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GLOBAL MAPPING OF PEDAGOGICAL COMPETENCE RESEARCH: BIBLIOMETRIC ANALYSIS USING SCOPUS DATA

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ABSTRACT

This study provides a comprehensive bibliometric analysis of pedagogical competence research, focusing on high school teachers. Using data from the Scopus database, we examined publication trends, key authors, and influential countries to identify research patterns and thematic developments in pedagogical competence. Our findings reveal a significant increase in publications, particularly from 2011 to 2024, reflecting growing global interest in improving teacher quality. The analysis highlights the dominance of countries like Indonesia, the United States, and Spain in contributing to this field. The study also identifies emerging themes such as digital pedagogy, teacher training, and the role of gender in teaching effectiveness. The results suggest that future research should focus on integrating technology in teacher professional development, especially in developing countries. Policy recommendations include prioritizing digital pedagogy training for educators to enhance teaching outcomes and student engagement, particularly in resource-limited settings. This study contributes to the ongoing discourse on improving pedagogical competence globally.

KEYWORDS: Pedagogical Competence, High School Teachers, Educational Technology, Bibliometric Analysis.

1. INTRODUCTION

Pedagogical competence encompasses the skills, knowledge, and attitudes essential for effective teaching, particularly in vocational and secondary education. It involves various aspects such as instructional design, classroom management, assessment procedures, and adapting teaching methods to diverse learners' needs (Setiawan et al., 2025). A teacher's pedagogical competence reflects their professional and personal qualities, combining experience and creativity (Fakhrutdinova et al., 2020).

Recent studies have highlighted the importance of pedagogical competence for high school teachers. Budiamai et al. (2021) emphasized the necessity of integrating innovative and digital learning designs, noting that technology enhances student participation and understanding. Dias-Trindade et al., 2021) stressed that pedagogical competence should include digital literacy, especially in distance learning. Ramdani et al. (2020) found that effective pedagogical competence significantly improves student outcomes. Kafedžić et al. (2018) suggested that gender influences teaching styles, impacting learning effectiveness.

Tadeko & Wilujeng (2024) emphasized continuous training and technology use in developing pedagogical competence, while Alhazzani (2024) linked pedagogy with technology for adaptive, innovative learning. Carrizo et al. (2023) highlighted the importance of data literacy in improving teachers' pedagogical decision-making. Bala & Kokla (2018) emphasized experiential learning to enhance teacher-student interaction. Setiawan et al. (2025) showed that digital media and Learning Management System strengthen teachers' pedagogical skills in planning and assessment.

However, obstacles like limited access to training, inadequate technological resources, and administrative burdens hinder teachers' professional development. Addressing these challenges requires strategies focused not only on technical training but also on transforming teaching paradigms. Therefore, studying pedagogical competence is vital for designing targeted policies and development programs to improve education quality.

This study uses a bibliometric analysis approach to provide a comprehensive picture of research developments in pedagogical competence. This analysis aims to identify trends, collaboration patterns, and knowledge maps in teacher pedagogical competence research based on available scientific publications. The data used in this study are sourced from the Scopus database of the world's most extensive and most trusted scientific index. **The research questions (RQs) that guide our study are as follows**

RQ1: What is the publication trend from year to year in the Scopus database?

RQ 2: Who are the leading actors based on Country, Institution, and Author?

RQ 3: How is the structure of influence and impact of scientific work on pedagogical competence?

RQ4: What are the main topics, keywords, and conceptual relationships emerging in the pedagogical competence literature?

RQ5: How is the collaboration map and the conceptual linkages between authors, documents, and primary references?

2. MATERIALS AND METHODS

2.1. Research Design

This article conducts a bibliometric analysis to determine the current state of research on pedagogical competence in high school teachers. The study consists of **two main components** First, a comprehensive bibliometric analysis examines patterns and developments in research on pedagogical competence. Second, a bibliographic coupling network analysis is conducted to identify research themes related in pedagogical competence.

2.2. Data Collection

This study chose Scopus to collect bibliographic data, as it is one of the largest databases of high-quality academic research. The data period analyzed spans from 1950 to June 2025, allowing researchers to trace the evolution of the topic longitudinally. The keywords used to search were “pedagogical competence" OR "teaching skills" OR "educational proficiency" OR "instructional ability" AND "high school" OR "secondary education" OR "secondary school" OR "senior high school" AND "teacher" OR "instructor" OR "educator" OR "facilitator".

To ensure a comprehensive analysis, we adopted a multidisciplinary approach that leverages the extensive Scopus database to capture multiple perspectives on pedagogical competence. By examining publications spanning more than seven decades, we identify shifts in the pedagogical competence discourse and emerging trends within each subject area. This dataset will form the basis for a robust bibliometric analysis, providing insight into the evolution of pedagogical competence research and highlighting influential authors, key publications, and collaborative networks within and across disciplines.

2.3. Data Processing and Tools

Using Boolean operators to retrieve journal articles from various disciplines related to pedagogical competence, we collected metadata for each selected article based on specific criteria and stored them in a CSV file. This initial dataset included a wide range of studies to ensure the inclusivity of relevant research, covering fields such as education, management, social sciences, and other related disciplines. To refine this selection, we conducted a systematic screening process by reading the abstract of each article individually to confirm its relevance to this bibliometric analysis. In addition to visualizing the collaboration network between researchers and institutions and keyword mapping, software such as RStudio and VOSviewer was used. These tools allow for interactive and informative visual presentation of data, thus revealing conceptual relationships and development directions of research on the pedagogical competence of high school teachers at global and regional levels. **Below is a flowchart of the bibliometric analysis procedure**

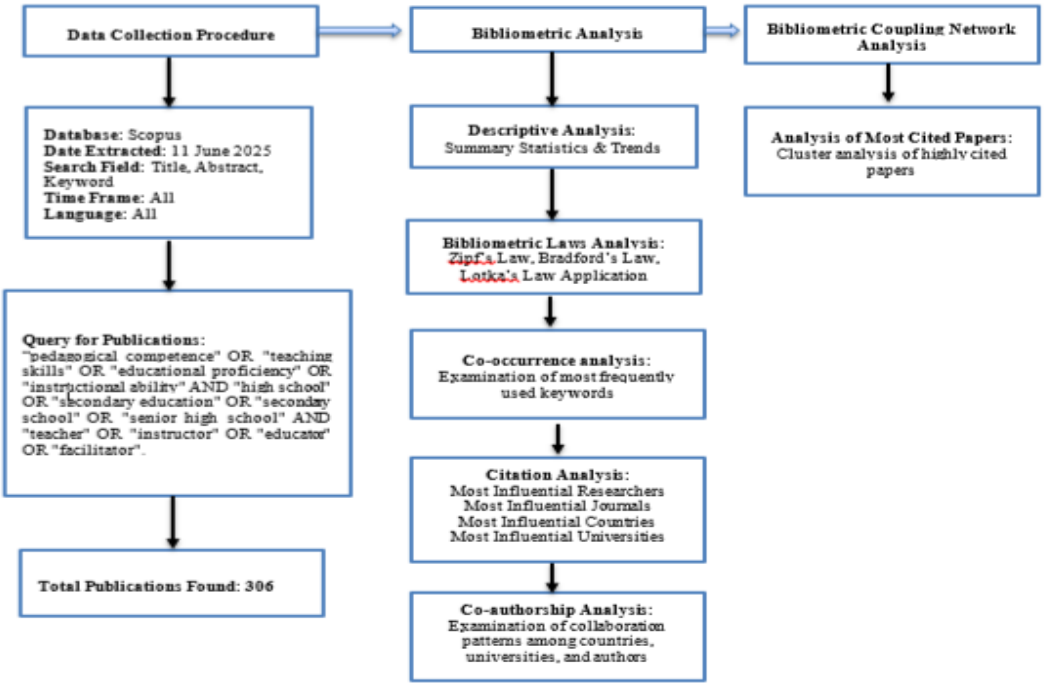

Figure 1: Flow Chart of the Bibliometric Analysis Procedure.

3. RESULTS AND DISCUSSION

The results of this study focus on the findings of 306 articles on pedagogical competence in the Scopus database. This data was obtained from identifying the number of articles published, publications from year to year, and journal sources. This study also highlights the most influential elements in the field of pedagogical competence, including authors, affiliations, and countries involved, for potential future research.

RQ1: What is the publication trend from year to year in the Scopus database?

In an era of increasingly dynamic educational transformation, pedagogical competence is one of the main pillars in ensuring the quality of the learning process. The role of teachers is no longer limited to delivering material, but rather as adaptive, reflective, and professional learning facilitators. Along with the increasing demands for the quality of education, attention to the study of pedagogical competence has also experienced significant growth. Analyzing scientific publication trends is a strategic step to understanding the extent to which this topic has developed in the global scientific community. Using data collected from the Scopus database, annual publication trends can provide an objective picture of academic research's intensity, consistency, and focus on pedagogical competence over time.

Figure 2 visualizes the number of yearly documents published related to the top. This graph analyzes the publication growth and development phases and their implications for the direction and dynamics of education research.

Analysis of publication trends related to pedagogical competence recorded in the Scopus database shows significant development dynamics in the last few decades. The number of publications was

limited and stagnated in the early period, namely between 1950 and 1999. The first article to appear was "Achieving the Imperative Needs of Youth" by Pond (1950). The lack of scientific output during this period indicates that pedagogical competence has not become a primary focus in global academic discourse.

Entering the early 21st century, especially between 2000 and 2010, there began to be an increase, although not yet stable. This period marked a transition phase in which interest in pedagogical competence grew, and the development of global discourse on teacher professionalism and competency-based education reform.

A more consistent increase occurred between 2011 and 2018. The number of publications experienced steady annual growth, reflecting increasing attention from academics to the issue of learning quality and strengthening the role of teachers. This momentum continued from 2019 to 2024, which was marked by a significant spike in publications, reaching more than 25 documents per year. Changes likely influenced this spike in global education policy and academic responses to learning challenges during the COVID-19 pandemic.

Meanwhile, the decline in the number of publications seen in 2025 and the estimates for subsequent years must be interpreted cautiously. This decline is likely not a reflection of declining interest but rather a result of temporary data input limitations (cut-off time) in the Scopus indexing system.

Overall, the identified publication patterns indicate that pedagogical competence has shifted from a marginal theme to the center of attention in educational studies. The significant increase in publication volume reflects the urgency of improving the quality of educators. Also, it indicates a transformation of learning approaches towards being more adaptive, technology-based, and contextual. These findings can be essential for developing a further research agenda and formulating educational policies based on scientific evidence.

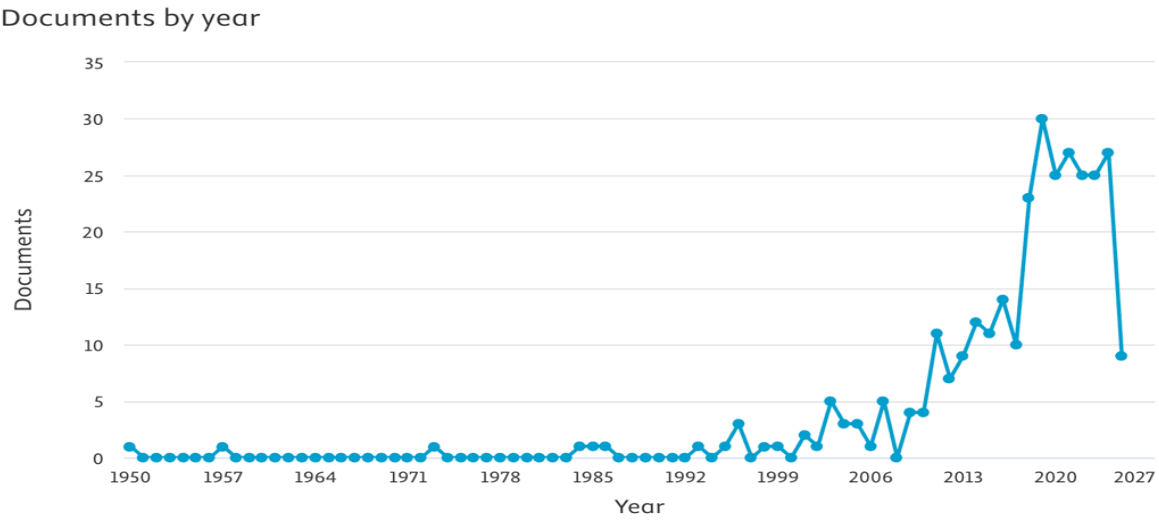

Figure 2: Documents by Year.

RQ 2: Who are the leading actors based on Country, Institution, and Author?

3.1. Document by Country or Territory

The distribution of scientific publications related to pedagogical competence by country in the Scopus database suite shows broad global participation, with the most prominent contributions coming from Asia, Europe, and North America. The graph shows that Indonesia ranks first with the most significant number of documents, namely 43. This indicates the high attention of researchers in Indonesia to pedagogical issues, especially in the context of national education policies and teacher professional development.

The United States and Spain occupy the second and third positions, respectively, with 39 and 33 documents. These countries make significant contributions to the global literature on pedagogical competition. Their involvement can be attributed to their strong academic traditions and focus on curriculum reform and teacher performance

evaluation.

Countries such as China, the UK, and the Netherlands also occupy important positions, reflecting their active role in promoting the quality of competency-based education through a scientific approach. Meanwhile, South Korea, Turkey, Malaysia, and Canada also appear on the list, indicating a growing engagement in contemporary pedagogical discourse.

This finding confirms that the issue of pedagogical competence has become a cross-country concern, not only limited to developed countries, but also developing countries that are trying to improve the quality of educators. Variations in the contribution level may reflect differences in educational policies, access to research resources, and national priorities of each country's academic development.

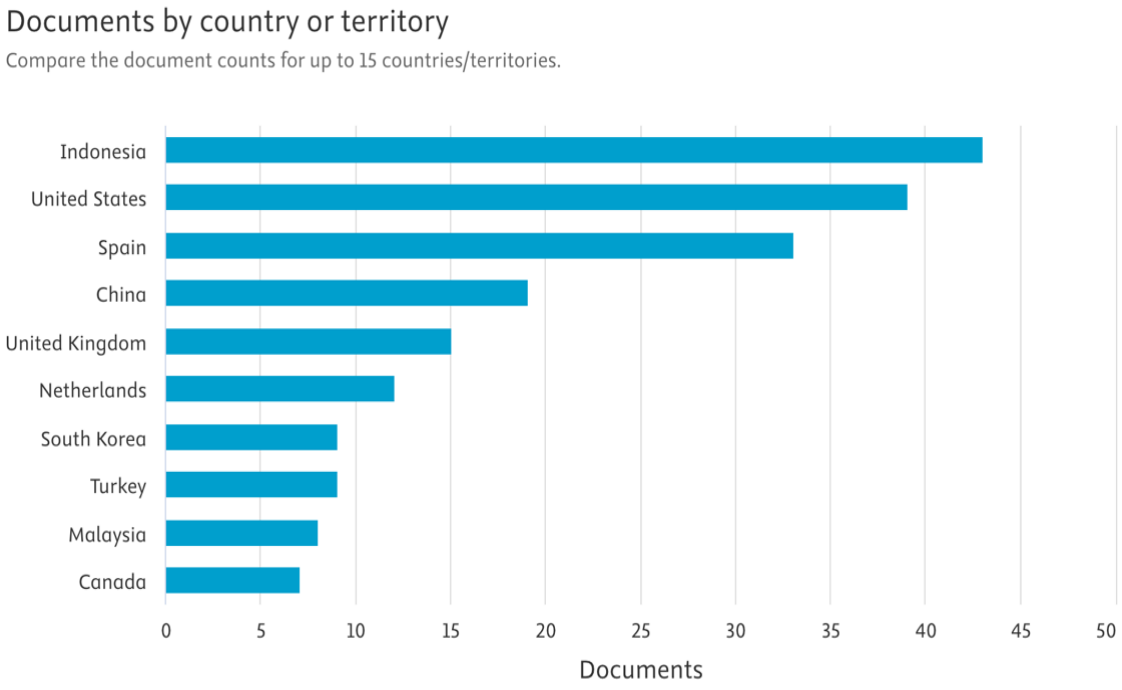

Figure 3: Documents by Country or Territory.

3.2. Author Contribution to Pedagogical Competence Publication

Analysis of the most productive authors in scientific publications on pedagogical competence indexed in Scopus reveals several names that consistently contribute significantly to developing academic discourse in this field. The author with the highest contribution is Maulana, R., who has produced five publications on this topic. **The research titles are** Dutch beginning teachers' intrinsic orientation for the profession: Measurement and consistency during the first year (Feng et al., 2021), Student perceptions of secondary education **teaching effectiveness** General profile, the role of personal factors, and educational level (Fernández-García et al., 2019), The use of secondary school student ratings of their teacher's skillfulness for low-stake assessment and high-stake evaluation (van der Lans & Maulana, 2018), Longitudinal effects of induction on teaching skills and attrition rates of beginning teachers (Helms-Lorenz et al., 2016), and Teaching skills of student teachers: Calibration of an evaluation instrument and its value in predicting student academic engagement (W. van de Grift et al., 2014). Maulana's dominance indicates active involvement in research development, most likely related to the focus on teacher professionalism and pedagogical assessment in national and international educational contexts.

In the following position is Helms-Lorenz, M., with four published documents. This author is known for studies on teaching effectiveness and teacher training, which are relevant to pedagogical competence. Of the fpapersents published by Helms-Lorenz, M., three of them are in collaboration with Maulana, R., **and one document is a partnership with another author entitled** Regional school context and teacher characteristics explaining differences in

effective teaching behavior of beginning teachers in the Netherlands (van der Pers & Helms-Lorenz, 2019).

Furthermore, there is a group of authors with the same number of documents (three publications each), such as Almerich, G., Fukuda, M., Huang, H.H., Wragg, E.C., and van de Grift (Fukuda et al., 2019; Suárez-Rodríguez et al., 2018; W. van de Grift et al., 2023; Wragg, 2003). Their presence indicates the existence of an internationally distributed academic community that contributes to the development of pedagogical discourse from various approaches and cultural contexts.

Several other names, such as Abdullah, A.G., Augustine, L., and Baek, S.G., each recorded with two publications, also strengthen that the issue of pedagogical competence is cross-border and multidisciplinary (Bertills et al., 2018, 2019; I. Ramli et al., 2020). Although their contributions in the number of publications are relatively fewer, their presence remains vital in enriching the diversity of perspectives and expanding the range of research topics.

These data reflect collaboration and an even distribution of knowledge among researchers from various countries. Further analysis of institutional affiliations and collaboration patterns could provide deeper insights into the research networks that form around the issue of pedagogical competence.

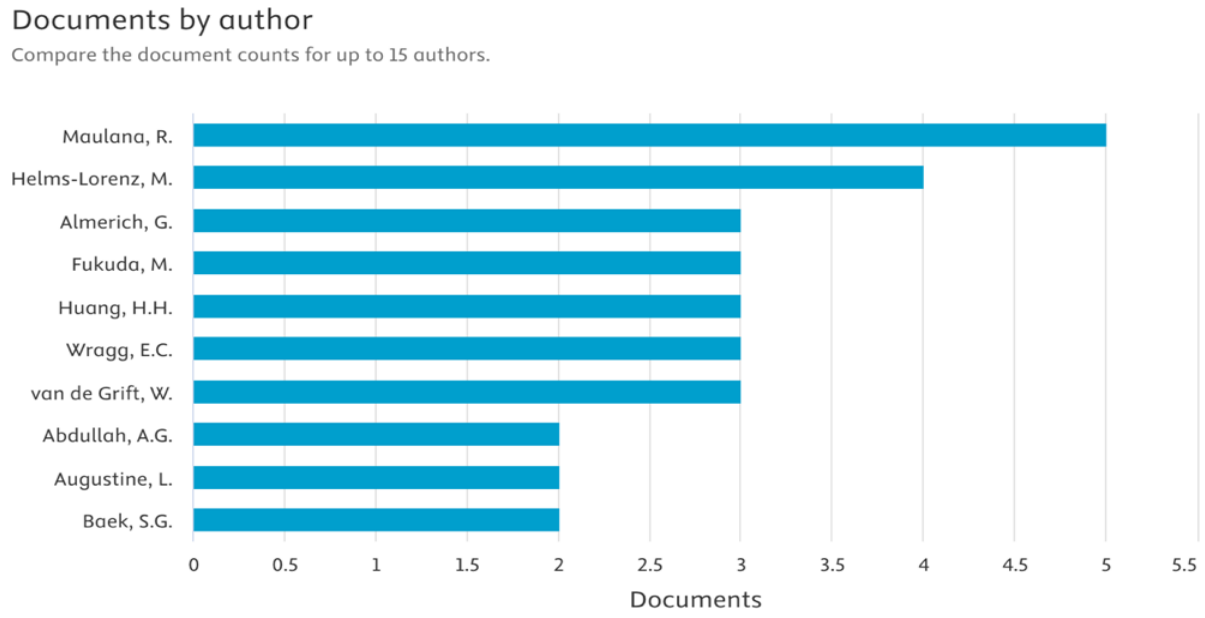

Figure 4: Documents by Author.

3.3. Institutional Contribution to Pedagogical Competence Publication

Analysis of the institutional affiliation of authors in scientific publications on the theme of pedagogical competence indexed in Scopus reveals the dominance of several universities from Indonesia and Europe. The two institutions that occupy the top rankings are Rijksuniversiteit Groningen (Netherlands) and Universitas Pendidikan Indonesia (UPI), each with seven documents. This achievement reflects the strategic position of the two institutions in developing and disseminating knowledge related to teacher professionalism and pedagogical practices.

In addition, Yogyakarta State University (UNY) is in third place with six documents, followed by Kazan Federal University (Russia), Universitas Negeri Malang (UM), and Universitas Negeri Padang (UNP), which each contributed four documents. The dominance of higher education institutions from Indonesia shows that the issue of pedagogical competence has become the primary research focus in the national academic environment, which aligns with the policy of strengthening the quality of education and the massive teacher certification program.

Contributions also came from several higher education institutions in Spain, such as Universitat de València, Universitat d'Alacant, Universidad de Valladolid, and Universidad de Salamanca, each with three documents. This shows the growing attention in the European region to strengthening pedagogical capacities in both basic and higher

education.

These findings indicate that pedagogical competence research is concentrated in countries with advanced research infrastructure and is also growing rapidly in developing countries with serious concerns about educational reform. The collaboration between institutions shown in these data is essential to forming a strong international research network in pedagogical studies.

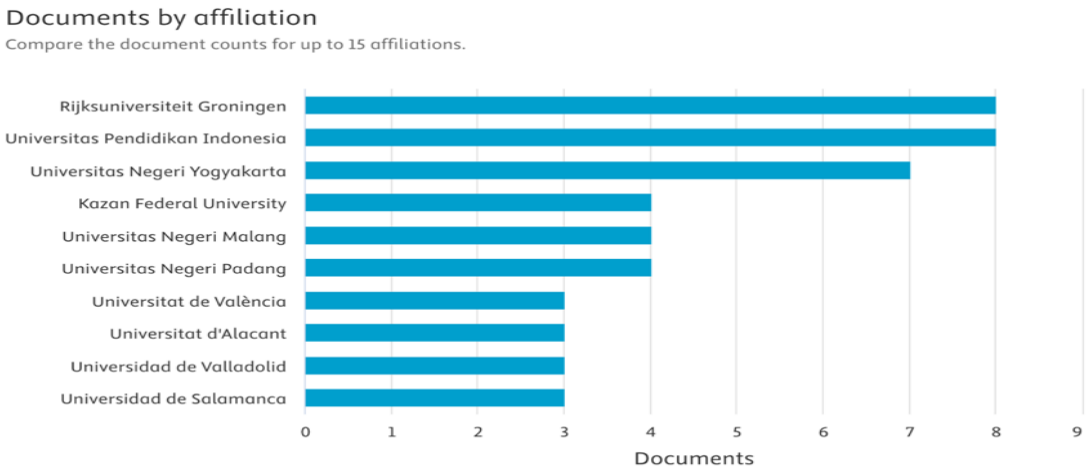

Figure 5: Documents by Affiliation.

RQ 3: How is the structure of influence and impact of scientific work on pedagogical competence?

3.4. Countries with the Highest Citations

The citation analysis by country shows a map of significant scientific influence in the study of pedagogical competence at the global level. The graph shows that Spain occupies the top position with the highest number of citations, 436. This position confirms the dominance of Spanish literature in providing strong theoretical and conceptual references in developing pedagogical competence discourse.

Followed by the Netherlands with 290 citations and the United States with 260 citations, these two countries have long been recognized as established centers of educational science production, focusing on pedagogical assessment, teaching effectiveness, and teacher professionalism. Their presence at the top of the rankings indicates a high level of trust in the research output of institutions and authors in these countries by the global scientific community.

Asian countries such as South Korea (112 citations) and Indonesia (102 citations) show impressive contributions, reflecting the increasing visibility and quality of educational research from the Asian region. Although the number of publications from these countries is high, the achievement in terms of citations shows that their work has also managed to gain recognition in the international literature.

Other countries in the top ten, such as Turkey, Germany, the UK, Italy, and Sweden, each recorded citation ranging from 68 to 88. This reflects a relatively even distribution of academic influence across European countries, indicating that research on pedagogical competence is a broadly developed and cross-geographical field of study.

These data underscore the importance of quality and relevance in pedagogical competence research. Countries with high citation rates are active in publishing and succeed in producing works that serve as primary references in further research developments worldwide.

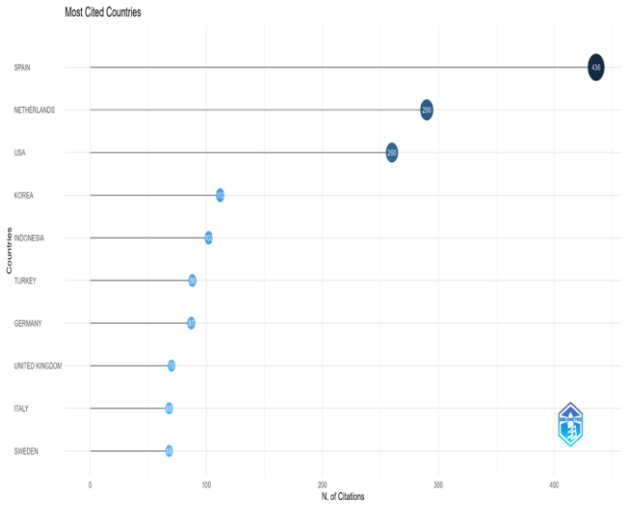

Figure 6: Most Cited Countries.

3.5. *Average Article Citations per Year*

The average citations per year graph provides an overview of the visibility and academic influence of publications discussing pedagogical competence over a specific period. Based on this visualization, from 1950 to the early 1980s, the number of citations to publications on pedagogical competence was almost nonexistent. This shows that the topic had not received widespread attention in the scientific literature then.

However, there was a sharp spike in the mid to late 1980s, with the average citation peak reaching almost four citations per article around 1993. This phenomenon can be attributed to the emergence of seminal works or early publications that made significant theoretical contributions and were referenced for a long time.

After the peak phase, the graph shows relatively high fluctuations. From 2000 to 2010, the average citations per year tended to be low, although there was continuity in references to previous studies. However, from 2011 to 2020, the average citations increased again, reaching peaks above two per article in certain years, such as 2013 and 2015.

This fluctuating trend from year to year shows that the academic influence of pedagogical competence publications is not only determined by the quantity of documents, but also by the quality, actual context, and thematic relevance of the articles. In recent years (2021–2025), the graph shows a stable trend with an average citation ranging from 1 to 1.5 citations per article, indicating that literature in this field continues to be an active reference in the global academic community.

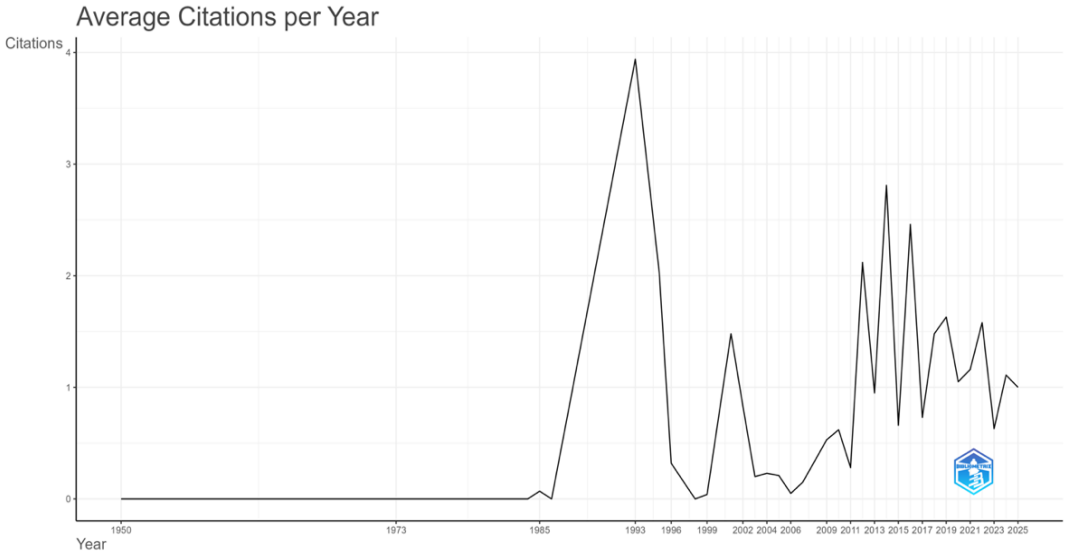

Figure 7: Average Citations per Year.

3.6. *Most Cited Documents Globally*

This graph depicts the ten scientific documents with the highest number of global citations in the domain of pedagogical competence, demonstrating the significant contribution of these works to the development of educational theory, methodology, and practice internationally.

The most prominent document is the work of Cheon SH (2014, J Sport Exerc Psychol), with 165 global citations. It is followed by the article by Almerich G (2016, Computers & Education), which obtained 154 citations (Almerich et al., 2016; Cheon et al., 2014). Both documents focus on psychological and technological approaches to developing teacher and student competencies, and they have attracted wide attention from academics across disciplines.

Other important contributions come from Walter HJ (1993, JAMA), who has 130 citations and expanded the scope of pedagogy to include health and educational interventions (Walter & Vaughan, 1993). While Theelen H (2019, Comput Educ) – 122 citations, shows the contemporary relevance of technology in learning, and Lee W (2012, Educ Psychol) and Van de Grift W (2014, Stud Educ Eval) – with 89 and 87 citations respectively, show the strong influence of educational psychology and teaching evaluation perspectives (Lee & Reeve, 2012; Theelen et al., 2019; W. van de Grift et al., 2014).

Other articles, such as those by Suárez-Rodríguez J, Jurik V, Rodríguez JMS, and Elder, C, were also noted to have significant global influence with citations ranging from 74 to 80 (Aparicio-Herguedas et al., 2020; Elder, 2001; Jurik et al., 2014; Suárez-

Rodríguez et al., 2018). Although ranked lower quantitatively, their contributions reflect the diversity of thematic approaches in pedagogical competence, from individual differences, technology evaluation, to linguistic assessment.

This map confirms that pedagogical competence research is locally relevant and significantly contributes to the global scientific community. The most cited works generally offer innovative approaches to instructional design, technology integration, and psychological understanding of educational processes.

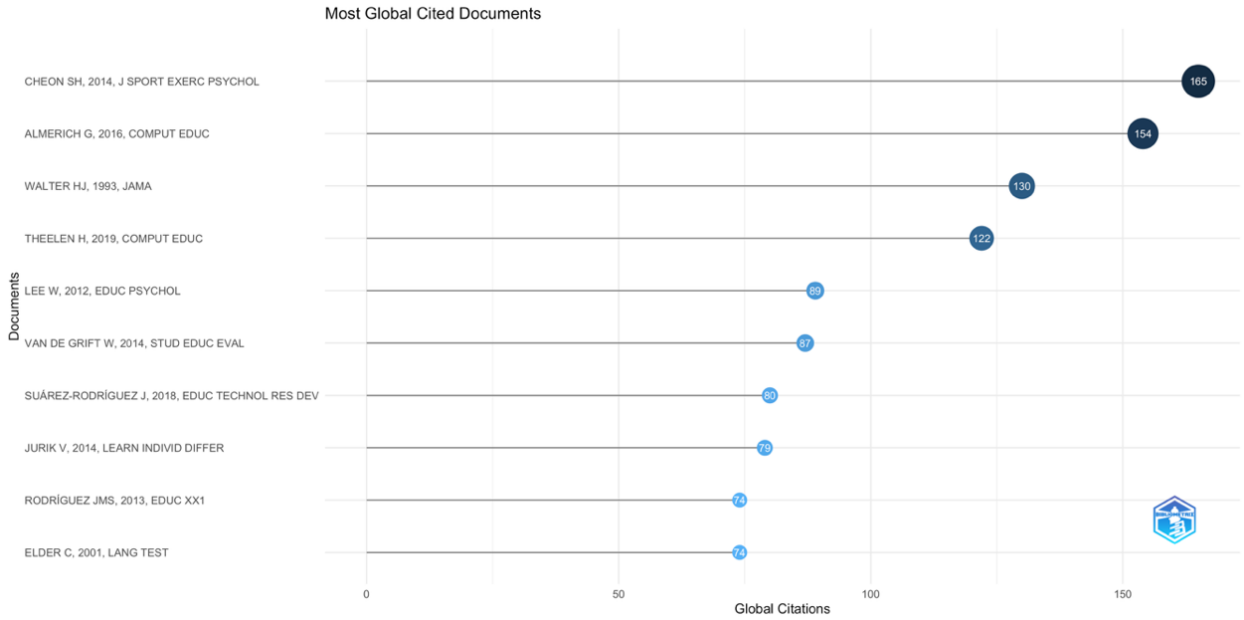

Figure 8: Most Global Cited Documents.

RQ4: What are the main topics, keywords, and conceptual relationships emerging in the pedagogical competence literature?

3.7. Keyword Frequency Development

The graph depicts the evolution of key themes in pedagogical competence research over time. The sharp rise in the frequency of terms like "teaching skills" and "teaching" since 2010 highlights the increasing emphasis on practical aspects of pedagogy. This shift mirrors global trends in curriculum reform and teacher professional development.

The steady growth of terms such as "students," "education," and "curricula" reflects the growing focus on student-centered learning and the re-evaluation of curriculum structures, aligning with the broader educational shift towards student engagement and active learning.

Additionally, the terms "female," "male," and "human" signal the integration of gender and humanistic perspectives in pedagogy, pointing to the importance of equity and social justice in teaching practices. These trends suggest a more inclusive and human-centered approach to education.

Including "personnel training" and "engineering education" indicates a growing recognition that pedagogical competence extends beyond traditional academic education. This demonstrates the increasing importance of professional training in technical fields, marking a shift towards broader applications of pedagogical skills in diverse educational contexts. The graph illustrates a diversification and deepening of pedagogical research, with increasing attention to practical teaching, inclusivity, and interdisciplinary education.

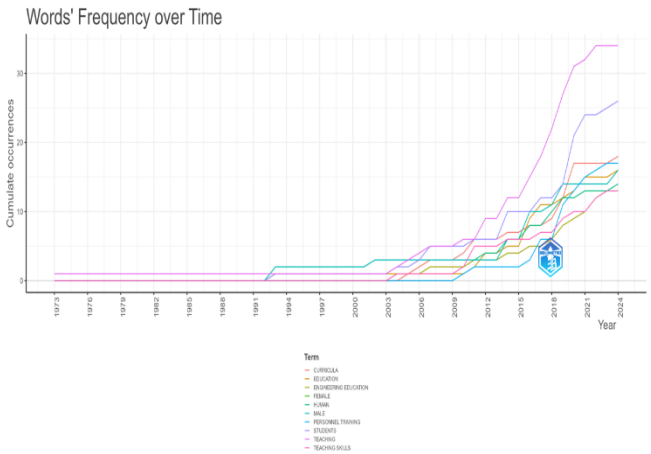

Figure 9: Word Frequency over Time.

3.8. Word Cloud of Dominant Keywords in Pedagogical Competence Study

This word cloud provides a concise yet informative visual representation of the most frequently occurring keywords in publications on pedagogical competence. The font size in this visualization indicates each term's relative frequency of occurrence, with the largest words indicating the dominance of a particular theme in academic discourse.

The words “teaching” and “students” appear most prominently, showing that the teaching process and student involvement are central to the conceptual and empirical constructions in pedagogical competence research. These two terms reflect the study’s primary orientation toward improving the quality of learning through the active roles of teachers and students.

Other terms that also stand out include “curricula”, “personnel training”, “education”, “teacher training”, and “teaching skills”, which show that in addition to focusing on teaching activities, this literature also pays attention to curriculum development, training of teaching staff, and the formation of pedagogical skills as the main components of teacher competence.

The presence of words such as “female,” “male,” and “human” reflects the dimension of inclusivity and a humanity-based approach to education. Meanwhile, terms such as “engineering education,” “educational computing,” and “learning systems” show the integration of technology and interdisciplinary approaches in strengthening pedagogical competence in the digital era.

Overall, this word cloud illustrates that pedagogical competence research is rooted in a broad and complex framework, encompassing instructional, curricular, social, and technological dimensions. This visualization can also be a starting point for further exploration in future studies mapping trends, gaps, and potential collaborations across themes.

Figure 10: Word Cloud.

3.9. Conceptual Structure (MCA)

The conceptual structure map derived from the Multiple Correspondence Analysis (MCA) method provides a clear view of the thematic shift in pedagogical competence research over time. The horizontal axis (Dim 1) shifts from traditional, human-centered, qualitative approaches to a more technology-oriented perspective. On the left, keywords like "questionnaires," "teachers," and "health education" reflect research focused on empirical data, human experience, and educational procedures. Moving to the right, terms such as "educational technology," "information and communication technologies," and "e-learning" highlight the growing importance of digital tools and the professional development of educators in the digital age.

Vertically (Dim 2), the map contrasts experimental and subject-specific research with reflective and conceptual studies. The upper side focuses on experimental methods like "human experiment" and "controlled study." In contrast, the lower side emphasizes terms related to professional growth and educational theory, such as "knowledge," "teacher," and "professional competence."

The central region, featuring terms like "teaching," "students," and "education," shows the convergence of technology and humanistic approaches, signaling a shift towards integrating digital advancements with traditional pedagogical practices in teacher development and student learning. This map reflects the evolving complexity of pedagogical research, blending quantitative, qualitative, and technological perspectives.

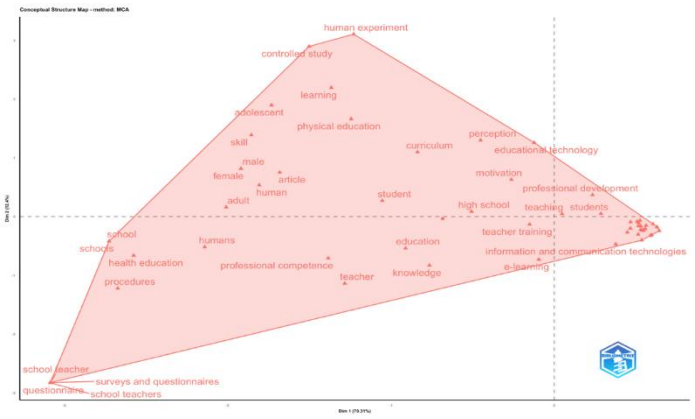

Figure 11: Conceptual Structure Map.

3.10. Most Relevant Keywords (trending topics)

The most relevant or frequently used keywords in publications on pedagogical competence reveal the dominant focus in research in this field. Based on the

graph, the word "teaching" appears as the keyword with the highest frequency (34 occurrences), followed by "students" (26 occurrences). This shows that the central theme in the pedagogical competence literature is still centered on the teaching process and the role of students as the main subjects in the educational process.

The words "curricula" (18), "personnel training" (17), "education", "female", and "male" (16 each) are next in line. The high frequency of the terms curricula and personnel training indicates significant attention to curriculum development and teacher training, as an effort to improve teaching effectiveness through measurable and structured competencies.

The presence of the words "female," "male," and "human" (14) indicates the existence of a gender equality dimension and a humanistic approach in pedagogical practice. This reflects attention to the diversity of learners and the need for an inclusive approach in modern education.

Furthermore, the terms "engineering education" and "teaching skills" (each with 13 occurrences) broaden the context of pedagogical research towards vocational and professional education and the importance of technical skills in the teaching process. This shows that pedagogical competence is essential in general education and relevant in skills-based and vocational education.

Thus, this keyword analysis not only shows thematic tendencies in pedagogical competence research but also reflects the development of academic discourse that responds to contemporary educational challenges in a comprehensive and multidimensional manner.

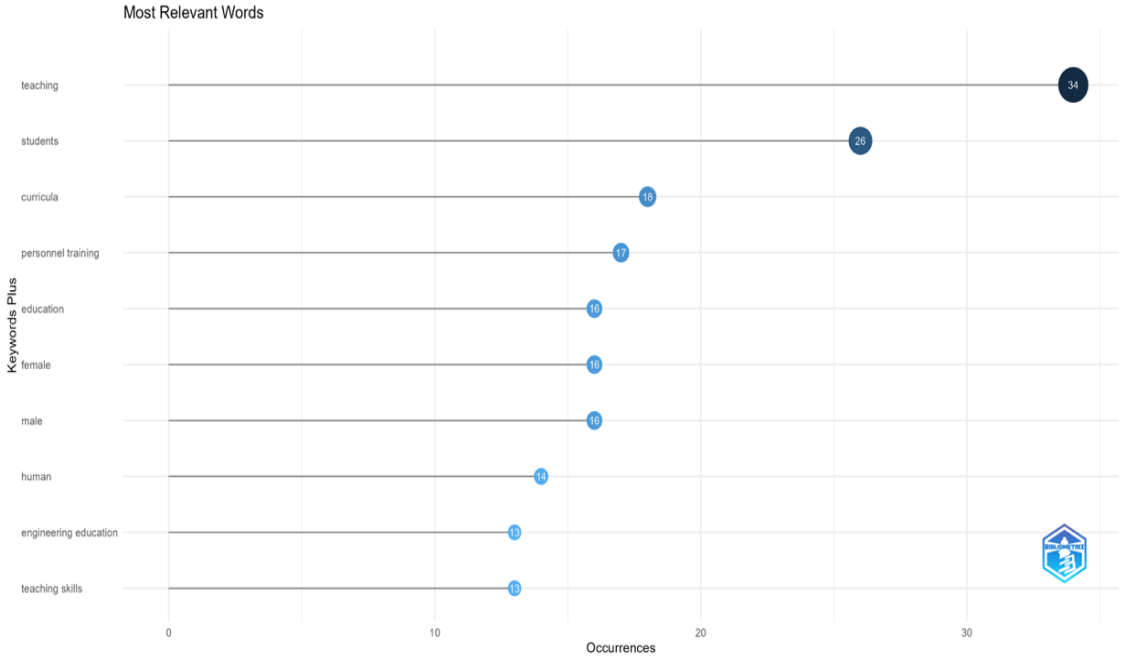

Figure 12: Most Relevant Words.

RQ5: How is the collaboration map and the conceptual linkages between authors, documents, and primary references?

3.11. Three-Field Plot

This Three-Field Plot provides a structured visualization of the relationships between three essential components in pedagogical competence research primary reference sources (CR – Cited References), authors (AU–Authors), and dominant themes/keywords (DE– Keywords/Descriptors). This approach shows how ideas from classical literature sources connect to active researchers and the study's central topics.

Most Influential Reference Sources (CR): Some of the primary references that are often referred to by authors in this field include:

Field, A. (2013). Discovering Statistics Using IBM SPSS Statistics – a widely used statistical methodology book (Field, 2013), Bandura, A. (1997). **Self-efficacy** The Exercise of Control – indicating the critical role of self-efficacy theory in a pedagogical context (Bandura et al., 1997), Cohen, J. (1988). Statistical Power Analysis – providing a basis for quantitative analysis (Cohen, 1988), Van de Grift et al. –collaborative work on evaluating teaching skills. These works form the methodological and theoretical foundations of many recent studies in the field of

pedagogical competence (Bandura et al., 1997; Cohen, 1988; Field, 2013).

Principal Author (AU) The most active authors in bridging theory and application in this area include Helms-Lorenz M, Maulana R, Almerich G, Chun S, and Augustine L. They appear as the central connection between the theory referred to and the practical themes studied. For example, Helms-Lorenz and Maulana are closely related to the theme of teaching skills, while Almerich is closely related to secondary education.

Dominant Theme/Keywords (DE) The main themes on which the research focuses include teaching skills, secondary education, teacher training, higher education, reflective practice, assessment, and beginning teachers. The authors' relationship with this theme indicates that researchers are heavily involved in developing teacher competencies, including technical skills, self-evaluation (reflective), and initial and advanced training.

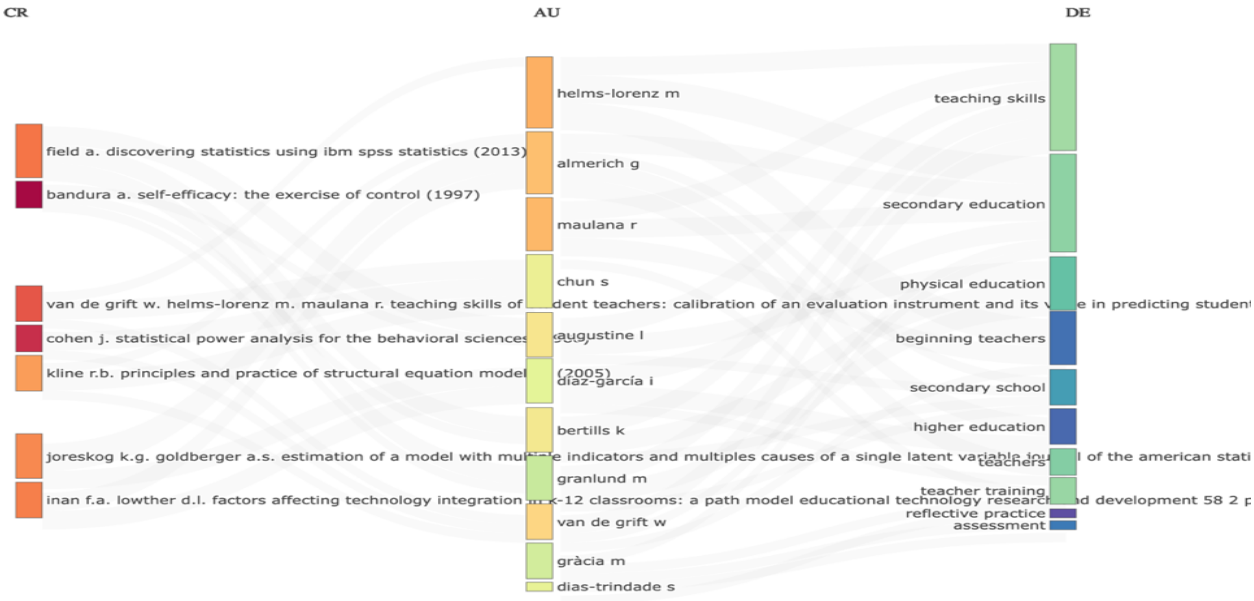

Figure 13: Three-Field Plot.

3.12. Co-Citation Network Visualization

This graph results from mapping a co-citation network that illustrates the connections between academic documents based on their co-occurrence in the bibliography of other articles. Each node represents a document, while the node size reflects the global citation frequency. Color and spatial proximity indicate thematic affinity and the strength of the relationship between groups of articles.

Centers of Influence (Large Nodes). Several documents emerge as central nodes that have high citation frequency and broad thematic reach

Cheon (2014) and Almerich (2016) appear to be the network's two main centers of gravity. Cheon focuses on psychological and motivational aspects of education, while Almerich is strongly connected to the theme of technology in education, especially the integration of ICT competencies in teaching (Almerich et al., 2016; Cheon et al., 2014).

Theelen (2019) also stands out as a significant node and connects more contemporary and applied study groups, such as simulation, learning technologies, and experiential training (Theelen et al., 2019).

Walter (1993), as an older node, still maintains its relevance, especially in its conceptual contributions to the affective aspects of health and education (Walter & Vaughan, 1993).

Thematic Groups (Color Clusters)

Different colors indicate thematic clusters connected based on citation similarity

Dark blue: Focus on ICT integration, digital pedagogy, and teacher training (e.g., Almerich, Rodriguez).

Light green: This color relates to motivation theory, student engagement, and psychological interventions (e.g., Cheon, Jurik, Granero-Gallegos).

Red: Involves innovative approaches and new technologies in learning, including simulation-based

training and video feedback (e.g., Theelen).

Yellow & purple: Connecting literature on teacher assessment, curriculum, professional evaluation, and reflective pedagogy (e.g., Helms-Lorenz, Van de Grift, Lesaux).

Collaborative Bridges and Thematic Transitions: Some nodes, such as Helms-Lorenz (2016) and Choi (2016), act as bridges between clusters. Their position among different colors indicates that their work encompasses or bridges several research dimensions, such as teaching competency, performance evaluation, and cross-cultural educational contexts (Choi & Lee, 2016; Helms-Lorenz et al., 2016).

This map shows that the literature on pedagogical competence has developed along four principal axes: educational psychology, instructional technology, and professional evaluation. This network shows who is most influential and how ideas from different disciplines interact to form a more complex conceptual structure in education today.

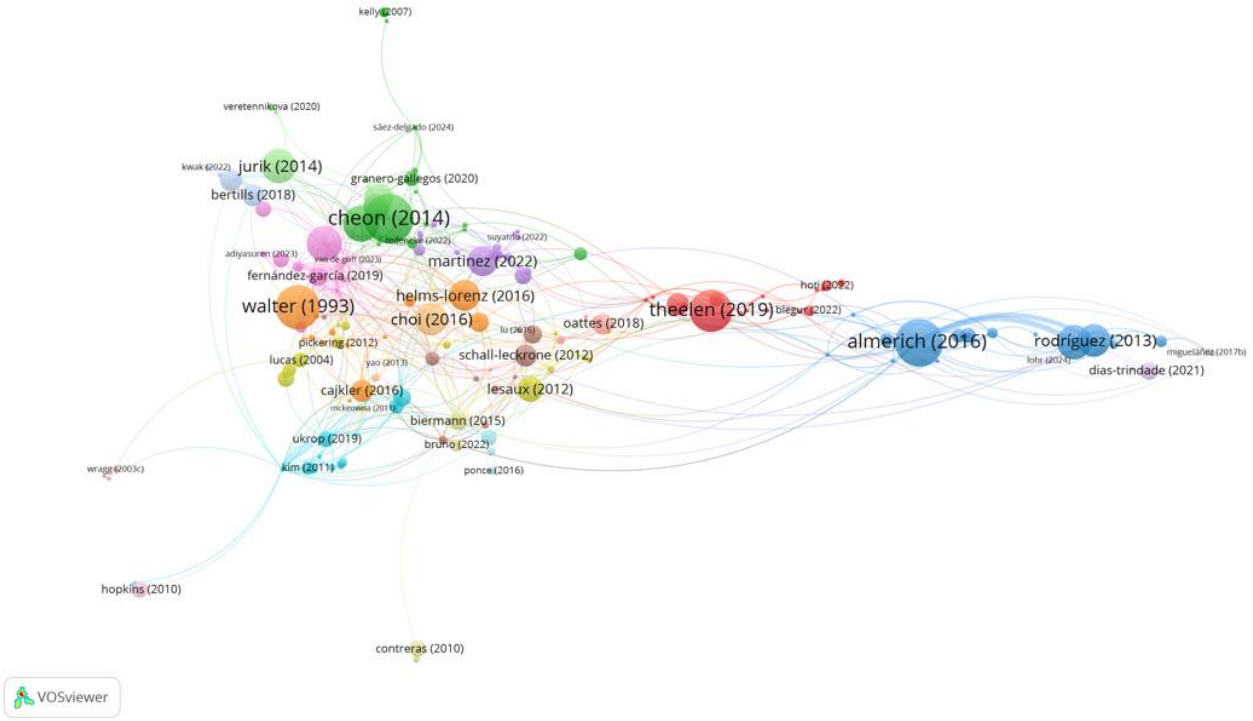

Figure 14: Co-Citation Network Visualization.

4. CONCLUSION

Pedagogical competence has evolved into a crucial factor for improving education quality, with a noticeable rise in research publications since the early 2000s. Key findings from this study reveal that technological integration, teacher training, and the evaluation of pedagogical skills are central to enhancing teaching effectiveness. Research trends indicate a growing focus on digital pedagogy, adaptive learning methods, and personalized instruction, which are necessary for meeting the diverse needs of students in today's education system. Additionally, gender and cultural considerations are gaining attention, highlighting the importance of inclusivity in teaching practices. Future research should delve deeper into technology integration in teacher professional development, particularly in underdeveloped regions where access to resources remains limited. Understanding how to embed digital pedagogy into teacher training programs effectively will be critical to sustaining the momentum gained in the last few decades. Moreover, examining the collaboration patterns between countries and institutions could foster international knowledge sharing and best practices in teacher education. For policy recommendations, developing countries must prioritize teacher training programs that incorporate digital competencies. Providing teachers with continuous, accessible training on educational technologies and pedagogical strategies will enhance their teaching skills and improve student engagement and learning outcomes. Such initiatives will be pivotal in achieving sustainable educational development, particularly in resource-constrained environments.

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