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Differentiated Instruction: A Literature Review on the Development of Critical and Creative Thinking Skills of Mathematics Students

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Abstract: Differentiated instruction has become a major focus in modern education, allowing teachers to tailor learning experiences to meet the unique needs and abilities of each student. This study aims to conduct a systematic review of the literature related to differentiated instruction from 2018 to 2024. The method employed is a Systematic Literature Review (SLR), which includes bibliometric analysis to map trends and developments in this field. The findings indicate that despite numerous challenges in implementation, such as time constraints and training deficiencies, this approach is still deemed effective in enhancing student engagement and learning outcomes. These findings provide valuable insights for educators and policymakers to formulate better strategies for implementing differentiated instruction, while also emphasizing the importance of technological support and professional development for teachers. This research is expected to contribute to the advancement of more inclusive and adaptive educational practices.

Keywords: Differentiated Instruction, Systematic Literature Review.

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A. INTRODUCTION

In recent years, there has been increasing attention to differentiated instruction as an approach that allows teachers to tailor learning to students' individual needs and abilities. Differentiated learning is considered as a response to differences in the classroom, including differences in learning styles, interests and academic readiness (Tomlinson, 2017). Through this approach, teachers can adapt content, processes, products and learning environments to support the optimal development of all students (Hall et al., 2011).

Differentiated learning approaches emerge from the need to create more inclusive learning experiences that take into account the diversity of students, especially in classes with different levels of ability. This is in line with the demands of modern education which increasingly emphasizes equity and quality education for all students (Tomlinson & Imbeau, 2010). Research shows that this approach can increase students' engagement and motivation in the learning process and help them achieve better learning outcomes (Coubergs et al., 2017; Joseph et al., 2013).

Since 2018, there has been a significant increase in the literature on differentiated learning, covering a range of contexts from primary to higher education. Research in various countries also shows that the implementation of differentiated learning still faces a number of challenges,

such as time constraints, lack of teacher training, and challenges in designing effective learning strategies (Heacox, 2018; Santangelo & Tomlinson, 2012). Nonetheless, differentiated learning continues to be considered as a potential approach to improve the quality of learning in heterogeneous classrooms (Weselby, 2014).

This study aims to systematically review the development of literature on differentiated learning from 2018 to 2024. The review will explore various perspectives, methodologies and current research results related to differentiated learning. Thus, this research is expected to provide a more comprehensive picture of the development of this approach in education and the challenges faced in its implementation.

B. METHOD

This research uses the Systematic Literature Review (SLR) method which aims to identify trends and knowledge growth in differentiated learning. Systematic literature review (SLR) is a systematic research method to collect, critically evaluate, integrate, and present findings from various research studies on a research question or topic of interest (Mubarok, 2022). In SLR, the Systematic Mapping Study (SMS) method is the initial stage in carrying out a Systematic literature review. The Systematic Mapping Study method is more descriptive, further supported by the Systematic literature review method which is exploratory and exploitative, thus providing adequate transparency and replication as a research method Armitage (2008). The Systematic Literature Review method with bibliometric analysis is used to map research trends related to literacy, reasoning, and critical thinking by comprehensively analyzing documents on the google scholar database for the period 2018- 2024.

Referring to the opinion of Schmeisser, B. (2013) there are five stages in bibliometric analysis research, namely: First, determining keywords, second, searching for article data, third, filtering articles, fourth, collecting and compiling data, fifth, analyzing data. First, determining the keywords, the determination of keywords is adjusted to the needs of searching for research topics, because this research analyzes related to differentiated learning (Differentiated Instruction). From the systematic literature review conducted, 200 articles indexed by Scopus and Google Scholar were selected.

Table 1. Rules for searching Systematic Literature Reviews on Differentiated Instruction

No	Criteria	Results
1	Object	Conducted a *systematic literature review on Differentiated Instruction*
2	Data source	Scopus and Google scholar
3	Keywords	2018-2024
4	Last time to search the database	November 8, 2024
5	Documents analyzed	The database information obtained was then analyzed with the help of Microsoft Excel, VOSviewer and *Harzing's Publish or Perish*.

This article search uses the Google Scholar database by utilizing the Publish or Perish application. The following is a display of article data obtained from the Publish or Perish application.

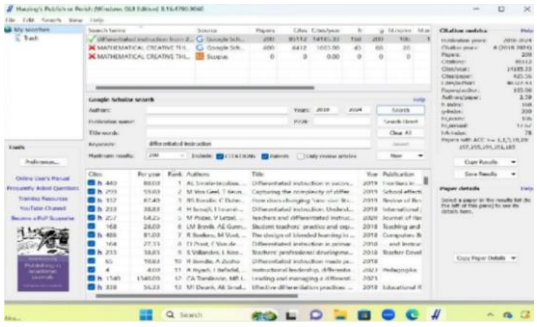

Figure 1. Search method through Publish or Perish Source: Publish or Perish

In searching for articles, researchers limit the year of publication by selecting the range from 2018 to 2024, so that the results of the article search are obtained as many as 200 articles. After searching for articles, the next step is to save the file in RIS file format. After the data is obtained and stored in the form of a RIS file or Research Information Systems Citation File, the next step is to enter the file into the Vosviewer software with the aim of visualizing network patterns or relationships between bibliometrics into three categories, including network visualization, Overlay visualization, and density visualization. Network visualization aims to visualize the strength or weakness of the network or relationship between research terms, Overlay visualization aims to visualize historical traces based on the year of publication of research, while density visualization aims to display the density or emphasis on research groups, Zakiyyah (2022). VOSviewer software is used as a bibliometric analysis tool to visualize networks in the form of authors, countries, journals, and keywords. This data was inputted to be used for co-authorship and co-occurrence analysis, resulting in a network map of authors, countries, journals, and keywords. In addition, from the citation analysis, a network map of scientific journals was generated. VOSviewer software was used for bibliometric network construction and visualization. This software provides an overview of information from publications, such as the author, organization, country, and keywords Huda (2023).

C. RESULTS AND DISCUSSION

Based on the data obtained from articles on differentiated learning, the main factors relevant to the topic were analyzed, including title and abstract analysis, and co-authorship analysis. VOSviewer software was used to map the co-occurrence of authors' keywords, and citation analysis.

1. Data acquisition from Harzing's Publish or Perish

This article examines the number of documents produced per year using Harzing's Publish or Perish software. Based on the articles obtained from the keyword search "differentiated instruction", according to the Scopus and Google Scholar databases, 200 articles were produced. Furthermore, the author saves the data from this search into the RIS format used in the VOSViewer application. Based on the results of the data acquisition shown in Figure 1, 10 articles were selected for review. The following is presented data on 10 articles from 2018- 2024.

Table 2. Articles on Differentiated Learning

No.	Author	Title	Year	Publisher
1	Al-Shaboul, Y., Al-Azaizeh, M., & Al-Dosari, N	Differentiated Instruction between Application and Constraints: Teachers' Perspective	2021	European Journal of Educational Research, 10(1), 127–143.
2	Xu, L., & Cheong, K.	Differentiated Instruction at The Age of Smart Education	2022	Faculty of Education and Liberal studies, City University, Malaysia.
3	Aldossari, A. T	The Challenges of Using the Differentiated Instruction Strategy: A Case Study in the General Education Stages in Saudi Arabia	2018	International Education Studies, 11(4), 74.
4	Subban, P., Suprayogi, M. N., Preston, M., Liyani, A. N., & Ratri, A. P. P.	Differentiation is Sometimes a Hit and Miss". Educator Perceptions of Differentiated Instruction in the Higher Education Sector	2024	Asia-Pacific Education Researcher
5	Al-rsa'i, M. S., & Shugairat, M. F.	Technology Driven Differentiated Instruction in Science Teaching	2019	International Journal of Education
6	Stollman, S., Meirink, J., Westenberg, M., & van Driel, J.	Teachers' interactive cognitions of differentiated instruction in a context of student talent development	2019	Teaching and Teacher Education
7	Ginja, T. G., & Chen, X.	Teacher educators' perspectives and experiences towards differentiated instruction	2020	International Journal of Instruction
8	Gheyssens, E., Coubergs, C., Griful- Freixenet, J., Engels, N., & Struyven, K.	Differentiated instruction: the diversity of teachers' philosophy and praxis to adapt teaching to students' interests, readiness and learning profiles	2022	International Journal of Inclusive Education
9	Variacion, D. A., Salic- Hairulla, M., & Bagaloyos, J.	Development of differentiated activities in teaching science: Educators' evaluation and self-reflection on differentiation and flexible learning	2021	Journal of Physics: Conference Series
10	Demir	The Impact of Differentiated Instructional Media on the Motivation and Opinions of Students towards Science Learning in Terms of Learning Styles	2021	Shanlax International Journal of Education,

Research conducted by Al-Shaboul et al (2021) to investigate the factors and barriers that affect the implementation of differentiated instruction in the classroom. This study aims to provide better insight into the challenges faced by teachers in implementing teaching strategies tailored to the individual needs of students, as well as to provide recommendations that can help in creating a classroom environment that supports effective differentiated

learning. The results showed that there are several factors and barriers that affect teachers' implementation of differentiated instruction. Some of the key findings of this study include:

a. Level of Implementation: The research found that despite the many barriers, implementing differentiated learning is still considered a worthwhile endeavor. Teachers have the opportunity to change and develop their teaching methods to create a future- ready generation.
b. Barriers Faced: Some of the key barriers identified include: Individual differences in students which was a major challenge. Unsupportive school environment. Challenges related to the nature of differentiated instruction itself. Lack of administrative support and adequate educational resources
c. Recommendations: This study recommends that universities adopt and adapt differentiated learning in their curricula and provide professional development training for supervisors and teachers to improve the implementation of this strategy in the classroom.

Research conducted by Xu, L., & Cheong, K. (2022) to develop and implement a differentiated instruction system supported by smart education. This research aims to: (1) Identifying and Overcoming Challenges, solving problems encountered in the implementation of differentiated learning, such as teachers' difficulties in distinguishing differences between students, complexities in the implementation of differentiated learning, and student evaluation methods; (2) Developing differentiated learning models, designing differentiated learning models in the context of smart education and exploring ways to put them into practice in university classrooms; (3) Improving Students' Learning Experience, using smart education technologies and platforms to provide more personalized feedback to students, so that they can understand their learning and living conditions more intuitively; and (4) Improve Teaching Quality, improve teaching quality and achieve predetermined training objectives by utilizing technology and platforms in intelligent education. The results show that the implementation of differentiated learning system supported by smart education successfully overcomes some of the problems encountered in traditional differentiated learning. Some of the key findings of this research include:

a. Improved Quality of Learning: Technologies and platforms in smart education help create a more comfortable and adaptive learning environment, which supports students in completing various learning exercises.
b. Data Visualization and Feedback: The use of technology allows students to see their learning and living conditions in the form of three-dimensional data displays, which helps them understand their progress and plan their learning career in the following year.
c. Increased Student Satisfaction: The survey results show that students are satisfied with the personalized evaluation provided, which not only provides positive feedback but also encourages them to confront and change their learning situation.
d. Adaptation to Informatics Education: This research shows that smart education can adapt to the future trend of informatics education and talent development, and assist students in completing various learning exercises in stages.

e. Teaching Mode Reform: This study confirms that the reform of teaching mode through smart education is important to improve the quality of teaching and achieve the set training objectives.

Research conducted by Aldossari, A. T (2018) aims to identify and analyze the challenges faced by teachers in implementing differentiated instruction strategies at the general education level in Eastern Province, Saudi Arabia. This study aims to determine the challenges faced by teachers in using differentiated learning strategies, identify the factors that influence the implementation of these strategies, including challenges related to the school environment, teachers, students, and curriculum, and provide recommendations for improving the implementation of differentiated learning strategies in the classroom, based on the views of teachers. The results of this study show that the challenges faced by teachers in implementing differentiated instruction at the general education level in the Eastern Province, Saudi Arabia, are as follows: (1) Level of challenge: Overall, the challenges faced by teachers in using differentiated learning are considered to be at a moderate level; (2) Student- Related Challenges: The most significant challenges stem from student factors, which include differences in students' abilities, interests and diverse learning needs; (3) School Environment Challenges: Challenges related to the school environment were also identified, including lack of support from the administration and inadequate facilities to effectively implement these strategies; (4) Teacher-Related Challenges: Some challenges are also related to the teachers themselves, such as lack of training and understanding of differentiated learning, 4) Challenges from Curriculum: Rigid and inflexible curriculum is also an obstacle in implementing differentiated learning; and (5) Differences Based on Gender and Education Level: This study also found significant differences in the challenges faced based on the gender of the teachers and the level of education taught.

While the research conducted by Suban et al (2024) aims to explore educators' perceptions regarding the implementation of differentiated learning in higher education, especially in the context of universities in Indonesia. This research aims to identify attitudes, subjective norms, and behavioral control factors that influence educators' intention to implement differentiated learning, provide critical insights into effective strategies, identify challenges, and inform policies and learning practices, responding to the need to accommodate student diversity. The results of the research on educators' perceptions towards implementing differentiated learning in higher education in Indonesia show several key findings: (1) Positive Attitude Toward Innovation: Educators showed a willingness to adopt innovative teaching methods, including the use of games, software applications, and social media platforms to increase student engagement; (2) Educators' experience and educational background had an effect on their attitudes and perceptions of support in the implementation of differentiated instruction. More experienced educators tend to have higher confidence in implementing differentiated learning; (3) Educators face various challenges in implementing differentiated instruction, including time constraints, large class sizes, and content complexity. All research participants acknowledged that these challenges can hinder the effectiveness of implementing differentiated learning; (4) Support from colleagues and professional development are essential to increase educators' confidence and ability to implement differentiated learning.

Continuous training and institutional support are needed to create an inclusive and adaptive learning environment; and (5) Implementing differentiated learning has the potential to improve the learning environment and student learning outcomes through innovative learning strategies and efforts from educators.

In addition, research conducted by Al-rsa'I (2019) to investigate how to implement Differentiated Instruction in science teaching by using technology. This study aims to show that the use of technology can enhance differentiated learning due to the diversity of technological tools and programs available. In addition, this study also emphasizes the importance of the TPACK (Technological Pedagogical Content Knowledge) model in understanding the relationship between content, teaching, and technology, and how technology can help in identifying students' interests, readiness levels, and appropriate learning patterns for individual students. The results show that the use of technology significantly enhances differentiated learning in science teaching. Key findings include: (1) Diversity of Technology Tools: The diversity of technology tools and programs allows the presentation of information in various formats, meeting the different learning needs of students; (2) TPACK Model: The application of the TPACK model is important for integrating content, pedagogical, and technological knowledge, assisting teachers in pedagogical decision- making and appropriate tool selection; (3) Identification of Student Interest and Readiness: Technology helps identify students' interests and readiness levels, enabling customization of instruction as per individual needs; (4) Challenges and Opportunities: While there are challenges in implementing differentiated learning in traditional environments, technological developments provide opportunities to improve future implementation; and (5) Teacher Training Recommendations: The study recommends training for science teachers in implementing the TPACK model and establishing an IT education center to support differentiated learning.

Research conducted by Stollman et al (2019) aims to investigate the application of differentiated learning (DI) by teachers in the teaching context and understand their cognitive interactions related to student differences. This research emphasizes the importance of considering student characteristics, such as readiness and prior knowledge, in designing learning projects that meet certain criteria. In addition, the study also explores variations in the way teachers think and act in different teaching situations and suggests that a uniform approach to DI implementation may not be effective due to context, situation and individual dependencies. The results show that teachers often implement differentiated learning (DI) in various forms, with a major tendency towards convergent differentiation. Students' readiness was the main characteristic considered, while students' learning profiles were given less attention. There was significant variation in teachers' cognitive interactions influenced by context and situation. This research emphasizes that a uniform approach to DI is not possible for all teachers and that better support is needed to help teachers understand and implement different forms of DI, including divergent differentiation, so that students can reach their full potential.

Research conducted by Ginja et al (2020) this study aims to investigate the perspectives and experiences of teacher educators regarding differentiated instruction in the context of teacher education institutions in Ethiopia. This study aims to: Understand the extent to which

educators understand the concept of differentiated learning, identify how educators implement differentiated learning to meet the needs of all students, and assess the effectiveness of differentiated learning models in pre-service teacher education programs according to educators' views. The research results showed the following findings: (1) Understanding of differentiated learning: Most educators have a positive understanding of the importance of differentiated learning, although some feel undertrained and unsure about how to implement it, many educators recognize that each student has different needs and ways of learning; (2) Teaching Practices: Differentiated learning approaches are still rarely practiced in the classroom. Many educators report that they rarely apply these techniques due to time and training constraints. Despite awareness of differences in students' readiness and interests, many educators find it difficult to adapt their teaching effectively; (3) Inhibiting Factors: Some of the factors that hinder the implementation of differentiated teaching include large class sizes, lack of access to professional training, and limited facilities. Misperceptions about differentiated learning are also an obstacle, with some educators arguing that this approach is only relevant for basic education, not higher education; and (4) Recommendations: The study recommends the need for adequate practical training in teacher training programs, as well as awareness raising through various academic events and the provision of necessary facilities and support from authorities are also considered important to facilitate the implementation of differentiated learning.

Research conducted by Gheyssens et al (2022) to explore the profile of teachers in Differentiated Instruction (DI) in relation to their teaching philosophy and practices. The study aimed to: Identify how teachers adjust their teaching based on students' interests, readiness, and learning profiles, develop a valid instrument to measure teachers' teaching philosophies and approaches in the context of DI, namely the DI-Quest instrument, find patterns of teachers' profiles based on DI-related factors in primary and secondary education, analyze the relationship between teachers' philosophies about DI and their daily teaching practices, and discuss the implications of the research results for future professional development and teacher education. Analysis of variance showed that each factor of the DI- Quest instrument significantly varied between the different profiles, indicating the validity of these groupings. These results have important implications for the professional development of teachers and teacher education, emphasizing the need for reinforcement of DI philosophy in daily practice.

Research conducted by Variacion et al (2021) aims to develop differentiated learning activities in science classes to improve understanding of the effectiveness and implementation of differentiated learning, as well as its impact on student learning experiences. The results showed that the differentiated learning activity module received excellent to outstanding ratings from the evaluators. Educators gave higher ratings to the Differentiated Learning Module compared to the traditional learning module (Non-DI). Overall, this study supports the application of differentiated learning activities in science teaching as an effective strategy to enhance students' learning experience and close the achievement gap among students.

Research conducted by Demir (2021) aims to test the effectiveness of differentiated learning according to students' learning styles, measure students' motivation level to learn science, assess how differentiated learning affects students' views on science learning. The research results in this study show that the application of teaching media integrated with

differentiated instruction has a positive impact on students' motivation in learning science, especially in the context of their learning styles.

2. Title and Abstract Analysis

Title and Abstract Analysis Systematic literature review in this article starts with the title and abstract. From 200 articles harvested using Publish or Perish software, the author then visualizes the database obtained using VOSviewer software. In the results of this visualization, researchers found 5 clusters related to one another. Differentiated Instructiom is the largest cluster in the visualization. The mapping visualization analyzed in this study is divided into 3 parts, namely 1) Network visualization (see figure 2), 2) Density visualization (see figure 3), and 3) Overlay visualization.

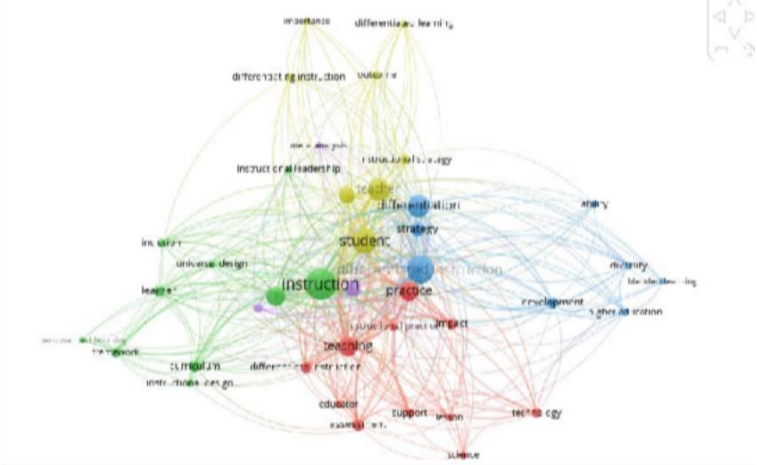

Figure 2. Visualization results of 200 Scopus and Google Scholar indexed article metadata

a. Group 1, marked in red, has 6 important terms that are interrelated to assessment, differentiated instruction, educator, instructional practice, teaching, and technology.
b. Group 2, marked in green, has 7 terms, namely curriculum, framework, inclusion, instructional design, instructional leadership, learner, and learning
c. Group 3, marked in blue, has 6 terms: ability, blended learning, development, differentiated instruction, diversity, higher education, and strategy.
d. In group 4, which is marked in yellow, there are 6 terms Calssroom, importance, instructional strategy, outcome, student, and teacher.

The relationship between terms and other terms is shown in each cluster. Each term is marked with a colored circle, Nabilla (2022). The size of the circle for each term differentiates the frequency of occurrence of the term. The size of the label circle shows a positive correlation with the appearance of the term in the title or abstract. The more frequently the term appears, the larger the circle size.

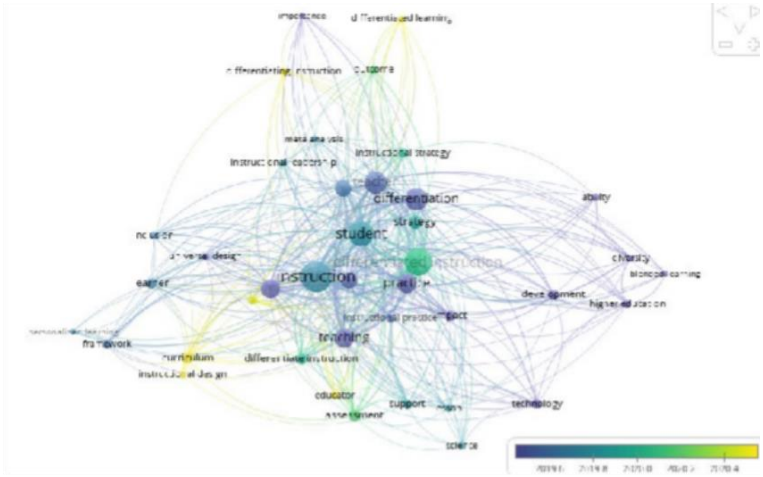

Figure 3. Overlay Visualization Results

Based on Figure 3 showing the overlay visualization, the color difference of each year shows the range of publication years. The purple network indicates the oldest publication year, while the yellow network indicates the latest publication year. The latest terms that appear are differentiated instructional, curriculum, instructional design, and educator. Based on the results of the overlay data mapping, it can be seen that research on the topic of differentiated learning is still relatively new, so it is very necessary to conduct research on this topic.

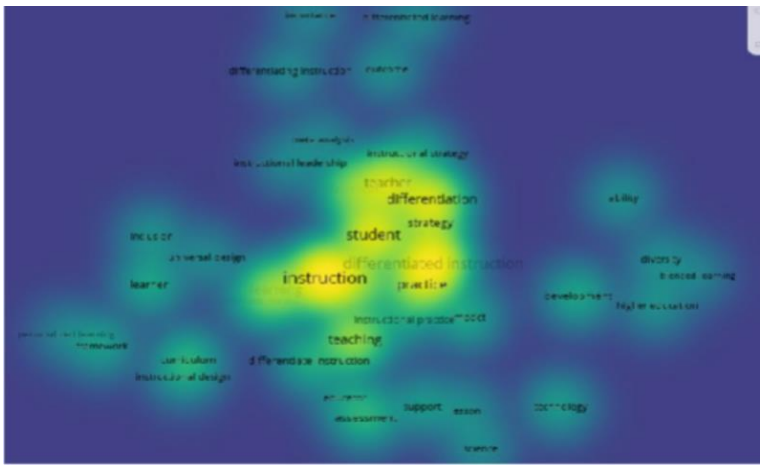

Figure 4. Density Visualization Results

Based on the results of Density Visualization in the figure above provides knowledge that, the brighter the yellow color and the larger the diameter of the term label, the more often the term appears. Conversely, if the yellow color is faded, it means that the number of people researching the term is small, Nabilla (2022), Indriyanti (2023), if the density is less / less it can be an opportunity for new research, Supriadi (2023). Referring to the results of the Density Visualization, above, it can be seen that research related to the terms differentiation, instruction, strategy, and practice has a large number of studies.

D. CONCLUSIONS AND SUGGESTIONS

Based on the bibliometric analysis of articles examining differentiated learning, it can be concluded that there are 200 articles relevant to this topic, which were analyzed using

VOSviewer software. The analysis showed that there were 40 terms grouped into 4 clusters, with frequently occurring terms including differentiation, education, and practice. The overlay visualization also illustrates the latest terms to emerge in 2024, instruction, strategy, and practice. Findings from the analysis of research titles and abstracts show that research related to differentiated learning is still relevant to improve success in developing students' academic and non-academic abilities. Although there are challenges in implementing differentiated learning, the benefits are significant in supporting the diverse needs of students and improving teaching effectiveness. Technology support, teacher training, and curriculum adaptation are important aspects to improve the implementation of this strategy in education. From this, it can be concluded that differentiated learning is an interesting and important topic to be studied further in an effort to improve the quality of mathematics learning in Indonesia.

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