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Social partnerships among academia, industry, and government in education: a bibliometric analysis

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This paper employed a bibliometric analysis technique to explore the literature on social partnership in education, aiming to uncover historical trends, research focus areas, influential publications, and contributors. Adopting a retrospective observational design, this study examined 1,208 journal articles in the Lens database from 1983 to 2023 related to education-practice partnerships. The research on the topic showed limited activity until late years, with a surge in publications. Key areas of interest included government involvement, healthcare-related partnerships, and collaborative approaches. Research methodologies such as qualitative research and empirical approaches were evident. Top-cited publications demonstrated enduring impact, while institutions and countries represented the multidimensional nature and global relevance of this field. The outcomes of this bibliometric analysis suggest that community-institutional partnerships, cooperative behavior, interprofessional relations, and government are the most important aspects of social partnerships embracing education entities. The results also imply that qualitative research is a valuable approach for investigating academic-practice collaborations. The findings of this study can inform policymakers about the need to consider strategies that promote interdisciplinary collaboration and address the evolving healthcare landscape.

KEYWORDS

academic-practice partnership, bibliometric analysis, education-practice partnership, government, university-industry cooperation

1 Introduction

Social partnership was identified as the establishment of stable connections involving mutual acknowledgment, institutionalized cooperation, and controlled contention among labor, business, and government (Streeck and Hassel, 2003). In the context of education, social partnership entails cooperative engagements among diverse stakeholders, including governments, educational institutions, and non-governmental organizations. The objective is to tackle localized and regional issues within the education sector, all while aligning with the preferences of employers, the needs of students, and the imperatives of policymakers (Tavares et al., 2020). These partnerships are inherently social as they aim to address broader societal goals such as workforce development, social equity, and community well-being. This symbiotic relationship ensures mutual advantages, fostering a dynamic that contributes to sustainable development and social transformation (Ma and Montgomery, 2021; Ntuli et al., 2023). Such collaboration may involve shared decision-making, resource allocation, and the emergence of

innovative initiatives, facilitating the conversion of scientific and technological breakthroughs into social benefit (Zhou and Wang, 2023).

Social partnerships in education can take different forms and models, depending on the context, goals, and actors. Some examples of such social partnerships are public-private partnerships, transnational strategic collaborative partnerships, and social innovation partnerships. Additionally, partnerships between academia and government bodies form a crucial aspect of social partnerships, aiming to align educational outcomes with national development goals. Public-private partnerships imply contractual agreements between public authorities and private entities. These agreements aim to leverage the participation of the private sector, which is incentivized by government backing, in delivering educational services or infrastructure to enhance accessibility, efficiency, and innovation (Xu, 2023). This model can be illustrated by the Lemann Foundation, a Brazilian non-profit organization that supports initiatives to shape up the quality and equity of public education in the country. The foundation collaborates with state and municipal authorities to concoct and implement expedient solutions for teacher training, school management, curriculum development, and educational technology (Avelar, 2023).

Transnational strategic collaborative partnerships assume bilateral collaborations of educational institutions across national borders to enhance their international competitiveness, mobility, and research capacity (Fehrenbach and Huisman, 2024). For instance, Singapore's Campus for Research Excellence and Technological Enterprise is a research consortium between Singapore's universities and research institutions from around the world that brings together top international researchers from various fields to collaborate on cutting-edge research projects, thus serving Singapore's national interest and addressing complex global challenges (Banozic-Tang and Taeihagh, 2022).

Social innovation partnerships imply the co-creation of public knowledge goods by diverse actors using digital technologies and platforms to address educational challenges and opportunities (Peters and Besley, 2022). The exemplar is the Bridge International Academies, a Kenyan network of low-cost private schools that uses a standardized curriculum, delivered through technology-enabled classrooms, and supported by data-driven management in order to provide quality education to children from low-income families across Africa (Gray-Lobe et al., 2022).

The literature on social partnerships in education has expanded considerably in recent years, reflecting the rising recognition of the importance of collaboration and community engagement in educational initiatives (Eichbaum et al., 2021; Pocol et al., 2022; Si and Lim, 2023). As education systems worldwide face increasing economic and societal challenges (Alciso et al., 2023; Aliyyah et al., 2023; Chomunorwa and Mugobo, 2023; Heng et al., 2022), there is a growing need to delineate research landscape surrounding the subject of partnerships between academia and practice, identify emerging trends, and shed light on potential avenues for future research in the field. The existing literature on the topic lacks a comprehensive understanding of its current state as well as its key themes and trends. Individual studies have evaluated various dimensions of the partnerships, such as the role of university-private sector partnerships in catalyzing regional competitiveness and economic growth, while a holistic bibliometric analysis that consolidates and evaluates the collective body of research is yet to be conducted. This gap may hinder the development of evidence-based practices and policies that could intensify cooperation among stakeholders for the sake of educational

provisions and social capital. Therefore, this study attempts to address the gap by conducting a bibliometric analysis of the literature on social partnerships encompassing academia, industry, and government collaborations in education. More specifically, we aim to answer the following research questions (RQs):

RQ1. What is the volume of publication in the literature on social partnership in education over the research period?

RQ2. What are the focus areas of the research on social partnership in education, and how the focus areas have changed over time?

RQ3. Which publications on social partnership in education have been cited the most over the research period?

RQ4. What are the most prolific institutions in the literature on social partnership in education?

2 Materials and methods

This study adopted a quantitative analysis approach called science mapping, which aims to comprehensively explore the body of literature within a particular knowledge spectrum through a broad-scale analysis of bibliographic data (Pan et al., 2023). This technique yields quantitative outcomes such as the main research areas or the most cited terms.

2.1 Literature search and retrieval

To obtain as relevant items as possible, the following Boolean search scheme was constructed:

[("partnership" OR "government-industry-academia" OR "government-university-industry" OR "university-government" OR "university-industry cooperation" OR "university-industry interaction" OR "university-industry linkage" OR "academia-industry" OR "industry-academia") AND ("beneficial for university" OR "beneficial for academia" OR "benefit for university" OR "benefit to university" OR "benefit for academia" OR "benefit to academia" OR "mutual benefit")].

The search string was applied in Lens database on 4 September 2023. Search fields were title, abstract, keyword, and field of study. Timespan was not limited. To be included in the bibliometric analysis, the document had to be an English-language journal article discussing social partnership involving actors from the education field. The electronic search returned 1,208 publications. After manual deduplication and eligibility assessment, a total of 250 papers were included in the final analysis. The resultant dataset was exported to comma-separated values excel format and processed in Bibliometrix package and VOSviewer software.

2.2 Data analysis

To explore trending topics and researchers' focus in the field over the period, a word cloud and an overlay co-occurrence map of

keywords were generated based on the collected metadata. For the co-occurrence network, a threshold of at least three keyword occurrences was set. Some general terms related to the education field (e.g., students) were removed. Eventually, 13 keywords were plotted on the overlay map.

3 Results

3.1 RQ1. “What is the volume of publication in the literature on social partnership in education over the research period?”

As can be deduced from [Figure 1](#), the research area of social partnership in education has been rather dormant throughout the period covered (1983–2023): up to 2009, no more than a dozen articles per year were published in journals. The rate approached 20 papers a year in 2015 and 2019. This moderately growing interest coincides with global efforts to address educational challenges through collaboration ([Haneberg et al., 2022](#); [Symeonidis and Impedovo, 2023](#); [Wang et al., 2024a](#)). For example, initiatives such as the United Nations Sustainable Development Goals have emphasized the need for internationally cooperated teacher training in developing countries ([Zaidan and Ehsan, 2024](#)). Additionally, the rise of vocational education and training programs in various countries has highlighted the need for collaboration between governments, industry, and educational institutions, as reflected in recent publications ([Allais, 2023](#); [Bravo et al., 2024](#); [Fontdevila et al., 2022](#)).

However, this level of scientific productivity was still behind other topics related to education, such as virtual reality, which has been yielding circa 50 to a 100 journal papers a year since the late noughties ([Battal and Tasdelen, 2023](#)).

This indicates that while the concept of social partnership in education has been present for several decades, it has not consistently been a high-priority research area. This may reflect the complexities of establishing and studying multi-stakeholder collaborations, which typically require longitudinal and interdisciplinary approaches that are resource-intensive and methodologically challenging. Moreover, partnerships reportedly often fail to endure beyond the first year ([Cardiff et al., 2024](#)), prompting calls for further research into the elements that contribute to their longevity. Additionally, funding priorities and research agendas within the education and social sciences fields may have historically focused on other areas, which has likely limited the number of published papers.

3.2 RQ2. “What are the focus areas of the research on social partnership in education, and how the focus areas have changed over time?”

Based on a wordcloud graph depicting the top 50 author’s keywords derived from the Lens dataset ([Figure 2](#)), it is evident that two prominent terms, “government” and “patient group engagement,” stand out as the central and largest elements in the plot, which suggests that these topics are of primary significance and receive considerable attention within the scholarly discourse. The high presence of the keyword “government” plays up a considerable emphasis on the role of government entities in shaping and influencing educational partnerships. This suggests that a substantial body of research is dedicated to understanding government policies, regulations, and initiatives designed to foster collaborations that include education entities. The prominence of this keyword underscores the critical role of government involvement as a focal point of inquiry in the field. One example from the dataset is the study ([Abbas et al., 2019](#)), which

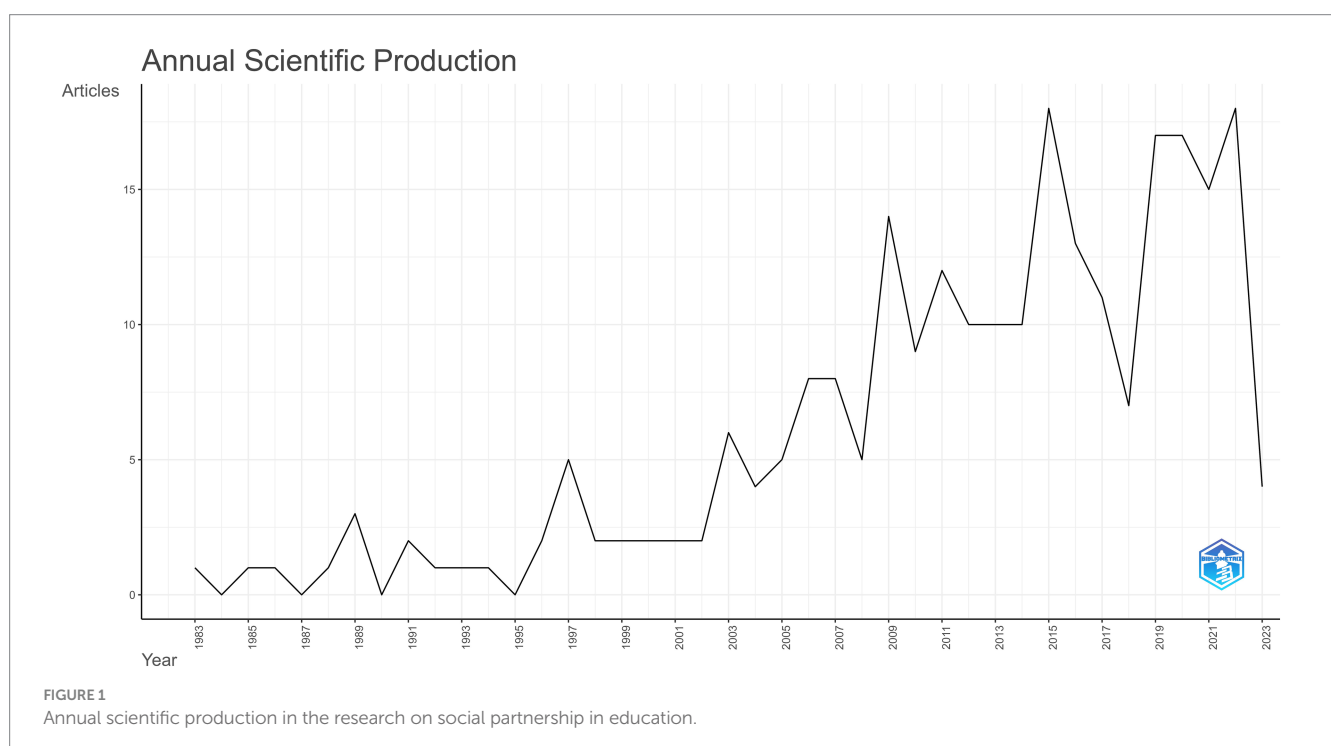




FIGURE 2
Word cloud for the research on social partnership in education.

looked into the collaboration between universities and the government in China.

The keywords reflect the different types of actors in the partnerships (e.g., industry, health sector, civil society) and the different levels of implementation (e.g., local, national, global). The presence of “nursing,” “health care,” and “cancer education” in the wordcloud reflects a strong connection between education-practice partnerships and healthcare-related fields. This suggests an interest in exploring synergic efforts in healthcare education, possibly driven by the need for interdisciplinary approaches to address complex healthcare challenges, such as those posed by the COVID-19 pandemic. For instance, the Lens dataset contains a study (Theobald et al., 2023) that showcases the implementation of an established University-Industry Integration Framework aimed at the creation of a postgraduate nursing education program specializing in cancer care. The framework served as a catalyst for forging significant partnership between Macmillan Cancer Support and De Montfort University, fostering a symbiotic relationship that ultimately bolstered workforce competence, elevated the quality of patient care, enhanced the program participants’ knowledge and skills within the realm of cancer care, and nurtured deeper collaborative ties between the academic and industry spheres.

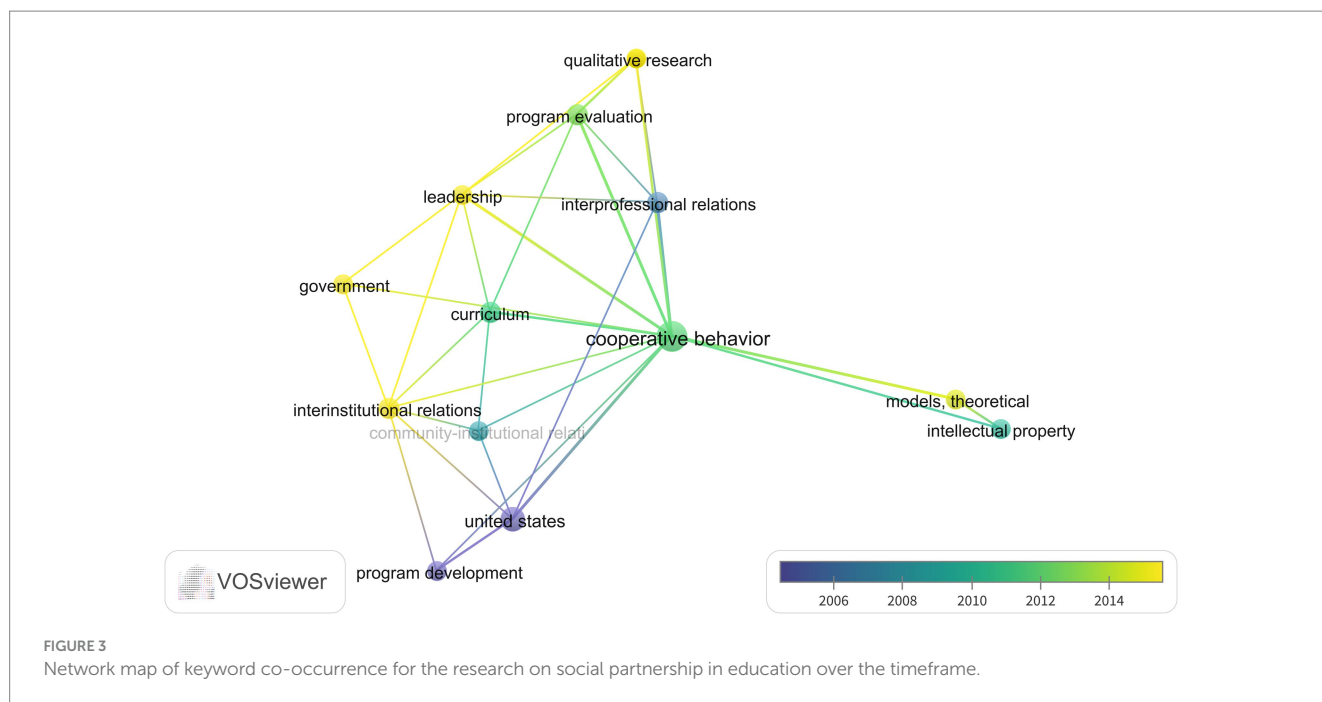
The terms related to research methodologies, such as “empirical approach” and “joint research” may indicate a commitment to rigorous research practices within this field. This spot can be exemplified by the journal publications jointly authored by AstraZeneca research workers and their partners from universities (see Rake et al., 2023).

All in all, the wordcloud analysis reveals that the research field of social partnership in education is multifaceted and dynamic, with a strong emphasis on government inclusion, the practical implementation of partnerships, healthcare and community engagement, collaborative approaches, and governance being explored by researchers in this field. This diverse array of keywords signifies a rich landscape of research interests and opportunities for further exploration in the academic-practice partnerships. Future research in this field may delve deeper into the intricacies of these themes, offering valuable insights for policymakers, educators, and practitioners seeking to enhance educational outcomes through effective partnerships.

VOSviewer’s keyword co-occurrence network (Figure 3) discovered that the gathered literature generally captures four themes as evidenced by 13 mostly used keywords distributed between four clusters at the outset (Figure 3). Cluster one encompasses keywords “community-institutional relations,” “curriculum,” “interinstitutional relations,” “program development,” and “United States.” It can be construed that these keywords collectively signify a focus on the development and implementation of educational programs that imply interaction between different stakeholders, such as community organizations and government agencies. The other term, “United States,” suggests that the theme is most specific to this country’s experiences and practices in public-academic coalition.

Cluster two comprises keywords “cooperative behavior,” “intellectual property,” and “theoretical models.” The presence of the “theoretical models” surfaces that the analyzed works within the nod address models intended for joint efforts of education institutions and other actors for a common goal, e.g., the cooperative innovation model between enterprises and universities contrived to “promote the coupling between regional innovation and economic development” (Cui and Li, 2022). The term “cooperative behavior” suggests that the cluster is also concerned with the ways in which different stakeholders can work together effectively, and lastly, “intellectual property” indicates that the research on social partnership in education deals with the ownership and sharing of knowledge.

Cluster three subsumes keywords “program evaluation,” and “qualitative research,” and “interprofessional relations.” The latter provides no additional context, whereas “program evaluation” implies the assessment of educational partnerships. In particular, the dataset includes a randomized control study (Mills-Dick et al., 2007) evaluating how social work practitioners’ competencies were influenced by an innovative model program designed and implemented by Boston University School of Social Work and Elder Services of the Merrimack Valley. Finally, it can be inferred that the collected studies tended to adopt a qualitative research design, such as one (O’Dwyer et al., 2022) investigating the establishment of fruitful university-industry collaborations in the pharmaceutical industry through a qualitative case study approach. These keywords collectively embrace research assessing the impact of multifield partnership initiatives that embrace education entities.



Cluster four covers keywords “government” and “leadership.” The government presence was explained above, while the leadership topic is represented in the dataset in a sparse and fragmented manner: one article (Tyndall et al., 2020) mentions student service leadership development as one of the mutual benefits from a service-learning community-academic partnership, while another (Poncelet et al., 2014) argues that the success of a one-year clerkship between an academic medical center and a community health system was attributed to continued support and investment from the leadership of both organizations.

The co-occurrence map shows the trends in publication on the color of the keywords, from purple (indicating that the keyword is used in papers with 2006 as a mean publication year) to yellow (keyword from publications that emerged around 2014). Figure 3 depicts that “qualitative research,” “leadership,” “government,” and “interinstitutional relations” are the trending keywords for the recent publications related to the topic of interest. These trends allegedly reflect the evolving nature of social partnership in education, where qualitative insights play pivotal role, while government policies and interinstitutional collaborations continue to shape the research landscape.

3.3 RQ3. “Which publications on social partnership in education have been cited the most over the research period?”

The top 10 publications regarding the education-practice subject (Table 1) have been arranged in order of their citation count, as per data from the Lens database. These papers collectively garnered 5,256 citations. The timeframe ranges from 1998 to 2009. This period coincides with the industrial transformation, the rise of knowledge-based economies and the increasing emphasis on university-industry-government collaboration as a driver of innovation and economic growth (Cheng et al., 2023; Duan and Jin, 2022; Kiss et al., 2023; Ryu

and Mah, 2024; Wang et al., 2024b). During this time, governments and international organizations began to prioritize policies that fostered collaboration between academia and industry (Phillips, 2024; Truong et al., 2024). These shifts may have provided a fertile ground for research on social partnerships, leading to the publication of influential studies during this period.

Six of the ten articles were published in the journal *Research Policy*. The document with the highest number of citations, totaling 1,224, is authored by D’Este and Patel (2007) and reports the findings of a large-scale survey among academic researchers in the United Kingdom to investigate the avenues through which the researchers engaged with industry, as well as the factors shaping those interactions.

3.4 RQ4. “What are the most prolific institutions in the literature on social partnership in education?”

Bibliometrix yielded the 15 institutions that authored the highest number of articles related to the topic. Table 2 demonstrates that the University of South Florida is the leading institution in terms of the number of publications on the subject, with four articles. From the country perspective, the USA dominates in the dataset with 21 documents.

These findings unearth that social partnership in education is a topic that attracts researchers from various disciplines since the top 15 entities include universities, research institutes, and a pharmaceutical company. The diversity of the institutions reflects the multidimensional nature of academic-practice linkage, which involves collaboration among different stakeholders such as educators, students, policymakers, and industry partners. The geographical distribution of the contributors suggests that social partnership in education is relevant to different contexts and cultures, and that there is potential for cross-cultural and comparative studies on the topic.

TABLE 1 Top ten articles on social partnership in education by the number of citations (Lens metrics).

Rank	Title	Authors (year)	Journal title	Citations
1	University-industry linkages in the UK: What are the factors underlying the variety of interactions with industry?	D'Este and Patel (2007)	Research Policy	1,224
2	Science-based technologies: university-industry interactions in four fields	Meyer-Krahmer and Schmoch (1998)	Research Policy	851
3	The sustainability of university-industry research collaboration: An empirical assessment	Lee (2000)	Journal of Technology Transfer	674
4	Factors affecting university-industry R&D projects: The importance of searching, screening and signalling	Fontana et al. (2006)	Research Policy	563
5	R&D cooperation between firms and universities. Some empirical evidence from Belgian manufacturing	Veugelers and Cassiman (2005)	International Journal of Industrial Organization	555
6	Exploring the knowledge filter: How entrepreneurship and university-industry relationships drive economic growth	Mueller (2006)	Research Policy	349
7	Who matters to universities? A stakeholder perspective on humanities, arts and social sciences valorisation	Benneworth and Jongbloed (2009)	Higher Education	286
8	Incubation of incubators: innovation as a triple helix of university-industry-government networks	Etzkowitz (2002)	Science and Public Policy	282
9	University-industry knowledge and technology transfer in Switzerland: What university scientists think about co-operation with private enterprises	Arvanitis et al. (2008)	Research Policy	268
10	University-industry interactions in applied research: The case of microelectronics	Balconi and Laboranti (2006)	Research Policy	204

TABLE 2 Institutions most productive in the research on social partnership in education.

Institution	Country	Publication count
University of South Florida	United States	4
Chalmers University of Technology	Sweden	3
Duke University	United States	3
Georgia Institute of Technology	United States	3
Merck KGaA	Germany	3
University of California	United States	3
University of Mississippi	United States	3
University of Pennsylvania	United States	3
Durham University	United Kingdom	2
Johns Hopkins University	United States	2
Korea Advanced Institute of Science and Technology	South Korea	2
Lund University	Sweden	2
National Taiwan University	Taiwan	2
Princess Margaret Cancer Center	Canada	2
Royal Institute of Technology	Sweden	2

4 Discussion

The finding that government is a central theme in the research underscores the critical role of policy frameworks in facilitating successful social partnerships. Government policies can significantly influence the level and nature of university-industry engagement (Kamal et al., 2024). This highlights the need for

policymakers to create supportive environments that incentivize collaboration.

Furthermore, the increasing focus on healthcare-related partnerships, supported by studies like Huynh (2024) emphasizing the benefits of university-industry partnerships in health research, suggests a growing recognition of the value of cross-sector collaboration in addressing complex societal challenges. This trend

necessitates the development of tailored partnership models that effectively bridge the education and healthcare sectors.

This bibliometric analysis also highlights a growing emphasis on qualitative research methods.

This shift aligns with calls for more in-depth understanding of the processes and dynamics within social partnerships (Asmuß and Thomsen, 2024). Qualitative approaches can provide rich insights into the lived experiences of stakeholders and the contextual factors that shape partnership success. The growing interest in program evaluation further emphasizes the need for rigorous assessment of partnership outcomes and impact. This focus on evaluation is crucial for ensuring accountability and identifying best practices in the field.

Building upon the identified trend of government involvement, our findings suggest that governments should proactively foster and invest in social partnerships by developing clear policy guidelines and funding mechanisms that support collaborative initiatives. The prominence of healthcare-related themes calls for educational institutions and healthcare providers to actively seek interdisciplinary collaborations to develop innovative solutions for healthcare education and practice. The increasing use of qualitative research highlights the need for researchers to employ rigorous qualitative methodologies to gain a deeper understanding of the complexities and nuances of social partnerships. Finally, the focus on program evaluation suggests that practitioners should implement systematic evaluation frameworks to assess the effectiveness and impact of their partnership initiatives.

4.1 Implications

The present bibliometric analysis illuminates nuanced dimensions of social partnerships within the educational landscape, unveiling patterns that subtly underscore the interplay between academia, industry, and government. The discernible prominence of government-related themes suggests that policy frameworks may serve as both catalysts and constraints, shaping the contours of collaborative endeavors. This centrality of governmental influence hints at a landscape where legislative and regulatory milieus potentially orchestrate the symphony of partnership dynamics, directing the engagement cadence among diverse stakeholders. Building upon this understanding, the complexities identified by Joshi et al. (2024) resonate within the context of educational partnerships. Instead of operating within the singular legal and institutional framework of one nation, actors engaged in polycentric systems governing transnational educational initiatives are simultaneously influenced by the disparate laws and regulations of multiple sovereign states. This convergence of varied legal paradigms may intricately shape, and at times complicate, the collaborative efforts among partners, introducing layers of negotiation and adaptation that impact the formation and sustainability of these alliances.

The temporal trajectory of publication volumes, marked by periods of dormancy followed by resurgent scholarly activity, may reflect shifting academic priorities and socio-economic imperatives. Such fluctuations could indicate that the vitality of research in social partnerships is responsive to broader contextual shifts, perhaps mirroring evolving educational needs or economic transformations. This ebb and flow might also imply that the field is poised at the confluence of emerging trends and enduring challenges, navigating through the tides of innovation and stability.

The intricate clustering of keywords reveals a tapestry of thematic intersections, particularly the intertwining of educational partnerships with healthcare sectors. This convergence may symbolize an expanding horizon where interdisciplinary collaborations become paramount in addressing multifaceted societal issues. The emergence of healthcare as a focal point within educational partnerships underscores a potential reimagining of how knowledge and practice coalesce to forge resilient and responsive educational frameworks.

Moreover, the ascendancy of qualitative research methodologies within this domain suggests a maturation of the field towards more profound, context-rich explorations. This methodological inclination could signify an appreciation for the layered complexities and subjective experiences that quantitative measures might overlook, thereby enriching the interpretive depth of scholarly inquiries. The simultaneous emphasis on program evaluation hints at an evolving consciousness towards accountability and evidence-based assessments, weaving a narrative that values both the form and function of collaborative initiatives.

The geographical and institutional concentrations unearthed in this study, notably the predominance of United States-based research, may reflect underlying structural and cultural proclivities that favor certain modes of partnership. This spatial specificity invites contemplation of how regional contexts and institutional legacies influence the articulation and evolution of social partnerships in education. It also opens avenues for comparative studies that might unravel the symbiotic relationships between local practices and global paradigms.

In sum, the implications drawn from this bibliometric tapestry suggest a field that is both reflective and anticipatory, intricately balancing the heritage of established practices with the impetus for innovative explorations. The interplay of government influence, interdisciplinary ventures, methodological diversity, and geographical focal points paints a vibrant portrait of social partnerships in education, inviting scholars to delve deeper into the symphonic complexities that define this collaborative nexus, especially in contexts where multiple legal and institutional frameworks intersect.

4.2 Limitations

While this study provides valuable insights, it is not without limitations. Firstly, the analysis relies on the scope and quality of the Lens database, which may not capture all relevant publications on social partnership in education. Moreover, this data source may have some errors or inconsistencies in the metadata of the publications, such as the author affiliations or keywords. Secondly, the research presented here primarily focuses on English-language publications, potentially limiting the representation of non-English-speaking regions and their inputs on the theme. Thirdly, this study primarily employs a quantitative approach and thus might not snapshot the full complexity of education-practice partnerships. Therefore, the results should be interpreted with caution and verified with other sources if possible. Future research should consider expanding the dataset and incorporating additional databases to address this gap.

5 Conclusion

In summary, this study offers a comprehensive analysis of the evolving landscape of social partnership in education over the research

period from 1983 to 2023. Through an extensive overview of the literature, we have unveiled the historical trajectory, focus of research, and key actors shaping this domain. Our findings portray both the progress made and the challenges that lie ahead in the pursuit of effective educational partnerships. The historical analysis reveals that the research landscape pertaining to social partnership in education has witnessed periods of limited activity followed by recent surges in scholarly productivity. While earlier years saw modest publication rates, recent times have witnessed a surge in publications and initiatives dedicated to enhancing education through collaborative efforts between academia, government, industry, and various stakeholders. This historical perspective underscores the importance of considering the broader context of educational research and the factors that have influenced research agendas over time.

Focal academic interest areas identified in this study inform us of the multifaceted nature of research on education-practice interaction. The prominence of “government” as a central theme emphasizes the pivotal role of government entities in shaping educational collaborations. The exploration of healthcare-related terms highlights the growing intersection of education and healthcare, driven by the demand for interdisciplinary solutions to complex healthcare challenges. Additionally, the emphasis on qualitative research underscores the evolving research landscape, signaling a shift towards in-depth qualitative inquiries on the subject matter. The examination of top-cited publications underscores the enduring impact of seminal works in this field. D’Este and Patel’s (2007) study on academic-industry interactions in the United Kingdom stands out as a foundational work, emphasizing the significance of understanding the channels and intentions behind partnerships between academia and industry. The identification of prolific institutions contributing to research on the partnerships reflects diverse and collaborative nature of this realm. The USA’s prominence as a contributor suggests the global relevance of this topic, inviting opportunities for cross-cultural studies and collaborative initiatives.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

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Author contributions

AS: Conceptualization, Data curation, Project administration, Writing – original draft. AB: Conceptualization, Data curation, Formal analysis, Writing – original draft. BA: Data curation, Formal analysis, Writing – original draft. GS: Resources, Writing – review & editing. ZA: Software, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Generative AI statement

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