



Research Trends in Philosophy of Science in Education: A Bibliometric Study of the Recent Period

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Abstract: This study examines research trends in the philosophy of science within the educational context, focusing on its ontological, epistemological, and axiological dimensions. Using a bibliometric approach, 868 academic publications from 2010 to 2024 were analyzed, sourced from Scopus and Google Scholar with keywords such as “Philosophy of Science in Education” and “Educational Philosophy and Knowledge. Data were processed and visualized using VOSviewer to identify patterns, themes, and collaboration networks. The findings revealed six key clusters: philosophical foundations in educational practices, ontological and epistemological dimensions in educational research, historical and scientific perspectives, problem-solving approaches, axiological dimensions, and Islamic perspectives in educational philosophy. These results highlight the growing integration of interdisciplinary perspectives, critical thinking, and value-based education to address global challenges such as technological advancements and cultural shifts. This study contributes to the literature by offering insights into the evolving role of philosophy in education, emphasizing the importance of ethical leadership, cultural inclusivity, and sustainable educational practices. The findings provide actionable guidance for policymakers, educators, and researchers in designing curricula and pedagogical strategies that align with 21st-century educational needs while fostering moral and social responsibility.

Keywords: axiology; bibliometric analysis; educational philosophy; ontology epistemology; philosophy of science in education

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INTRODUCTION

Education is the main foundation in the formation of quality individuals and society. Through education, individuals can develop their potential, broaden their horizons, and form character and moral values that become the foundation for creating a civilized and cultured society. In addition, education also plays an important role in driving a country's economic, social, and political growth by producing intelligent, innovative, and creative human resources. In this context, the relevance of education must be continuously updated to remain responsive to the demands of the times, especially in rapid social and technological changes (Anam, 2019; Nasikhin et al., 2022). As a conceptual foundation, the philosophy of science provides direction for education to ensure that the goals, methods, and curriculum developed are evidence-based and grounded in strong ethical values. The ontology, epistemology, and axiology dimensions in the philosophy of science help education define what is worth learning, how knowledge is acquired, and why moral values are an important part of the learning process (Araújo, 2021; Audi, 2010). This relationship provides theoretical legitimacy for education and encourages adopting a more holistic and inclusive approach in the face of global challenges.

However, although the relationship between the philosophy of science and education has been widely recognized, research mapping global dynamics in this field is still limited. Previous studies have focused on specific aspects, such as applying certain philosophical theories in curricula or falsification-based learning methods (Kayumova & Strom, 2023). Other theoretical research highlights the importance of axiological values in building ethical and sustainable education (Abidah et al., 2020; Whewell, 2023). While these contributions are significant, research that systematically analyzes global research trends in the philosophy of science and education has not been fully explored. Given the importance of data-driven approaches to understanding research developments in these fields, this gap is evident. Bibliometric analysis, which offers quantitative-based insights into publication patterns, dominant themes, and research collaborations, has great potential to fill this gap. With this method, research can identify trends, geographical distribution, and academic contributions from different perspectives of the philosophy of science in education, providing a more holistic view of how the field is evolving (Buchanan et al., 2022; Melville et al., 2019; Pierre, 2019).

A critical gap in the literature lies in integrating systems thinking with philosophical principles in science education. While systems thinking has gained prominence in understanding complex educational phenomena, its philosophical foundations remain underexplored, mainly epistemological and pedagogical frameworks. A

deeper examination of its alignment with ontological, epistemological, and axiological dimensions could enhance its role in shaping educational strategies (Kadirhanogullari & Kose, 2024). Additionally, bibliometric analyses in education research rarely examine the intersection between the philosophy of science and education, often treating them as separate domains. This prevents a holistic understanding of their interconnectedness. A comprehensive bibliometric approach is essential to bridge this gap by identifying dominant research themes, scholarly contributions, and emerging trends (Bozkurt, 2023).

Moreover, limited international collaboration in this field has led to fragmented insights into how different education systems integrate philosophical dimensions into curricula. Despite the growing global interest in the philosophy of science in education, collaborative research remains scarce, restricting knowledge exchange and comparative analyses. Addressing this issue could foster cross-cultural understanding and enhance the integration of philosophical perspectives into educational frameworks. Finally, the role of the philosophy of science in fostering inclusive and sustainable education remains insufficiently explored. As ethical and value-based education becomes a priority, there is a pressing need to investigate how ontological, epistemological, and axiological dimensions contribute to inclusive and sustainable pedagogical models. Given the increasing emphasis on ethics, diversity, and interdisciplinary approaches, further research is crucial to inform policy and curriculum development (Fitria et al., 2023).

This study aims to explore research trends in the philosophy of science in education through a bibliometric approach. By utilizing the Scopus database as the primary data source and visualization tools such as VOSviewer, this study analyzes publication patterns, geographical distribution, research themes, and collaboration between researchers (Granić & Marangunić, 2019; Yanuarti & Suprpto, 2021). The focus on current data allows this article to make a relevant and contextual contribution to the philosophy of science and education literature. This research aims to map trends and offer recommendations for policymakers and educational practitioners. With a better understanding of the dynamics of research in this area, it is hoped that educational strategies can be designed that are relevant to the development of science and are ethical, inclusive, and sustainable. The results of this study also contribute to building a firmer foundation for interdisciplinary collaboration, strengthening the integration of philosophy of science dimensions in educational curricula, and creating learning approaches relevant to the global challenges of the 21st century.

Through this analysis, this study contributes to understanding how the philosophy of science guides education by integrating ontological, epistemological, and axiological dimensions. A well-grounded philosophical foundation ensures that learning systems align with technological advancements and foster ethical reasoning, critical thinking, and social integrity. In a rapid digital transformation era, a philosophical perspective in education is essential to balancing scientific knowledge with moral values, preparing individuals to navigate modern societal complexities. Moreover, this research underscores the importance of incorporating philosophical principles into educational policies to develop sustainable and inclusive curricula. Strengthening philosophical dimensions in education enables institutions to formulate policies that address contemporary challenges while anticipating future educational needs.

METHODS

This study aims to conduct a bibliometric analysis of scientific publications that discuss the relationship between the philosophy of science and education. In order to achieve this goal, this research sets several specific objectives, including (Sigahi & Szelwar, 2022). 1) Building a Descriptive Structure: Evaluate the volume and distribution of publications on the philosophy of science in education, identifying relevant authors, journals, and disciplines; 2) Analyzing the Impact of Scientific Publications: Assess the contribution of publications to the development of new knowledge through citation analysis and identify authors, institutions, and countries of significant influence. 3) Tracking Collaboration Patterns: Analyze collaboration patterns between authors, countries, and institutions in this research area; 4) Identifying Key Research Areas and Emerging Trends: Discover key research topics, emerging trends, and areas not widely explored in the academic literature.

Bibliometric analysis provided significant benefits in this research by offering a deeper understanding of the structure of scientific data in the philosophy of science and education. This method involves identifying, analyzing, and evaluating literature, providing valuable insights into the chronological development of this research area. Additionally, it helps identify influential authors, scholarly articles, journals, key topics, and citation patterns within the academic community (Bujaki et al., 2023; Sumadisastro et al., 2024). This study employed a systematic approach to collecting and analyzing data, ensuring a comprehensive mapping of the relationship between philosophy of science and education, mainly focusing on its ontological, epistemological, and axiological dimensions. This approach identified key research trends, collaboration patterns among scholars, and significant contributions in this academic field. The procedures used in this research are as follows: 1) *Data Collection*: Research data were obtained using Publish or Perish (PoP) software designed to collect data from journal articles, scientific proceedings, and scientific reviews indexed in Scopus and Google Scholar databases

(Hamidi et al., 2022). The search keywords used in this study were "Philosophy of Science in Education," "Educational Philosophy and Knowledge," and "Ontological, Epistemological, and Axiological Perspectives in Education." The period analyzed was from 2010 to 2024, covering various documents, such as journal articles, proceedings, and literature reviews. The data obtained focused on publications relevant to the philosophy of science in the context of education; 2) *Data Preprocessing*: The collected data was then processed using Microsoft Excel to sort and categorize the documents based on theme, author, journal, and number of citations. This process also included removing duplicate data and filtering out irrelevant documents to ensure data accuracy and relevance; 3) *Data Visualization*: VOSviewer software was used to visualize the results of the bibliometric analysis. This tool helps create interactive bibliometric maps, including linkage, co-citation, and co-occurrence analyses. These visualizations help identify significant collaboration patterns and research trends in the literature. 4) *Bibliometric Analysis*: Bibliometric analysis was conducted in this study with a focus on several key aspects, namely Content Analysis (Analyzing article documents, contributing authors, journals, institutions, and countries), Citation Analysis (Assessing the impact of research based on the number of citations), Co-Author Analysis (Evaluating collaboration patterns between authors), and Co-Occurrence Analysis (Identifying research trends and frequent theme patterns).

The accuracy of bibliometric studies depends heavily on the search results obtained from the databases or journals used. To measure scientific productivity on a particular research topic, it is important to ensure that the field of study is adequately represented in the journal datasets used for bibliographic searches. In selecting databases for bibliometric studies, there are two main factors to consider: the extent to which the database covers specialized literature in a particular field and the accuracy of the data, including issues such as inconsistencies, author name errors, and lack of standardization in journal titles or affiliations (Sant, 2019; Thomas et al., 2020). For article document selection, this study applied the PRISMA criteria as a guide to systematically evaluate research (Hanif, 2023). This process involves identifying, screening, and selecting relevant documents, as shown in Figure 1. This approach is designed to ensure that only documents that meet the eligibility criteria are included in the bibliometric analysis so that the research results are reliable and relevant to the study objectives.

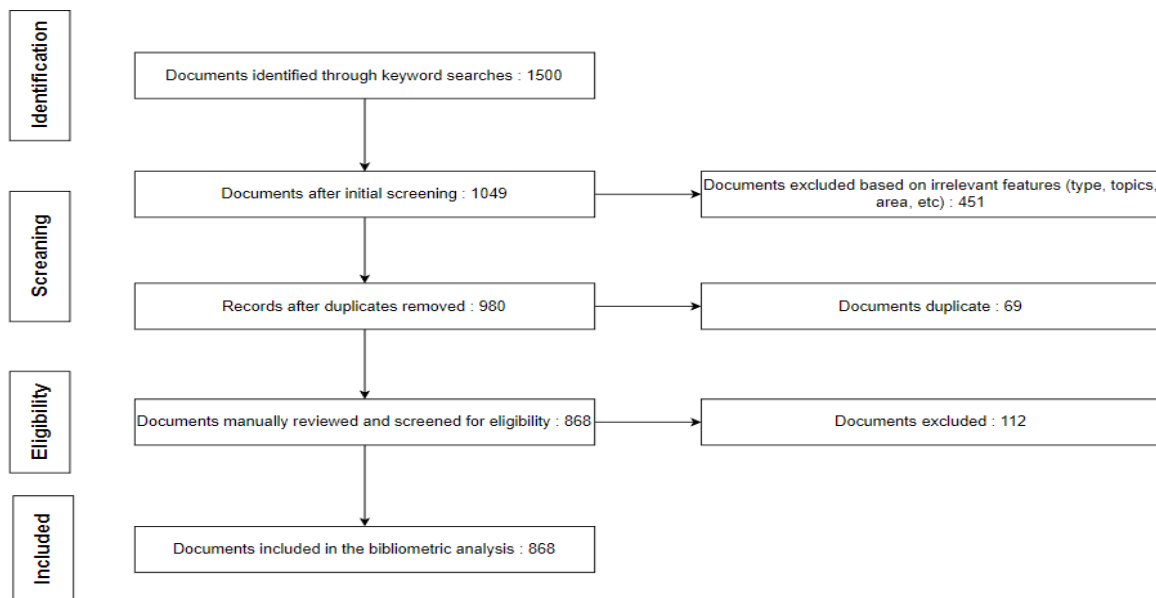


Figure 1. PRISMA guidelines describing the collection of documents from Scopus and Google Scholar

Table 1. Search Criteria

Criteria	Details
Database	Scopus and Google Scholar
Citation Index	SCIE (Science Citation Index Expanded) and SSCI (Social Sciences Citation Index)
Topics	" <i>Philosophy of Science in Education</i> " (PSE), "Educational Philosophy and Knowledge" (EPK), and "Ontological, Epistemological, and Axiological Perspectives in Education" (OEAPE)
Period	2010 – 2024
Document Type	Articles, proceedings papers, reviews

This research focuses on three main themes, as described in Table 1. These three themes were chosen to provide a comprehensive picture of the relationship between the philosophy of science and education in various aspects. Although the three themes are often used overlappingly in the literature (e.g., using the term "Educational Philosophy" generically to cover all topics related to the philosophy of education), there has been no bibliometric analysis that evaluates these themes together. Therefore, this study aims to bridge this gap by thoroughly analyzing these themes. In addition to articles published in academic journals, the research dataset includes other documents, such as conference proceedings papers and literature reviews. Eight hundred sixty-eight documents relevant to the topics have been collected and are ready for analysis, covering the period from 2010 to 2024. The results of this analysis are expected to provide deep insights into research trends, collaboration patterns, and scholarly contributions to the philosophy of science and education.

RESULT AND DISCUSSION

Bibliometric analysis is an effective approach for evaluating, visualizing, and exploring large-scale scientific data. This study applied bibliometric analysis to examine research trends in the philosophy of science in education, aiming to provide a broader understanding of how this field has evolved. The findings reveal key thematic clusters, influential publications, and collaborative networks, contributing to identifying gaps and future directions in this research domain. The annual increase in publications over this period shows a fluctuating but generally stable trend, as seen in Figure 2. The sharp decline in 2024 may be due to the data search deadline of August 2024. Most of the document types analyzed were journal articles (80.16%), followed by conference proceedings (15.97%), and the rest were editorial reviews. This analysis was conducted to gain a broader understanding of research trends related to the philosophy of science in education, including proposed approaches to integrate the values of ontology, epistemology, and axiology in the context of education.

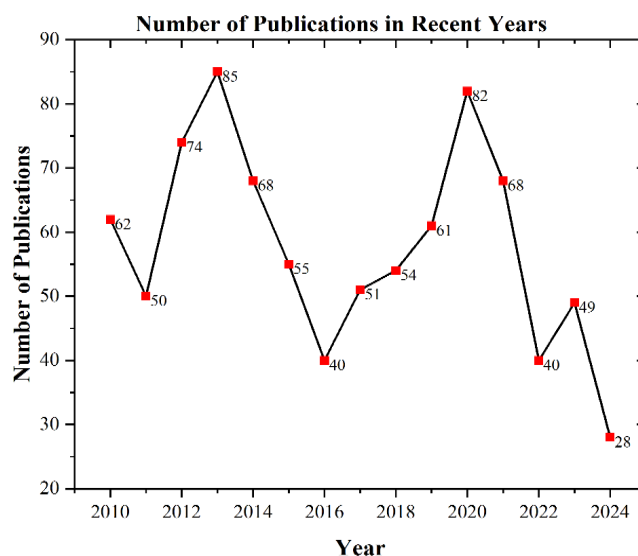


Figure 2. Number of Publications in Recent Years

The number of publications from 2010 to 2024 shows significant variation, with clearly visible periods of peak and decline. At the beginning of the decade, the number of publications started with 62 documents in 2010 and peaked in 2013 with 85 publications. This trend reflects increased attention to the importance of the philosophy of science in education and the development of multidimensional approaches to education, such as a focus on epistemological and axiological values. However, declines in specific years, such as 2015 and 2024, could be due to changes in research priorities or external factors affecting scientific production.

This trend highlights the importance of the philosophy of science in shaping an educational system that is more critical, innovative, and relevant to global challenges. While the significant increase in publications indicates excellent attention to this topic, the variation in the number of publications reflects the dynamics influenced by the development of academic literature and the needs of the educational community (Luthfiyah & Khobir, 2023). In this category, the primary sources included in the analyzed data include relevant philosophy of science perspectives and fall into the research category on ontological, epistemological, and axiological values-based education. These sources provide important insights into the purpose of sustainable education. Table 2 presents the primary sources analyzed in this study. Table 3 shows the most relevant articles based on the citations obtained.

Table 2. Ranking of the 10 sources that contain the analyzed records

Source Titles	Records	% of 868	JCR Impact	SJR Impact
Educational Philosophy and Theory	74	8.53	2.09	0.725
Science & Education	39	4.5	1.5	0.804
American Educational Research Journal	25	2.88	3.6	2.232
Academic Medicine	25	2.88	5.3	1.56
Philosophy of Music Education Review	23	2.65	0.7	0.168
The Journal of Environmental Education	20	2.30	1.7	0.955
Journal of Qualitative Studies in Education	18	2.07	1.1	0.664
International Journal of Philosophical Studies	15	1.73	0.7	0.259
Studies in Philosophy and Education	12	1.38	0.9	0.678
European Journal of Education	12	1.38	2.8	0.79

Table 2 highlights the top 10 journals contributing to the analyzed records in this study, emphasizing their role in shaping the field of philosophy of science in education. Educational Philosophy and Theory is the most prominent source, with 74 records (8.53%), reflecting its centrality in publishing works related to philosophical perspectives in education. Science and education follow with 39 records (4.5%), showcasing its focus on integrating scientific and philosophical paradigms in educational contexts. Journals such as American Educational Research Journal (2.88%, 25 records) and Academic Medicine (2.88%, 25 records) have the highest JCR impact factors, indicating their strong influence and recognition in the academic community. Meanwhile, niche journals like Philosophy of Music Education Review (2.65%, 23 records) and The Journal of Environmental Education (2.30%, 20 records) illustrate philosophical frameworks' application in specialized education areas. This ranking underscores the diversity of publication outlets in the field, with contributions spanning generalist and specialized journals, highlighting the multidisciplinary and evolving nature of research in the philosophy of science in education (Hayati & Dalimunthe, 2022).

Table 3. Ranking of the 10 most cited documents

Title	Authors & Year	Publisher	Total Citations
Understanding and applying research paradigms in educational contexts	(Kivunja & Kuyini, 2017)	International Journal of Higher Education	3882
Exploring the Philosophical Underpinnings of Research: Relating Ontology and Epistemology to the Methodology and Methods of the Scientific, Interpretive, and Critical Research Paradigms	(Scotland, 2012)	Canadian Center of Science and Education	3857
Personal views on the future of entrepreneurship education	(Fayolle, 2018)	Schooling and the acquisition of knowledge	1660
Designing and implementing an integrated technological pedagogical science knowledge framework for science teachers professional development	(Jimoyiannis, 2010)	Quality & Quantity	1618
A Review of key paradigms: positivism VS interpretivism	(Alharahsheh & Pius, 2020)	Global Academic Journal of Humanities and Social Sciences	1383
The Positivism Paradigm of Research	(Park et al., 2020)	Academic Medicine	1350
Critical race theory and the whiteness of teacher education	(Sleeter, 2017)	A research agenda for entrepreneurship education	1346
Why 'What Works' Still Won't Work: From Evidence-Based Education to Value-Based Education	(Biesta, 2010)	Studies in Philosophy and Education	1278
Philosophy of technology assumptions in educational technology leadership	(Webster, 2017)	Science Studies and Science Education	964
Formation in professional education: An examination of the relationship between theories of meaning and theories of the self	(Benner, 2011)	International Journal of Qualitative Studies in Education	893

Table 3 provides an overview of the top 10 most-cited documents in the field of philosophy of science in education, showcasing their influence in shaping the research landscape. The most-cited article, "Understanding and Applying Research Paradigms in Educational Contexts," by Kivunja and Kuyini (2017), with 3882 citations, highlights the critical role of research paradigms in educational practices. Similarly, "Exploring the Philosophical Underpinnings of Research" by Scotland (2012), with 3857 citations, emphasizes the importance of aligning ontology and epistemology with methodological choices in educational research.

Other highly cited works, such as "A Review of Key Paradigms: Positivism vs. Interpretivism" (2020) and "The Positivism Paradigm of Research" (2020), focus on methodological debates, reflecting the ongoing relevance of philosophical paradigms in educational research. Meanwhile, Biesta's "Why 'What Works' Still Won't Work: From Evidence-Based Education to Value-Based Education" (2010) emphasizes the shift towards value-based approaches, underscoring the axiological dimension in educational frameworks. Interdisciplinary contributions, such as Jimoyiannis's (2014) study on integrating technological pedagogical frameworks, highlight the application of philosophical principles in contemporary educational challenges. Additionally, works addressing specific themes, such as Sleeter's (2017) exploration of critical race theory in teacher education and Webster's (2011) analysis of philosophical assumptions in educational technology, expand the scope of philosophical inquiry to include social and technological contexts. Overall, these documents represent foundational and diverse contributions to the field, reinforcing the significance of philosophical frameworks in addressing both theoretical and applied aspects of education. Their high citation counts indicate their continued relevance and impact on advancing research and practice in educational philosophy (Ni'mah et al., 2024).

Table 4. Ranking of the 10 authors who contributed the most publications

Authors	Institution	Country	Records	% of 868
RB Johnson	University of South Alabama	USA	9	1.04
MA Peters	Beijing Normal University	China	9	1.04
M Young	University of London	UK	7	0.81
J Muller	University of Capetown	South of Africa	6	0.69
M Bang	University of Washington	USA	5	0.58
G Hornby	University of Canterbury College of Education	New Zealand	5	0.58
RH Ellaway	University of Calgary	Canada	5	0.58
AEJ Wals	Wageningen University & Research	Netherlands	4	0.46
NZ Chesky	State University of New York	USA	4	0.46
L Le Grange	Stellenbosch University	South of Africa	4	0.46

Table 4 identifies the top 10 authors contributing the most publications in philosophy of science in education. RB Johnson (University of South Alabama, USA) and MA Peters (Beijing Normal University, China) lead the list, each with nine publications (1.04% of the total records), indicating their significant role in shaping research trends in this domain. Other notable contributors include M Young (University of London, UK) with seven publications (0.81%) and J Muller (University of Cape Town, South Africa) with six publications (0.69%). These authors represent leading institutions across different regions, demonstrating the global nature of this research field. Authors such as AEJ Wals (Wageningen University & Research, Netherlands) and L Le Grange (Stellenbosch University, South Africa) provide unique regional perspectives, enriching the discipline's diversity of thought and approaches. Using data processed with VOSviewer, we conducted a co-authorship analysis to examine the structure of scientific collaboration within the philosophy of science in education. This analysis aims to identify research collaboration patterns and map the intellectual networks that drive conversations and innovations in this domain (Sumadisastro et al., 2024; Yanuarti & Suprpto, 2021). The visualization illustrates how researchers and institutions interact, collaborate, and contribute collectively to advancing knowledge by integrating ontological, epistemological, and axiological perspectives into educational frameworks. These insights highlight the dynamics of scholarly interactions that shape this field's theoretical and practical development.

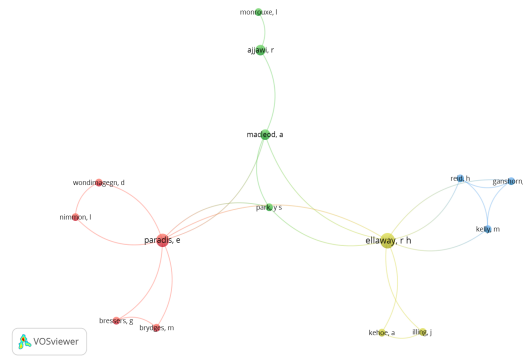


Figure 3. Network Visualization Analysis for Co-Authorship

The network visualization in Figure 3 illustrates the collaborative relationships among researchers contributing to the literature on the philosophy of science in education. This figure highlights key connections and clusters within the co-authorship network, emphasizing the structure of academic collaboration in the field. Researchers such as "Paradis, E," "Ellaway, R H," and "Macleod, A" emerge as central nodes, indicating their significant roles in fostering collaboration and advancing research in this domain. The visualization also reveals distinct clusters of researchers, suggesting the presence of subgroups focusing on specific topics or methodologies within the broader field. For instance, the cluster associated with "Paradis, E" shows strong connections with researchers like "Brydges, M" and "Wondimagegn, D," indicating close collaboration on shared research themes. Similarly, the cluster centered around "Ellaway, R H" highlights collaborative efforts with "Kehoe, A" and "Illing, J," demonstrating focused research partnerships. The results obtained from the cluster analysis with VOSViewer identified four main clusters based on 71 terms that showed an occurrence more significant than 2. These groupings indicate the research paths or strands explored by the publications under study: 1) Cluster 1: Philosophical Foundations in Educational Practices; 2) Cluster 2: Ontological, Epistemological, and Axiological Dimensions in Educational Research; 3) Cluster 3: Historical and Scientific Perspectives in Education; 4) Cluster 4: Problem-Solving Approaches in Educational Disciplines; 5) Cluster 5: Axiological Perspectives and Their Integration into Education; 6) Cluster 6: Islamic Perspectives in Educational Philosophy. The following Figures 4 and 5 provide an overview of the interconnectedness of these clusters and the general themes linking each of them.

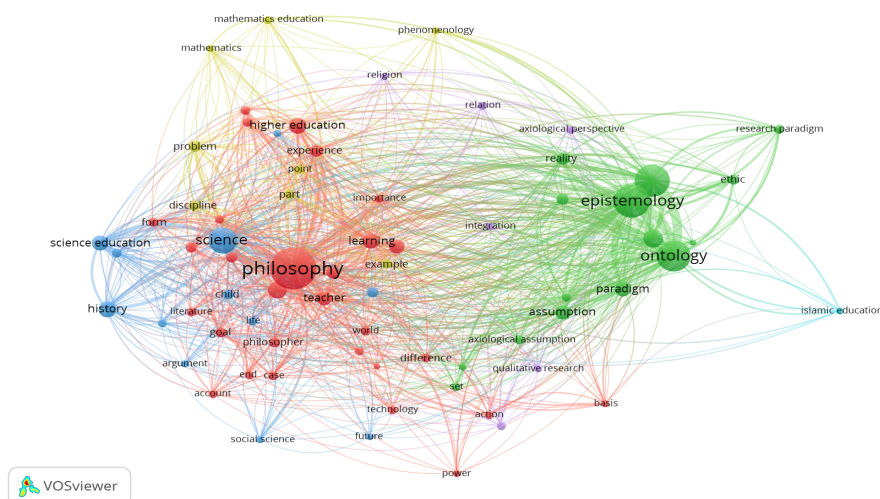


Figure 4. Overview Network Visualization for Co-Occurrence

Figure 4 presents a network visualization of the terms used in the research field of philosophy of science in education. Each keyword is represented by a label and circle, where the label and circle's size reflect the term's weight in the co-occurrence analysis. More prominent labels and circles indicate terms with higher frequencies and stronger connections to other keywords. This visualization highlights the relationships between clusters, showcasing how themes such as "philosophy," "epistemology," "ontology," and "science education" are interconnected and central to the field.

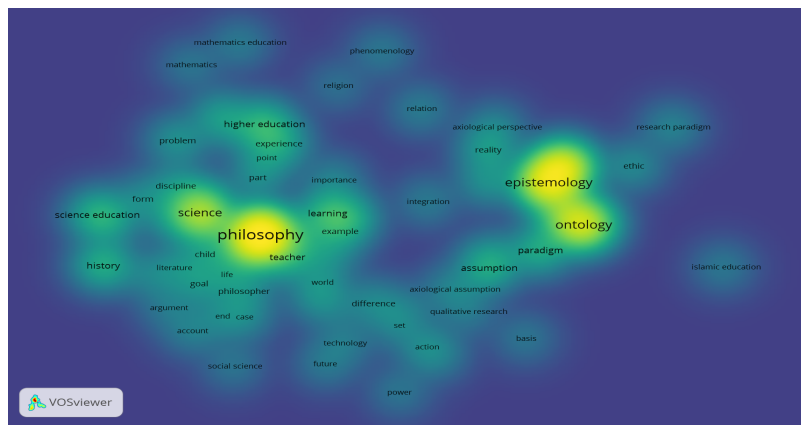


Figure 5. Overview Density Network Visualization for Co-Occurrence

Figure 5 illustrates a density visualization, providing an overview of the distribution of research focus within the field. Areas with high light intensity correspond to terms and clusters receiving significant research attention. The central focus on terms such as "philosophy," "epistemology," and "ontology" reflects their critical role in shaping the theoretical and methodological underpinnings of educational research. Additionally, moderate-intensity clusters highlight emerging or niche areas, such as "axiological perspectives" and "Islamic education," indicating a growing interest in these domains. Table 5 presents the data obtained following the analysis of cluster 1, Philosophical Foundations in Educational Practices, which showed the ten most frequently used labels, as well as their weight.

Table 5. Quantitative Analysis of Cluster 1

Label	Link	Total Link Strength	Occurrences
Educational Philosophy	38	70	40
Educational Technology	14	19	8
Curriculum	26	47	18
Teacher Education	22	35	15
Learning	46	117	43
Practice	51	162	60
Goal	27	50	21
Higher Education	36	108	49
School	30	57	22
University	22	45	16

Cluster 1 underscores the importance of educational philosophy as a foundation for developing educational practices and frameworks. The findings suggest that concepts such as educational philosophy, learning, educational practices, and curriculum play a central role in shaping the orientation of education at various levels, from schools to universities. Educational philosophical frameworks help define learning objectives, design teaching strategies, and build curricula that are relevant to the needs of students and society. Higher education serves as the main space for applying and developing these philosophical principles, whether through teacher education, research, or innovations in teaching (Anggreni et al., 2024).

In this analysis, higher education and teacher education indicate that educational institutions strategically ensure that philosophical values are effectively applied in the educational environment (An & Oliver, 2021). The philosophy of education focuses on knowledge transfer, developing critical thinking skills, and deep reflection. In addition, the attention to educational technology in this cluster indicates that the application of technology is beginning to be considered in the context of educational philosophy. Technology can serve as a tool to enhance the learning experience as long as its application still considers ethical aspects and broader educational values (Kimmons & Johnstun, 2019).

This finding confirms that educational philosophy should remain a reference in developing educational policies and practices, especially in the face of modern challenges such as globalization, technology, and social change (Nasir et al., 2020). A philosophy-based curriculum allows the development of learning that emphasizes cognitive aspects and develops character, morality, and critical thinking skills (Alsubaie, 2016). Educational institutions, particularly universities, can use these insights to improve curriculum design and teacher training programs in line with philosophical principles. Researchers can further explore how technology can strengthen educational values without compromising basic philosophical principles.

Table 6. Quantitative Analysis of Cluster 2

Label	Link	Total Link Strength	Occurrences
Ontology	63	631	187
Epistemology	64	692	209
Axiology	62	629	191
Research Paradigm	17	55	16
Philosophical Underpinning	18	28	8
Methodology	43	224	64
Reflection	27	52	15

The second cluster, titled "Ontological, Epistemological, and Axiological Dimensions in Educational Research," highlights the essential philosophical foundations that shape educational research's nature, scope, and purpose. This cluster emphasizes how integrating ontology, epistemology, and axiology into research paradigms ensures that inquiries into education are methodologically rigorous and ethically and philosophically grounded (Al-Ababneh, 2020). Key terms such as ontology, epistemology, and axiology represent the core dimensions that inform educational research's conceptual and practical frameworks. Ontology helps researchers examine the nature of reality and what constitutes legitimate objects of inquiry, while epistemology focuses on knowledge's sources, limits, and validity (Pretorius, 2024). Conversely, Axiology guides the value-driven considerations, ensuring that research aligns with ethical principles and societal goals. Terms like research paradigm and philosophical underpinning emphasize the role of broader frameworks in providing coherence and relevance to research practices. These concepts guide researchers in selecting approaches that align with their philosophical orientations, enabling them to explore educational phenomena with greater clarity and purpose. Additionally, including methodology and reflection underscores the dynamic nature of educational research. Methodology provides the tools and processes for inquiry, while reflection allows researchers to evaluate their methods, assumptions, and ethical implications critically. This reflective practice is crucial for refining research designs and ensuring that studies contribute meaningfully to the field (Handema et al., 2023).

The findings from this cluster demonstrate that educational research must transcend technical execution to include deep philosophical considerations. By addressing questions of reality, knowledge, and values, researchers can design studies that not only answer immediate educational questions but also contribute to the broader discourse on the purpose and impact of education. This cluster serves as a foundation for advancing research that is both intellectually robust and socially responsible (Pearce, 2021). The third cluster focuses on the integration of historical and scientific perspectives in the context of education. This cluster explores how understanding historical developments and scientific advancements can enhance educational practices, inform curriculum design, and provide a deeper context for addressing contemporary educational challenges through interdisciplinary approaches.

Table 7. Quantitative Analysis of Cluster 3

Label	Link	Total Link Strength	Occurrences
History	37	143	49
Psychology	28	54	21
Science Education	36	139	47
Sociology	21	39	13
Argument	18	29	11

The third cluster, "Historical and Scientific Perspectives in Education," emphasizes integrating historical and scientific insights to enrich educational practices. This cluster explores how historical developments and advancements in science education, psychology, and sociology provide a nuanced understanding of education's evolution and application in addressing contemporary challenges. Historical perspectives are particularly valuable for contextualizing the development of educational systems and philosophies (Anderson, 2022). They allow educators and researchers to draw lessons from past practices, identify recurring patterns, and better understand the trajectory of pedagogical innovation. This historical grounding helps inform curriculum design and adapt it to societal needs while maintaining a connection to foundational principles. Insights from science education and psychology further enhance teaching methodologies by emphasizing evidence-based practices and fostering critical thinking skills. Science education offers a framework for inquiry-based learning, encouraging students to engage with knowledge through experimentation and analysis (Xue & Li, 2024). Psychology contributes to understanding learner behavior, motivation, and cognitive processes, enabling the development of teaching strategies that are both effective and learner-centered. Sociology adds another dimension by examining the social and cultural factors that shape educational systems. It highlights the role of social dynamics, equity, and inclusivity in designing educational frameworks that address the diverse needs of learners. This interdisciplinary perspective ensures that education is about knowledge transfer and fostering a

more equitable and culturally sensitive learning environment. Moreover, including arguments within this cluster indicates the importance of developing learners' abilities to reason, debate, and articulate ideas effectively. This skill is essential for preparing students to navigate the complexities of global challenges and contribute meaningfully to societal progress (McCrudden & Rapp, 2024). By integrating these perspectives, educational practices can become more responsive to the demands of a rapidly changing world. This cluster underscores the value of interdisciplinary approaches that connect historical and scientific insights with practical applications, creating educational frameworks that are both theoretically sound and contextually relevant (Luckin & Holmes, 2016). Institutions can use these findings to develop curricula and pedagogical strategies that address current challenges and anticipate future educational needs. The fourth cluster explores problem-solving approaches in educational disciplines integrating innovative methodologies, interdisciplinary perspectives, and real-world applications. These approaches address challenges in various fields of education, emphasizing critical thinking, collaboration, and adaptability to equip learners with the skills needed to tackle complex educational problems in diverse contexts.

Table 8. Quantitative Analysis of Cluster 4

Label	Link	Total Link Strength	Occurrences
Mathematics Education	16	38	12
Phenomenology	16	30	11
Discipline	29	60	20
Problem	30	68	25

The fourth cluster, "Problem-Solving Approaches in Educational Disciplines," explores how innovative methodologies and interdisciplinary perspectives are applied to address multifaceted educational challenges. This cluster underscores the critical role of fostering analytical thinking, collaboration, and adaptability to equip learners with the skills to solve complex problems in diverse educational settings. Key terms like mathematics education highlight the importance of discipline-specific approaches in cultivating structured problem-solving abilities. Mathematics education, for instance, emphasizes logical reasoning and precision, which are transferable to broader contexts requiring critical and analytical skills. Meanwhile, phenomenology introduces a philosophical dimension by focusing on understanding learners' lived experiences, offering valuable insights into educational challenges' subjective and cultural aspects (Aikenhead, 2021; Telaumbanua et al., 2023).

The presence of terms like discipline and problem indicates the centrality of problem-solving across various educational contexts. These terms emphasize creating adaptable frameworks that allow educators and learners to navigate issues ranging from curriculum development to real-world applications collaboratively. Such approaches encourage academic mastery and the ability to apply knowledge effectively in dynamic and unpredictable scenarios (Sengupta et al., 2022). This cluster highlights the need for interdisciplinary integration, where problem-solving is not confined to single disciplines but draws on diverse fields and methodologies. By fostering these capabilities, educational practices can bridge theoretical insights with practical applications, preparing learners to contribute meaningfully to addressing global and local challenges (Hurlow, 2022). The findings also suggest that educational institutions should prioritize experiential learning, collaborative projects, and innovative pedagogies to ensure learners are equipped for the complexities of contemporary education and beyond.

Table 9. Quantitative Analysis of Cluster 5

Label	Link	Total Link Strength	Occurrences
Axiological Perspectives	18	29	15
Qualitative Research	24	38	11
Religion	19	28	8
Relevance	17	40	13

The fifth cluster, "Axiological Perspectives and Their Integration into Education," highlights the importance of values and ethical considerations in shaping educational practices and research. This cluster emphasizes the role of axiological perspectives in understanding education's relevance in fostering moral, cultural, and societal development. Axiological perspectives and relevance underscores the significance of aligning educational goals with value-based principles (Manik et al., 2024). These findings suggest that education is not merely about knowledge acquisition but also about instilling values that prepare learners to navigate ethical dilemmas and contribute to societal well-being. The inclusion of qualitative research within this cluster indicates the role of interpretive approaches in exploring how values are perceived, integrated, and operationalized within educational contexts. Qualitative methodologies provide the tools to examine complex phenomena such as moral reasoning, cultural influence, and ethical decision-making, which are central to the

axiological dimension of education (Djafar et al., 2021). The term religion reflects the influence of spiritual and cultural traditions on educational values. This finding highlights the need to incorporate diverse cultural and religious perspectives into education, fostering inclusivity and mutual understanding among learners from varied backgrounds (Class et al., 2021). Overall, this cluster highlights the importance of integrating axiological perspectives into education's theoretical and practical aspects. By emphasizing values, relevance, and qualitative inquiry, this cluster contributes to developing ethically grounded and culturally responsive educational frameworks. These insights encourage further exploration of how axiological principles can be effectively embedded in curricula, teaching practices, and research methodologies to address the complex ethical challenges of contemporary education (Akkerman et al., 2021).

Table 10. Quantitative Analysis of Cluster 6

Label	Link	Total Link Strength	Occurrences
Islamic Education	11	32	11

The sixth cluster, titled "Islamic Perspectives in Educational Philosophy," highlights the unique contributions of Islamic education to the broader discourse on educational philosophy. This cluster emphasizes integrating values, principles, and teachings rooted in Islamic tradition into contemporary educational frameworks. This cluster's focus on Islamic education underscores its relevance in fostering a holistic approach to education, combining intellectual development with spiritual and moral growth. This perspective aligns with the broader theme of axiological integration, where values play a central role in shaping educational practices and goals. Islamic educational philosophy offers insights into character development, ethical decision-making, and a sense of community responsibility. These principles resonate with the objectives of contemporary education, which aim to prepare learners for academic success and contribute to a just and equitable society (Pranajaya et al., 2024). The findings from this cluster also highlight the potential for Islamic education to enrich global educational practices by promoting inclusivity, cross-cultural understanding, and ethical leadership. Integrating Islamic perspectives into educational philosophy ensures that diverse cultural and spiritual values are respected and reflected in teaching and learning processes (Wijaya, 2021).

Research on the philosophy of science in education has predominantly focused on theoretical discussions, such as philosophical influences on curricula, epistemological discourse, or axiological values in education. However, these studies often lack systematic, data-driven mapping of global research trends. This study fills that gap by integrating bibliometric analysis, offering a quantitative perspective on how ontological, epistemological, and axiological dimensions shape education worldwide. Unlike previous bibliometric studies in education focusing on specific disciplines, this research systematically examines the intersection between the philosophy of science and education, providing a structured visualization of research clusters, influential scholars, and emerging themes. The use of co-occurrence, citation, and co-authorship analysis uncovers new interdisciplinary pathways, such as integrating systems thinking in epistemology, the role of axiological perspectives in global educational policies, and the increasing influence of Islamic educational philosophy. Additionally, this study identifies gaps in international collaboration, revealing fragmented research efforts across different regions. Mapping co-authorship networks highlights existing scholarly connections and potential opportunities for future interdisciplinary and cross-cultural collaborations. This research bridges theoretical and empirical approaches, demonstrating how bibliometric methods can enhance educational philosophical inquiry. The findings offer valuable insights for educators, policymakers, and researchers, contributing to curriculum development, interdisciplinary research, and the advancement of philosophy-based educational frameworks in a globalized world.

The findings of this research have significant implications for the development of philosophy-based educational frameworks, interdisciplinary collaborations, and policy recommendations. Identifying thematic clusters—such as integrating axiological perspectives, interdisciplinary problem-solving approaches, and Islamic perspectives in educational philosophy, demonstrates how philosophical dimensions shape educational research and practice globally. This study highlights the utility of bibliometric analysis as a robust, data-driven method for evaluating research impact in education. The results can guide future empirical studies in adopting systematic approaches to analyze philosophical contributions to education. By mapping co-authorship networks, this study identifies key scholars and institutions driving research in this field, thereby promoting greater international collaboration and cross-cultural exchange in educational philosophy research. The findings underscore the increasing emphasis on value-based education, ethical reasoning, and interdisciplinary integration, which are critical for designing inclusive and sustainable educational policies. These insights provide a foundation for curriculum reform, ensuring that philosophical principles remain central to education in an era of rapid technological and societal change.

CONCLUSION

This study conducted a bibliometric analysis to explore global research trends in the philosophy of science in education from 2010 to 2024. Using VOSviewer, the study identified key ontological, epistemological, and axiological dimensions influencing educational frameworks. The results reveal a growing scholarly focus on integrating philosophical principles into education, significantly contributing to critical thinking, ethical considerations, and interdisciplinary approaches. The analysis identified six main research clusters, including philosophical foundations in education, historical-scientific integration, problem-solving methodologies, axiological perspectives, and Islamic educational philosophy, underscoring the increasing importance of value-based and holistic education. These findings emphasize the need for educational policies and curricula aligning with philosophical principles, ensuring modern education fosters critical thinking, ethical leadership, and social responsibility. The study also highlights the limited global collaboration in this domain, suggesting the potential for stronger international partnerships to create more inclusive and culturally diverse educational strategies. By applying these insights, policymakers, educators, and researchers can design more sustainable and ethically grounded curricula, addressing contemporary educational challenges while fostering culturally inclusive and adaptive learning systems. As the philosophy of science continues to shape educational discourse, integrating its principles into educational policy and practice will be essential in developing globally competent and ethically aware learners in an increasingly interconnected world.

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