



OPEN ACCESS

EDITED BY

Alejandro Silva Cortés,
Metropolitan Institute of Technology, Colombia

REVIEWED BY

Vanessa García,
Corporación Universitaria Americana,
Colombia
Rodolfo Casadiego Alzate,
Politécnico Gran Colombiano, Colombia

*CORRESPONDENCE

Alejandro Valencia-Arias
✉ valencijho@crece.uss.edu.pe

RECEIVED 18 January 2023

ACCEPTED 20 July 2023

PUBLISHED 09 August 2023

CITATION

Valencia-Arias A, Gómez-Bayona L,
Moreno-López G, Sialer-Rivera N, Bernal O-V,
Gallegos A and Arias-Vargas FJ (2023) Research
trends around open innovation in higher
education: advancements and future direction.
Front. Educ. 8:1146990.
doi: 10.3389/feduc.2023.1146990

COPYRIGHT

© 2023 Valencia-Arias, Gómez-Bayona,
Moreno-López, Sialer-Rivera, Bernal, Gallegos
and Arias-Vargas. This is an open-access article
distributed under the terms of the [Creative
Commons Attribution License \(CC BY\)](#). The
use, distribution or reproduction in other
forums is permitted, provided the original
author(s) and the copyright owner(s) are
credited and that the original publication in this
journal is cited, in accordance with accepted
academic practice. No use, distribution or
reproduction is permitted which does not
comply with these terms.

Research trends around open innovation in higher education: advancements and future direction

Alejandro Valencia-Arias^{1*}, Ledy Gómez-Bayona²,
Gustavo Moreno-López³, Noelia Sialer-Rivera⁴,
Olga-Vélez Bernal⁵, Ada Gallegos⁵ and
Francisco Javier Arias-Vargas⁶

¹Escuela de Ingeniería Industrial, Lord of Sipan University, Chiclayo, Peru, ²Facultad de Ciencias Empresariales, University of San Buenaventura Medellín, Medellín, Colombia, ³Coordinación de Investigación, Marco Fidel Suárez University Institution, Bello, Antioquia, Colombia, ⁴Facultad de Ciencias de la Salud, Lord of Sipan University, Chiclayo, Peru, ⁵Instituto de Investigación y Estudios de la Mujer, Universidad Ricardo Palma, Lima, Peru, ⁶Universidad de Medellín, Medellín, Antioquia, Colombia

Open innovation in higher education has emerged as a vital approach, especially in the context of the COVID-19 pandemic, to foster collaboration, knowledge exchange, and address challenges in the academic sector. This study investigates the impact of open innovation on entrepreneurial skills, value co-creation, and technology transfer barriers by examining collaborations between universities and industries in emerging economies and knowledge absorption in SMEs. Additionally, it underscores the significance of open innovation in enhancing teaching and learning quality and aligning with Sustainable Development Goals. To address research gaps, a bibliometric study using VOSviewer software is proposed, aiming to analyze co-occurrence between keywords and explore the relationships between variables. Following the PRISMA statement's parameters for systematic literature review, the methodology ensures a comprehensive and replicable approach for accurate findings. The study reveals an increasing trend in literary production, with the United Kingdom and Spain leading academic progress. Prominent research trends include technology transfer through open innovation strategies, diversification of business models due to innovation policies, factors influencing collaboration between companies and universities, and the emergence of Education 4.0 with novel educational systems leveraging technology. These findings have implications for supporting the education sector, benefiting students, graduates, and the broader community.

KEYWORDS

open innovation, PRISMA, higher education, knowledge transfer, knowledge management

1. Introduction

In the current context, open innovation in higher education is positioned as an important tool for analysis, as it promotes collaboration and knowledge sharing among different actors, both inside and outside higher education institutions, and has been a protagonist both in the period of the pandemic by COVID-19 and in the post-pandemic period, since it speaks of the need to adapt to new forms of teaching and learning (Tejedor et al., 2021), so different paradigms

have even been proposed that analyze open innovation from different spheres, such as the development of entrepreneurial skills (Iglesias-Sánchez et al., 2019).

Open innovation, in addition, allows for promoting changes and transformations in the educational aspect in general, so the scientific literature gives an account of different approaches and perspectives that allow understanding it from the general, with review articles such as Heras-Rosas and Herrera (2021) who propose a bibliometric analysis to analyze trends in open innovation and the role of the university, or even Ramírez-Montoya and García-Peñalvo (2018) who materialize a systematic review of literature on the relationship between co-creation and open innovation.

Likewise, from more specific aspects, there is research presented from multiple approaches, such as the analysis of cases of open innovation in collaboration between universities and industry in emerging economies (Rostoka et al., 2019) or the proposal of co-creation of value as another form of open innovation that involves cooperation between university and industry (Osorno-Hinojosa et al., 2022), which shows the importance of the topic today in terms of promoting collaboration and knowledge exchange among the network involved.

In this sense, open innovation is of great importance in the context of higher education, since it allows overcoming the different barriers that exist between technology transfer in universities, a situation that can have a positive impact not only on these institutions but also on the economy in general, as it encourages the creation of new companies, as well as the generation of new jobs (Quiñones et al., 2019). Likewise, in the context of higher education, open innovation can improve the quality of teaching and learn through the identification of topics of interest and rejection in university students (Galán et al., 2021), while it is also evident that in other contexts such as industry, specifically in small and medium-sized enterprises (SMEs), it can improve knowledge absorption capacity, as well as inter-organizational learning in collaboration with academia (Avalos-Quispe and Hernández-Simón, 2019; Hervas-Oliver et al., 2021).

Therefore, it is evident that open innovation, in the context of higher education, is positioned as a highly relevant topic as it allows for increasing the levels of collaboration between university and industry, which can result in an effective way to transfer knowledge, as well as to generate specific solutions to real problems (Chiang and Hung, 2010; Vélez-Rolón et al., 2020). While, in cognitive terms, some authors have mentioned its importance for the promotion of both creativity and critical thinking in university students, impacting the development of entrepreneurship, as well as their future job performance (McPhillips and Licznarska, 2021).

Based on the above, the scientific literature justifies the importance of open innovation in higher education, as a way for different universities, or higher education institutions, to enable the strengthening of the higher education system, to have an approach based on quality education (Espinosa, 2020), which specifically responds to the fourth Sustainable Development Goal (Khan et al., 2022).

However, despite the manifest importance that open innovation has in higher education, there are still different research gaps, which account for the need, on the one hand, to unify the existing knowledge and, on the other hand, to generate new knowledge about the different challenges that exist, such as the implementation of open innovation in higher education institutions (Laursen and Salter, 2014; Jayabalan

et al., 2021), the need to investigate university-industry collaboration through open innovation and how this impacts firm performance (Inauen and Schenker-Wicki, 2012; Costa et al., 2021; Neves et al., 2021).

For the above arguments, it is intended, for this research, to conduct a bibliometric study, to detect research trends around open innovation in higher education. Higher Education Institutions seek competitiveness and long-term sustainability, determining indicators such as enrollment, student retention, % of graduates, and effectiveness of quality management systems, however, the achievement of these indicators can be leveraged and enhanced when there are partnerships and collaborative work, within the stakeholders in Higher Education Institutions, the industrial sector is one of those that generate more visible impact by applying the knowledge generated in the academy, therefore, open innovation in this type of institutions is essential for their survival (Alexander et al., 2015). What are the research trends around open innovation in Higher Education Institutions?

The bibliometric method is conceived as a scientific mapping that achieves the visualization of the groups of different fields of knowledge, achieving through this tool to classify the structure and dynamics of the scientific topic, enabling the analysis and evaluation of scientific publications, in this method, relationships between articles and their authors are raised, measuring different aspects such as co-citation, co-authorship, co-words, and with them, productivity, impact, citations, their performance or hybrid metrics, among these (Župić and Čater, 2015; Donthu et al., 2021; Mukherjee et al., 2022).

It is important, in the application of this type of method, to use an appropriate tool for the analysis of the information. For example, there is the VOSviewer software, which allows visualizing the co-occurrence between keywords, showing the existing relationship between variables (Valenzuela et al., 2017). In this way, the results of a keyword can achieve the understanding of a topic, more deeply, from the relationship between variables (Valenzuela et al., 2017).

This article presents a structure with a theoretical framework, method, and materials, results where different aspects of comparison are shown, starting with the volume of publications found in the database between 2007 and 2022; then, the main authors in scientific productivity on open innovation for the context of higher education are established; The main journals of scientific dissemination are also recognized, as well as the countries with the highest cumulative number of publications on the topic; then, based on this information, a visualization of the co-authorship networks of the main authors, of the networks of co-occurrence of the keywords, and concludes with an analysis of the keywords according to (increasing, decreasing and emerging) is presented; then the discussion continues and finally, the conclusion is presented where the essential concepts for future research on the topic are recognized by identifying the evolution of the keywords.

This article presents a structure with different aspects of comparison, starting with the volume of publications found in the database between 2007 and 2022; then, the main authors in scientific productivity on open innovation for the context of higher education are established; also, the main journals of scientific dissemination are recognized, as well as the countries with the highest cumulative number of publications on the subject; Finally, the essential concepts for future research on the subject are recognized by identifying the evolution of the keywords.

1.1. Background

Innovation is a ubiquitous reality in all sectors (Grimpe and Sofka, 2009), including the field of education. Therefore, governments must establish state agencies and national information systems to support and strengthen various levels of education. In the specific case of Colombia, it is the Ministry of National Education that is responsible for overseeing and managing all basic, middle, and higher education institutions to ensure their efficient and sustainable operation (Ministerio de Educación Nacional, 2023). In terms of research promotion, Higher Education Institutions (HEIs) receive financial support from the Ministry of Science, Technology, and Innovation to foster the generation, transfer, and application of knowledge. This support aims at advancing and developing communities, businesses, and the state (Ministerio de Educación Nacional, 2023).

However, when analyzing statistical data related to enrollment, retention, and graduation in Higher Education Institutions, significant differences among Latin American countries are evident, indicating a noticeable gap (Anzola Montero, 2011). Some identified causes include a lack of academic quality, high-interest rates for student loans, high tuition costs, and the lack of relevance of academic programs to the needs of the business sector (Kuzmenko, 2021; Gómez and Andrés Uzín, 2022).

Furthermore, a lack of evidence has been found in quality management system audits related to environmental actions on university campuses and other actions related to environmental, social, and economic responsibility in HEIs (García Rangel et al., 2022).

These findings highlight difficulties in social responsibility, especially in terms of inclusion, and the financial challenges that institutions face (Hidalgo, 2017). Recent studies have analyzed sustainability in conjunction with the market economy, implying that institutions must strive for a balance between tuition fees, knowledge transfer, the generation of dynamic capabilities, the exercise of corporate social responsibility with stakeholders, and the necessary investments to offer relevant and quality education (Habicht et al., 2012; Gómez-Bayona et al., 2023; Kim and Jugend, 2023).

In addition to the challenges, education faces various difficulties that hinder its competitiveness. The Covid-19 pandemic has exacerbated these limitations and accentuated pre-existing deficiencies in educational institutions. Processes such as program internationalization, *per capita* salary reductions due to increased unemployment and challenges in technology-supported education have been affected. These factors have widened the existing gaps between social classes and between urban and rural populations (Habicht, et al., 2012; Martín et al., 2021).

Higher Education Institutions face challenges that require establishing strategic alliances to improve their competitiveness and organizational sustainability in a changing environment. These institutions, in their quest to make a significant contribution to the Sustainable Development Goals (SDGs), have incorporated alignment with these objectives into their processes and projects. However, they encounter limitations in key areas such as research, outreach, and internationalization, where specialized resources are required, including highly qualified human talent, national and international contacts, relationships with companies and associations, and advanced technologies. These resources are not always available individually, underscoring the need for institutions to open and collaborate

through networks to achieve innovative processes of higher quality and competitiveness in the market (Bernal et al., 2019).

In this context, open innovation (OI) emerges as a solution to establish synergies between organizations and achieve co-creation and modification of products, processes, services, and structures (Alvarez-Aros et al., 2022). These open processes enable institutions to make changes in their educational models, explore different academic modalities, enter desired emerging markets, expand their portfolio of services and academic programs, leverage advanced technologies in laboratories, obtain government resources for research projects, and establish connections with business networks to offer continuous education, among other opportunities (Ramírez and García-Peñalvo, 2018; Echeverri-Romero et al., 2022). It is important to note that innovation models, although specific to each institution, can be influenced by international allies, suggesting greater penetration into foreign markets, learning about new cultures and approaches that generate competitive advantages, a global vision of education, and the possibility of international funding for projects, which can result in increased institutional competitiveness (Perez Perez, 2022).

2. Materials and methods

Concerning the objective of this research, a bibliometric study is carried out, since, what is indicated by Moral-Muñoz et al. (2020), allows the analysis of scientific production, and cooperation between researchers, as well as the main research trends related to the central theme, as they did (Gao, 2020). Likewise, the materialization of a bibliometric analysis facilitates the statistical evaluation of scientific activity, based on frequency analysis, allowing a holistic recognition of the scale of authors, journals, countries, publications, and keywords (Donthu et al., 2021).

However, to perform the bibliometric analysis, the parameters of the PRISMA statement for the systematic execution of the literature review are considered, including inclusion and exclusion criteria, details of the source of information, the search strategy, the management of the data obtained, as well as the selection process, as detailed in Díaz et al. (2021). In addition, it is essential to mention that, by using the parameters of the PRISMA statement, a complete and accurate report is guaranteed so that other users can adequately interpret and evaluate the results of the research, based on detailed criteria that allow for a replicable methodology (Page et al., 2021).

2.1. Inclusion and exclusion criteria

For the present research, the inclusion criteria contemplate all articles that, from their title, as the main metadata, contain the combination of Open Innovation, as well as all the synonyms of Higher Education, validated by the UNESCO thesaurus. While the exclusion criteria are designed from two phases, as evidenced in Díaz et al. (2021), where the first one speaks of a screening of incomplete articles, as well as those with both erroneous and incomplete indexing, as well as the second exclusion base called Eligibility, through which, after analyzing the main metadata, the exclusion of articles not related to the searched subject matter was considered relevant.

2.2. Information source

To the items suggested by the PRISMA statement for the systematic conduct of literature reviews, it is necessary to detail the source of information from which the data or records to be analyzed in the research will be extracted. This bibliometric analysis, by focusing on secondary sources of information given its scope, is carried out through the Scopus interdisciplinary database, since this, due to scope and content, is part of the two largest and most important databases today (González-Serrano et al., 2019). However, other databases such as Web of Science, Dimensions, and others are not selected as sources of information due to the lack of standardization and homogenization tools for the metadata obtained from each of them.

2.3. Search strategy

After selecting the Scopus database as the source of information for this research, it is essential to detail the means of data extraction, known as the search strategy, which in this case was carried out by applying a specialized search equation that took into account the characteristics of the database, as well as the inclusion criteria necessary for the relevance of the review. Therefore, the following search equation was used:

[TITLE ({open innovation}) AND TITLE (education OR "Universit*" OR college* OR academic* OR "high* education*")].

2.4. Data management

After performing the specialized search, the database yielded a total of 108 documents that, in the titles, had the terms "Open Innovation" together with synonyms or equivalent terms of Education. These records are between the years 2007 and 2022. Subsequently, bibliometric quantity indicators are created using the Microsoft Excel® tool, as well as structure indicators using the free software VOSviewer.

2.5. Selection process

Finally, following the detailed steps of the PRISMA statement, Figure 1 shows the following flow chart that describes the process of inclusion, exclusion, and final selection of articles to be included in this literature review based on bibliometric analysis. In this sense, as suggested by the PRISMA statement, it is necessary to mention how the articles were selected to reduce bias in the research. Therefore, the application of inclusion and exclusion criteria, defined in section 2.1, was independently carried out by each of the article's authors, and their differences were collectively addressed.

3. Results

The bibliometric quantity indicators are those that allow identifying the scientific or academic productivity for the number of publications (Durieux and Gevenois, 2010), recognizing the publication trend of different authors, scientific journals, and even

countries, about a topic, being for this specific case the implementation of open innovation strategies in the context of higher education. (Gros and Lara, 2009; Villacrés et al., 2021).

In this sense, Figure 2 shows the volume of publications on the subject in the time interval identified by the database, i.e., between 2007 and 2022. It can be seen that, although it is a subject that shows sustained growth, the years 2012 and 2015 show a faster growth rate than their predecessors, with a total of 11 publications each. However, despite this figure, 46.3% of the total number of publications were presented in the last 5 years, which explains the relevance of the subject and its current publication trend.

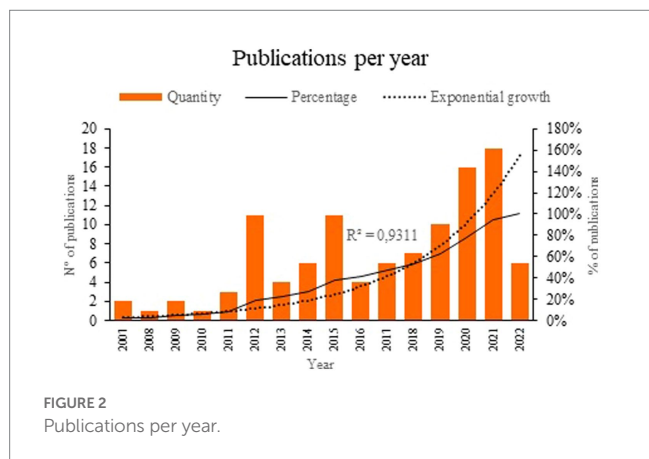
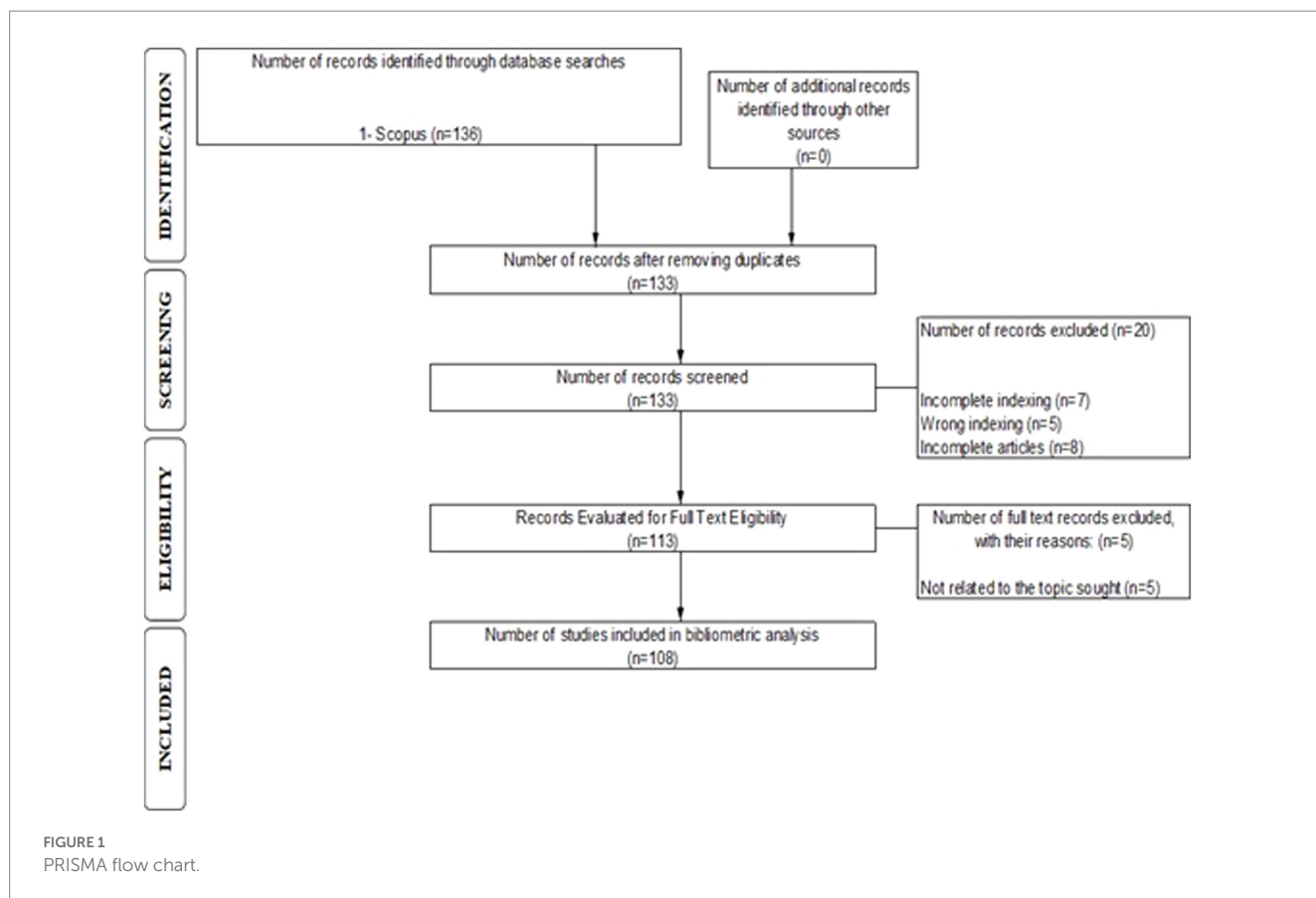
About the most cited papers in recent years, which, therefore, account for the main recent trends in research, some studies refer to how universities and companies work together to innovate and improve, finding that those institutions that are more at the center of the network of connections are more successful in collaborations such as the creation of new companies and externally funded research projects, likewise, the authors refer that the protection of intellectual property through patents can limit the ability of universities to collaborate with other companies (Huggins et al., 2019).

Another of the main contributions of recent years, talks about how universities in Spain, Italy, and Ecuador have managed the flow of knowledge during the pandemic, evidencing that, although students and professors like to be present in the classroom, they also recognize the positive aspects of virtual teaching; however, problems were also identified, such as shorter tutorials and lack of variety in online resources (Tejedor et al., 2021).

Likewise, among the most cited studies in recent years, others mention that, although governments promote innovation in small and medium-sized enterprises through university-industry-government collaboration, these collaborations fail in pre-competitive research and development, so that, by analyzing three pre-competitive projects, to identify the main challenges, the phases of initiation and planning, execution, closure, and monitoring and control were found, as well as the multiple difficulties in each of these phases, suggesting practices and theories for future research in open innovation (Bertello et al., 2021).

In addition, this bibliometric analysis made it possible to identify the main authors, in terms of scientific productivity, in the generation of knowledge on open innovation in higher education. This can be seen in Figure 3, which presents the list of the 10 authors who have published the most on the subject, finding that they are the authors, of Mexican affiliation, Arturo Molina and Jhonattan Miranda, with a total of 6 and 5 publications, respectively. Although the difference in productivity is not so important, and more considering that these 10 authors are responsible for less than 10% of the total scientific production on the subject, it is necessary to mention that these main authors have focused mainly on addressing aspects related to the context of Education 4.0, which has been reflected in works that address 3D Environments (Espinosa et al., 2020) and Teaching-Learning Systems (Miranda et al., 2021) based on open innovation labs.

Likewise, the scope of the bibliometric review made it possible to recognize the main journals of scientific dissemination in terms of academic productivity; that is, those that publish most frequently on open innovation in the context of higher education. In addition, to favor graphic visibility, Table 1 shows the abbreviations used to shorten the length of the name of the journals.



In that order of ideas, Figure 4 categorizes the top 10 journals, having the Swiss journal “Journal of Open Innovation: Technology, Market, and Complexity,” which, with a total of 15 publications, represents 13.9% of the total number of publications that have focused on addressing all theoretical, methodological and applied aspects of open innovation in its different dimensions: organizations, entrepreneurship or, as in the specific case, higher education institutions.

In second place is the German scientific journal “Journal of the Knowledge Economy,” with a total of 4 publications. This journal focuses on the approach to factors that make it possible to communicate, interpret and analyze information, increase

productivity, and create new products, services, systems, and processes; in other words, to innovate. In that sense, it is possible to observe publications of this journal that have analyzed the theoretical role of universities in the adoption of open innovation in industry (Laine et al., 2015), as well as the very capacity that polishes higher education institutions have for open innovation (Baron, 2021) as well as the very capacity that institutions of Polish higher education have for open innovation (Osorno-Hinojosa et al., 2022).

Finally, regarding the identification of the main bibliometric indicators of quantity, we have the recognition of the countries where research on open innovation is most frequently promoted in the context of higher education. Therefore, Figure 5 lists the 10 countries that, at present, account for a greater cumulative number of publications on the subject between 2007 and 2022, having that, with a total of 16 related kinds of research, the United Kingdom is the country where there is a greater tendency to scientific production on open innovation in higher education, followed by countries such as Spain and the United States, with a total of 10 and 7 studies, respectively. In these countries, typical of the context of developed countries, the approach of cooperation between universities and the productive sector for the production of knowledge is frequent (Osorno-Hinojosa et al., 2022; Xia and Weng, 2022).

Figure 5 also shows the presence of Latin American countries, such as Mexico and Brazil, among the main countries in terms of scientific productivity in the subject, recalling that Mexican-affiliated authors are among the most productive (see Figure 3). For the context of these countries, priority is given to the literary production on open innovation programs, research, and development in universities

TABLE 1 Journal abbreviations.

Revista	Abreviación
Journal of Open Innovation: Technology, Market, and Complexity	J. Open Innov.: Technol. Mark. Complex.
Journal of the Knowledge Economy	J. Knowl. Econ.
European Journal of Innovation Management	Eur. J. Innov. Manage.
IFIP Advances in Information and Communication Technology	IFIP Adv. Info. Comm. Technol.
International Journal of Entrepreneurial Behaviour and Research	Int. J. Entrep. Behav. Res.
2017 Congreso Internacional de Innovación y Tendencias en Ingeniería, CONIITI 2017 – Conference Proceedings	Congreso Int. Innov. Tendencias Ing., CONIITI - Conf. Proc.
International Journal of Innovation and Technology Management	Int. J. Innov. Technol. Manage.
Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)	Lect. Notes Comput. Sci.
Sustainability	Sustainability
2008 ITI 6th International Conference on Information and Communications Technology, ICICT 2008	ITI Int. Conf. Inf. Commun. Technol., ICICT

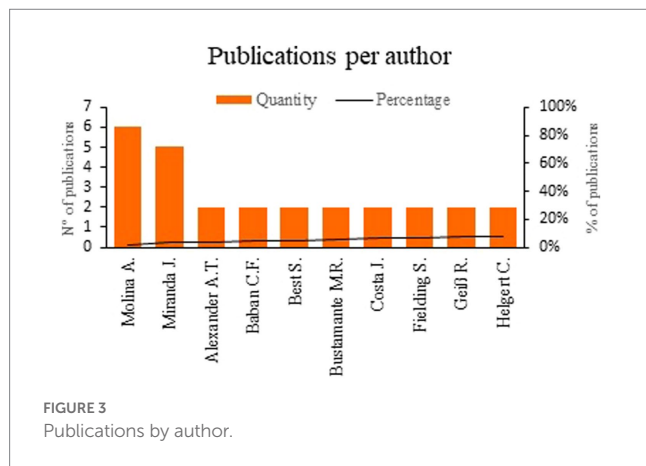
characterized by different colors. The main cluster is the dark blue cluster, mainly composed of the aforementioned author Jhonattan Miranda (see Figure 3); this cluster is the main cluster since it has a direct connection with at least one member of each of the remaining 5 clusters and is characterized by publications that study different mobile platforms created in open innovation laboratories (Espinosa et al., 2020). In the second term, there is the green cluster, represented mainly by the most productive author on the subject: Arturo Molina (see Figure 3); this cluster is composed, in turn, by the authors, also of Mexican affiliation, José Bernardo Rosas-Fernández and Daniel Cortés Serrano, who have studied issues such as the development of responsive, intelligent and sustainable products in open innovation laboratories (Molina et al., 2018; Molina-Gutiérrez et al. 2018; Figure 6).

The purpose of bibliometrics is to show what is the network of co-occurrence of keywords in the theme; that is, those terms that have been used together as keywords in the research. This network is composed of 5 thematic clusters of different colors, having the central axis of the network in the yellow cluster, with topics related to the management and transfer of knowledge between universities and industries. On the other hand, there is the blue thematic cluster, on the management and administration of intellectual property.

In turn, there is the green thematic cluster, which directly relates the barriers to patent registration and the need to address them through innovation and development policies. These barriers are complemented by the red thematic cluster, on the determinants of collaboration between industry and universities, which lead to the purple thematic cluster, on technology transfer, specifically to small and medium-sized enterprises (SMEs) (Figure 7).

Finally, the present bibliometric analysis made it possible to identify the behavior of the main keywords in studies associated with open innovation in higher education indexed in the Scopus database, as shown in Figure 8, based on a Cartesian plane that relates on the X-axis the frequency of each keyword, while the Y-axis measures the average year of use of each one of them. Therefore, as is characteristic of each Cartesian plane, the figure is divided into 4 different quadrants, where quadrant 4 positions the most frequent concepts of the theme but which, due to the low average year of use, are considered not very current, being categorized as decreasing concepts for the thematic. In this quadrant is the concept of Knowledge Transfer, which was previously mentioned by Roper and Hewitt-Dundas (2013) as one of the main elements of discussion around the processes of open innovation through Research and Development (R&D).

Then we have Quadrant 3, where the less current and less frequent concepts are positioned Cartesianly among the selected keywords, finding terms that are not very important for future research agendas. In this quadrant, we have concepts such as Co-Creation, Knowledge Management, Business Development, and then Barrier, which refers to the main existing barriers to the implementation of open innovation programs in the context of higher education. However, studies such as those of Bissola et al. (2017) refer to the importance of co-creation models to generate open innovation and articulation with the business sector to face challenges that allow them to build new work schemes in entrepreneurs. Or as the contributions of Vélez-Rolón et al. (2020) in the transformation of culture when building shared knowledge between academia and the business sector to motivate participation and consolidation of teamwork schemes. Thus, a better understanding



(Oliveira et al., 2020), as well as the application of open innovation and Education 4.0 in universities and entrepreneurship (Miranda et al., 2019).

In addition, the present bibliometric analysis, using the VOSviewer software, establishes the main indicators of structure in research on open innovation for the context of higher education, taking into account that these indicators allow the analysis of scientific cooperation, based on networks (Gomez et al., 1999), as well as the terms or keywords that are used jointly in research on the subject (Ding and Yang, 2020).

In this sense, using Figure 6, it is identified that the authors' co-authorship network is explained by 6 different clusters,

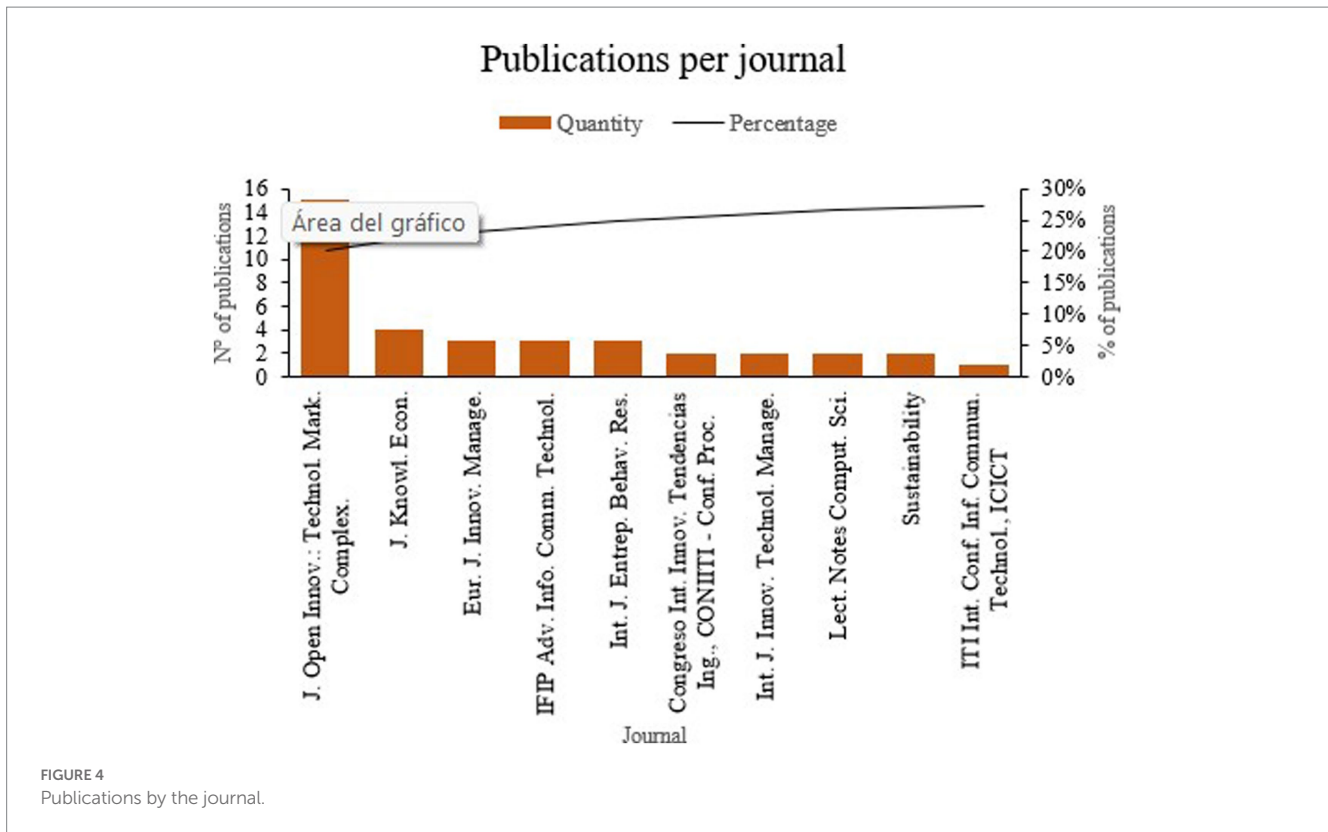


FIGURE 4 Publications by the journal.

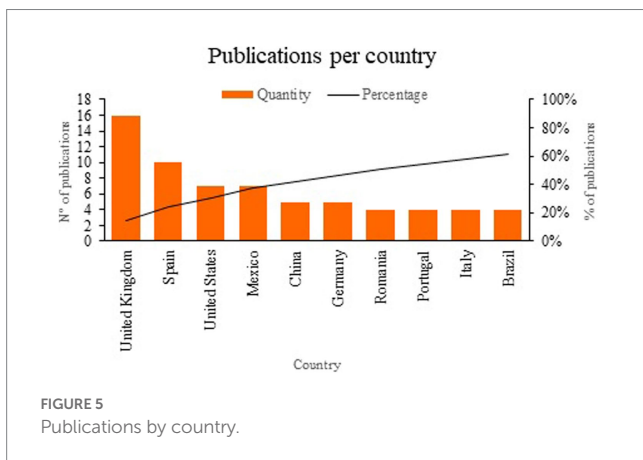


FIGURE 5 Publications by country.

of these issues is currently required to consolidate effective processes of knowledge contribution and open and shared innovation between the academy and the business sector.

It is thus observed that in each of the results, the most representative topics are given from the management and transfer of knowledge to generate value in open innovation and research and the development of new institutional bets, however, it is identified that academic and scientific production in these topics requires greater emphasis in developing countries and it is considered a great bet to generate academic proposals and knowledge transfer for universities that have gradually positioned themselves in important world rankings and mainly in Ibero-America.

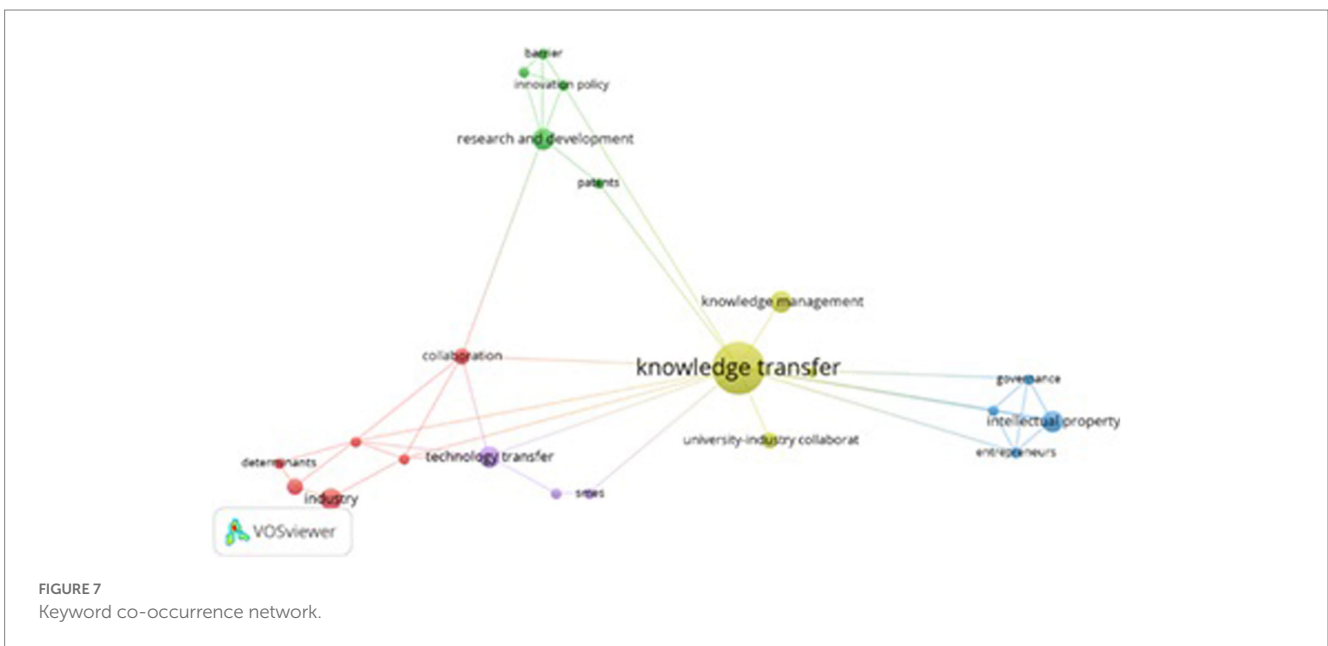
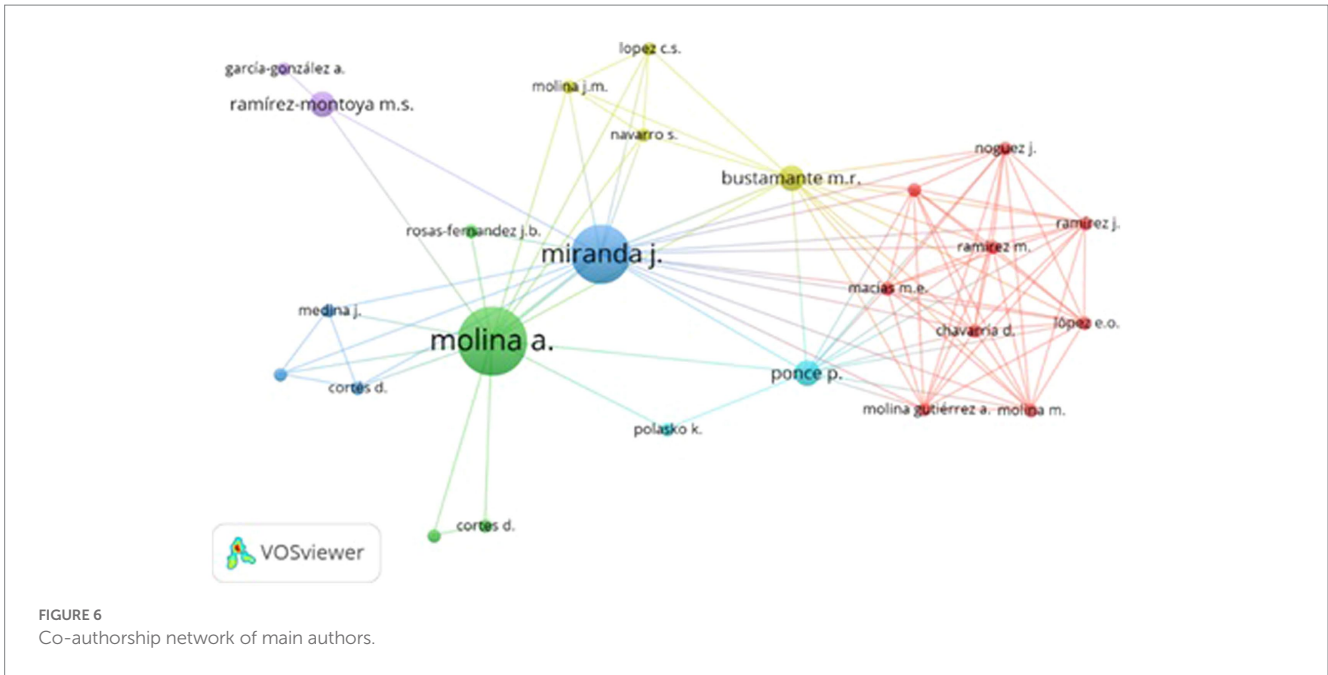
Likewise, the topics of sustainability and university social responsibility have been valuable topics to generate a culture of

technology transfer in educational institutions, it is required that more studies of this type are proposed and strengthened to motivate knowledge management in a continuous and structured manner.

Further on, we have Quadrant 2, where we find less frequent concepts in the subject, but which, thanks to a high average year of use, are considered current terms, categorized as emerging keywords in the research field. In this sense, there are important concepts such as Technology Transfer as a result of open innovation strategies involving universities and enterprises (Angrisani et al., 2022), Business Models, as derivations of the promotion that innovation policies can exert on open innovation in terms of diversification of business models (Aranha and Carvalho, 2022), Determinants alluding to the factors that influence or determine the collaboration between companies, generally from the industrial sector, with universities, within the framework of open innovation (Baban et al., 2021), Education 4.0, which alludes, according to Miranda et al. (2021), to a new educational era, through which emerging information and communication technologies (ICT), as well as some other advanced tools in innovative facilities, are used predominantly, and finally Educational innovation as a concept related to the context mentioned above of education 4.0, in terms of the design and implementation of new educational systems involving new technologies and learning activities (González and Cruzat, 2019).

4. Discussion

The bibliometric analysis conducted in this study reveals an interesting and promising landscape of open innovation in higher

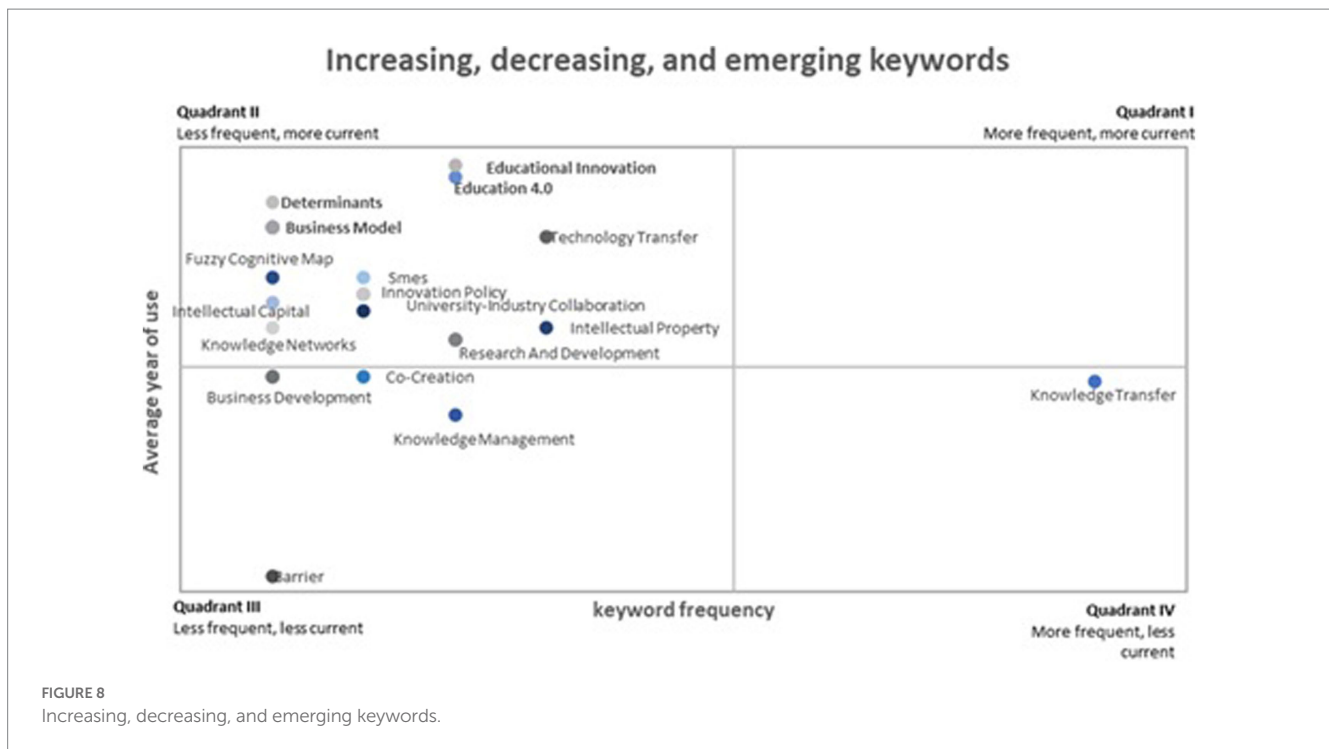


education. The findings highlight a concentration of research in certain thematic areas, including knowledge transfer, education 4.0, educational innovation, governance, intellectual property, knowledge transfer, and value co-creation. These thematic clusters reflect the current concerns and challenges faced by higher education institutions regarding open innovation. However, it is essential to critically assess the breadth and depth of research within these areas to determine if they adequately address the multifaceted nature of open innovation in higher education.

While the identified thematic clusters provide valuable insights, it is important to recognize their limitations. The scarcity of publications in this field indicates a lack of attention and research focus on open innovation within higher education. This raises questions about the

extent to which higher education institutions are truly embracing open innovation as a strategic approach. The limited number of publications per year suggests a potential lack of awareness or understanding of the benefits and challenges associated with open innovation in the higher education sector.

Moreover, the concentration of research in specific countries, such as Mexico, the United States, Spain, and England, warrants careful consideration of the representation and generalizability of the findings. While these countries may have a strong research culture and resources to support open innovation initiatives, it is crucial to explore how open innovation practices are adopted and implemented in other regions and contexts. Future research should strive to capture a more diverse range of perspectives and experiences to provide a



comprehensive understanding of open innovation in higher education worldwide.

The insights gained from the findings have significant implications for research roles in institutions at the forefront of leading research activities and promoting knowledge exchange both internally and externally with industry links. Understanding the identified thematic clusters and research trends can inform the allocation of research resources and the development of research strategies. Institutions can prioritize and support research activities that align with the identified thematic clusters, ensuring their relevance and impact. At the same time, the findings should also serve as a call to action for institutions to broaden their research focus and explore areas that have received limited attention, such as innovation management and university-industry collaboration.

In addressing the gaps in the existing literature, future research should aim to explore and analyze the implementation and impact of open innovation strategies in higher education institutions more comprehensively. This can involve in-depth case studies, comparative analyses across different institutional contexts, and longitudinal studies to capture the long-term effects of open innovation. Additionally, studies focusing on the practical implications and challenges of integrating open innovation into higher education systems can provide valuable insights for institutions seeking to embrace open innovation as a strategic approach. Furthermore, interdisciplinary research collaborations that bridge the fields of education, innovation management, and business can contribute to a more holistic understanding of open innovation in higher education.

To fully leverage the potential of open innovation in higher education, it is important to address the challenges and barriers faced by institutions when implementing open innovation strategies. These may include institutional cultures, bureaucratic processes, and risk-averse mindsets that can hinder the effective implementation of open innovation practices. Exploring strategies for overcoming these

challenges and identifying best practices for integrating open innovation into traditional academic structures will be crucial for institutions to maximize the benefits of open innovation in the higher education sector.

In conclusion, while the bibliometric analysis provides valuable insights into the current state of open innovation in higher education, a critical and analytical perspective reveals limitations and gaps that need to be addressed. By acknowledging these limitations and focusing on filling the gaps in the literature, future research can provide a more comprehensive understanding of open innovation in higher education and guide institutions in effectively implementing open innovation strategies to drive innovation, collaboration, and sustainable growth in the evolving educational landscape.

5. Conclusion

It is concluded that there is important academic growth in the topic of innovation to build sustainability in academic environments, being open innovation, an important research bet in projects that generate value not only to the academy itself but also to the business sector and decision-making effectively and productively. In this case, there is evidence of a representative growth of thematic lines in technology transfer, open innovation, education 4.0, and strategies for academic articulation with the business sector. Likewise, the results show greater academic production in the United Kingdom and Spain; however, it is expected that these topics will be relevant in developing countries to achieve significant academic and business growth.

Regarding the object of research of this study, it is identified that, in recent years, publications on the subject of open innovation in higher education training institutions have increased; an important aspect for the academic models that are evidenced and for those who contribute, from the administrative management, in decision making,

to facilitate spaces for collaboration and cooperation among professionals who are part of the internal and external stakeholders. Also, the most productive authors on this subject have been identified, which become a reference for future publications.

Likewise, it has been established which are the journals with the most publications on the subject, which also become a reference for the specialized study of open innovation and the role of universities. The most influential countries in this topic have been the United Kingdom and Spain; however, countries such as the United States, Mexico, Germany, and China have been growing in production of these topics, to benefit the academic and social development of countries with a productive impact.

In this sense, there is a great opportunity for new research in developing countries that can represent a starting point for the improvement of organizational processes within educational management, since, as evidenced in this study, the models or schemes of work within educational institutions can represent an incorporation of innovations in the medium and long term that benefit not only educational leaders, but all stakeholders that interact in the academic community.

Likewise, the most relevant topics have been identified, including knowledge transfer, knowledge management, and entrepreneurship. From the point of view of the organizations, these topics are fundamental to building learning and supporting the educational sector, mainly universities, since they allow a dynamic of continuous growth in these trending topics, which benefit and expand the knowledge of students, graduates, and the community in general. In the same way, topics such as the behavior of individuals in society and the university cloisters themselves, have been trending in recent times to understand the needs, tastes, desires, and intentions of new students, students who enter educational institutions to find learning experiences that generate value to their professional and especially personal process. This is a real opportunity to understand that society is changing and requires innovation and teaching and learning processes based on new disruptive and dynamic work models and articulation with the business sector mainly to identify market opportunities, society, and customers or users of the local, national and international market.

Concerning the latter, the purpose of the research was also to analyze the role they play in the promotion of innovation. The analysis of this study leads to the conclusion that the role played by universities in open innovation is based on three main points:

- The training of human talent that is necessary for organizations and that, finally, becomes one of the main strategies in organizational planning, since to the extent that human talent is updated, in knowledge and in topics that contribute to administrative processes, it can prospect projects that benefit and empower the organizational brand.

- Research, since the generation of knowledge is essential for the subsequent process of organizational development. Research has become, for the different economic sectors, an alternative to deepen and improve administrative, process, negotiation, financial, and competitiveness aspects. For the educational sector, it is even more important to apply research alternatives and encourage the community to investigate innovative aspects that contribute to the academic and economic development of society.

- Entrepreneurship, since it contributes to economic development with portfolios of products or services relevant to market needs and the changing tastes, desires, and preferences of individuals.

Entrepreneurship requires analysis and innovation proposals that generate value for the processes, as well as articulation with other companies in the sector, to compete nationally and internationally.

Taking into account the results of this research, and the importance of open innovation topics to transform administrative and academic processes in university environments, it is expected that research proposals will be consolidated in this line to generate greater knowledge construction and capacity for analysis and incorporation of new approaches and business models that contribute to society, thus it is expected that students, teachers, and the academic community will be mobilized to new ways of innovating and transferring knowledge continuously and differentially.

It is expected to contribute to the academy with this study and, at the same time, to contribute to the academic directors in the planning and structuring of training to collaborators to benefit the management of the educational sector, since, when mentioning open innovation, one of the main components is in the training and interaction with dialogues that build society and enhance articulation with the internal and external environment. In this way, future studies are proposed that contribute, from open innovation to different areas or departments of the universities; likewise, to the articulation that can be made, from innovation to the generation of competitive alternatives that improve the reputation of the universities.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

AV-A and LG-B: conceptualization. GM-L and NS-R: methodology, formal analysis, and investigation. AG and FA-V: software. AV-A, NS-R, and O-VB: validation. AV-A, LG-B, and GM-L: resources. AV-A: data curation. NS-R and O-VB: writing – original draft preparation. NS-R, O-VB, and AG: writing – review and editing. NS-R: visualization. O-VB and AG: supervision. NS-R and O-VB: project administration. AV-A, AG, and FA-V: funding acquisition. All authors have read and agreed to the published version of the manuscript.

Funding

This research has been financed with its own resources by the Marco Fidel Suárez University Institution. The APC was funded by Universidad Señor de Sipán.

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.

Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated

organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

References

- Alexander, A. T., Miller, K., and Fielding, S. (2015). Open for business: universities, entrepreneurial academics and open innovation. *Int. J. Innov. Manag.* 19:1540013. doi: 10.1142/S1363919615400137
- Alvarez-Aros, E. L., Bernal-Torres, C. A., and Tovar, Y. S. (2022). *Colaboración externa de la innovación abierta y desempeño financiero de las PYMES en Tamaulipas, México*: Revista de Administração de Empresas, 62
- Angrisani, M., Dell'Anno, D., and Hockaday, T. (2022). From ecosystem to community. Combining entrepreneurship and university engagement in an open innovation perspective. *Int. J. Technol. Manag.* 88, 71–92. doi: 10.1504/IJTM.2022.121443
- Anzola Montero, G. (2011). Realidad de los posgrados en Colombia y su situación frente a la reforma de la Ley 30. *Rev. UDCA Actual. Divulgac. Cien.* 14, 3–5. doi: 10.31910/rudca.v14.n2.2011.768
- Aranha, E. A., and Carvalho, S. (2022). Innovation policy, open innovation and business model in the university. *J. Technol. Manag. Innov.* 17, 110–121. doi: 10.4067/S0718-27242022000100110
- Avalos-Quipe, G. A., and Hernández-Simón, L. M. (2019). Open Innovation In Smes: Potential and Realized Absorptive Capacity For Interorganizational Learning In Dyad Collaborations With Academia. *Journal of Open Innovation: Technology, Market, and Complexity*, 3:72. doi: 10.3390/joitmc5030072
- Baban, C. F., Baban, M., and Rangone, A. (2021). Investigating determinants of industry–university collaboration in an open innovation context: comparative evidence from an exploratory study. *Sci. Technol. Soc* 26, 482–502. doi: 10.1177/09717218211020475
- Baron, M. (2021). Open innovation capacity of the polish universities. *J. Knowl. Econ.* 12, 73–95. doi: 10.1007/s13132-017-0515-8
- Bernal, O. I. V., Ríos, J. A. B., Giraldo, J. A. L., and Vargas, F. J. A. (2019). Asociatividad empresarial y liderazgo ambidiestro como generadores de innovación. *Rev. Cienc. Soc.* 25, 51–72. doi: 10.31876/rcs.v25i2.27333
- Bertello, A., Ferraris, A., Bernardi, P. D., and Bertoldi, B. (2021). Challenges To Open Innovation In Traditional Smes: An Analysis Of Pre-competitive Projects In University-Industry-government Collaboration. *Int. Entrep. Manag. J.* 1, 89–104. doi: 10.1007/s11365-020-00727-1
- Bissola, R., Imperatori, B., and Biffi, A. (2017). A rhizomatic learning process to create collective knowledge in entrepreneurship education: open innovation and collaboration beyond boundaries. *Manag. Learn.* 48, 206–226. doi: 10.1177/1350507616672735
- Chiang, Y. H., and Hung, K. P. (2010). Exploring open search strategies and perceived innovation performance from the perspective of inter – organizational knowledge flows. *R&D Manag.* 40, 292–299. doi: 10.1111/j.1467-9310.2010.00588.x
- Ministerio de Ciencia, Tecnología e Innovación. (2023). ¿En busca de recursos para financiar tu maestría o doctorado en el exterior? Aplica al Programa Crédito Beca de Colfuturo 2023. Recuperado de https://minciencias.gov.co/sala_de_prensa/en-busca-recursos-para-financiar-tu-maestría-o-doctorado-en-el-exterior-aplica-al
- Costa, J., Neves, A. R., and Reis, J. (2021). Two sides of the same coin. university-industry collaboration and open innovation as enhancers of firm performance. *Sustainability*, 13:3866. doi: 10.3390/su13073866
- Ding, X. W., and Yang, Z. (2020). Knowledge Mapping Of Platform Research: a Visual Analysis Using Vosviewer And Citespace. *Electron Commer Res.* 3, 787–809. doi: 10.1007/s10660-020-09410-7
- Díaz, M., Teixidó, M., Gil, R. M., Cabeza, L. F., and Aras, L. M. (2021). A comparative analysis of Scopus and web of science (WoS) literature on the autism crisis. *Rev. J. Autism Dev. Disord.* 9, 618–634. doi: 10.1007/s40489-021-00277-4
- Donthu, N., Kumar, S., Mukherjee, D., Pandey, N., and Lim, W. (2021). How to conduct a bibliometric analysis: an overview and guidelines. *J. Bus. Res.* 133, 285–296. doi: 10.1016/j.jbusres.2021.04.070
- Donthu, N., Kumar, S., Mukherjee, D., Pandey, N., and Lim, W. M. (2021). How To Conduct a Bibliometric Analysis: An Overview And Guidelines. *Journal of Business Research*, 133, 285–296. doi: 10.1016/j.jbusres.2021.04.070
- Durieux, V., and Gevenois, P. A. (2010). Bibliometric indicators: quality measurements of scientific publication. *Radiology* 255, 342–351. doi: 10.1148/radiol.09090626
- Echeverri-Romero, R. D., Silva-Castellanos, T. F., Ruano-Arcos, L. D., Sánchez-Álvarez, J., and Ordóñez-Tovar, I. D. (2022). Ventaja competitiva de las PYMES hortofrutícolas en Colombia: el rol de la innovación abierta y la orientación emprendedora. *Rev. Investig. Desarro. Innovac.* 12, 171–184. doi: 10.19053/20278306.v12.n2.2022.15256
- Espinosa, E. M. (2021). Calidad e innovación en la educación superior. Tres décadas de investigación en el Centro para la Calidad e Innovación de la Educación Superior de la Universidad de Guadalajara. *Rev. Educ. Super. Soc.* 33, 324–360. doi: 10.54674/ess.v33i1.392
- Espinosa, J. M. M., Miranda, J., Cortés, D., Medina, J., and Molina, A. (2020). “3D virtual environments to support new product development: a mobile platform based on an open innovation laboratory applied in higher education” *Lecture Notes in Computer Science*, 483–496. doi: 10.1007/978-3-030-54407-2_41
- Galán, J. G., Martínez-López, J. Á., Lázaro-Pérez, C., and García-Cabrero, J. (2021). Open Innovation During Web Surfing: Topics Of Interest and Rejection By Latin American College Students. *Journal of Open Innovation: Technology, Market, and Complexity*, 1:17. doi: 10.3390/joitmc7010017
- Gao, Y. (2020). Global trends and future prospects of e-waste re-search: a bibliometric analysis. *Environ. Sci. Pollut. Res.* 26, 17809–17820. doi: 10.1007/s11356-019-05071-8
- García Rangel, F., Vega Cano, R., and Vallaes, F. (2022). Ética, Desarrollo Sostenible y Responsabilidad Social desde la docencia en instituciones de educación superior latinoamericanas. *Emerg. Trends Educ.* 4, 48–61. doi: 10.19136/etie.a4n8.4729
- Gómez-Bayona, L., Moreno-López, G., Bernal, O. V., and Ramírez, R. G. (2023). Gestión estratégica en los posgrados universitarios para ser competitivos. *Rev. Virtual Univ. Norte* 69, 7–42. doi: 10.35575/rvucn.n69a2
- Gómez, G. M., and Andrés Uzin, P. G. J. (2022). Effects of COVID-19 on education and schools' reopening in Latin America. *COVID-19 Int. Develop.*, 119–135. doi: 10.1007/978-3-030-82339-9_9
- Gomez, I., Fernandez, M., and Sebastian, J. (1999). Analysis of the structure of international scientific cooperation networks through bibliometric indicators. *Scientometrics* 44, 441–457. doi: 10.1007/bf02454849
- González, C., and Cruzat, M. (2019). Innovación educativa: La experiencia de las carreras pedagógicas en la Universidad de Los Lagos, Chile. *Educación* 28, 103–122. doi: 10.18800/educacion.201902.005
- González-Serrano, M. H., Jones, P., and Llanos-Contrera, O. (2019). An overview of sport entrepreneurship field: a bibliometric analysis of the articles published in the web of science. *Sport Soc* 23, 296–314. doi: 10.1080/17430437.2019.1607307
- Grimpe, C., and Sofka, W. (2009). Search patterns and absorptive capacity: low-and high-technology sectors in European countries. *Res. Policy* 38, 495–506. doi: 10.1016/j.respol.2008.10.006
- Gros, B., and Lara, P. (2009). Estrategias de innovación en la educación superior: el caso de la Universitat Oberta de Catalunya. *Catalunya. Rev. Iberoam. Educ* 49, 223–245. doi: 10.35362/rie490681
- Habicht, H., Mösllein, K. M., and Reichwald, R. (2012). Open innovation maturity. *Int. J. Knowledge-Based Organ. IJKBO* 2, 92–111. doi: 10.4018/ijkbo.2012010106
- Heras-Rosas, C. d. l., and Herrera, J. M. (2021). Research Trends In Open Innovation and The Role Of The University. *Journal of Open Innovation: Technology, Market, and Complexity*, 1:29. doi: 10.3390/joitmc7010029
- Hervas-Oliver, J.-L., Sempere-Ripoll, F., and Boronat-Moll, C. (2021). Technological innovation typologies and open innovation in SMEs: beyond internal and external sources of knowledge. *Technol. Forecast. Soc. Change* 162:120338. doi: 10.1016/j.techfore.2020.120338
- Hidalgo, D. A. (2017). Hacia una fundamentación de la sostenibilidad en la educación superior. *Rev. Iberoam. Educ.* 73, 15–34. doi: 10.35362/rie730197
- Huggins, R., Prokop, D., and Thompson, P. (2019). Universities and Open Innovation: The Determinants Of Network Centrality. *J. Technol. Transf.* 3, 718–757. doi: 10.1007/s10961-019-09720-5
- Iglesias-Sánchez, P. P., Jambrino-Maldonado, C., and Heras-Pedrosa, C. d. l. (2019). Training Entrepreneurial Competences With Open Innovation Paradigm In Higher Education. *Sustainability*, 17:4689. doi: 10.3390/su11174689
- Inauen, M., and Schenker-Wicki, A. (2012). The impact of outside – in open innovation on innovation performance. *Eur. J. Innov. Manag.* 14, 496–520. doi: 10.1108/14601061111174934
- Jayabalan, J., Dorasamy, M., and Raman, M. (2021). Reshaping Higher Educational Institutions Through Frugal Open Innovation. *Journal of Open Innovation: Technology, Market, and Complexity*, 2, 145. doi: 10.3390/joitmc7020145
- Khan, P., Juhl, S. K., and Akhtar, S. (2022). Vinculum Of Sustainable Development Goal Practices and Firms' Financial Performance: A Moderation Role Of Green Innovation. *JRFM*, 3:96. doi: 10.3390/jrfm15030096

- Kim, G. M., and Jugend, D. (2023). How can open innovation contribute to circular economy adoption? Insights from a literature review. *Eur. J. Innov. Manag.* 26, 65–98. doi: 10.1108/EJIM-01-2021-0022
- Kuzmenko, A. O. (2021). La cultura de integridad académica de los doctorandos: la experiencia de América Latina. *Parte 2*, 162–171. doi: 10.12958/2227-2844-2021-6(344)-2-162-171
- Laine, K., Leino, M., and Pulkkinen, P. (2015). Open innovation between higher education and industry. *J. Knowl. Econ.* 6, 589–610. doi: 10.1007/s13132-015-0259-2
- Laursen, K., and Salter, A. (2014). The Paradox Of Openness: Appropriability, External Search and Collaboration. *Research Policy*, 5, 867–878. doi: 10.1016/j.respol.2013.10.004
- Martín, M. L. P., Rivera, E. R. E., Cotrina, A. R. R., and Becerra, S. F. C. (2021). Tendencias y desafíos de los programas de posgrado latinoamericanos en contextos de COVID-19. *Rev. Venezolana Gerencia* 26, 123–138. doi: 10.52080/rvg93.10
- McPhillips, M., and Licznarska, M. (2021). Open Innovation Competence For a Future-proof Workforce: A Comparative Study From Four European Universities. *JTAER*, 6, 2442–2457. doi: 10.3390/jtaer16060134
- Ministerio de Ciencia, Tecnología e Innovación. (2023). ¿En busca de recursos para financiar tu maestría o doctorado en el exterior? Aplica al Programa Crédito Beca de Colfuturo 2023. Recuperado de https://minciencias.gov.co/sala_de_prensa/en-busca-recursos-para-financiar-tu-maestria-o-doctorado-en-el-exterior-aplica-al
- Ministerio de Educación Nacional. (2023). Recuperado a partir de. Available at: <https://www.mineducacion.gov.co/CNA/1741/article-187237.html>
- Miranda, J., López, C., Navarro, S. M., Bustamante, M. R., Molina, J. A., Molina, A. (2019). Open Innovation Laboratories As Enabling Resources To Reach the Vision Of Education 4.0. 2019 IEEE International Conference on Engineering, Technology and Innovation (ICE/ITMC). doi: 10.1109/ice.2019.8792595
- Miranda, J., Montoya, M. S. R., Molina, A. (2021). Education 4.0 Reference Framework For the Design Of Teaching-learning Systems: Two Case Studies Involving Collaborative Networks And Open Innovation. *IFIP Advances in Information and Communication Technology*, 692–701. doi: 10.1007/978-3-030-85969-5_65
- Molina, A., Miranda, J., Chavarría, D., Noguez, J., Ramírez, M. Á. A., Macías, M. T., et al. (2018). Open Innovation Laboratory For Rapid Realisation Of Sensing, Smart and Sustainable Products: Motives, Concepts And Uses In Higher Education. *IFIP Advances in Information and Communication Technology*, 156–163. doi: 10.1007/978-3-319-99127-6_14
- Molina-Gutiérrez, A., Miranda, J., Chavarría, D., Noguez, J., Ramírez, M., Macías, M. E., et al. (2018). Open Innovation Laboratory For Rapid Realisation Of Sensing, Smart and Sustainable Products: Motives, Concepts And Uses In Higher Education. *IFIP Advances in Information and Communication Technology*, 156–163. doi: 10.1007/978-3-319-99127-6_14
- Moral-Muñoz, J. A., Herrera-Viedma, E., Santisteban-Espejo, A., Cobo, Manuel, J. (2020). Software tools for conducting bibliometric analysis in science: an up-to-date review. *Inf. Prof* 29. doi: 10.3145/epi.2020.jan.03
- Mukherjee, D., Lim, W., Kumar, S., and Donthu, N. (2022). Guidelines for advancing theory and practice through bibliometric research. *J. Bus. Res.* 148, 101–115. doi: 10.1016/j.jbusres.2022.04.042
- Neves, A. R., Costate, J., and Reis, J. (2021). Using a systematic literature review to build a framework for University-Industry linkages using open innovation. *Procedia Computer Science*, 181 23–33.
- Oliveira, M. M. d., Reisdorfer-Leite, B., Rudek, M., Junior, O. C. (2020). “Evaluation of the impact of open innovation and acceleration programs on Research and Development performed by universities” in *Transdisciplinary engineering for complex socio-technical systems—real-life applications* (IOS Press), 92–101.
- Osorno-Hinojosa, R., Koria, M., and Ramírez-Vázquez, D. D. C. (2022). Open innovation with value co-creation from University–industry collaboration. *J. Open Innov. Technol. Mark. Complex* 8:32. Available at: doi: 10.3390/joitmc8010032
- Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T., Mulrow, C. D., et al (2021). The Prisma 2020 Statement: An Updated Guideline For Reporting Systematic Reviews. *International Journal of Surgery*, (88), 105906. doi: 10.1016/j.jisu.2021.105906
- Perez Perez, J. E. (2022). Tradition or innovation? Cafe Galavis, a brand with an international vision. *Emerald Emerg. Markets Case Studies* 12, 1–27. doi: 10.1108/EEMCS-08-2021-0249
- Quiñones, R. A., Caladad, J. A. A. G. Q. H., Caballes, S. A. A., Abellana, D. P. M., Jabilles, E. M. Y., and Ocampo, L. A. (2019). Open Innovation With Fuzzy Cognitive Mapping For Modeling The Barriers Of University Technology Transfer: A Philippine Scenario. *Journal of Open Innovation: Technology, Market, and Complexity*, 4:94. doi: 10.3390/joitmc5040094
- Ramírez-Montoya, M. S., and García-Peñalvo, F. J. (2018). Co-creation and Open Innovation: Systematic Literature Review. *Comunicar: Media Education Research Journal*, 54, 9–18. doi: 10.3916/c54-2018-01
- Ramírez, M. S., and García-Peñalvo, F. J. (2018). Co-creación e innovación abierta: Revisión sistemática de literatura= co-creation and open innovation: systematic literature review, 9–18.
- Roper, S., and Hewitt-Dundas, N. (2013). Catalysing open innovation through publicly-funded R&D: a comparison of university and company-based research centres. *Int. Small Bus. J.* 31, 275–295. doi: 10.1177/0266242612454671
- Rostoka, Z., Locovs, J., and Gaile-Sarkane, E. (2019). Open Innovation Of New Emerging Small Economies Based On University-construction Industry Cooperation. *Journal of Open Innovation: Technology, Market, and Complexity*, 1:10. doi: 10.3390/joitmc5010010
- Tejedor, S., Cervi, L., Pérez-Escoda, A., Tusa, F., and Parola, A. (2021). Higher Education Response In the Time Of Coronavirus: Perceptions Of Teachers And Students, And Open Innovation. *Journal of Open Innovation: Technology, Market, and Complexity*, 1:43. doi: 10.3390/joitmc7010043
- Valenzuela, L. M., Merigó, J. M., Johnston, W. J., Nicolas, C., and Jaramillo, J. F. (2017). Thirty years of the journal of Business & Industrial Marketing: a bibliometric analysis. *J. Bus. Ind.* 32, 1–17. doi: 10.1108/JBIM-04-2016-0079
- Vélez-Rolón, A. M., Méndez-Pinzón, M., and Acevedo, O. L. (2020). Open innovation community for university–industry knowledge transfer: a Colombian case. *J. Open Innov.* 6:181. doi: 10.3390/joitmc6040181
- Villacrés, R., Arguello, P., and Pullutaci, E. (2021). Open innovation experiences developed in the hub Center project for the solution of high impact problems of the central region of the country. *ESPOCH Congresses*, 555–572. doi: 10.18502/epoch.v1i1.9595
- Xia, H., and Weng, J. (2022). Effectiveness of industry-university-research cooperation in China: impact of innovation input and open innovation environment. *Int. J. Innov. Sci.* 14, 62–78. doi: 10.1108/IJIS-08-2020-0122
- Župić, I., and Čater, T. (2015). Bibliometric methods in management and organization. *Organ. Res. Methods* 18, 429–472. doi: 10.1177/1094428114562629