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## **Research Trends of Mathematics Learning for Deaf Junior High School Students in Indonesia: A Systematic Literature Review**

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**Abstract:** This study constitutes a Systematic Literature Review that analyzes various research articles conducted in Indonesia and published in Google Scholar-indexed journals from 2014 to 2023. The primary focus of this research is to examine different aspects related to the study of mathematics learning for deaf junior high school students in Indonesia. The findings from this investigation indicate that there is no significant trend in the increase of research on mathematics learning for deaf junior high school students in Indonesia within the last three years. Moreover, it is revealed that the most commonly used research design is Research and Development (R&D), with Geometry being the most popular subject matter. Additionally, the most frequently chosen instruments are "tests" and "questionnaires," and the majority of research locations are centered around Java Island & Bali, with the most highlighted research topic being the development of learning media. Based on the outcomes of this research, several recommendations can be proposed, including the need to intensify research efforts in this field, exploring other mathematical topics for investigation, and ensuring a broader and more even distribution of research locations.

**Keywords:** Mathematics learning, Deaf, Junior high school, SLR.

### **Introduction**

Education is a fundamental human right that should be guaranteed for every individual regardless of any factors such as socio-economic status, gender, religion, ethnicity, physical condition, or disability (Assembly, 1949). This aligns with the universal principles of human rights, which emphasize the importance of accessing education as a means for the full development of individual potential, as well as building a more just and inclusive society (Alfredsson & Eide, 2023). The existence of equitable and inclusive education serves as a strong foundation in creating equal opportunities for all individuals to pursue their dreams and aspirations (Cerna et al., 2021). In other words, children with disabilities have an equal right to education (Alifulloh et al., 2023; Peka, 2023; Taneja-Johansson et al., 2023).

Education holds a transformative power for all children, serving as a crucial pillar for their development, empowerment, and integration into society (Manion & Jones, 2020). This significance is magnified for children

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with special needs, for whom education is not just a right but a necessity that paves the way for overcoming barriers and achieving personal and social milestones (Swargiary & Roy, 2024). Specifically, for deaf children, education acts as a vital bridge connecting them to the world of sound and communication. Through specialized educational approaches, such as sign language, visual aids, and tailored teaching methods, deaf children can achieve a level of comprehension and expression that aligns with their hearing peers (Adams & Rohring, 2021). The provision of a conducive learning environment tailored to their unique needs enables these children to develop critical thinking skills, enhance their academic achievements, and fosters their socio-emotional growth (Buli-Holmberg & Jeyaprabhan, 2016). Nevertheless, education for deaf children is not just about providing them with the tools necessary for navigating life, building self-esteem, and opening doors to opportunities that would otherwise remain inaccessible. Education for deaf children also remains about academic learning, including mathematics, to assist them in their daily lives (Kelly et al., 2022).

For deaf junior high school students, the importance of mathematics extends beyond the classroom walls, serving as a critical foundation for both their future academic pursuits and real-world applications (Knors & Marschark, 2014). At this pivotal stage, mathematics not only sharpens their problem-solving and logical thinking skills but also prepares them for a range of post-secondary education options and career paths, particularly in STEM (Science, Technology, Engineering, and Mathematics) fields where demand and opportunities continue to grow (Searle et al., 1974). Proficiency in mathematics for these students can be a game-changer, breaking down barriers and leveling the playing field with their hearing peers (Schilling-Dickey, 2022). It equips them with the quantitative skills necessary to navigate life's challenges, manage personal finances, and engage in civic duties with confidence. Moreover, for deaf students, excelling in mathematics can significantly enhance their self-efficacy and academic self-concept, providing a strong sense of accomplishment and the motivation to pursue higher education and professional goals (Hassan & Ibraheem, 2022). Therefore, prioritizing mathematics education for deaf high school juniors not only fosters their academic growth but also empowers them to fully participate in and contribute to society (Manchishi, 2015).

A strategic approach to improving mathematics education for deaf junior high school students encompasses the initiation of targeted research focused on their specific learning needs in mathematics (Nunes, 2020). The significance of delving into the educational needs of deaf learners in the context of mathematics is highlighted in studies by (Marschark et al., 2001), which underscore the imperative of addressing the distinct obstacles these students face. Such research endeavors are instrumental in enabling academics to devise customized educational content and teaching strategies that cater to these unique challenges, thereby facilitating more enriching and impactful learning experiences for this demographic. Additionally, investigating the mathematical education of deaf junior high school students holds promise for enhancing the caliber of education nationwide in Indonesia, while also expanding the horizons for these students to realize their full academic capabilities (Chen & Wang, 2021).

As of March 2024, the sole study that has specifically explored the trends in research concerning mathematics education for deaf children in Indonesia within the scope of journals accredited by SINTA Kemendikbud (Indonesian government accreditation system for academic journals) is the one conducted by Alifulloh et al. (2023). This investigation offers an exhaustive review covering the full range of educational levels, from early childhood education up to tertiary education. Distinguished by its precise focus compared to earlier studies, this research aims to aggregate data from various studies that deal with the mathematics education of deaf junior high school students in Indonesia. It employs a methodology that includes content analysis of findings from studies in the fields of mathematics education and special education that were published in Indonesia between the years 2014 and 2023.

In a broader context, a study conducted by Nur et al. (2021) provided an extensive overview of research in mathematics education within Indonesia, examining trends observed over the past seven years. This examination involved the analysis of 595 articles published between 2015 and March 2021, sourced from highly ranked journals selected through the national database Sinta. Utilizing primarily qualitative (41.85%), quantitative (32.94%), and developmental (17.82%) methodologies, the study predominantly focused on junior high school students (35.63%). While emphasizing key areas such as mathematical ability (27.23%), technology application (13.28%), and cognitive processes (9.92%), certain domains, including the philosophy and history of mathematics education, early childhood mathematics learning, and issues related to multiculturalism, multilingualism, and equity, received limited exploration.

Additionally, another investigation sharing a similar conceptual framework with the current research is the one conducted by Fauzi & Pradipta (2018). This study aimed to assess the range of research methods utilized in biology education in Indonesia throughout the year 2017. Through content analysis, 122 articles were examined,

revealing that the most commonly employed methods included Research and Development (R&D), quasi-experimental designs, media/learning sources, questionnaires, and frequency and percentage analyses, with a particular focus on senior high school subjects. These findings highlight the importance for researchers to carefully select appropriate methods, considering the diverse approaches, designs, and techniques evident in educational research on biology in Indonesia.

However, this current research diverges from previous investigations, particularly in its focus on exploring all articles within the Google Scholar database published in Indonesia from 2014 to 2023. Its objective is to examine a selection of articles pertaining to mathematics learning, specifically focusing on deaf elementary school students in Indonesia. Moreover, the content analysis is constructed upon several fundamental parameters.

This study seeks to comprehensively examine the following inquiries: (1) How has the quantity of research efforts regarding the learning of mathematics among deaf junior high school students in Indonesia evolved over time? (2) What are the various research methodologies utilized in studies on the learning of mathematics among deaf junior high school students in Indonesia? (3) Which recurring themes emerge frequently in research pertaining to the learning of mathematics among deaf junior high school students in Indonesia? (4) What are the common tools and instruments employed by researchers in their investigations of the learning of mathematics among deaf junior high school students in Indonesia? (5) Which geographical regions are prominently featured in research concerning the learning of mathematics among deaf junior high school students in Indonesia? (6) What are the primary focal points of research conducted by scholars in the domain of mathematics learning among deaf junior high school students in Indonesia?

## **Method**

### **Research Design**

This section outlines the methodology utilized to examine recent research (covering the period from January 2014 to December 2023) on Mathematics Learning for Deaf Junior High School Students in Indonesia. Classified as a Systematic Literature Review (SLR), this study follows the principle of content analysis and seeks to analyze findings from various research efforts published in scholarly journals and university repositories in Indonesia, as indexed by Google Scholar.

The implementation of a Systematic Literature Review (SLR) is crucial for tackling the issue under consideration for several significant reasons. Firstly, an SLR enables a thorough examination of numerous scholarly articles concerning mathematics education for deaf elementary school students in Indonesia. This comprehensive approach ensures that all pertinent research findings are taken into account, leading to a comprehensive understanding of the subject matter (Boell & Cecez-Kecmanovic, 2015). Secondly, an SLR facilitates the identification of trends and patterns within the existing literature, including prevalent research methodologies, frequently studied topics, and commonly chosen research locations (Ammirato et al., 2023). By recognizing these patterns, researchers can gain valuable insights into the current landscape of research and areas in need of further investigation. Moreover, an SLR allows for the synthesis of findings from various sources, providing a holistic perspective on the topic and informing the development of informed recommendations for future research endeavors (Paul et al., 2021). In summary, the systematic and rigorous nature of an SLR is indispensable for addressing the complexities surrounding mathematics education for deaf elementary school students in Indonesia, ensuring that interventions and initiatives are grounded in evidence-based practices and contribute significantly to the advancement of the field.

### **Data Source**

The data for this study were gathered through the examination of articles within the fields of Mathematics Education and Special Education, sourced from research conducted in these areas and accessible via Google Scholar. The process involved the utilization of Publish or Perish 8 software and the application of specific criteria: (1) The research was conducted between 2014 and 2023. (2) The research was conducted in Indonesia. (3) The research focused on mathematics learning for deaf junior high school students. (4) The research specified the mathematics topics explored. Utilizing the keywords "Mathematics and Deaf," 43 relevant articles were initially identified, and subsequent application of more stringent criteria resulted in the selection of 15 articles for examination and analysis in this study.

## Research Instruments

In accordance with the research objectives, it is crucial to implement an instrument or set of inclusion criteria (Alifulloh et al., 2023; Al-Zubidy & Carver, 2019). This study employs a content analysis guideline as the instrument, which encompasses specific observed aspects as detailed in Table 1. The content analysis evaluates six main aspects: (1) annual publication frequency, (2) research methodology, (3) selected mathematical topics, (4) data collection tools, (5) research locations (provinces in Indonesia), and (6) research focus. Notably, predetermined categories were not initially established for aspects (1) and (6) due to a lack of prior studies as references. Meanwhile, categories for aspects (2), (3), and (4) were predefined before data collection, adapted from Fauzi & Pradipta (2018) and Alifulloh et al. (2023).

Table 1. Aspects and categories

Aspects	Categories
Types of Research (2)	A.1- R and D
	A.2- CAR
	A.3- Qualitative Research
Mathematical Topics (3)	B.1- Numbers
	B.2- Algebra
	B.3- Geometry
Data Collection Instruments (4)	C.1- Questionnaire
	C.2- Documentation
	C.3- Test
	A.4- Quantitative Research
	A.5- Mix Method
	B.4- Statistics & Probability
	C.4- Interview
	C.5- Observation

## Data Analysis

The literature analysis requires careful scrutiny of identified data (Boell & Cecez-Kecmanovic, 2015). Each reviewed article is categorized based on predetermined criteria, which rely on details provided in the abstracts, methods, and discussions presented by the authors (Firmansyah & Umar, 2023). The collected data undergoes analysis using data processing software, particularly Microsoft Excel. The processed findings are visually presented through tables and line charts, which illustrate emerging trends in each reviewed category alongside descriptive captions. This approach ensures a thorough comprehension of the literature, emphasizing the importance of categorization and visual representation for the effective analysis of trends observed within the examined articles.

## Results and Discussion

### Number of Publications

The quantity of publications reflects the frequency of research conducted within a particular timeframe (Durieux & Gevenois, 2010). As depicted in Figure 1, articles addressing mathematics learning for deaf junior high school students in Indonesia are available from 2014 to 2023. There is no discernible consistent pattern in the fluctuation of research studies from year to year. However, as indicated in Figure 1, the number of research studies reached its peak in 2021 and 2022 during this period. Nonetheless, this figure subsequently declined in the subsequent year. The graph illustrating the number of research studies on mathematics learning for deaf junior high school students in Indonesia indicates a limited involvement of researchers in this area.

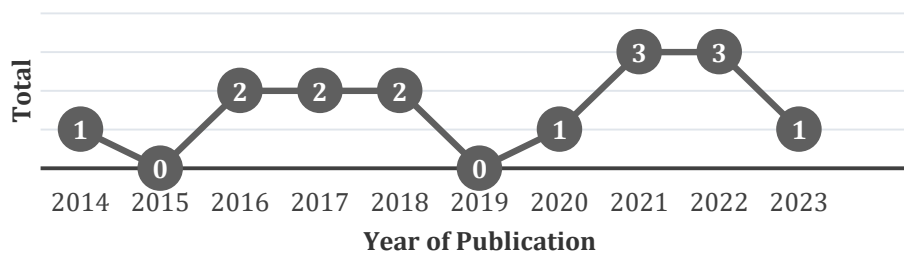


Figure 1. Number of research studies from 2014 to 2023

Research is frequently motivated by researchers' commitment to ensuring educational equity for children with special needs, a concern highlighted in governmental legislation (Armstrong & Moore, 2004). The lack of

adequate attention given to researching mathematics learning for deaf children represents a significant challenge, often resulting in learning being viewed merely as a duty without concurrent research-driven endeavors to improve its effectiveness (Santos & Cordes, 2022). Consequently, conducting research is regarded as the most viable means to tackle this issue (Marschark et al., 2001).

### Types of Research

The selection of research methodology greatly influences the emphasis of the research. As indicated in Figure 2, researchers studying mathematics learning for deaf junior high school students in Indonesia mostly utilize Research & Development research designs. This prevalence of research and development aligns with prior observations in the field of education, particularly during the pandemic period, where there was an uptick in the adoption of research and development designs by educational researchers (Husamah et al., 2022). The graph highlights that research in this area is predominantly characterized by a predominance of Research and Development studies, although other methodologies are also utilized.



Figure 2. Research types

Moreover, research and development (R&D) is frequently employed as a design in educational research (Fauzi & Pradipta, 2018). Developmental research emerges as a notable trend in educational research (Waitoller & Artiles, 2013). Within this approach, academics commonly create educational materials using their previous findings and developmental processes. These materials might manifest as textbooks, modules, or instructional resources (Gravemeijer, 1994).

### Mathematical Topic

Mathematics encompasses a broad spectrum of topics, including numbers, geometry, algebra, and statistics and probability, as outlined by TIMSS standards (Al-Saadi, 2021). However, a content analysis of selected research articles indicates a limited exploration of mathematics topics, addressing only a fraction of these subject categories. Figure 3 illustrates that, out of the total studies, 7 specifically focus on geometry, emerging as the most frequently researched topic in the context of mathematics learning for deaf junior high school students in Indonesia. Conversely, the absence of research on algebra in the same context may be attributed to the inherent difficulty of these topic, which are not included in the prescribed curriculum for mathematics in deaf junior high schools in Indonesia (based on educational curriculum documents in Indonesia). Consequently, algebra, statistics, and probability stand out as the least investigated topics. This observation aligns with (Agustyaningrum et al., 2021), which affirm that algebra, as an abstract mathematical concept, presents challenges for learners, while topics such as statistics and probability are inherently complex in the field of mathematics.

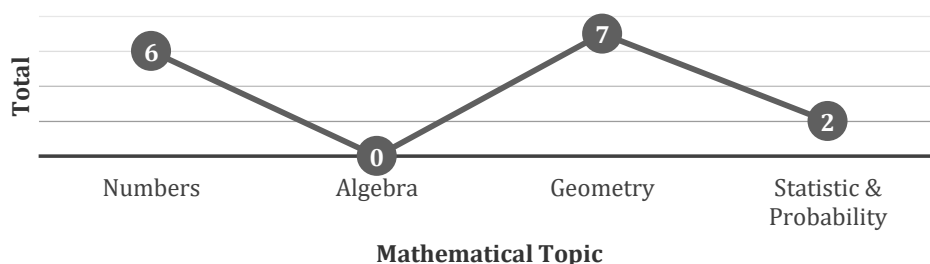


Figure 3. Mathematical Topics Explored

The content analysis conducted also identified specific mathematical themes. As shown in Table 2, the subject of integers and plane figures emerged as the most commonly studied topics in research related to mathematics learning for deaf junior high school students in Indonesia. Additionally, the subject of statistics and probability, which generally appears infrequently (excluding algebra, which is not considered), appeared twice, suggesting that both instances focus on statistics. This indicates that no research was found on the topic of probability within the scope of research on mathematics learning for deaf junior high school students in Indonesia.

Table 2. Mathematical topic details

Topics		Frequency	
Numbers	Integers	4	
	Fractions	1	6
	Social arithmetics	1	
Algebra	Algebra	0	0
Geometry	Plane figure	4	
	Solid figure	1	
	Curve Surface Solid	1	7
	Pythagoras theorem	1	
Statistics and Probability	Statistics	2	2
<b>Total</b>		<b>20</b>	<b>15</b>

### Data Collection Instruments

In research on the development of mathematics teaching materials for deaf junior high school students, researchers employ various instruments for data collection. Multiple instruments may be utilized within a single study (Qi & Mitchell, 2012). Figure 4 illustrates that questionnaire and tests are the primary instrument used for data collection in research concerning mathematics learning for deaf junior high school students. This aligns with prevalent research methodologies like Research and Development (R&D), which incorporate questionnaire and tests as a key data collection tool (Randolph, 2008). Additionally, test-based data collection is considered more objective than using observations.

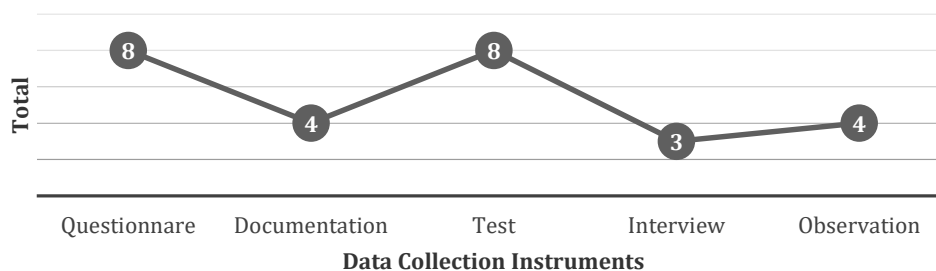


Figure 4. Instruments Used in Research

### Research Location

Selecting the research location plays a vital role in influencing the results of a study (Tuckman & Harper, 2012). A carefully chosen location improves the accuracy and applicability of findings, making it easier to gather essential data. Researchers need to take into account factors such as accessibility, representativeness, safety, and the availability of facilities to ensure that the research site aligns effectively with the study objectives (Alifulloh et al., 2023).

Table 3 underscores the unequal distribution of research concerning mathematics learning for deaf junior high school students in Indonesia. Geographically, the majority of research locations are concentrated in Java, Bali, and Nusa Tenggara Island, with West Java and Bali provinces leading with 3 research projects each. This pattern aligns with the findings of Shaturaev & others (2021), who associate Java as an island with better access to education in Indonesia. Interestingly, consistent with the observations of Alifulloh et al. (2023), the content analysis indicates that the eastern region of Indonesia has never been selected as a research location for mathematics learning for deaf junior high school students.

Table 3. Distribution of the Number of Research Based on Research Locations.

Island	Province	Frequency	Total
Sumatera	Lampung	2	2
	Jakarta	1	
Java	West Java	3	6
	Central Java	1	
	East Java	1	
Bali & Nusa Tenggara	Bali	3	6
	NTB	1	
	NTT	2	
Borneo	South Borneo	1	1
East Indonesia	...	0	0
Total		15	15

### Research Focus

Establishing the research focus is a crucial step in the research process. Identifying the research focus is essential for gaining a deep understanding of various topics and phenomena across different fields of study, highlighting the specific aspects to be investigated (Daniel & Harland, 2017). The research focus serves as the main guiding principle for researchers, helping them to achieve optimal and relevant outcomes that are aligned with the intended research objectives (Starkey & Madan, 2001). In the field of mathematics education research, there are numerous research focuses that can be explored to improve understanding of mathematics learning and teaching (McLeod, 1992).

Based on Table 4, the most common research focus in mathematics learning for deaf junior high school students in Indonesia is the development of learning media. According to the content analysis of research, there are 7 studies addressing the development of learning media. In second place, the focus of research that is often researched is mathematical understanding, totaling 3 studies. From the content analysis regarding the research focus in mathematics learning for deaf junior high school students in Indonesia, it is evident that learning media receive more attention compared to other research focuses.

Table 4. Distribution of Research Focus

No.	Research Focus	Frequency
1	Learning Design	1
2	Mathematical Communication	1
3	Mathematical Understanding	3
4	Learning Difficulties	1
5	Learning Methods	1
6	Learning Approaches	1
7	Development of Learning Media	7
Total		15

### Conclusion

This study entailed the examination of articles focusing on mathematics learning for deaf junior high school students in Indonesia, which were published in Google Scholar-indexed journals from 2014 to 2023. Interestingly, there was no observable trend indicating a notable increase in the number of studies addressing mathematics learning for deaf junior high school students in Indonesia over the past decade. Among the multitude of publications, it was noted that research and development studies emerged as the predominant research method. Specifically, the topic "Geometry" was the most commonly selected mathematics topic. Additionally, questionnaires and tests were identified as the most frequently utilized data collection tools. Geographically, Java, Bali, and Nusa Tenggara Islands, particularly the provinces of West Java and Bali, were prominent locations for research on mathematics learning for deaf junior high school students in Indonesia. Meanwhile, eastern Indonesia never appeared in research. Furthermore, the development of learning media emerged as the most extensive research focus area in the analyzed articles.

### Recommendations

Based on the findings of this study, a variety of suggestions can be made to offer guidance for future research endeavors. Firstly, it is essential to promote collaborative efforts to increase the frequency of investigations into mathematics learning for deaf junior high school students in Indonesia, emphasizing the need to diversify research methodologies beyond the conventional research and development approaches. Secondly, there is a call for an extensive exploration of the intricate aspects of mathematical topics, particularly focusing on pedagogical techniques suitable for deaf junior high school students. Thirdly, researchers are urged to provide comprehensive descriptions of their research instruments, including assessments of both validity and reliability. Lastly, it is recommended that future research on mathematics learning for deaf junior high school students should encompass other regions of Indonesia, especially the eastern part, to ensure a more balanced representation of educational practices for deaf students throughout the country.

## **Scientific Ethics Declaration**

The authors declare that the scientific ethical and legal responsibility of this article published in EPESS journal belongs to the authors.

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