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Review Article

Mapping Research on Differentiated Instruction: A Bibliometric Review of the Literature in the Last 20 Years

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Abstract
Differentiated Instruction (DI) has emerged as a vital pedagogical approach over the past two decades, focusing on adapting teaching methods to meet student's individual needs in heterogeneous classrooms. Introduced by Carol Ann Tomlinson, differentiated instruction enhances learning outcomes, motivation, and active student participation, particularly in classrooms with diverse abilities and needs. Research on differentiated instruction has shown significant growth, both in the number of publications and in the topics explored, such as its application in various subjects, the use of technology, and its impact on different student groups. The United States and Europe are the primary contributors to this research, with leading journals serving as key publication platforms. Future research could benefit from increased collaboration between institutions in these regions and those in the United States and Europe, which could promote the exchange of culturally relevant practices and broaden the application of DI. However, implementing differentiated instruction continues to face challenges, including limited resources, time constraints, and inadequate teacher training. Bibliometric analyses map the development of differentiated instruction research over the past two decades, identifying trends, collaboration networks, and key themes in the literature. This review aims to guide future research and insights for educators, researchers, and policymakers regarding the evolution and implementation of differentiated instruction in education.

Keywords: Bibliometric Analysis, Bibliometrix, Differentiated Instruction, Heterogeneous Classrooms, Pedagogical Approaches, Student-Centered Learning

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1. INTRODUCTION

Differentiated Instruction has evolved over the past two decades into a highly important pedagogical approach, recognized for its ability to meet the diverse learning needs of students in heterogeneous classrooms (Smale-Jacobse et al., 2019; Tupiño et al., 2023). Introduced by Carol Ann Tomlinson, differentiated instruction emphasizes the importance of adapting teaching methods, materials, and learning environments to accommodate the individual characteristics of each student, such as learning styles, interests, readiness levels, and cultural backgrounds (Djatmika & Astutik, 2023). With the growing focus on inclusivity and equity in education, differentiated instruction is increasingly applied in regular classrooms consisting of students with diverse abilities and needs (Thakur, 2014). Research shows that the implementation of differentiated instruction not only enhances learning outcomes but also improves motivation, active participation, and student satisfaction with the learning process (Utami et al., 2022). Additionally, differentiated instruction plays a crucial role in supporting students with special educational needs, gifted students, and those from diverse cultural backgrounds (Subban, 2006).

The development of research on differentiated instruction over the past two decades has shown significant growth, both in the number of publications and in the diversification of topics addressed (Muh. Asriadi et al., 2023). Bibliometric analyses reveal various aspects of differentiated instruction, including the application of differentiated instruction strategies in specific subjects, the use of technology in differentiated

instruction, and its impact on different student groups (Coban, 2022; Dal & Abu, 2023; Utami et al., 2022). Analytical tools like VOSviewer and RStudio have facilitated the visualization of relationships between themes in differentiated instruction research, showing how these topics have evolved and interacted in academic literature (Groenewald et al., 2024).

The United States and Europe lead in contributions to research on differentiated instruction, with journals such as *Teaching and Teacher Education* and *Journal of Advanced Academics* serving as major platforms for publishing this research (Sun & Xiao, 2024). Collaboration between leading European universities, such as Vrije Universiteit Brussel, has further expanded the scope and relevance of differentiated instruction research, particularly in addressing global challenges in education (Sun & Xiao, 2024)

Despite the rapid growth of differentiated instruction research, there are still several challenges in its implementation in practice (Aldossari, 2018; Onyishi & Sefotho, 2020). Many teachers report difficulties in effectively integrating differentiated instruction, primarily due to limitations in resources, time, and adequate training (Muh. Asriadi et al., 2023). Large class sizes and the increasingly complex needs of students often pose significant barriers to the optimal implementation of differentiated instruction (Groenewald et al., 2024). Therefore, future research needs to continue exploring solutions to these challenges, including the use of more advanced technology and more flexible approaches to differentiated instruction (Yuen et al., 2023).

In recent years, bibliometric analysis has become a valuable tool for mapping the landscape of differentiated instruction research, allowing researchers to track trends, identify influential publications, and uncover gaps in the literature (Shareefa & Moosa, 2020). This bibliometric review aims to provide a comprehensive mapping of differentiated instruction research over the past two decades, with a particular focus on trends, collaboration networks, and thematic focuses in the literature (Dal & Abu, 2023; Shareefa & Moosa, 2020). By identifying key contributors and institutions, this review is expected to serve as a guide for future research and provide insights for educators, researchers, and policymakers regarding the development and sustainability of differentiated instruction (Smale-Jacobse et al., 2019). Based on this, several research questions arise, including:

1. What are the publication trends related to differentiated instruction over the past two decades, in terms of both quantity and geographic distribution?
2. What are the main themes discussed in the literature on differentiated instruction over the past twenty years, and how have these themes evolved over time?
3. Who are the most influential authors, institutions, and countries in differentiated instruction research?
4. How do collaboration networks between authors and institutions in differentiated instruction research, particularly in the United States and Europe, operate?
5. What role has technology played in supporting the implementation of differentiated instruction as discussed in the literature over the past two decades?

2. DATA AND METHOD

This research employs a bibliometric approach to examine trends in differentiated instruction studies within the context of differentiated learning. Research trends reflect the collective focus of scholars on specific scientific issues (Mazov et al., 2020) and typically emerge from the alignment of community interests with prior scientific findings (Chen et al., 2023). Bibliometric mapping reveals intellectual connections within the dynamic system of scientific knowledge (Li & Xu, 2022). This analysis utilizes bibliographic databases like Scopus, a major source for academic publications, including titles, authors, abstracts, keywords, and references. Scopus, known for its rigorous content selection and evaluation, covers a wide range of scientific journals, conference proceedings, and books globally (Echchakoui, 2020).

2.1. Article Selection Process and Method

The extraction of bibliographic data from Scopus took place on September 12, 2024, yielding 990 documents related to differentiated instruction. The search query used was "TITLE (differentiated instruction)." The selection process started by applying filters based on the chosen time frame (2001–2022) and limiting the results to articles, as they represent the most common and significant type of scientific publication. Articles generally present original research findings, making them suitable for bibliometric

analysis and comparison using various indicators. Furthermore, the focus was on articles written in English. The dataset was further refined by eliminating duplicate entries and ensuring the relevance of the articles to the research topic. In the end, 751 articles were selected for inclusion and analysis in this bibliometric study. Figure 1 illustrates the complete selection process.

2.2. Data Analysis

The extracted documents were in Microsoft Excel (.csv) format, containing data such as author names, affiliations, titles, countries, journal names, and keywords. This file was analyzed descriptively in line with the research objectives. Bibliometrix software was used to visualize the data, offering a range of functions for analyzing bibliometric indicators, such as publication and citation counts, author collaboration networks, and keyword co-occurrence networks (Aria & Cuccurullo, 2017). The software ensures consistent application of standard bibliometric measures, allowing for reliable data comparison across studies in differentiated instruction.

A quantitative descriptive analysis was conducted to identify key aspects, such as source titles, leading countries, and affiliations in differentiated instruction research. Author collaboration and citation frequencies were analyzed using collaboration analysis (Khaldi & Prado-Gascó, 2021). Additionally, knowledge co-occurrence mapping was used to visualize trends in differentiated instruction research, including keywords and themes. As noted by (Pei et al., 2023), frequently used keywords highlight prominent themes in a research field.

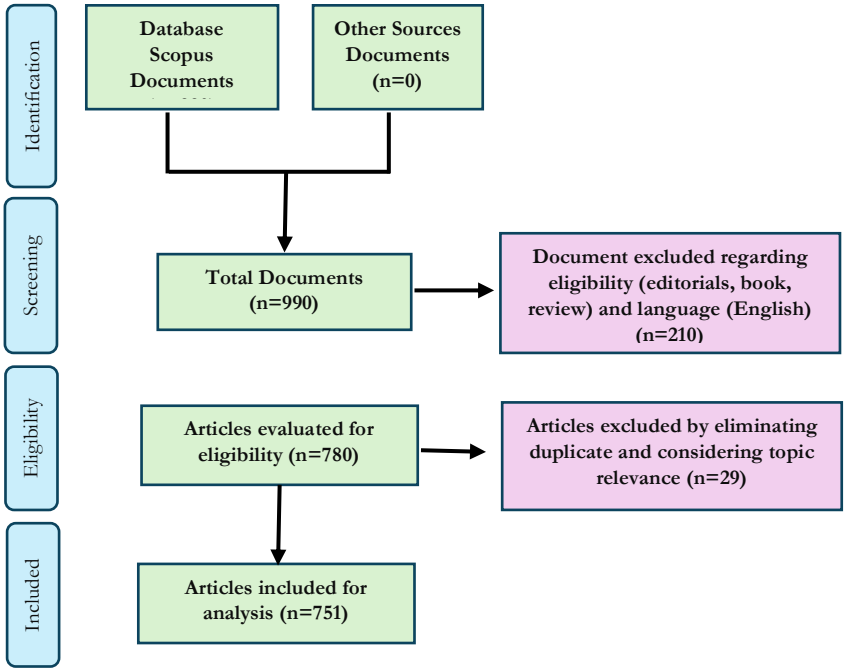

Figure 1. Article Selection Process and Methods

3. RESULTS

3.1. Main Information

Table 1 presents key information in the field of differentiated instruction literature, based on data extracted from the Scopus database. The study reveals substantial annual growth and significant impact, as reflected by the average citations per document. This field includes both domestic and international collaboration, as evidenced by the co-authorship patterns. The percentage of international collaboration indicates a high collaboration index within this area of study. With a variety of interdisciplinary keywords and themes, research in differentiated instruction continues to explore and contribute to numerous domains, fostering innovation and creativity within the scientific community.

3.1.1. Publication Trends

The publication trends on differentiated instruction from 2004 to 2024 show a general increase. Although there were declines in certain years, as illustrated in Figure 2, the overall research trend has continued to rise.

Table 1. Main Information of Bibliometric Data

Description	Results
Main Information About Data	
Timespan	2004:2024
Sources (Journals, Books, Etc)	417
Documents	751
Annual Growth Rate %	25.64
Document Average Age	5.25
Average Citations Per Doc	13.49
References	30594
Document Contents	
Keywords Plus (Id)	1033
Author's Keywords (De)	1842
Authors	
Authors	1791
Authors Of Single-Authored Docs	126
Authors Collaboration	
Single-Authored Docs	141
Co-Authors Per Doc	2.83
International Co-Authorships %	10.52
Document Types	
Article	658
Conference Paper	93

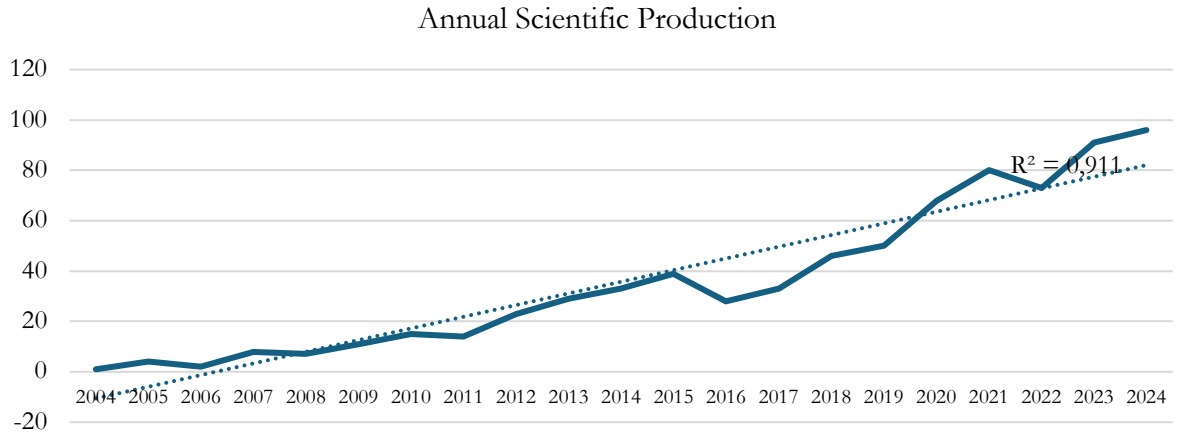

Figure 2. Annual Scientific Production of Differentiated Instruction

Research on differentiated instruction over the last 20 years, from 2004 to 2024, demonstrates that this topic has gained significant academic attention during this period. A total of 417 sources, including journals, books, and other types of scholarly publications, were utilized in this study. This reflects the breadth of available and relevant information on this topic, indicating the diversity of literature across various publication types. In total, 751 documents were analyzed, comprising articles, conference papers, and other scholarly sources relevant to differentiated instruction.

The average annual growth rate for publications in this field is 25.64%, indicating a rapid increase in the number of studies published each year. This underscores the growing interest in differentiated instruction among researchers. The average age of the documents analyzed is 5.25 years, suggesting that most articles and sources in this dataset are relatively recent and align with contemporary research. The average citation per document is 13.49, indicating that these studies have garnered significant attention

from other researchers, with each document being referenced approximately 13 times on average. This reflects the relevance and quality of the research.

The study is supported by an extensive number of references, totaling 30,594 across 751 documents, illustrating the depth and scope of research conducted in this area. Keywords extracted from the titles and abstracts of the cited references amount to 1,033, highlighting the main themes and concepts frequently discussed in the literature on differentiated instruction. Additionally, the authors themselves provided 1,842 unique keywords, showcasing significant diversity in how they describe their research focus and themes. A total of 1,791 authors contributed to these 751 articles, underscoring the global interest in differentiated instruction among academics worldwide.

Out of the total documents, 126 were authored by a single author, indicating that most research in this field involves collaboration among multiple authors. On average, each document has 2.83 authors, reflecting the collaborative nature of research on differentiated instruction. Approximately 10.52% of the documents in this study were produced through international collaborations, indicating global engagement in differentiated instruction research, where academics from different countries work together. Most of the documents analyzed are journal articles (658), followed by conference papers (93). This demonstrates that journal articles remain the dominant medium for research publication, while conferences also play a crucial role in disseminating new findings.

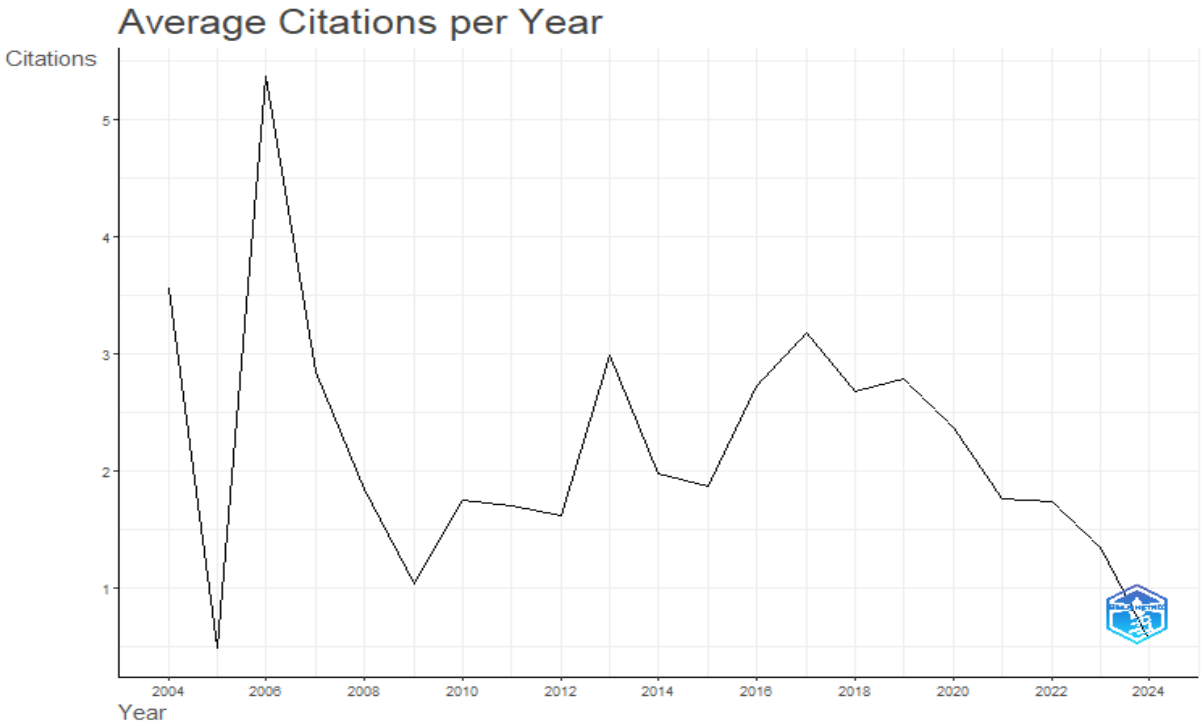

Figure 3. Average Citations Per Year in the Differentiated Instruction

The trend in scientific publications on differentiated instruction, based on the number of articles published annually from 2004 to 2024, shows a consistent increase. During the early period, the annual number of articles was relatively low, under 25 per year until around 2010. Afterward, there was a gradual increase in scholarly production, especially after 2015, when the annual number of articles began approaching 50. A significant spike occurred in 2020, with annual publications exceeding 75 articles. Despite minor declines in certain years, the overall trend shows consistent growth, nearing 100 articles per year by 2024.

This trend highlights a significant rise in scholarly output over approximately two decades, with an accelerated increase after 2015. While the general trend is upward, some years exhibit fluctuations. For instance, a decline in the number of publications occurred in 2018 and 2019, but scientific production rebounded significantly in subsequent years. A notable surge in scientific output on differentiated instruction occurred between 2020 and 2024, with annual publications approaching 100 documents by 2024, marking a peak in research interest during this period. An R^2 value close to 1 (0.911) indicates a very

strong correlation between time and the increase in the number of publications. This means the upward trend is highly predictable, suggesting a sustained and growing interest in differentiated instruction research.

In the early period, there was a significant surge in average citations, peaking around 2006–2007, when the average citations per document exceeded five. This likely indicates that certain publications during these initial years received considerable attention from the scientific community. Following this peak, there was a sharp decline in average citations until 2010, dropping below two. This decline might reflect reduced interest or relevance of some early publications. Between 2010 and 2020, the average citations per year showed a fluctuating pattern. While there were minor increases between 2012 and 2018, the overall graph suggests instability in average citations. This variation may indicate that the impact of publications in this field depended on the relevance of topics or the quality of studies published in specific years.

After 2020, a notable decline in average citations per year was observed, approaching near zero by 2024. This decline could be attributed to several factors, such as newer publications not having had sufficient time to garner significant citations or a potential decrease in the quality or relevance of research in recent years. A primary reason for the decline in recent years (2022–2024) is that newer articles often require several years before achieving substantial citations. Thus, these recent publications may not yet have been fully recognized or cited by the academic community.

3.1.2. Thematic Development

The Sankey diagram in Figure 4 illustrates the thematic development of keywords associated with differentiated instruction and the leading authors in the field (Schmidt, 2008). These keywords reflect key concepts and dominant themes in the scientific discourse on this topic, originating from earlier publications and further refined by specific researchers. The diagram visualizes the flow of information and the role of quantitative data in advancing the main subject. Additionally, it highlights the connections between authors (Bonilla-Chaves & Palos-Sánchez, 2023), underscoring the increasing link between " differentiated instruction".

3.2. Researchers' Profile and Source Titles

3.2.1. Top Author

Influential authors in the field of differentiated instruction research are identified based on the analysis of various metrics, such as the h-index, g-index, m-index, total citations (TC), number of publications (NP), and the starting year of publication (PY_start).

Table 2. List of Top Authors and Their Impact in Diferensiasi Instruction Research

Author	h_index	g_index	m_index	TC	NP	PY_start
Struyven K	10	15	1,25	337	15	2017
Gheyssens E	6	6	1,20	90	6	2020
Pozas M	6	12	1,20	160	13	2020
Consuegra E	5	5	0,83	65	5	2019
Griful-Freixenet J	5	5	0,62	184	5	2017
Letzel V	5	8	1,00	139	8	2020
Schwab S	5	5	0,83	93	5	2019
Vanderlinde R	5	7	0,71	109	7	2018
Vantieghem W	5	6	0,71	108	6	2018
Dack H	4	6	0,57	82	6	2018

Based on the analysis, the most influential author in differentiated instruction research is Struyven K. Struyven stands out as one of the leading contributors in the field, with an h-index of 10 and a g-index of 15, reflecting their ability to publish impactful research that consistently attracts citations. With a total

of 337 citations from 15 publications since 2017, Struyven has played a significant role in advancing differentiated instruction research. The m-index of 1.25 further indicates a strong publication and citation rate relative to the time since their first publication in this area.

The next influential author is Gheyssens E. Although Gheyssens began their research in 2020, they have already achieved an h-index of 6 and a g-index of 6, demonstrating consistent citation impact across their six publications. With a total of 90 citations and an m-index of 1.20, Gheyssens has successfully maintained their influence in the field of differentiated instruction within a relatively short time frame. Another author making a significant impact in a short period is Pozas M, who also started their research in 2020. Pozas boasts an impressive g-index of 12, reflecting highly cited publications despite having an h-index of only 6. With 160 citations from 13 publications, Pozas's work has been well-received by the academic community, and their m-index of 1.20 highlights high productivity and impact since the beginning of their career.

Consuegra E has also made a notable contribution to differentiated instruction research, with an h-index of 5 and a g-index of 5, accumulating 65 citations from five publications since 2019. Their m-index of 0.83 suggests steady growth, albeit at a slightly slower pace compared to other authors. Griful-Freixenet J has achieved an h-index of 5 and a significant total of 184 citations from only five publications since 2017. This indicates that their work is highly cited relative to the number of publications. With an m-index of 0.62, their steady accumulation of citations demonstrates ongoing influence in the field. Letzel V has also made meaningful contributions since 2020, with an h-index of 5, a g-index of 8, and 139 citations from eight publications. Their m-index of 1.00 highlights balanced and impactful research output within a short timeframe.

Schwab S, with an h-index and g-index of 5, has published five works on differentiated instruction since 2019, accumulating 93 citations. Their m-index of 0.83 suggests consistent citation levels in a short period. Similarly, Vanderlinde R, with an h-index of 5 and a g-index of 7, has garnered 109 citations from seven publications since 2018. Their m-index of 0.71 indicates consistent influence in the differentiated instruction research community, although their growth rate is slightly slower compared to others. Vantieghem W began publishing in 2018 and has an h-index of 5 and a g-index of 6, with 108 citations from six publications. Their m-index of 0.71 reflects moderate but consistent impact in the field. Lastly, Dack H has contributed six publications since 2018, achieving an h-index of 4 and a g-index of 6, with 82 citations. With an m-index of 0.57, Dack has shown steady contributions, although their citation growth rate is slower than that of other authors.

Table 3. Top Sources and Their Local Impact

Source	h_index	g_index	m_index	TC	NP	PY_start
Teaching and Teacher Education	11	16	0,85	604	16	2012
International Journal of Inclusive Education	9	16	0,75	292	16	2013
Journal of Advanced Academics	9	12	0,53	254	12	2008
International Journal of Instruction	6	9	0,54	114	9	2014
Teachers and Teaching: Theory and Practice	6	8	0,50	236	8	2013
Cogent Education	5	8	0,50	67	11	2015
Studies in Educational Evaluation	5	5	0,50	233	5	2015
Asia Pacific Journal of Education	4	4	1,00	32	4	2021
Frontiers in Education	4	8	0,67	91	8	2019
Kappa Delta Pi Record	4	6	0,40	40	7	2015

In the bibliometric analysis of various leading academic journals that play a role in disseminating research on differentiated instruction, metrics such as h-index, g-index, m-index, total citations (TC), number of publications (NP), and the year of first publication (PY_start) provide an overview of the local impact of these sources in the field of education, particularly related to differentiated instruction research.

The *Teaching and Teacher Education* journal emerges as the most influential source in differentiated instruction research, with an h-index of 11 and a g-index of 16, demonstrating the broad impact of the articles published within it. With 604 total citations from 16 publications since 2012, this journal plays a key role in the development of DI knowledge. An m-index of 0.85 indicates that this journal consistently publishes highly impactful work.

Next is the *International Journal of Inclusive Education*, with an h-index of 9 and a g-index of 16, accumulating 292 citations from 16 publications since 2013. An m-index of 0.75 shows strong growth in the field of inclusive education, which is closely tied to the principles of differentiated instruction. The articles published here contribute significantly to the discourse on inclusive and adaptive education. The *Journal of Advanced Academics* also shows a strong impact, with an h-index of 9 and a g-index of 12, reflecting its significant contribution with 254 total citations from 12 publications since 2008. With an m-index of 0.53, this journal offers valuable insights into teaching strategies tailored to the needs of gifted and high-achieving students.

The *International Journal of Instruction* has garnered 114 citations from 9 publications since 2014, with an h-index of 6 and a g-index of 9. An m-index of 0.54 indicates stable growth in its local influence on differentiated instruction research, focusing on effective and innovative classroom instruction. With an h-index of 6 and a g-index of 8, along with 236 total citations from 8 publications since 2013, this journal contributes to the understanding of how teachers apply theory to daily classroom practice, including in the context of differentiated instruction. An m-index of 0.50 shows that this journal has maintained steady influence in the related literature. *Cogent Education* is a journal with an h-index of 5 and a g-index of 8, accumulating 67 citations from 11 publications since 2015. Although its influence is relatively lower compared to other journals, an m-index of 0.50 reflects that this journal consistently provides relevant contributions to differentiated instruction research. With an h-index of 5 and a g-index of 5, the *Studies in Educational Evaluation* journal has contributed 233 citations from 5 publications since 2015. An m-index of 0.50 shows significant influence despite having a relatively small number of publications, focusing on educational evaluation related to the implementation of differentiation strategies in classrooms.

The *Asia Pacific Journal of Education* stands out with an h-index of 4 and a g-index of 4, accumulating 32 citations from 4 publications since 2021. An m-index of 1.00 indicates that this journal is growing rapidly and has the potential to become one of the important sources for DI studies in the Asia-Pacific region. *Frontiers in Education*, with an h-index of 4 and a g-index of 8, and 91 citations from 8 publications since 2019, is starting to show increasing influence in differentiated instruction research, with an m-index of 0.67 indicating rapid growth in a short time. The *Kappa Delta Pi Record* journal has an h-index of 4 and a g-index of 6, with 40 citations from 7 publications since 2015. An m-index of 0.40 shows that while its influence is growing more slowly, this journal remains an important source for research related to teaching and education.

3.2.2. Top sources

The size of the bubbles in the graph represents the number of articles published by an author in a particular year. The larger the bubble, the more articles the author published that year. The legend on the right shows the number of articles represented by each bubble size. The color intensity of the bubbles indicates the number of citations the articles received per year. Dark blue bubbles represent a higher number of citations, while lighter bubbles represent fewer citations. Based on the legend: Light bubbles indicate 0 citations, and darker bubbles indicate up to 20 citations. According to the graph, it shows that:

Struyven K: Demonstrates consistent article production from 2016 to 2023, with a high number of articles in recent years. His works appear to be highly cited, as indicated by the dark blue bubbles. Pozas M: Similar to Struyven K, also consistently publishes articles from 2018 to 2023, with several highly cited articles. Letzel V: Publishes a moderate number of articles, especially between 2019 and 2023, with some works receiving good citations. Vanderlinde R: Publishes fewer articles but consistently from 2012 to 2023, with varying citation levels. Marshall J: Published articles consistently from 2010 to 2016, but the citations seem to be low (lighter bubbles). Other authors (Shareefa M, Vantieghem W, Wan SW-Y): Have sporadic article production, with citation levels ranging from low to moderate.

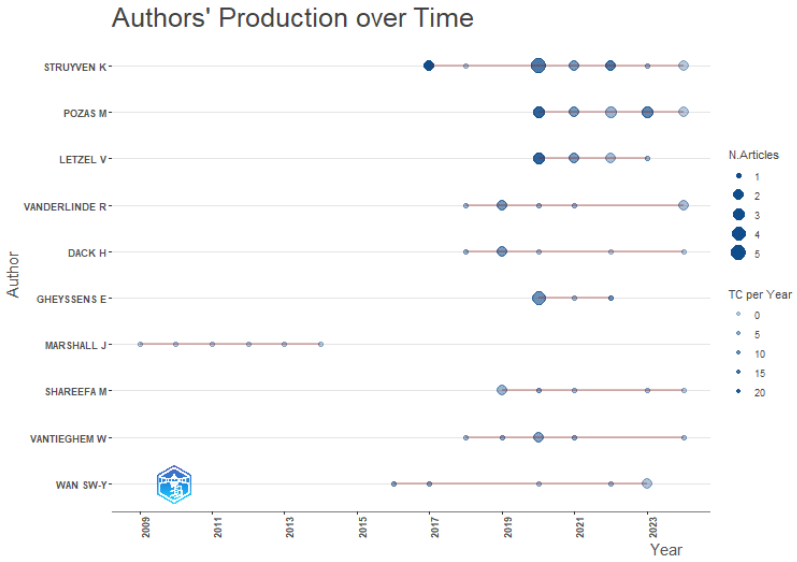

Figure 4. Top Author Production Over Time

This graph illustrates the trends in productivity and impact (in terms of citations) of various authors over a certain period. Authors like Struyven K and Pozas M show high productivity and strong citation impact in recent years, while other authors like Marshall J and Vantieghem W have more moderate or sporadic output with varying levels of impact.

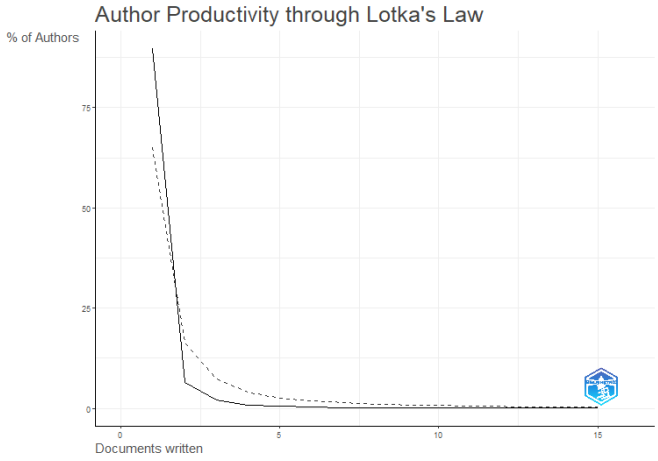

Figure 5. Author Productivity Through Lotka's Law

The image explains Author Productivity Based on Lotka's Law. % of Authors: On the y-axis, the percentage of authors involved in writing documents is shown. Number of Documents Written: On the x-axis, the number of documents written by each author is shown. Lotka's Law Curve: This graph illustrates the distribution of author productivity based on Lotka's Law, an empirical law stating that the number of authors publishing *n* articles is inversely proportional to the square of *n*. In general, this law suggests that most authors write only a few documents, while only a small number of authors write many documents.

The curve sharply declines at the beginning, indicating that the majority of authors write only a few documents. Around 75% of authors write only 1 or 2 documents. After 3 documents, the number of authors involved drops drastically, and at the point of 5 or more documents, very few authors remain productive. At the far right of the curve (for more than 10 documents), only a small number of authors write more than 10 documents, causing the curve to flatten significantly. This graph supports Lotka's Law, which shows that in the academic community, the majority of authors contribute with only a few documents, while only a handful of authors are highly productive and write a large number of documents.

This phenomenon is common across many disciplines, where scientific contributions are dominated by a few prolific authors.

Table 4. Top Sources and Their Local Impact

Source	h_index	g_index	m_index	TC	NP	PY_start
Teaching and Teacher Education	11	16	0,85	604	16	2012
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Cogent Education	5	8	0,50	67	11	2015
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The table above contains indicators that describe the quality and impact of various journals in the field of education. Below is an explanation of each indicator in the table h-index: Measures the productivity and citation impact of a journal. This value indicates that the journal has at least *h* articles that have each been cited *h* times. For example, *Teaching and Teacher Education* has an h-index of 11, meaning that 11 articles from that journal have been cited at least 11 times. The higher the h-index, the greater the influence of the journal. g-index: Similar to the h-index, but it gives more weight to the most highly cited articles. A journal with a high g-index shows that its most influential articles have received a large number of citations. For example, the *International Journal of Inclusive Education* has a g-index of 16, indicating that several of its articles have received many citations.

m-index: Measures the ratio between the h-index and the number of years since the journal started publishing or has been active. This provides a perspective on how quickly the influence of a journal grows. For example, *Teaching and Teacher Education* has an m-index of 0.85, indicating that this journal has developed its academic impact at a relatively fast pace compared to other journals that may grow more slowly. Total Citations (TC): The total number of citations received by the journal. For example, *Teaching and Teacher Education* has 604 total citations, indicating that its articles have been cited that many times by other researchers. A high number of citations signals a strong reputation and significant contribution to academic literature.

Number of Papers (NP): The number of articles published by the journal. For example, *Kappa Delta Pi Record* has published 7 articles, while *Cogent Education* has published 11 articles. PY_start (Publication Year Start): Indicates the year the journal started publishing. For example, the *Journal of Advanced Academics* began in 2008, while the *Asia Pacific Journal of Education* started as recently as 2021. Journals like *Teaching and Teacher Education* and the *International Journal of Inclusive Education* have high h-index and g-index values, indicating that these journals have many frequently cited and influential articles in the field of education. Journals like the *Asia Pacific Journal of Education* and *Frontiers in Education* are relatively new but show good progress with high m-index values (1.00 and 0.67), indicating rapid growth in influence.

Although *Cogent Education* and *Studies in Educational Evaluation* have fewer citations, they still make contributions to educational literature, although their impact may not be as significant as some of the other journals. Overall, this table provides an overview of how the quality, influence, and growth of each journal are measured and compared to one another.

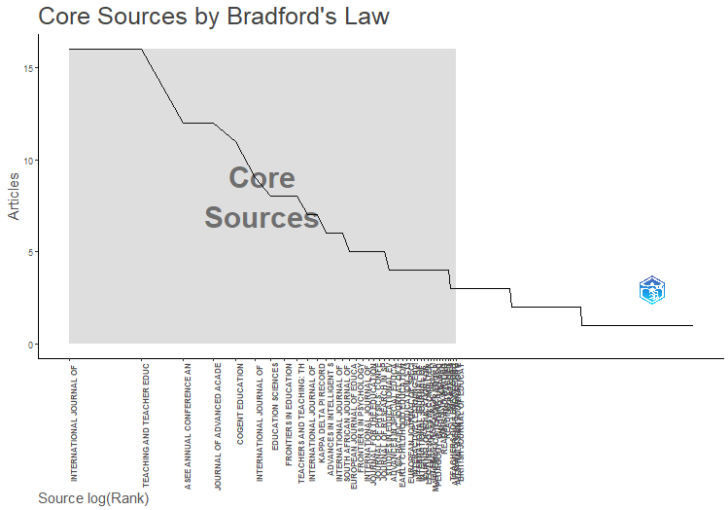

Figure 6. Core Sources Through Bradford's Law

The image shows the Core Sources based on Bradford's Law. Sources (log(Rank)): On the x-axis, there is a list of journals or scientific information sources ranked by their importance. Moving to the right indicates lower-ranked sources. Articles: The y-axis shows the number of articles published by each source, illustrating how many articles are produced by each journal or source. Core Sources: The shaded area in the middle of the graph represents the core sources. These are a small group of journals or sources that generate the majority of articles in a particular field, as predicted by Bradford's Law. Bradford's Law states that journals in a specific field can be divided into several groups. The first group (core) consists of a few journals that produce the majority of articles in the field, while the subsequent groups contain more journals that produce fewer articles.

This graph demonstrates that the core sources are located at the beginning of the curve (on the left), where the number of articles produced is high (about 15 articles per source). After the core sources, the number of articles generated by other journals drops sharply, and the curve flattens, indicating that more journals are producing fewer articles. Journals such as the *International Journal of Teaching and Teacher Education*, *ASE Annual Conference*, and *Cogent Education* appear to be in the core sources group, contributing significantly to the total number of published articles. Other sources appearing after the core sources tend to produce fewer articles (fewer than five), and the number of articles decreases as the source's rank increases. This graph supports Bradford's Law, where a small number of journals or sources produce the majority of scientific articles in a field, while a large number of other journals contribute only a small portion. These core sources are crucial in academic literature as they are the main contributors to the advancement of knowledge in the field.

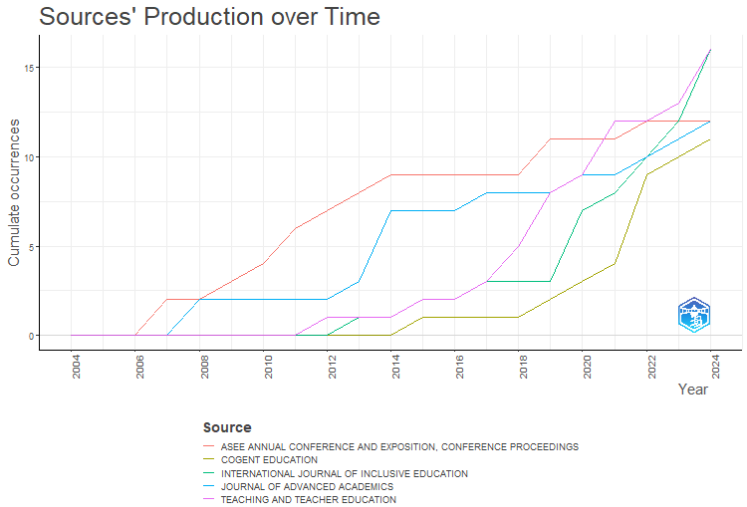

Figure 7. Top Sources Publication Growth.

The graph shows the cumulative number of publications from various academic sources over the years, from 2004 to 2024. The x-axis represents the years, while the y-axis shows the cumulative number of publications from each source. Five sources are represented, each with a different colored line: ASEE Annual Conference and Exposition, Conference Proceedings (Orange Line), Cogent Education (Green Line), International Journal of Inclusive Education (Blue Line), Journal of Advanced Academics (Purple Line), and Teaching and Teacher Education (Pink Line). Steady Growth: All sources show an upward trend over time, though the rate of increase varies. 2004–2010: The graph indicates minimal production for most sources before 2010, with the exception of a few early publications from ASEE Annual Conference and Exposition. 2010–2014: Significant growth is observed in Teaching and Teacher Education, International Journal of Inclusive Education, and ASEE Annual Conference. Post-2014: There is a marked increase in Teaching and Teacher Education (Pink Line), which surpasses the other sources around 2021. Cogent Education (Green Line) and Journal of Advanced Academics (Purple Line) show slower, consistent growth starting from 2016 onward.

Teaching and Teacher Education (Pink Line) demonstrates the most significant growth in recent years, particularly between 2021 and 2024, where its cumulative total is the highest compared to the other sources. ASEE Annual Conference and Exposition initially led in publications but was surpassed by other journals around 2012. Cogent Education and Journal of Advanced Academics exhibit moderate and steady growth without major surges, indicating consistent and gradual contributions. From 2021 to 2024, there is a notable acceleration in publications from all sources, reflecting an increase in academic output in the field. The graph reveals growth trends in publications across all listed sources, especially in the last decade. Teaching and Teacher Education has experienced the most significant rise recently, indicating its increasing relevance or popularity in educational research. Overall, the upward trend in publications across all sources reflects the growing academic interest in the fields they represent.

3.3. Most Influential Literature

Highly Cited Articles, the article by *Suprayogi Mn (2017)* in *Teaching and Teacher Education* (DOI: 10.1016/j.tate.2017.06.020) is the most locally cited, with 58 local citations, suggesting strong relevance and influence within the local academic community. It also has 157 global citations, indicating significant global recognition, with a local-to-global ratio of 36.94. Similarly, differentiated instruction *Xon Fa (2014)* in *Journal of Education for the Gifted* (DOI: 10.1177/0162353214529042) has 49 local citations and 172 global citations, showing a strong global impact with a local-to-global ratio of 28.49.

Table 5. Most Highly Cited of differentiated instruction Paper from 2004 to 2024

Document	DOI	Local Citations	Global Citations	Ratio	Normalized Local.Citations	Normalized Global Citations
Suprayogi Mn, 2017, Teach Teach Educ	10.1016/j.tate.2017.06.020	58	157	36,94	10,02	6,15
Smit R, 2012, Teach Teach Educ	10.1016/j.tate.2012.07.003	56	113	49,55	9,27	5,35
Coubergs C, 2017, Stud Educ Eval	10.1016/j.stueduc.2017.02.004	50	79	63,29	8,64	3,10
Differentiated Instruction Xon Fa, 2014, J Educ Gifted	10.1177/0162353214529042	49	172	28,49	17,02	7,92
Subban P, 2006, Intern Educ J		48	166	28,96	2,00	1,63
Reis Sm, 2011, Am Educ Res J	10.3102/0002831210382891	47	160	29,37	9,40	6,67
Roy A, 2013, Int J Inclusive Educ	10.1080/13603116.2012.743604	45	100	45,00	16,52	2,79
Santangelo T, 2012, Action Teach Educ	10.1080/01626620.2012.717032	41	74	55,40	6,78	3,50
Deunk Mi, 2018, Educ Res Rev	10.1016/j.edurev.2018.02.002	38	115	33,0	10,99	6,11
Van Geel M, 2019, Sch Eff Sch Improv	10.1080/09243453.2018.1539013	33	102	32,35	113,793,103	608,591,885

Balanced Influence, Articles such as *Smit R (2012)* and *Coubergs C (2017)* demonstrate a balanced influence between local and global citations. Both articles have relatively high ratios of local to global citations (49.55 and 63.29, respectively). This suggests that these studies are not only globally recognized

but are also particularly impactful within their local academic contexts. Early Influential Works *Subban P (2006)*, although published earlier, has sustained its influence, as seen with its 48 local and 166 global citations. This longevity points to foundational work in differentiated instruction, which continues to guide research and practice today.

Normalized Citation Impact, The normalized local and global citations offer insight into the relative citation impact adjusted for the publication year. For example, *Van Geel M (2019)* has the highest normalized local citations at 11.37, signaling that it has rapidly gained local attention in a short time, while *Reis Sm (2011)* in *American Educational Research Journal* (DOI: 10.3102/0002831210382891) shows a balanced normalized global impact (6.67).

3.4. Top Countries And Affiliations

Explanation of the table illustrating the contribution of scientific articles from various countries this column shows the countries of origin of the authors of the scientific articles. For example, USA represents the United States, BELGIUM represents Belgium, and so on. The total number of articles published by authors from that country. For instance, the United States published 157 articles, which is the highest number compared to other countries in the table. The percentage of articles published by that country out of the total number of articles. For example, articles from the United States account for 20.91% of the total published articles.

Table 6. Countries With The Highest Number of Documents and Citations

Country	Articles	Articles %	SCP	MCP	MCP %	TC	Average Article Citations
USA	157	20,91	145	12	7,64	3207	20,4
Belgium	33	4,39	29	4	12,12	893	27,1
China	27	3,60	21	6	22,22	603	22,3
Indonesia	26	3,46	23	3	11,54	496	22,5
Canada	23	3,06	21	2	8,70	489	21,3
Germany	23	3,06	17	6	26,09	260	21,7
Netherlands	22	2,93	18	4	18,18	250	50
Australia	19	2,53	18	1	5,26	250	10,9
South Africa	14	1,86	13	1	7,14	190	38
Turkey	14	1,86	14	0	0	123	6,5

The number of articles published by authors from a single country only (without international collaboration). For example, the United States has 145 SCP, indicating that most of the articles are published by authors entirely from the United States. The number of articles published through collaboration between countries, or articles written by authors from more than one country. For example, the USA has 12 MCP, meaning only 12 articles were published through international collaboration. The percentage of articles from that country that are the result of international collaboration (MCP). For instance, China has 22.22% MCP, indicating that around one-fifth of the articles published by authors from China are the result of international collaboration.

The United States (USA) is the largest contributor with 157 articles, or 20.91% of the total articles, followed by Belgium (33 articles) and China (27 articles). Germany has the highest percentage of international collaboration with 26.09%, followed by China with 22.22%, indicating that authors from these countries frequently collaborate with authors from other countries. Turkey has 0% MCP, meaning that all articles published from this country were written solely by authors from Turkey, with no collaboration with international researchers. The United States has a high SCP figure (145 articles), indicating that the majority

of articles were published by authors from a single country. Belgium and Canada also have a significant proportion of SCP.

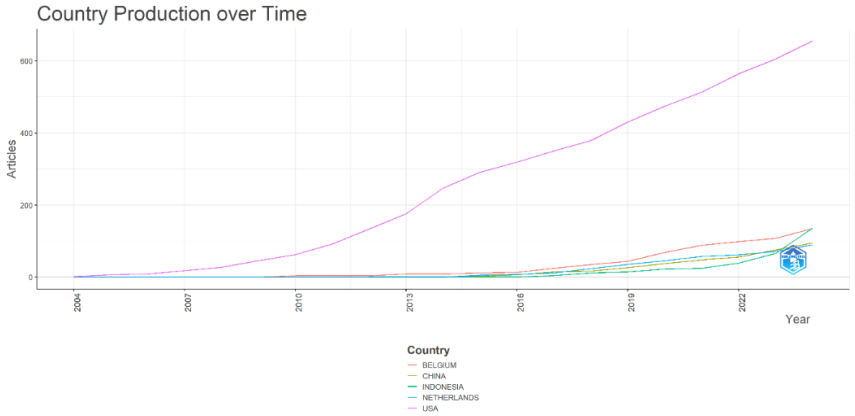

Figure 8. Document Growth of differentiated instruction by Country

This table provides insight into the distribution of scientific publications across different countries and the extent to which international collaboration occurs. Countries such as Germany and China have relatively high international collaboration, while the United States tends to publish more articles with domestic authors. International collaboration can extend the impact of research, and this table shows how it varies across countries.

The graph shows the number of articles produced by various countries from 2004 to 2024. The x-axis represents the years, and the y-axis shows the number of articles produced. Five countries are represented in this graph, each with a different colored line: Belgium (Red Line), China (Green Line), Indonesia (Light Blue Line), Netherlands (Blue Line), and USA (Purple Line). The United States (Purple Line) stands out with a significantly higher number of articles compared to other countries. Around 2010, there is a sharp increase, and since then, the production of articles from the USA has continued to rise at a much faster pace than other countries.

Countries like Belgium, China, Indonesia, and the Netherlands show slower growth rates compared to the USA, but they began to display faster article production after 2016. After 2019, there is a notable increase in the number of articles produced by China (Green) and the Netherlands (Blue), which start approaching Belgium's (Red) production levels. Indonesia (Light Blue) also shows steady growth. The USA clearly dominates this graph with a significantly higher number of articles than the other countries. A significant difference is evident from around 2010, and the gap continues to widen. By 2024, the USA's article production reaches over 600, while the other countries remain below 200 articles. China and the Netherlands show sharper increases in article production since 2020, closing in on Belgium. Indonesia shows a stable growth trend, though its numbers are still relatively low compared to other countries. This graph demonstrates that the United States is the dominant global leader in academic article production, with a significant increase since 2010. While countries like Belgium, China, the Netherlands, and Indonesia show growth trends, they remain far below the USA's article production. There are signs of faster growth in China and the Netherlands in recent years, which could be significant in future competition in article production.

The graph on Most Relevant Affiliations explains the number of authors associated with specific universities or institutions. The x-axis represents the number of authors, while the y-axis shows the names of the universities involved. Based on the graph, Yale University has the highest number of authors (47 authors), followed by Ghent University (42 authors). These two institutions have a significantly higher number of authors compared to the others. University of Twente ranks third with 20 authors. University of Toronto and Brock University each have 16 authors, while University of Copenhagen has 15 authors. Institutions such as Purdue University, University of Connecticut, and University of Virginia have lower author counts (14 and 4 authors, respectively).

There is a notable difference between institutions with very high author counts, like Yale University and Ghent University, compared to others with much fewer authors. The majority of institutions in this

graph have between 4 and 20 authors, with the two top institutions far surpassing the number of authors from others. This graph illustrates that Yale University and Ghent University are the two institutions with the most significant author contributions in the displayed data, followed by University of Twente. Most other institutions contribute fewer authors, indicating a stronger academic concentration at a few leading universities.

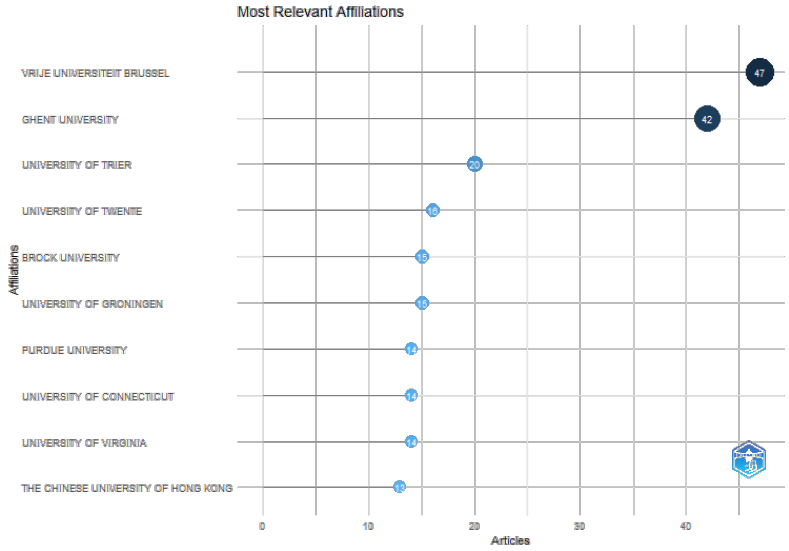

Figure 9. Top Affiliations

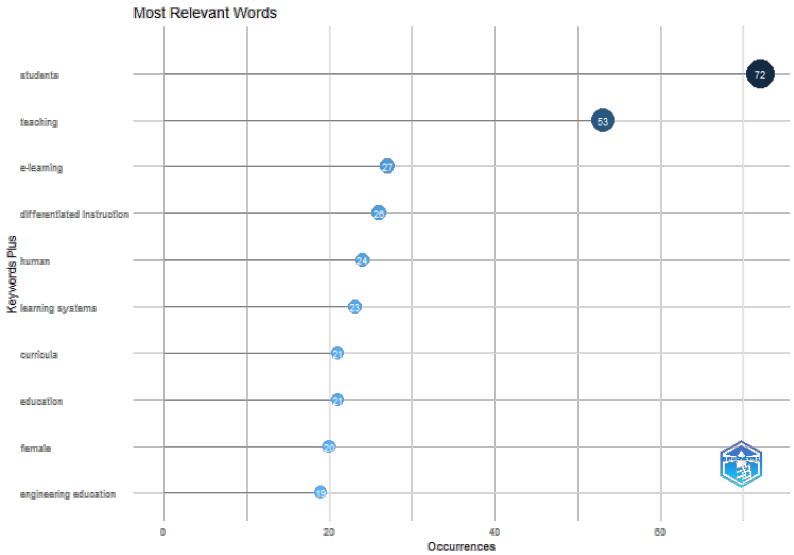

Figure 10. Most Frequent Words

Teaching and Education are the most frequently discussed topics in the context of differentiated instruction research. The graph shows that researchers have focused more on teaching practices and general education when discussing this strategy. E-learning and blended learning also play an important role, possibly indicating their increasing relevance in the context of digital or blended education. The term differentiated instruction, which is the main focus of this study, appears with moderate frequency, suggesting that this topic is often connected to other educational terms.

Based on the most relevant words data, it can be seen that research tends to focus on how differentiated instruction is applied in teaching, with particular attention given to strategies like e-learning and blended learning, which may have become more prominent in the last decade. This analysis helps to illustrate the evolution of the topic and relevant keywords in research over the past two decades, while also identifying the most frequently discussed topics in the literature.

3.5. Analysis of Knowledge Structures

The image shows a frequency graph of various terms used in research from 2007 to 2024. This graph illustrates the cumulative emergence of different terms relevant to the study of differentiated instruction (DI), providing insights into the development of DI concepts in the context of research over the past 20 years. Based on the graph, differentiated instruction is displayed as one of the key terms being analyzed. This allows the authors to demonstrate how the topic of differentiated instruction has evolved over the last 20 years. The graph shows that differentiated instruction began to appear consistently around 2014 and has steadily increased since then, indicating that this concept is being increasingly discussed and researched in education.

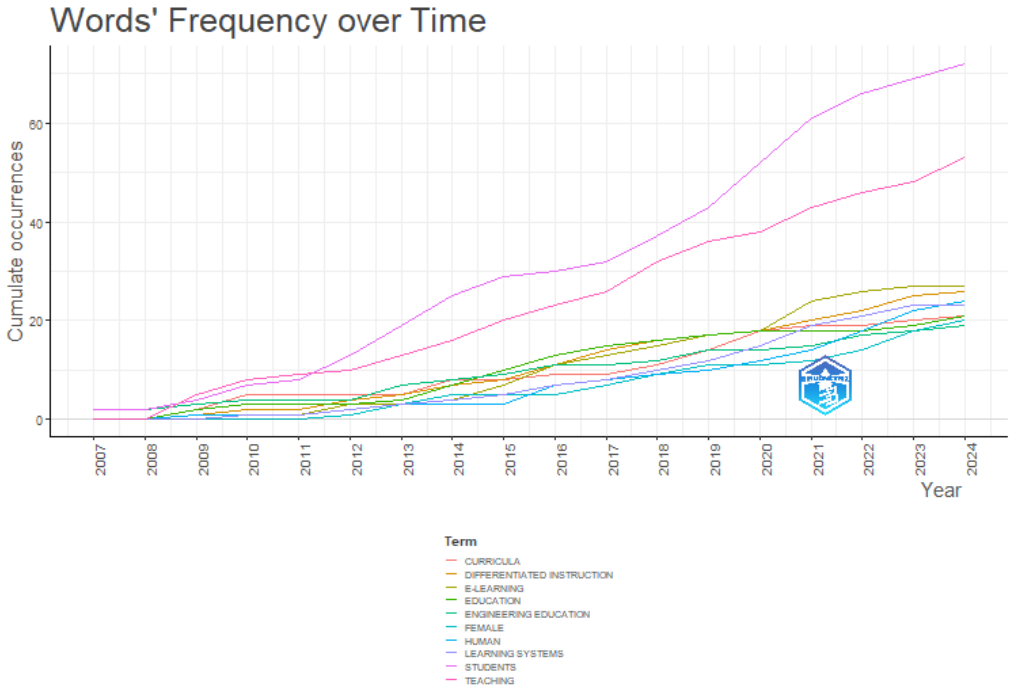

Figure 11. Words' Frequency Over Time

Other terms like Curriculum, Teaching, and Education also show a rising frequency over time, reflecting growing attention to the broader educational context, including the application of curriculum and teaching methods related to differentiated instruction. E-learning and Learning Systems have also shown an increase since 2020, likely linked to changes in teaching methods during the COVID-19 pandemic, where online learning became more popular and relevant in the context of DI. This graph supports the discussion that research related to differentiated instruction continues to grow, in line with the global focus on more inclusive education and teaching methods tailored to individual student needs. In the article, the visualization of these trends can be used to show the rising research interest and application of differentiated instruction over time, as well as how it connects with other educational trends such as Curricula, E-learning, and Teaching.

The image illustrates the connections between various terms that frequently appear together in the research literature. This graph is particularly useful for identifying the relationships between differentiated instruction and other terms in related research. Each node represents a term that is commonly used in the literature, and the size of the node indicates how frequently the term appears. For instance, the large nodes labeled students and teaching indicate that these two terms are frequently mentioned in research related to differentiated instruction. Nodes colored in red represent terms closely associated with topics such as e-learning, learning systems, teaching methods, and personalized learning. This suggests that these topics often appear together in research, particularly in studies focusing on learning technologies and personalized education. The blue nodes group terms related to human subjects, such as human, female, male, learning, and student. These terms are more connected with studies on human aspects and demographics in learning, indicating that differentiated instruction also takes into account social and demographic factors in education.

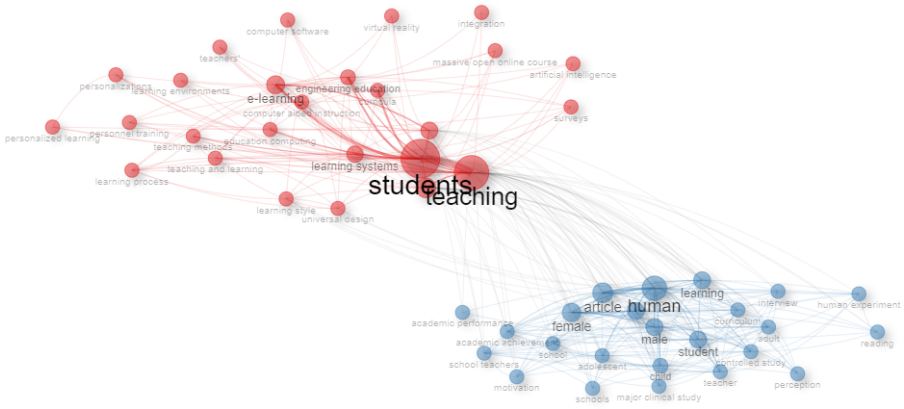

Figure 12. Co-Occurrence Network

The lines connecting the nodes represent how often two terms appear together in the same articles. The thicker the line, the more frequently the two terms are closely linked in research. The red nodes focused on e-learning, learning systems, and teaching methods highlight a strong relationship between differentiated instruction and technology in education. This reflects a growing trend in teaching that increasingly utilizes technology to adapt learning methods to the individual needs of students. The blue nodes emphasize the importance of studies related to human aspects, gender (male, female), and student characteristics (student, child) in the implementation of differentiated instruction. This shows that differentiated instruction is not only concerned with technology or teaching methods but also with understanding individual needs based on social and demographic factors.

Finally, the nodes labeled students and teaching are at the center of the network, indicating that these two concepts are highly dominant in research on differentiated instruction. This makes sense, as the focus of differentiated instruction is on tailoring education to meet the diverse needs of students and providing teaching that is responsive to varying abilities.

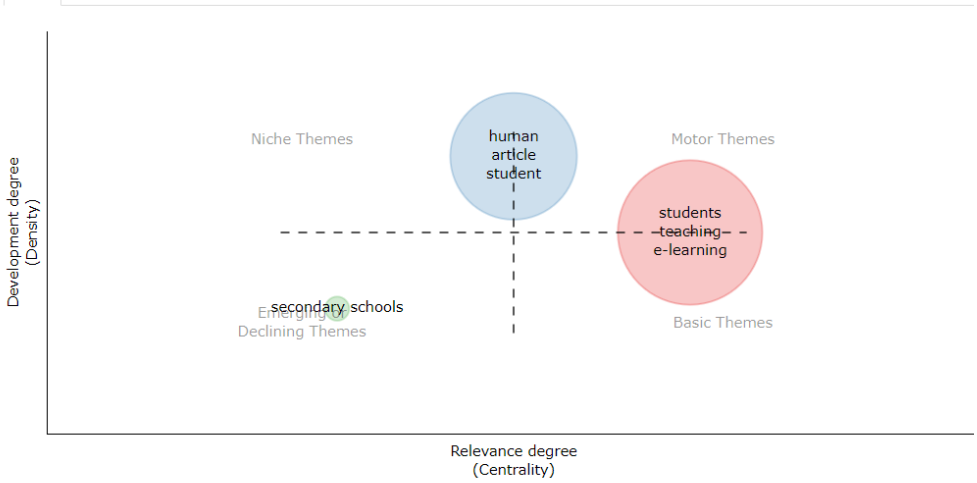

Figure 13. Thematic Map

The thematic map from the bibliometric analysis of differentiated instruction research over the past 20 years is divided into four quadrants based on two dimensions: Degree of Development (Density) on the vertical axis and Relevance Degree (Centrality) on the horizontal axis. Top Left Quadrant (High Development, Low Relevance): This quadrant indicates themes that are well-developed in terms of theory or methods but have low central relevance within the broader research landscape. For example, the term "human article student" falls into this category. Interpretation: These themes have a solid theoretical

foundation but are not highly connected to central or widely discussed topics in differentiated instruction research.

Top Right Quadrant (High Development, High Relevance): Themes in this quadrant have both high development and high relevance. The term "students teaching e-learning" is an example. Interpretation: These topics are at the core of current research in differentiated instruction, indicating a significant focus on innovative teaching methods like e-learning, which is central to the field. Bottom Left Quadrant (Emerging Themes): This quadrant represents themes that are either newly emerging or declining. They have low development and low relevance. For instance, "secondary schools" is an example of a theme that fits this category. Interpretation: This suggests that topics related to secondary schools may be waning in importance or are not yet fully developed in the context of differentiated instruction, with research shifting to more pressing issues like technology-driven teaching.

Bottom Right Quadrant (Basic Themes): Themes in this quadrant are central to the research area but are not yet fully developed. For example, "students-teaching-e-learning" falls into this category. Interpretation: These themes have strong connections with many other research areas but require more in-depth development. This indicates that while differentiated instruction is linked to e-learning, there is still much more research needed to develop this theme fully. Overall, this map highlights that in the past 20 years, the primary focus of research has been on students, teaching, and e-learning, which are the driving forces in differentiated instruction. However, some themes, such as those related to secondary schools, might need further exploration or are experiencing declining interest in the research landscape.

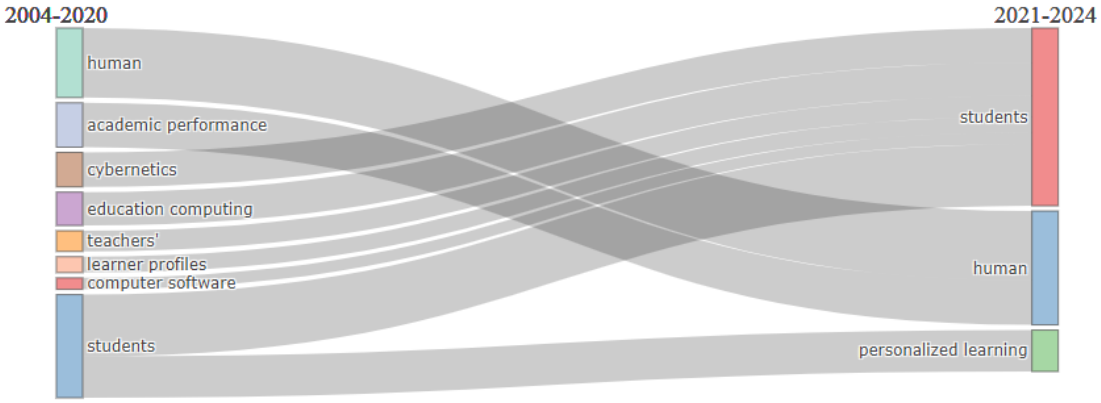

Figure 14. Thematic Evolution

The Thematic Evolution graph shows the development of research themes related to differentiated instruction over two time periods: 2004–2020 and 2021–2024. This graph illustrates how certain themes have evolved or changed over time in the context of differentiated instruction research. Period 2004-2020 A theme focusing on human factors, including both teachers and students, began to emerge and played an important role. This theme focused on how differentiated learning impacts students' academic outcomes. This theme likely refers to the application of systems theory to understand the complex interactions and processes in teaching. The use of technology in education to support various differentiated approaches to learning. A focus on teachers, their roles, and how they implement differentiated instruction. The importance of understanding student profiles as a basis for differentiated instruction. Related to the use of software in supporting differentiated learning strategies. The central theme remained students, highlighting how differentiated teaching approaches impact them.

Period 2021-2024, The focus on students remains dominant, indicating that students continue to be a central theme in differentiated instruction research. This theme continues to be relevant, reflecting the ongoing consideration of human aspects in teaching and learning. A shift toward more personalized learning, emphasizing the importance of tailored teaching approaches that cater to the individual needs and potential of students.

Evolution from 2004-2020 to 2021-2024, Students and Human themes remain strong and relevant, demonstrating the continued central focus on students and human aspects in differentiated teaching. Personalized Learning emerges as a new and growing theme in the later period (2021–2024), reflecting a trend in teaching differentiation, where instructional strategies are becoming more personalized for each student. Themes such as Cybernetics and Education Computing, which were prominent earlier, do not appear in the 2021-2024 period. This suggests that these topics may have been replaced by more current and relevant themes reflecting advancements in technology and modern educational practices. This evolution highlights a shift toward more personalized and student-centered approaches in differentiated instruction, with a growing emphasis on tailoring learning experiences to individual student needs. The decline of some older themes indicates the adaptation of research to new trends in educational technology and pedagogical approaches.

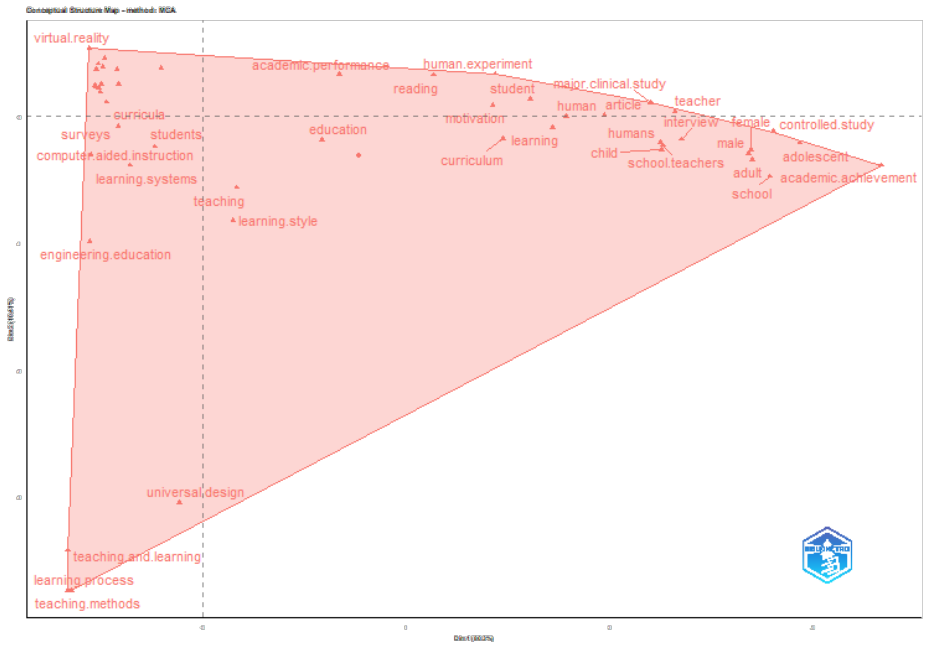

Figure 15. Factorial Analysis using MCA

This graph shows the interconnections of various research topics related to differentiated instruction over the past 20 years. Several topics, such as virtual reality, academic performance, curriculum, teaching methods, and teaching and learning, emerge as key themes that frequently appear in the literature. This indicates that differentiated instruction research is not confined to one specific area but spans across multiple domains, including academic achievement, learning styles, instructional design, and even virtual reality. The shaded areas on the graph highlight the research spaces where topics are more frequently mentioned and interconnected. For example, teaching methods, learning process, and universal design appear at the bottom, indicating that these fields are often associated with differentiated instruction approaches.

On the top right, topics such as academic achievement, school teachers, adolescent, and child are shown. This suggests that research related to differentiated instruction often involves studies on academic performance and the role of teachers in the context of children's and adolescents' education. On the top left, terms like virtual reality, computer-aided instruction, and learning systems stand out. These may indicate the increasing use of technology in research related to differentiated teaching approaches. There are also terms referring to research methodologies, such as controlled study, human experiment, surveys, and major clinical study, highlighting that research on differentiated instruction frequently employs a range of scientific methods to evaluate the effectiveness of various teaching strategies.

Overall, the graph provides an overview of the various topics explored in relation to differentiated instruction, illustrating the connections between different teaching methods, academic achievement, the use of technology, and the focus on students and teachers. This visualization can be used to identify key research themes and potential gaps in the literature on differentiated instruction over the past 20 years.

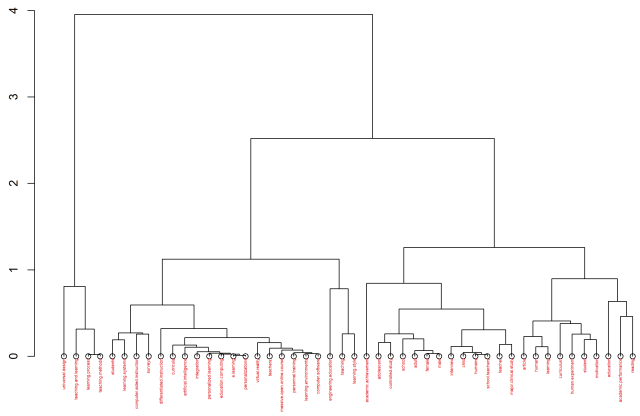

Figure 16. Thematic Dendrogram

The diagram you described is a dendrogram, which is a tree-like structure that visually represents the hierarchical clustering of elements or items. Each point, or leaf, in the diagram corresponds to an individual element, such as countries or categories, and the red text labels identify these elements. The leaves at the bottom represent individual elements, and these are grouped into clusters as you move upward in the diagram. The branches show how these elements are grouped together, with shorter branches indicating higher similarity between the elements.

The vertical axis y shows the distance or dissimilarity between clusters. A shorter branch length means the elements are more similar, while a longer branch indicates more differences. The point at which two clusters merge indicates their level of dissimilarity. If they merge higher up in the dendrogram, it implies that the clusters are less similar to each other, and if they merge lower, they are more similar. As you move upwards in the dendrogram, smaller clusters combine to form larger clusters, showing how elements with similar characteristics are grouped together at different levels. For example, in the right side of the dendrogram, there are several subclusters formed from elements that are more closely related. This suggests that the closer elements share more similarities.

The elements grouped by shorter branches (e.g., "united states" and "belgium") are more similar in characteristics (e.g., economic factors, geographical proximity, or other metrics). Larger clusters at the top represent broader groupings that may encompass a more diverse set of elements.

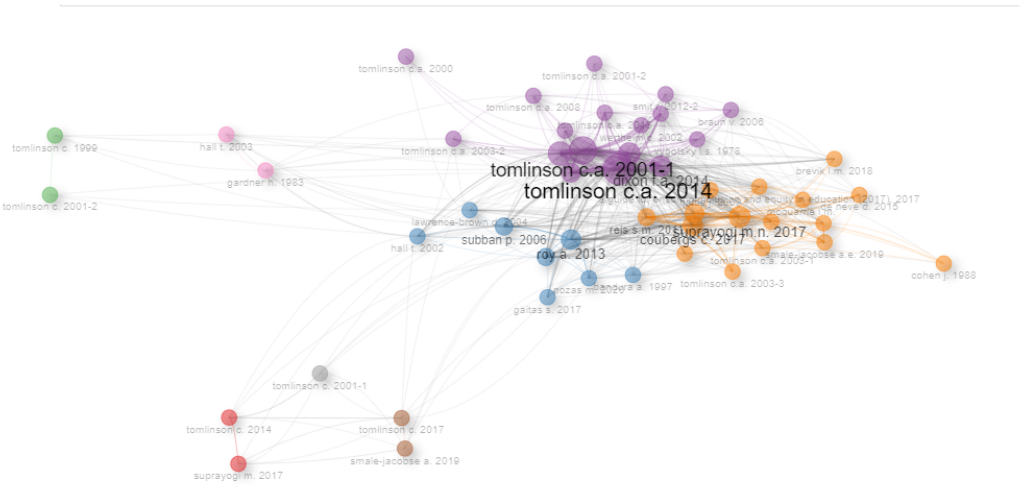

Figure 17. Co-Citation Network.

The works of Tomlinson C.A. (such as 2001-1 and 2014) appear to be highly dominant in this network, marked by the centrally located nodes. Carol Ann Tomlinson is widely recognized as a pioneer of

differentiated instruction theory. Her works serve as the theoretical and practical foundation for research on differentiated teaching. The large nodes indicate that Tomlinson's works are frequently cited together in other research discussing differentiated instruction, making her a key reference in the field over the past 20 years.

The purple and blue clusters represent research closely related to the core concepts of differentiated instruction. This research likely discusses theory, implementation, and the effectiveness of differentiated teaching models in various educational contexts. The orange and green clusters may represent more specific or sub-topics still related to differentiated teaching, such as its application in specific fields (e.g., science, inclusive education, or teaching strategies for diverse student groups).

The connections between nodes show how works in the field of differentiated instruction are interrelated. For instance, works by other researchers, such as Suprayogi M.N. 2017 or Brevik M. 2018, seem to be closely connected to Tomlinson's works, possibly indicating a focus on further research or practical applications of differentiated teaching. From this co-citation pattern, it can be concluded that there are several seminal works in this field (such as Tomlinson's) that continue to dominate the literature, but research in this area is also evolving with different clusters that may encompass new research areas in the context of differentiated instruction.

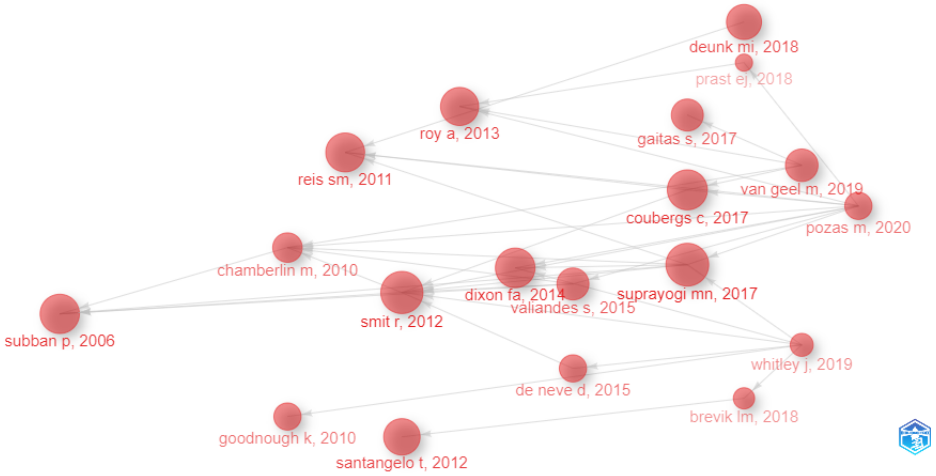

Figure 18. Historiograph Map

Each point (node) represents a significant academic work in the citation network related to differentiated instruction. The size of the node reflects the influence of the work, measured by how frequently it has been cited by other works. The lines connecting two nodes represent citation relationships, where one work cites another. These lines help trace how ideas or concepts from one study evolve and are influenced by previous research. Larger nodes, such as Subban, P. 2006, Roy, A. 2013, Suprayogi, M.N. 2017, Deunk, M.I. 2018, and Van Geel, M. 2019, indicate that these works have had a significant impact on the development of literature on differentiated instruction.

Subban, P. 2006 appears to be one of the seminal works, as it is located at the beginning of the timeline and has many connections to subsequent works, indicating that this research laid the foundation for later studies. The connections between works such as Reis, S.M. 2011, Coubergs, C. 2017, and Pozas, M. 2020 show the flow of idea development and how the theory of differentiated instruction has been expanded and applied in various contexts, possibly including inclusive education, education policy, or teaching methods. The works of Deunk, M.I. 2018 and Prast, E.J. 2018 indicate more recent works linked to earlier seminal research, suggesting they may present new perspectives or findings within the framework of differentiated teaching.

This historiograph also allows us to see how research in the field of differentiated instruction has evolved over time, with seminal works appearing early (such as Subban, P. 2006), followed by subsequent research that expands or applies these concepts in newer contexts. This historiograph demonstrates how the concept of differentiated instruction has evolved from seminal works to contemporary research, helping

trace the influence between these works. Works like Subban, P. 2006 and Roy, A. 2013 have had a significant influence in shaping subsequent research, and many newer works, such as Pozas, M. 2020, likely adapt previous findings to contemporary educational contexts.

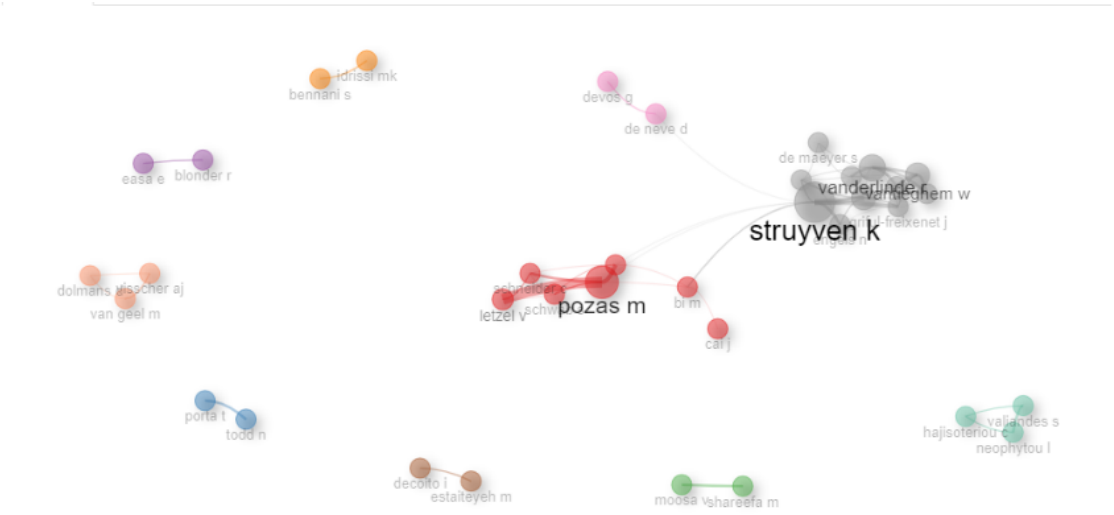

Figure 19. Collaboration Network

The Collaboration Network image illustrates the relationships between researchers working on the same topic, specifically related to differentiated instruction. In this image, each point represents a researcher, with their names displayed around the points, such as Struyven K, Pozas M, Vanderlinde R, and Letzel V. The size of the point indicates the level of involvement a researcher has in collaboration. For example, Struyven K has the largest point, indicating that this researcher is highly active and has many collaborations with other researchers. The connecting lines between the points represent collaborative relationships between two researchers, typically based on the number of papers or research they have co-authored. The thicker the line, the stronger the collaboration between those researchers. For example, there is a strong collaborative relationship between Pozas M and Letzel V, as well as with other researchers in the red-colored group.

Researchers grouped together with the same color indicate a community or research group that collaborates intensively. Examples of such communities are seen in the groups around Struyven K (gray), Pozas M (red), and other groups like Easa E and Blonder R (purple), as well as Vallianes S and Neophytou L (green). Each group represents researchers who frequently work together, usually on specific subtopics of differentiated instruction. Researchers like Struyven K and Pozas M appear to be at the center of this collaboration network. They have many collaborative connections with other researchers, signifying their importance in research related to differentiated instruction. Some researcher groups, such as Porta T and Todd N, or Dolmans DHJM and Van Geel M, appear more isolated from the main network. This suggests that they may be working on more specialized topics or are less connected with other researchers in the field of differentiated instruction.

This image explains the Countries' Collaboration World Map, showing the collaboration between countries in research related to differentiated instruction over the past 20 years. The lines connecting various countries indicate the level of collaboration between countries in differentiated instruction research. The thicker the line, the more frequently researchers from those two countries collaborate. For example, a thick connection between the United States and European countries suggests intensive collaboration between researchers in these regions. The United States is marked in the darkest shade of blue, indicating that it is the largest contributor to differentiated instruction research, both in terms of the number of publications and international collaboration. Other countries that are also active in this research, though with lower intensity (in lighter shades of blue), include countries in Europe, parts of Asia, and Africa.

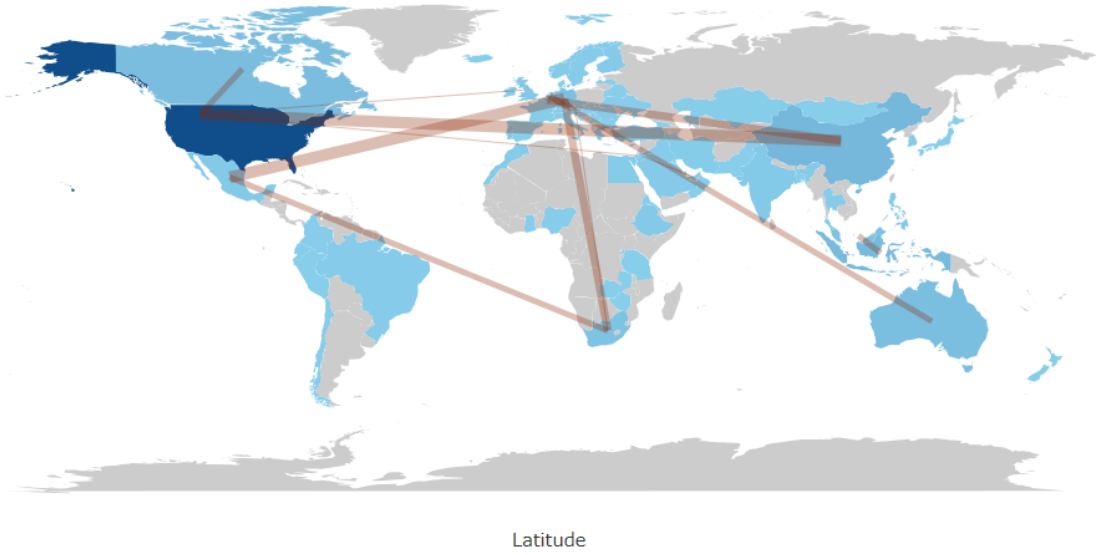

Figure 20. Country Collaboration Map

Countries with limited collaboration are displayed in lighter blue or have almost no connecting lines, indicating lower or minimal collaboration in this field. These countries may have fewer publications or rarely participate in international collaboration. The map also shows that the main centers of collaboration in differentiated instruction research are in North America, Europe, and Asia. Countries in these regions frequently collaborate in research, indicating that these regions have developed research communities in this topic. Globally, research collaboration on differentiated instruction is fairly widespread, with participation from countries across all continents. However, the intensity of collaboration is higher in developed countries, especially in North America and Europe, while countries in Africa, Asia, and South America show less frequent collaboration.

4. DISCUSSION

This bibliometric analysis provides a comprehensive overview of the research landscape on differentiated instruction over the past two decades. The analysis reveals several key trends and patterns in DI research, which have important implications for future research as well as educational practice. One of the most notable findings is the increasing number of publications on DI, particularly after 2015. This trend indicates growing interest in addressing the diverse needs of students through DI strategies. The rise in publications may also reflect a broader shift in education towards inclusivity and equity, as well as the need for more personalized teaching approaches in heterogeneous classrooms. The rapid growth in DI research highlights the importance of this pedagogical approach in enhancing student engagement and academic achievement.

Another important finding is the dominance of institutions and researchers from the United States and Europe in DI research. This geographic concentration suggests a gap in global representation, with regions such as Asia, Africa, and South America being underrepresented in the DI literature. Future research could benefit from increased collaboration between institutions in these regions and those in the United States and Europe, which could promote the exchange of culturally relevant practices and broaden the application of DI. Identifying key themes in DI research also provides insights into how the focus of this research has evolved. Initially, DI research focused more on classroom management and basic instructional differentiation. However, more recent studies have expanded this scope to include the use of technology in DI, its application in specific subjects (such as science and mathematics), and its impact on various student groups, including gifted students and those with special needs. The growing interest in technology-supported DI, such as e-learning and blended learning, aligns with the global shift towards digital education, especially during and after the COVID-19 pandemic. This trend underscores the need for further exploration of how advanced technologies can support flexible, personalized learning environments.

While there has been positive development in DI research, this analysis also highlights several ongoing challenges in its implementation. Many teachers report difficulties in effectively applying DI due to constraints such as large class sizes, limited resources, and insufficient training. These barriers indicate that further research is needed to explore practical solutions to address these challenges, particularly in resource-constrained educational settings. Moreover, professional development for teachers should become a priority in future research and policy discussions, to ensure educators have the necessary skills to effectively implement DI strategies

In conclusion, this bibliometric analysis provides valuable insights into the development and current state of DI research. It identifies key contributors, major themes, and challenges that have shaped the field over the past 20 years. Moving forward, research should continue to explore innovative approaches to DI, including the integration of advanced technology and more flexible teaching methods. These efforts will be crucial in addressing the remaining challenges of DI implementation and ensuring that all students receive personalized support according to their needs. This discussion is expected to serve as a guide for future research and provide clearer insights for educators, researchers, and policymakers regarding the direction of DI research and its implications for educational practice.

5. CONCLUSION

This bibliometric review provides a comprehensive mapping of research on differentiated instruction (DI) over the past two decades, highlighting key trends, influential contributors, and emerging themes. The increase in publications in this field, especially after 2015, reflects a growing recognition of DI as a crucial pedagogical approach to meet the diverse needs of students. This review also identifies the dominance of institutions and researchers from the United States and Europe, while noting the lack of representation from other regions, such as Asia and Africa. This highlights the need for broader global collaboration to expand the scope of DI research and ensure its relevance in diverse educational contexts. The findings emphasize the development of DI research, from its initial focus on classroom management to more recent explorations of technology-based learning and its impact on various student groups. As global education systems shift towards more inclusive and personalized learning environments, the role of DI is likely to continue evolving, especially with the integration of advanced technologies.

However, challenges in DI implementation remain, with many educators facing difficulties due to limited resources, time, and insufficient training. Future research should focus on addressing these barriers by exploring more flexible, technology-based DI approaches, as well as providing better support for teachers in various educational settings. In conclusion, this review not only provides valuable insights into the development of DI research but also highlights areas that still require further investigation. By identifying key contributors and thematic trends, this review serves as a guide for future research, as well as offering direction for educators, researchers, and policymakers seeking to enhance the effectiveness and sustainability of DI in modern educational systems.

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