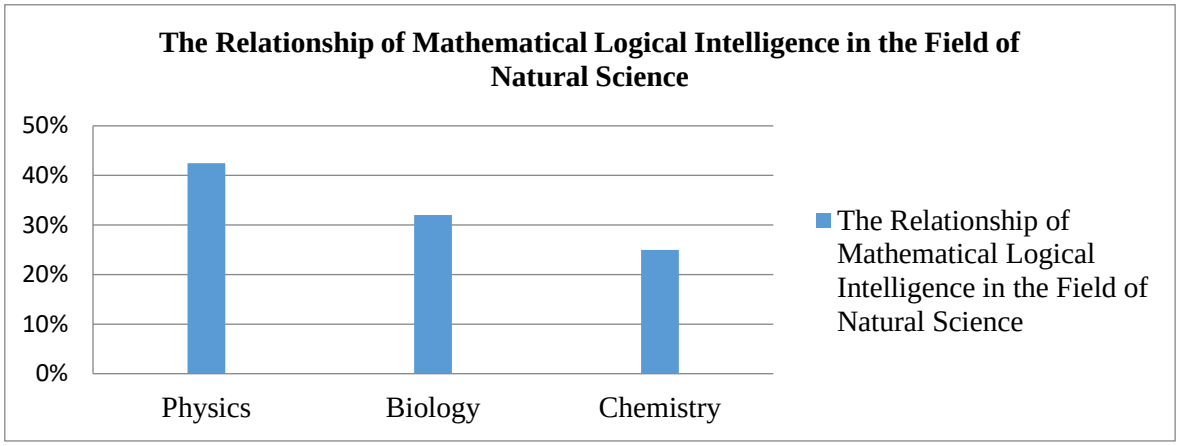

Figure 3. The Relationship of Mathematical Logical Intelligence in the Field of Natural Science

From Figure 3, it can be seen that the mathematical logical intelligence of junior high school students is related to the fields of natural science. based on the articles obtained, physics is most related to the mathematical logical intelligence of junior high school students. Furthermore, the field of biology has a relationship with mathematical logical intelligence rather than the field of chemistry in junior high school.

In junior high school, biology is the most studied field of knowledge in junior high school. In middle school science, there is a significant emphasis on the discussion of biology because of the importance of experimental teaching in improving student learning outcomes and skills. Experimental teaching in bioscience is essential for students to effectively understand abstract concepts. Experimental teaching is a basic way of teaching biology and a basic learning method for students to acquire knowledge (Ren, 2022).

Numeracy ability is an individual's ability to carry out calculations, especially basic mathematical operations, while logical ability is the ability to think rationally or based on reality (Fauziah et al., 2015). Logical-mathematical intelligence is related to logical and mathematical abilities, which is very important in understanding mathematics and science, especially physics (Samsi, 2021). Therefore, to be able to master physics, you must be able to master mathematics first so that the problems contained in the physics content can be solved easily (Haryadi, 2016).

Logical-mathematical intelligence is also often used in chemistry learning. Students need to have mathematical skills in learning chemistry to solve chemistry problems, including understanding variable equations, multiplication and division of decimal numbers, number conversion, rounding numbers, and graphic interpretation (To'at et al., 2018). Likewise the relationship between mathematics and biology. Mathematics can explain aspects of the structure or function of a living system and can also be used to understand the statistical consequences of dealing with large collections of genes, cells, or organisms (Nanjundiah, 2003).

Mathematical logical intelligence has various aspects, as shown in Figure 4.

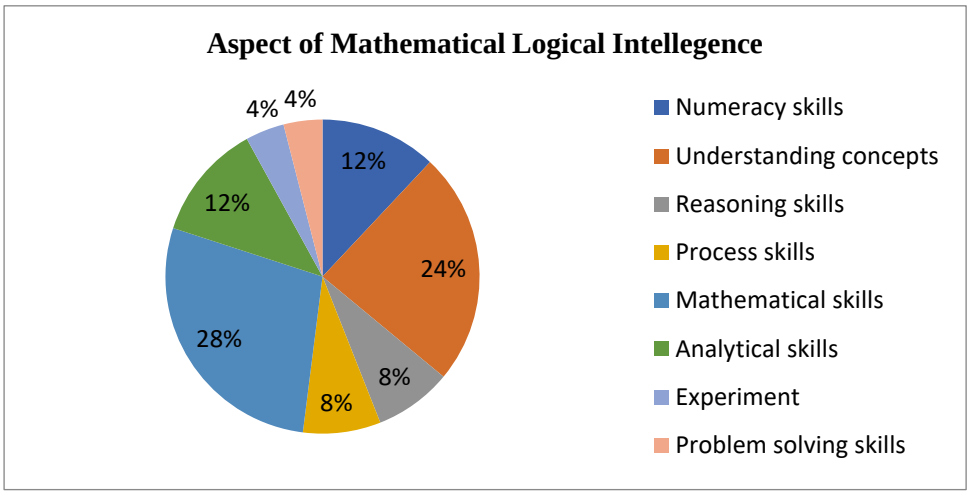

Figure 4. Aspect of Mathematical Logical Intellegence

Based on the analysis of the articles that have been carried out, it can be seen that the aspect of mathematical logical intelligence in natural science learning at junior high school level shows a percentage of mathematical skills of 28%, conceptual understanding of 24%, analytical ability and numeracy ability of 12%, processing ability and reasoning ability of 8%, and experimentation and problem solving ability 4% each.

Mathematical logical intelligence has various supporting factors, as shown in Figure 5.

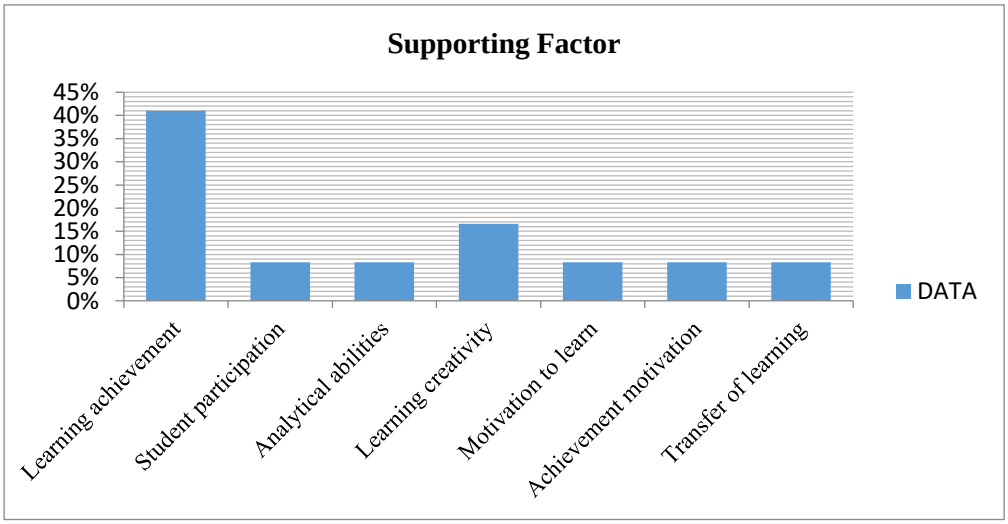

Figure 5. Supporting Factor

Based on the analysis of the articles that have been carried out, it can be seen that the supporting factors for mathematical logic in natural science learning at junior high school level show a percentage of learning achievement of 41%, learning creativity of 16.6%, and for analytical abilities, learning creativity, motivation to learn, student participation. , achievement motivation, and transfer of learning have the same results of 8.3%.

Good learning achievement in science can show that students have strong mathematical abilities, such as analytical skills, logical reasoning, and mathematical problem solving. This ability also helps students analyze data logically, draw appropriate conclusions, and use mathematical logic.In addition, good learning achievement also reflects students' ability to formulate scientific hypotheses and plan experiments, showing the development of strong mathematical logical intelligence. Thus, good learning achievement in science and the development of junior high school students' mathematical logical intelligence support each other.

Overall, this systematic review has explored the Mathematical Logical Intelligence of Junior High School Students in Science Learning. The articles discussed cover various aspects such as mathematical logical intelligence in science, science learning achievement, achievement motivation, learning participation,

numerical ability, understanding of mathematical concepts, and reasoning ability. These findings provide valuable insight into exploring the Mathematical Logical Intelligence of Junior High School Students in Science Learning. Further research is needed to continue to explore and develop a more comprehensive understanding of the Mathematical Logical Intelligence of Junior High School Students in Science Learning.

CONCLUSION

Based on the results of the systematic literature review research that has been carried out, it can be concluded that mathematical logical intelligence has a close relationship with science learning outcomes of junior high school students. The mathematical logical intelligence of junior high school students in learning natural sciences is mostly found in class VIII with a percentage of 50%. The relationship between mathematical logical intelligence in natural sciences is highest with the field of physics, namely 43%. The highest aspect of mathematical logical intelligence is mathematical ability, namely 28%. The factor most commonly found in supporting the mathematical logical intelligence of junior high school students in learning natural sciences is the learning achievement factor, namely 41%.

References

Anriani, N., Pamungkas, A. S., Iskandar, K., & Istiandaru, A. (2019). Improving logical thinking skills using HOTS-based mathematics teaching material. *Journal of Physics: Conference Series*, *1188*(1). https://doi.org/10.1088/1742-6596/1188/1/012093

Anwar, M. K., Laasiliyah, M. L., Ayun, N., & Romdhoni, V. A. (2021). Kajian Teoritis Integrasi Literasi Numerasi dalam Modul IPA SMP. *Proceeding of Integrative Science Education Seminar (PISCES)*, *1*, 441–448.

Ariawati, K. N., Suarjana, I. M., & Sudarmawan, G. A. (2021). Implementasi Model Discovery Learning Berbantuan Powerpoint Terhadap Hasil Belajar IPA. *Jurnal Imiah Pendidikan Dan Pembelajaran*, *5*(2), 332. https://doi.org/10.23887/jipp.v5i2.36781

Arini, D. (2018). Hubungan Kecerdasan Logis Matematis dan Partisipasi Belajar dengan Nilai Hasil Belajar Siswa pada Mata Pelajaran Ilmu Pengetahuan Alam di SMP IT Insantama. *Seminar Nasional Teknologi Pendidikan*, *01*, 87–97.

Azinar, J. A., Munzir, S., & Bahrun. (2020). Students' logical-mathematical intelligence through the problem-solving approach. *Journal of Physics: Conference Series*, *1460*(1). https://doi.org/10.1088/1742-6596/1460/1/012024

Boumediene, S., & Nacera, B. (2022). Level of logical-mathematical intelligence among middle school students Senouci. *Journal of Legal and Social Studies*, *02*, 36–59.

Cahyaningtiyas, W. (2019). Hubungan Hasil Belajar Matematika Materi Bilangan Bulat dengan Hasil Belajar IPA pada Materi Objek dan Pengamatan. *Prosiding Seminar Nasional Pendidikan STKIP Kusuma Negara*, 1–6. http://jurnal.stkipkusumanegara.ac.id/index.php/semnara2019/article/view/195%0Ahttps://jurnal.stkipkusumanegara.ac.id/index.php/semnara2019/article/download/195/160

Chusni, M. M. (2017). Pengaruh Kemampuan Dasar Matematika Dan Kemampuan Penalaran Terhadap Hasil Belajar Ipa/Fisika Pada Peserta Didik Kelas Vii Smp Muhamadiyah Muntilan, Kabupaten Magelang, Jawa Tengah. *Berkala Fisika Indonesia : Jurnal Ilmiah Fisika, Pembelajaran Dan Aplikasinya*, *9*(1), 16–23. http://journal2.uad.ac.id/index.php/bfi.

Fauziah, K., Nurhayati, & Arsyad, M. (2015). Analisis Hubungan Antara Kecerdasan Logis-Matematis Dengan Hasil Belajar Fisika Peserta Didik Kelas XI IPA SMA Negeri Di Kabupaten Jeneponto. *Jurnal Sains Dan Pendidikan Fisika (Jspf)*, *11*(3), 239–244. https://ojs.unm.ac.id/JSdPF/article/view/1740

Fitriyani, N. I. (2021). Metode PRISMA Untuk Memprediksi Penyakit Kanker Payudara. *JII : Jurnal Inovasi Informatika Universitas Pradita*, *6*(September 2021), 13–18.

Furner, J. M., & Kumar, D. D. (2007). The mathematics and science integration argument: A stand for teacher education. *Eurasia Journal of Mathematics, Science and Technology Education*, *3*(3), 185–189. https://doi.org/10.12973/ejmste/75397

Guo, R. (2018). *Chapter 3 - Studying Borders, Evaluating Border Effects* (R. B. T.-C.-B. R. M. (Third E. Guo (ed.); pp. 51–80). Elsevier. https://doi.org/https://doi.org/10.1016/B978-0-444-64002-4.00003-9

Hadi, S., Tamansiswa, U. S., Palupi, M., & Indonesia, U. I. (2020). *SYSTEMATIC* (Issue March).

Hakim, D. L. (2023). Relationship between Science and Mathematics Student Learning Outcomes. *Jurnal Penelitian Pendidikan IPA*, *9*(5), 3890–3898. https://doi.org/10.29303/jppipa.v9i5.3684

Haryadi, R. (2016). Korelasi antara Matematika Dasar dengan Fisika Dasar. *JPPM (Jurnal Penelitian Dan Pembelajaran Matematika)*, *9*(1), 124–127.

Hidayat, R., & Hayati, H. (2019). Pengaruh Pelaksanaan SOP Perawat Pelaksana terhadap Tingkat Kecemasan Pasien di Rawat Inap. *Universitas Pahlawan Tuanku Tambusa*, *3*(23), 274–282.

Isam, E., Rahmawati, N. K., & ... (2021). Korelasi Kecerdasan Numerik dan Pemahaman Konsep Bangun Datar dengan Hasil Belajar IPA. *Prosiding Seminar Nasional Pendidikan STKIP Kusuma Negara III*, 150–157. http://jurnal.stkipkusumanegara.ac.id/index.php/semnara2020/article/view/1130

Kaur, T., McLoughlin, E., & Grimes, P. (2022). Mathematics and science across the transition from primary to secondary school: a systematic literature review. *International Journal of STEM Education*, *9*(1). https://doi.org/10.1186/s40594-022-00328-0

Kurniawati, Yenni. 2019. Metode Penelitian Pendidikan Bidang Ilmu Pendidikan Kimia. Pekanbaru: Cahaya Firdaus

Kostrova, Y. (2019). *Teaching Higher Mathematics to Students of Natural Sciences: Problems and Solutions*. *47*(Iscfec 2018), 371–375. https://doi.org/10.2991/iscfec-18.2019.95

Lamanauskas, V. (2013). Natural Science Education Importance in Adolescence. *Journal of Baltic Science Education*, *12*(4), 396–398. https://doi.org/10.33225/jbse/13.12.396

Lamanauskas, V., Šlekienė, V., & Ragulienė, L. (2016). Natural Science Understanding and Mathematical Abilities Education Using the Project Mat2smc Didactic Material. *Natural Science Education in a Comprehensive School (NSECS)*, *22*(1), 59–69. https://doi.org/10.48127/gu/16.22.59

Maimunah. (2021). Hubungan Pemahaman Konsep Operasi Bilangan Pecahan dengan Hasil Belajar IPA Materi Kalor. *Prosiding Seminar Nasional Pendidikan STKIP Kusuma Negara III SEMNARA 2021 E-ISSN*, 35–41.

Mardiyatmi, E., & Abdullah, S. I. (2018). Pengaruh Kemampuan Dasar Matematika Dan Kreatifitas BelajarTerhadap Kompetensi Belajar Fisika (Survei Pada Siswa Smp Negeri Di Kota Tangerang. *Jurnal Pendidikan MIPA*, *1*(1), 46–57.

Mariana, I. M. A., & Praginda, W. (2009). *Hakikat IPA dan Pendidikan IPA*.

Moher, D., Liberati, A., Tetzlaff, J., & Altman, D. G. (2010). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. *International Journal of Surgery*, *8*(5), 336–341. https://doi.org/10.1016/j.ijsu.2010.02.007

Mufida, I. A. H. (2018). Hubungan antara Kompetensi Matematis dengan Kemampuan Analisis Kasus dan Grafik Siswa SMP Kelas VIII pada Materi Gerak Makhluk Hidup dan Makhluk Tak Hidup. *E-Journal Pendidikan IPA*, *7*(2), 93–97.

Murni, S., Ruqoyyah, S., & Fasha, L. H. (2020). Analysis of mathematical thinking skills in multiple intelligence perspectives of primary school students. *Journal of Physics: Conference Series*, *1657*(1). https://doi.org/10.1088/1742-6596/1657/1/012013

N. K. D. Geria Putri, Sadia, I. W., & Suastra, I. W. (2014). Determinsi Nilai Bahasa Indonesia, Matematika, dan Motivasi Berprestasi terhadap Prestasi Belajar IPA Siswa SMP Negeri di Kota Denpasar. *E-Journal Program Pascasarjana Universitas Pendidikan Ganesha*, *4*(1).

Nakakoji, Y., & Wilson, R. (2018). First-year mathematics and its application to science: Evidence of transfer of learning to physics and engineering. *Education Sciences*, *8*(1). https://doi.org/10.3390/educsci8010008

Nanjundiah, V. (2003). Role of Mathematics in Biology. *Economic and Political Weekly*, *38*, 3671–3673. https://doi.org/10.2307/4413964

Nufus, S. S., Jamaluddin, & Bachtiar, I. (2017). Pengaruh Pembelajaran Berbasis Multiple Intelligences terhadap Kesadaran Metakognisi dan Hasil Belajar IPA Biologi Siswa Kelas VIII SMPN 11 Mataram. *J. Pijar MIPA*, *1*(8), 85–102. http://clpsy.journals.pnu.ac.ir/article_3887.html

Oktaviani, D., Nurimani, & Kurniawan, B. (2021). Hubungan Pemahaman Konsep Pecahan terhadap Hasil Belajar IPA Materi Listrik Dinamis. *Prosiding Seminar Nasional Pendidikan STKIP Kusuma Negara III SEMNARA*, 109–113. http://jurnal.stkipkusumanegara.ac.id/index.php/semnara2020/article/view/1112

Pérez, M. E. del M., Guzmán Duque, A. P., & García, L. C. F. (2018). Game-based learning: Increasing the logical-mathematical, naturalistic, and linguistic learning levels of primary school students. *Journal of*

New Approaches in Educational Research, *7*(1), 31–39. https://doi.org/10.7821/naer.2018.1.248

Probowening, Sopyan, A., & Handayani, L. (2014). Pengembangan Strategi Pembelajaran Fisika Berdasarkan Teori Kecerdasan Majemuk untuk Meningkatkan Motivasi dan Hasil Belajar Siswa SMP. *UPEJ Unnes Physics Education Journal*, *3*(1), 66–71.

Rahim, U., & Rafiun, A. (2017). Peran Matematika dalam Menunjang Mata Pelajaran IPA, Bahasa Inggeris dan Bahasa Indonesia. *Jurnal Pendidikan Matematika*, *3*. https://www.neliti.com/publications/317669/peran-matematika-dalam-menunjang-mata-pelajaran-ipa-bahasa-inggeris-dan-bahasa-i

Ren, H. (2022). Rethinking in Biology Experiment Teaching in Middle School. *Highlights in Science, Engineering and Technology*, *14*, 150–156. https://doi.org/10.54097/hset.v14i.1604

Roisah Nurbaiti. (2016). Pengembangan LKPD IPA Berbasis Multiple Intelligences pada Tema "Cahaya dan Penglihatanku" untuk Meningkatkan Keterampilan proses Sains Siswa SMP Kelas VIII. *Resma*, *3*(2), 13–22.

S.Sh.Karimova. (2022). The Role and Importance Of "Natural Sciences" in The Development of Understanding of Nature in General Secondary Schools. International Scientific Journal. *INTERNATIONAL SCIENTIFIC JOURNAL : Science and Innovation*, *1*(6), 56–74. https://doi.org/10.4337/9781782548522.00010

Šafranj, J. (2016). Logical/Mathematical Intelligence in Teaching English as a Second Language. *Procedia - Social and Behavioral Sciences*, *232*, 75–82. https://doi.org/10.1016/j.sbspro.2016.10.019

Samsi, A. N. (2021). Analisis Hubungan Antara Kecerdasan Logis-Matematis dengan Hasil Belajar Fisika Peserta Didik pada Materi Suhu dan Kalor. *Prosiding Seminar Nasional Pendidikan IPA II*, 3.

Sheoran, S., Chhikara, S., & Sangwan, S. (2019). Assessing logical mathematical intelligence of young adolescents: A sample study from Haryana, India. *The Pharma Innovation Journal*, *8*(4), 726–729. www.thepharmajournal.com

Shirawia, N., Alali, R., Wardat, Y., Tashtoush, M. A., Saleh, S., & Helali, M. (2023). Logical Mathematical Intelligence and its Impact on the Academic Achievement for Pre-Service Math Teachers. *Journal of Educational and Social Research*, *13*(6), 239–254. https://doi.org/10.36941/jesr-2023-0161

Susanti, D., & Apriani, R. (2020). Peningkatan Hasil Belajar Ilmu Pengetahuan Alam Dengan Tema Cita-Citaku Menggunakan Media Audio Visual Pada Kelas IV MIN 1 Kota Padang. *Jurnal Kajian Dan Pengembangan Umat*, *3*(2), 27–37.

To'at, A., Hidayah, H., & Fatichatul, F. (2018). Analisis Kemampuan Matematis Siswa terhadap Hasil Belajar pada Materi Termokimia Kelas XI IPA 2 di SMA Negeri 15 Semarang. *Prosiding Seminar Nasional Edusaintek FMIPA UNIMUS*, 579–583.

Trihono, T. (2022). Hubungan antara Keterampilan Proses Sains dan Kemampuan Matematika dengan Pemahaman Konsep Sains dalam Pembelajaran Penemuan Terbimbing. *Jurnal Pendidikan Mipa*, *12*(3), 747–753. https://doi.org/10.37630/jpm.v12i3.675

Usmeldi, & Amini, R. (2019). The Effectiveness of Guided Inquiry Learning Model to Improve Science Process Skill on Heat Matter. *Unnes Science Education Journal*, *1417*(1), 7–14. https://doi.org/10.1088/1742-6596/1417/1/012080

Vohland, K., Land-Zandstra, A., Ceccaroni, L., & Lemmens, R. (2021). The Science of Citizen Science. In *Proceedings of the Nova Scotian Institute of Science (NSIS)* (Vol. 51, Issue 2). https://doi.org/10.15273/pnsis.v51i2.11167

Widiastuti, S. (2012). Pembelajaran Proyek Berbasis Budaya Lokal untuk Menstimulasi Kecerdasan Majemuk Anak Usia Dini. *Jurnal Pendidikan Anak*, *1*(1), 59–71. https://doi.org/10.21831/jpa.v1i1.2907

Wijayanti, F., Widiyatmoko, A., Januari, D., & Alamat, □. (2015). Pengembangan LKS IPA Berbasis Multiple Intelligences pada Tema Energi dan Kesehatan untuk Meningkatkan Kemampuan Berpikir Kreatif Siswa. *Unnes Science Education Journal*, *4*(1). http://journal.unnes.ac.id/sju/index.php/usej

Wiladatika, L., Sitompul, S. S., & Mahmuda, D. (2017). Hubungan Keterampilan Matematika dengan Kemampuan Menyelesaikan Soal Materi Gaya pada Siswa SMP Mujahidin Pontianak. *Jurnal Pendidikan Dan Pembelajaran Untan*, *6*(1), 1–9.