Multidisciplinary Journal for Education
Social and Technological Sciences

http://polipapers.upv.es/index.php/MUSE/
e-ISSN: 2341-2593

Studying University-Industry Collaboration in Latin America: A Systematic Review of the period 1993-2022

Malena Méndez-Isla[1], Mariana Versino[1], Sebastián Varela[2,*]

[1]Center of Urban and Regional Studies, National Council of Scientific and Technical Research - Saavedra 15, Buenos Aires, Argentina; malenamendezisla@gmail.com, mversino@gmail.com
[2]Instituto de Investigaciones en Humanidades y Ciencias Sociales (IdIHCS)-Universidad Nacional de La Plata. -Av. 7 N° 776- La Plata, Argentina
*Corresponding author: varela.sebastian@gmail.com

Received: 15 August 2024; **Accepted**: 21 September 2024; **Published**: October 2024

Abstract

This article offers a comprehensive examination of perspectives on university-industry interactions in Latin America. Distinguishing itself from international reviews, the study employs a systematic review of 274 articles across Scopus, Scielo, and Dialnet databases. The research addresses the temporal evolution, disciplinary fields, conceptual approaches, methods, and prevailing topics in the region. Findings reveal a focus on management, economics, business, social sciences and engineering disciplines. Qualitative methods dominate, while theoretical-conceptual approaches encompass meso-institutional and micro-interactional levels. Key research themes include collaboration results, knowledge transfer, innovation, technological transfer, and collaboration barriers.

Keywords: University; Industry; University-industry collaboration; Knowledge transfer; Latin America

To cite this article: Méndez-Isla, M., Versino, M., Varela, S. (2024). Studying university-industry collaboration in Latin America: a systematic review of the period 1993-2022. Multidisciplinary Journal for Education, Social and Technological Sciences, 11(2), 108-136. https://doi.org/10.4995/muse.2024.21800

1. Introduction

This article analyzes the literature on university-industry collaboration in Latin America. Thus, it aims to contribute to the knowledge about the perspectives adopted to study the linkage between the university and its socio-productive environment. A systematic review of the literature is conducted using the Scopus, SciELO and Dialnet databases. While Scopus has 890 journals published in Latin America in its collection, Web of Science (WoS) has 223 and SciELO has 1,358. (Beigel, 2022). Thus, SciELO and Dialnet databases were selected because they seek to give visibility to Ibero-American scientific literature and contain academic production from Latin America that isn't in the traditional databases. The Dialnet database provides access to Latin American literature that is not included in WoS, Scopus or SciELO. Scopus was selected for its international high visibility and complementary coverage to SciELO and Dialnet, facilitating comparisons with other studies. Additionally, Scopus offers better coverage of Latin America than Web of Science (Rodrigues y Abadal, 2014). This work includes reading and conducting an interpretative analysis of 274 articles selected from a total of 14,472 search results. The specific objectives of the work are:

1. Describe the temporal evolution of studies on the topic
2. Identify the disciplinary fields that investigate these interactions
3. Identify the main methodological strategies implemented
4. Determine the theoretical-conceptual perspectives referred to in the works
5. Specify the main research topics addressed by the articles.

These objectives are achieved by analyzing data aggregated from qualitative information. This information was constructed through the reading and discussion of articles within the framework of working meetings. Thus, variables and categories were developed in dialogue with the theoretical background from international and regional systematic reviews.

The guiding questions for this inquiry are: What disciplinary fields contribute to knowledge on the topic? What conceptual and methodological perspectives are employed in addressing it? And, what research themes dominate? As mentioned, the goal is to construct knowledge regarding the analytical proposals of articles examining the interactions between universities and other social

actors. It is noteworthy that 88% of the scientific and technological institutions in the sample are universities. The remaining 12% consists of national research councils, national institutes of agricultural technology, non-university higher education institutions, scientific parks, technological centers and technology transfer units engaged in knowledge transfer activities. These papers that involve institutions as national research councils were left in the dataset because in Latin America these institutions fund university research and university-industry collaborations.

The study follows the proposal by Tranfield et al. (2003), who examine the application of systematic review procedures from the medical sciences to the field of administration. Additionally, it follows the theoretical-methodological approach put forth by Wolfswinkel et al. (2013), suggesting a five-step method for a rigorous literature review. These steps include: 1) Definition of search criteria and article inclusion/exclusion criteria, 2) Conducting searches for terms in digital databases, 3) Sample selection, 4) Qualitative analysis of articles and 5) Structuring and presenting quantitative results. Adapting this framework resulted in a state-of-the-art overview that highlights the main perspectives used for analyzing the subject.

Previous systematic reviews on the topic have primarily focused on research published in databases such as Web of Science (Sjöö & Hellström, 2019), Scopus (Cordeiro Bastos et al., 2021; Compagnucci & Spigarelli, 2020), and EBSCO (Perkmann et al., 2013; Haidar et al., 2019). These studies typically examine university-industry collaboration in a general context and predominantly in English. The selected databases then exclude a significant portion of Latin American research (Beigel, 2022). For instance, Haidar et al. (2019) note that 60% of the collaborations they analyzed occurred in the US, Italy, the UK, and Spain, with the remaining 40% in other European and Asian countries. The present study applies a tested methodology using new data from SciELO and Dialnet, both of which have substantial contributions from Latin America. To achieve more comprehensive coverage of the field, this Latin American data is integrated with Scopus data. Consequently, the study population includes articles published in Scopus, SciELO, and Dialnet, following established criteria.

Previous reviews have concentrated on a specific set of variables and categories aligned with the aforementioned geographical focus. In the present study, these variables are recovered, and new ones are created to capture local specificities. As Sutz (2010) notes, the 'third mission' of universities

in Latin America, often understood as an extension of teaching and research functions, has two distinct approaches: one emphasizes cooperation between universities and economic growth, while the other, rooted in the 1918 Córdoba University Reform Movement, defines extension as a social commitment. This regional context has shaped the literature on the subject, leading to the development of specific categories. Additionally, the particular characteristics of local companies necessitate a tailored approach to accurately reflect the absorptive capacities of the regional industry.

The article is organized as follows. Section 1 outlines the methodology employed and the limitations of the study. Section 2 presents the results of the systematic literature review of Latin American collaboration between universities and their socio-productive environments during the period 1993-2022. Section 3 introduces the discussion and outlines further lines of inquiry.

2. Methods

The methodology applied for this research can be summarized in the following steps, adapted from Wolfswinkel et al. (2013):

(1) Search criteria were defined to identify academic articles addressing the proposed study topic in one or multiple countries in Latin America. First, a country filter was used to search in the databases. The filter in the data sources is based on the first author's country affiliation. Second, in the manual selection the criterion was that the papers had focused on one country or countries of Latin America.

(2) The platforms for conducting searches were: Scopus, SciELO and Dialnet. SciELO and Dialnet databases were chosen because both aim to showcase Ibero-American scientific literature, including academic production from Latin America not covered by other international databases (Miguel, 2011). These databases include articles in Spanish which make it possible to cover Latin American production that isn't indexed in other English-language databases. No searches were conducted on RedALyC (Network of Scientific Journals from Latin America, the Caribbean, Spain and Portugal) due to its interface hindering systematic access to the required information. Scopus was selected for being one of the largest bibliographic databases and also because its coverage includes Latin American and Social Sciences production that is not included in Web of Science. Also

Scopus database was paid and available from the institutional library that supported this work. Furthermore, the three databases selected allows the researchers to have access not only to the metadata but also to the complete text of the articles.

(3) Search terms covering a broad range of synonyms were defined. These were transformed into 10 searches detailed in Appendix. Ten searches were conducted on each platform using Boolean operators in English, Spanish and Portuguese. Searches on SciELO and Dialnet were performed in November 2022, yielding 13,197 non-duplicated articles. Scopus searches were conducted in June 2023, resulting in 28,545 records, excluding duplicates. A country threshold was used to filter records to have a Latin America corpus. The filter is based on the first author's country affiliation and the words used were: Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Guatemala, Haiti, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Puerto Rico, Uruguay and Venezuela. The application of this geographical filter generated 1,275 non-duplicated articles. Excluding duplicates, a total of 14,472 results were obtained from the three databases (SciELO, Dialnet and Scopus).

(4) 4,592 articles were pre-selected from the 14,472 results through the examination of titles, abstracts and metadata based on the following criteria: relevance to the proposed study topic, publication in Latindex-indexed academic journals (for SciELO and Dialnet articles) and the availability of full text.

(5) 274 articles on the topic were selected based on the following criteria: A. Papers that focus on one or more Latin American countries. B. Papers that include empirical work following Wolfswinkel et al. (2013). No temporal limits were set and results spanned the interval from 1993 to 2022. Thus, in this work a Latin American paper is a paper that has a Latin America-affiliated first author and has a thematic focus on one or more Latin American countries.

(6) The articles were read and discussed in team meetings. The analytical dimensions for their study were developed through the reading and analysis of international systematic reviews that encompass publications on the topic in international repositories. This interpretative and systematic process facilitated data construction and tabulation in an Excel spreadsheet. The results of the qualitative analysis were then inputted into this spreadsheet, providing insights into the fields, methodologies, theoretical-conceptual approaches and research themes.

(7) The quantitative results derived from aggregating data generated through the qualitative analysis of the 274 articles were processed using the R programming language, which was also employed for creating the plots. The units of analysis are these 274 articles from SciELO , Dialnet and Scopus, published in academic journals focusing on the study topic and featuring empirical work. The graphs presented in the following section are author-created based on these databases.

As mentioned in point six, to address the five specific objectives outlined, a series of variables and categories were developed. The design of the variables used for analyzing the articles involved a detailed review of previous literature that bibliometrically addresses international literature on university-industry collaboration.[1] The data collection and analysis decisions taken for each specific objective are outlined below:

- Specific Objective 1: Describe the temporal evolution of studies on the topic. This aspect is studied in a series of international systematic reviews (Ankrah and Al-Tabbaa, 2015; Compagnucci and Spigarelli, 2020; Cordeiro Bastos et al., 2021; Haidar et al., 2019; Nsanzumuhire and Groot, 2020; Vick and Robertson, 2017). In this work, the temporal evolution of studies on the topic was addressed by examining the number of articles published per year and the cumulative frequency over time.

- Specific Objective 2: Identify the disciplinary fields investigating university-industry interactions. The construction of the disciplinary field's variable was carried out by adapting the categorization from Scopus. The categorization exercise resulted in findings derived from the reading of the articles.

- Specific Objective 3: Account for the main methodological strategies implemented in the analyzed works. This objective holds a central position in the research question, aiming to uncover: What strategies are utilized to study university-industry collaboration in Latin America? Within this framework, the principal variable is methodology, encompassing the categories of qualitative, quantitative and mixed methods. This classification is employed in the same terms as one of the

[1] These include: Ankrah and Al-Tabbaa (2015), Compagnucci and Spigarelli (2020), Cordeiro Bastos et al. (2021), Haidar et al. (2019), Lerena et al. (2018), Nsanzumuhire and Groot (2020), Olvera et al. (2018), Perkmann et al. (2013), Perkmann et al. (2021) and Vick and Robertson (2017).

consulted reviews, which focused on the case of the United Kingdom (Vick and Robertson, 2017). Additionally, a new variable constructed inductively and named “case study”.

- Specific Objective 4: Understand the theoretical-conceptual perspectives referenced in the works. This analytical dimension consists of two variables. The first variable, general theoretical perspectives, was developed in dialogue with regional and international precedents (Zabala, 2004; Ankrah and Al-Tabbaa, 2015; Vick and Robertson, 2017). This variable includes two categories: 1. Micro-interactional, referring to perspectives focused on actors and processes. 2. Meso-institutional, accounting for various aspects of organizations, their contexts and the outputs they achieve. The variable specific theoretical perspectives employed a deductive strategy based on the team's prior theoretical knowledge in dialogue with Shinn (2002) and includes the following categories: Triple Helix, Sabato's Triangle, National Innovation Systems (NIS) approaches, Regional Innovation Systems (RIS), Sectoral Innovation Systems (SIS), Entrepreneurial University, Network Theories, Political Science Approaches, Higher Education Approaches and Mode 2 of Knowledge Production.

- Specific Objective 5. Specify the main research topics addressed by the articles. The construction of topic categories retrieved the "4 University-Industry Collaboration themes (UIC)" (Ankrah and Al-Tabbaa 2015, Vick and Robertson 2017, Nsanzumuhire and Groot 2020, Cordeiro Bastos et al. 2021), also known as "Four Central Measures" (Perkmann et al., 2013; Perkmann et al., 2021). Additional topics, both present in Cordeiro Bastos et al. (2021) and developed through an inductive strategy, were incorporated. The resulting categories include: motivation, channels, barriers, activities, outputs, knowledge transfer, absorptive capacities, entrepreneurial university, innovation, policies and extension.

Before discussing the results, it is important to acknowledge the research limitations. First, the selection of specific databases (Scopus, SciELO, and Dialnet) has restricted the inclusion of works not indexed in these sources, limiting the study's comprehensiveness. Additionally, the regional inclusion criteria—based on the author’s affiliation and thematic focus on Latin American countries—combined with the selection of only papers with available full texts and empirical content, may have constrained the research corpus. The strict adherence to a methodological procedure, as followed by predecessors (Wolfswinkel et al., 2013), aimed at facilitating future comparative studies, may have inadvertently limited the scope of this work.

3. Results

In this section, the research findings are presented in five points, addressing each of the specified specific objectives. These include temporal evolution of academic production, disciplinary field of articles, adopted methodologies, theoretical-conceptual approaches and key research topics.

3.1. Temporal Evolution of Studies on the Topic

Graph 1 reveals a clear upward trend in production from the early 1990s, depicting the annual frequency of publications between 1993 and 2022. While only one article was recorded in 1993, the maximum annual frequency reached 33 articles in 2020. This illustrates substantial growth in production on the studied theme from 2010 onwards.[2]

Without aiming for strict comparisons, it is interesting to note that this general trend of increase coincides with the findings of a set of systematic reviews on the production of the field at an international level (Ankrah and Al-Tabbaa, 2015; Compagnucci and Spigarelli, 2020; Cordeiro Bastos et al., 2021; Haidar et al., 2019; Nsanzumuhire and Groot, 2020; Vick and Robertson, 2017).

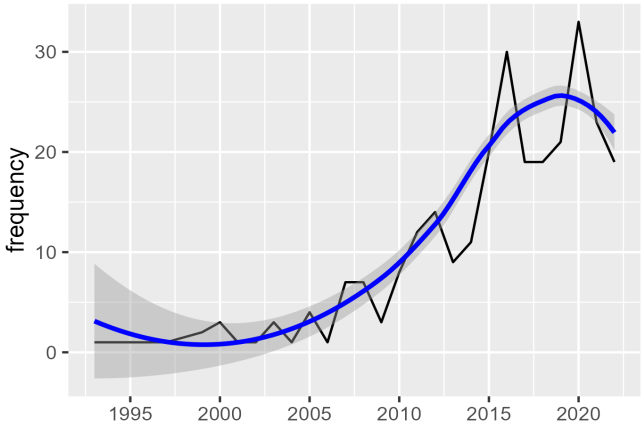

Figure 1. Number of articles per year. 1993-2022.

Cordeiro Bastos et al. (2021) provide a periodization that places the initial treatment of the topic in the international literature between 1969 and 1979. They also identify a developmental phase

[2] All graphics in this article were created by the authors using the ggplot2 R package. In this scatterplot, the line indicates the relationship between the variables with a lowess (locally weighted scatterplot smoothing) fit.

from 1980 to 1999, an expansion of work on the topic between 2000-2010 and its consolidation between 2011-2018. The databases analyzed in this article record the commencement of works on the topic in 1993, allowing us to assert that the 1990s marked the emergence period for the theme. Thus, the 2000s represent its developmental phase and the 2010s denote the expansion of the theme. One might question whether the 2020s will be a consolidation phase marked by a plateauing of the growth curve or if it will register a decline, as hinted in the years worked up to the writing of this article (2020 to 2022).

Relating our findings to those of Cordeiro Bastos et al. (2021) suggests that this topic has gained increasing relevance on both international and regional research agendas. Notably, the emergence of themes focused on analyzing interactions between universities and socio-productive sectors, as well as the growth of scientific production on this topic in Latin America, has occurred with a delay of approximately five to ten years compared to developed countries.

3.2. Disciplinary Fields

The selection of categories for this variable derives from empirical analysis based on the Scopus categorization. This categorization was enriched with new categories emerging from the article readings. Additionally, the construction of categories for this variable sought to engage with the consulted precedent that addressed this theme (Cordeiro Bastos et al., 2021). These authors conducted a quantitative analysis of the total search results with categories defined by Scopus' automatic classification, namely: business, management and accounting, social sciences and engineering. In constructing the categories used in this work for qualitative analysis, we adopted this proposal, modifying the category of business, management and accounting. The modification aimed to include another field proposed by Scopus: economics, econometrics and finance. Thus, the variable related to this field was termed management, economics and business. The results obtained can be observed in the following graph:

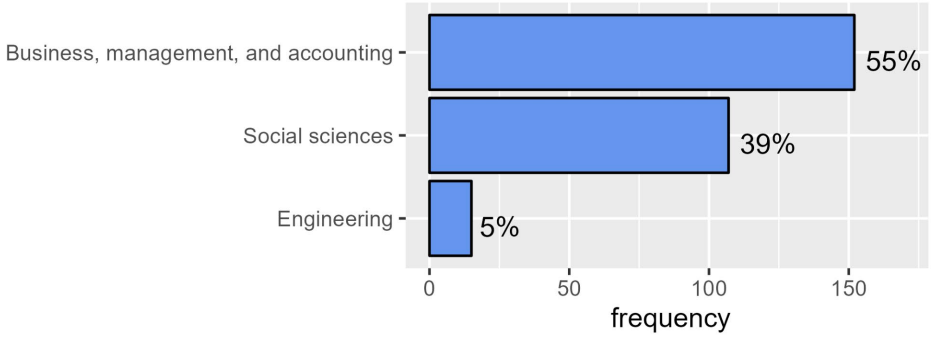

Figure 2. Articles by discipline. Period 1993-2022.

Thus, regarding the variable disciplinary field, it is noteworthy that 55% (152 articles) belong to management, economics and business, 39% (107 articles) to social sciences and 5% to the engineering field (15 articles).

These results differ from those found by other authors who analyzed international literature. It is worth noting that in the quantitative analysis conducted by Cordeiro Bastos et al. (2021), they found a balanced participation of the following disciplinary areas with a predominance of business, management and accounting (41.89%), compared to engineering (34.19%), which is very similar to social sciences (35.98%). In contrast, the findings related to literature in the Latin American context, as observed, indicate a disciplinary predominance of management, economics and business on one hand and social sciences on the other, with a much lesser emphasis on engineering.

3.3. Methodological approaches

Regarding the methodological approaches, qualitative methods were employed in 151 articles (55%), quantitative methods in 69 articles (25%), while the remaining 54 articles (20%) adopted a mixed-methods approach. It is important to note, on the other hand, that out of the total works, 154 (56%) were based on case studies.

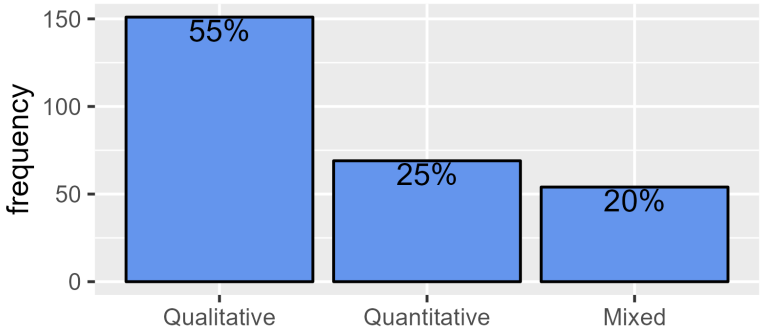

Figure 3. Articles by method. Period 1993-2022.

The topic of methods in the surveyed articles is addressed by international reviews such as Perkmann et al. (2013) and Vick and Robertson (2017). Perkmann et al. (2013) analyze 36 selected articles using criteria that, to some extent, exclude articles employing solely qualitative methodologies and will not be considered. In contrast, Vick and Robertson's (2017) analysis focuses on academic works in the United Kingdom, involving a qualitative study of 56 selected articles out of a total of 638 search results. They arrive at the following percentages: 54% of the articles employ quantitative methodologies, including surveys of researchers and companies, as well as studies on collaboration outcomes; 27% of the articles use qualitative methodologies and 6% apply mixed methods (Vick and Robertson, 2017).

Conversely, in the case of studies analyzing Latin American experiences, qualitative methodology predominates significantly. If we combine those exclusively using qualitative methods with those combining qualitative and quantitative methodologies, the total reaches 75% of the overall total. These results may be attributed to the lack of reliable statistical information concerning collaboration experiences between universities and industry in the region. To this could be added the lack of resources for research that involves the collection of quantitative information representative of the study populations. Moreover, the heterogeneity of the universe of universities in Latin America contributes to the difficulty of constructing aggregated quantitative information on the topic. This item can also be related with the majority of works based in case studies as will be seen forward.

3.4. Conceptual Approaches

The analysis of the theoretical proposals referenced in the articles aimed to construct reading keys that would help organize the reviewed literature, accounting for both the different types of perspectives and their presence in the literature. Thus, two variables were created and their results are presented below. As mentioned in the methodological section, the first refers to the levels of analysis of the articles. The second is about the main conceptual perspectives to the study of the topic in Latin America.

3.4.1. General Theoretical Perspective - Level of Analysis

The first variable examines theoretical-conceptual approaches by identifying the levels of analysis employed in the works. Addressing this question allowed for a dialogue with Latin American authors such as Zabala (2004) and Di Bello (2013), as well as two international systematic reviews (Ankrah and Al-Tabbaa, 2015; Vick and Robertson, 2017). Thus, two broad types of theoretical perspectives are distinguished: on one hand, a micro-interactional approach (Zabala, 2004) focused on the linkages' processes themselves and, on the other, a meso-institutional approach (Zabala, 2004) situated at an intermediate level of analysis concerning organizational and contextual aspects of linkages.

The micro-interactional level studies linkages from the perspective of the involved actors and the forms relationships take. It is dedicated to studying the processes themselves, drawing from constructivist perspectives and addressing questions such as "How?", "Why?" and "In what way?" linkages are built, sustained and modified. This level is studied by other authors using terms such as sociopolitical (Vick and Robertson, 2017) or interactional (Ankrah and Al-Tabbaa, 2015). This perspective deviates from the idea of a structural determination of practices (Di Bello, 2013).

The meso-institutional level studies linkages by accounting for factors framing and conditioning them, addressing economic, normative, organizational, administrative and geographical aspects, among others. It is related to the scenario in which interactions occur, offering different types of barriers, restrictions, opportunities and incentives for collaboration that may be contradictory. Di Bello (2013) emphasizes that, at the meso-institutional level, structural aspects are reworked and adapted. Additionally, this level includes works addressing aggregated results of interactions at an

institutional scale. Other authors refer to the meso-institutional level as contextual (Vick and Robertson, 2017) or interdependence level (Ankrah and Al-Tabbaa, 2015).

Through the reading of the articles, it was possible to study the proposed conceptual approaches and obtain the following results: 58% of the articles are located at the meso-institutional level, while 42% remain at the micro-interactional level referring to interactive processes.

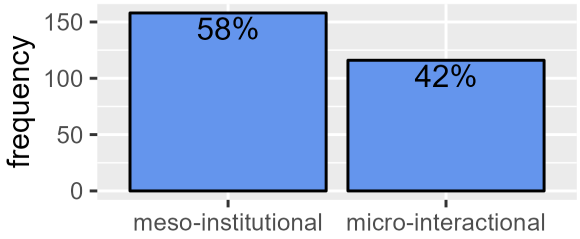

Figure 4. Articles by general theoretical perspective. Period 1993-2022.

It is worth noting that Zabala (2004) identifies a third level of analysis: the macro-structural level, in addition to the aforementioned meso-institutional and micro-interactional levels (Zabala, 2004). In this logic, a third category of approaches could be considered, analyzing the linkage at a macro or structural level, aiming to account for the role of science in the general historical context. However, in the articles obtained from the conducted searches, no works were identified that position themselves or incorporate macro-structural levels of analysis, which might prompt the need for such analysis in this study. This, in turn, allows reflection on how and to what extent the works on the subject in Latin America engage with conceptual developments with broader theoretical aspirations.

3.4.2. Specific Theoretical Perspective

The second variable aimed to understand to what extent different specific theoretical-conceptual perspectives are referenced by the analyzed works. In these works, referencing a theoretical perspective does not always imply its application in theoretical-methodological terms for the analysis. The categories were not mutually exclusive, as many works refer to more than one conceptual perspective.

- NIS, RIS and SIS Approaches

The concept of National Innovation Systems (Lundvall and Freeman, 1988; Lundvall, 1988) was developed based on empirical research conducted in Japan (Freeman, 1987) and Nordic countries (Lundvall, 1985). According to Lundvall (1985), the National Innovation System (NIS) is linked to the institutions that intervene in the learning processes: universities, research institutes, science-based industries and other producers. Arocena and Sutz (1999) argue that it is necessary to consider that the concept of NIS is a relational concept that is ex post at the center and ex ante at the periphery. There are also perspectives on Regional Innovation Systems (RIS) (Braczyk et al., 1998), initially used for the analysis of European regions and more recently applied to the analysis of Latin American cases (Niembro, 2018). The approach of Sectoral Systems of Innovation (Breschi and Malerba, 1997) has also been used for the analysis of productive sectors in Latin America (Stubrin, 2022).

- Triple Helix

Etzkowitz and Leydesdorff (1997a, 1997b, 2000) conceptualize the university's interaction with the environment based on the proposal of the "Triple Helix model" to understand the interrelationships conceptualized as co-evolutionary and self-organized among universities, industry and governments diffused in central countries. Thus, after characterizing the first transition from the "teaching university" to the "research university" that took place in the 19th century as the "First Academic Revolution," the Triple Helix model would account for the relationships among actors that emerge from the "Second Academic Revolution," marking the transition to the "entrepreneurial university" (Etzkowitz and Webster, 1998).

- Sabato's Triangle

Refers to the conceptualization by Sabato and Botana (1968), originating from Argentina and early on proposing a linkage scheme in which the state occupies a central position, articulating scientific-technological infrastructure and productive structure. This approach emerged in Latin America in the late 1960s within the framework of the so-called Latin American Thought in Science, Technology and Development. This perspective structures its analysis around the issues of science, technology, and development by framing them as subjects of public policy. The proponents of this thought analyze the dependency of Latin American societies by critiquing, on one hand, the policies for creating scientific-technological institutions promoted by central countries in the 1950s and, on

the other hand, the unfavorable conditions under which technology is incorporated into the region's productive sphere. This group, composed of engineers, scientists in the exact or natural sciences, and economists aligned with the developmental thinking of the Economic Commission for Latin America and the Caribbean (ECLAC) or Dependency Theory, generated alternative approaches to science and technology policies in Latin America. Their critical reflections emerged from professional practice in R&D institutions or international development organizations. Key figures include Jorge Sábato, Amílcar Herrera, Oscar Varsavsky, Máximo Halty Carrère, Miguel Wionseck, Francisco Sagasti, José Leite Lopes, Osvaldo Sunkel, and Marcel Roche.

- Network Theories

This category brings together a heterogeneous set of network perspectives, including, but not limited to, knowledge networks (Casas, 2001), techno-economic networks (Callon, 2001). Callon and Latour developed the Actor-Network Theory, aiming to understand the role of researchers in the processes of knowledge production and dissemination as they form networks of meaning around them (Latour, 2008). One way to understand the links between academic and socio-productive sectors with a comprehensive territorial perspective is through the concept of knowledge networks. Generated in Latin America, the knowledge network approach (Casas, 2001) is oriented towards analyzing scientific-technological cooperation aimed at solving local and regional social problems. Knowledge networks are interactions that occur among sets of actors to develop or apply knowledge.

- Policy and Management Approaches

This category encompasses works with perspectives from both political science and science, technology and innovation policy and management. It includes approaches dedicated to reflecting on public policies, on the one hand and specifically focused on the technological aspect of the links between institutions, on the other. These studies mostly fall within the field of administration and management of innovation policy instruments. Among them, a distinction can be made between works that adopt a normative perspective -such as those devoted to recounting "best practices" or "models" for the diffusion of certain linkage management instruments and those conducted from a descriptive, more or less critical approach.

- Higher Education Approaches

Perspectives aimed at understanding higher education institutions were included within this category. Within these perspectives, concepts such as the "entrepreneurial university" (Clark 1998) and "academic capitalism" (Slaughter and Leslie 1997, Slaughter and Rhoades 2004) have been coined to account for recent transformations that have given rise to new forms of linkage between the university and the market. The university is a complex and highly specific object of study. Within the so-called "Science, Technology and Society (STS) field" the university is often approached from a perspective that often lacks an analysis of the internal dynamics of these institutions. Higher Education Studies, by the very nature of its object of study, overlaps with some of the lines of inquiry traditionally explored within STS. Historically, there have been certain difficulties in establishing a dialogue between these two fields.

- Mode 2 of Knowledge Production

The perspective proposed by Gibbons et al. (1994) refers to different modes of knowledge production that would characterize the recent changes in the ways of ‘doing science' within research organizations, including universities. These authors contrast a "traditional" "Mode 1" of producing knowledge characterized by defining problems from a disciplinary logic, with a "new" "Mode 2" that defines research problems not strictly disciplinarily but based on the "context of application" and involving actors not exclusively academic. This perspective has been characterized as a diagnosis of the times and has received two types of criticisms: one related to the empirical status of the proposal and another related to the normative character of the model (Tuunainen, 2013). The detailed results are presented in the following graph.

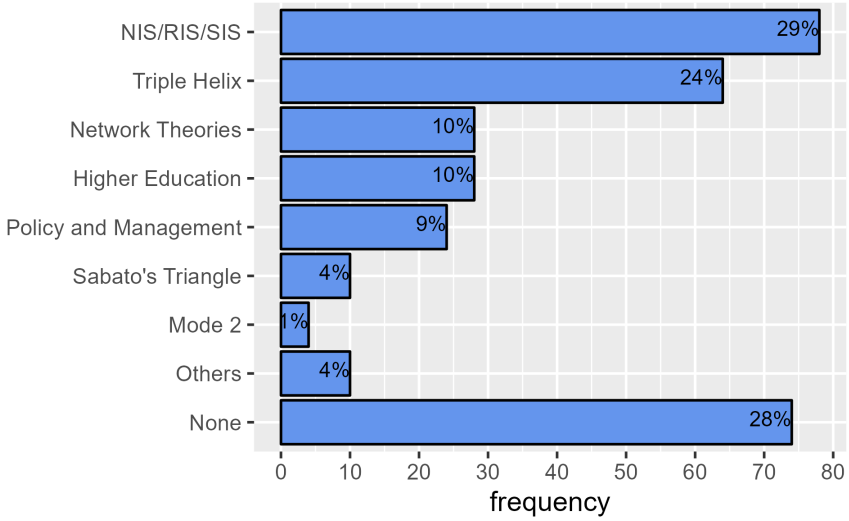

Figure 5. Articles by specific theoretical perspective. 1993-2022. (Multiple Response).

Firstly, 29% of the analyzed works align with approaches based on the notions of National Innovation Systems (NIS) (Freeman, 1987; Lundvall, 1988), Regional Innovation Systems (RIS) (Braczyk et al., 1998) and Sectoral Innovation Systems (SIS) (Breschi and Malerba, 1997). These perspectives conceive interaction from a systemic point of view related to the articulation between Science and Technology (S&T) institutions, the socio-productive sector and the state (Di Bello, 2020), which can be situated at the meso-institutional level mentioned in the previous point.

Secondly, 24% of the works indicate adherence to the Triple Helix model developed by Etzkowitz and Leydesdorff (1997). The Triple Helix model, like different variants of Innovation Systems, are approaches that conceive interaction from a meso-institutional perspective.

Works adhering to network theory, situated at a micro-interactional analysis level, represent 10% of the works. They refer to some type of network theory such as knowledge networks (Casas, 2001), techno-economic networks (Callon, 2001) and socio-technical networks (Latour, 2008), among others. This is a way of conceiving interaction that, as mentioned, differs from the systemic and is located at an interactive or micro level.

The same percentage (10%) of the total articles represents those conducted from a higher education perspective (which includes the notion of the entrepreneurial university). Then, 9% of the works use political science and political management perspectives, while 4% fall within the

institutional perspectives of Sabato's Triangle (Sabato and Botana, 1968). Additionally, 1% of the works refer to Mode 2 of knowledge production and finally, 4% of the total works mention other approaches.

A notable 28% do not reference any theoretical perspective: this accounts for 74 works, of which 37 belong to the field of administration, 29 to the field of social sciences and 8 to the field of engineering. These results prompt reflection on the extent to which the production on this topic effectively incorporates the mentioned perspectives or others that may exist.

3.5. Main Research Topics

For the construction of the categories in this variable, contributions from various mentioned sources were gathered (Ankrah and Al-Tabbaa, 2015; Arza, 2010; Cordeiro Bastos et al., 2021; Nsanzumuhire and Groot, 2020; Perkmann et al., 2013; Perkmann et al., 2021; Vick and Robertson, 2017). In these works, a series of research topics related to university-industry collaboration are defined, aiming to generate consensus that allows for some standardization in the categories. Eight of these topics are taken as categories for the present variable because they are representative of the analyzed articles and can facilitate future comparative analyses. Additionally, an effort was made to capture emerging topics that do not align with the more standardized themes, leading to the construction of three new categories.

As mentioned, international systematic reviews identify a set of "university-industry collaboration topics" (UIC topics), which include motivation, channels, barriers and outputs (Ankrah and Al-Tabbaa, 2015; Cordeiro Bastos et al., 2021; Nsanzumuhire and Groot, 2020; Vick and Robertson, 2017). These topics are also referred to as "Central Measures" (Perkmann et al., 2013; Perkmann et al., 2021), sharing the mentioned themes and replacing channels with knowledge transfer activities. In constructing the variable of research topics, the categories were defined as follows:

- Motivation

Motivations refer to the reasons that lead actors to interact. These can be economic, cognitive, productive, or related to the intention of pushing the technological frontier (Arza, 2010; 2016).

- Channels

The concept of channels aims to standardize university-industry linkages into four major interaction pathways. Thus, following Arza (2010, 2016), there are four types of channels defined in relation to the institutional motivations of each party. In the traditional channel, universities educate professionals who will work in companies. In the services channel, scientific institutions pursue economic motivations and companies seek to solve short-term production problems. In the commercial channel, scientific institutions transform their developments into patents, licenses and spin-offs, among other things. In the bidirectional channel, universities pursue intellectual motivations and companies seek to push the technological frontier by participating in knowledge construction (Arza; 2010, 2016).

- Activities

This category refers to the various types of actions involving the circulation of scientific-technological knowledge, including both commercialization activities and activities involving academic engagement such as collaborative research and contract research. Thus, this category is broader than the channels category, as it encompasses articles that study specific knowledge transfer activities without necessarily organizing their reflection around the thematic framework of channels.

- Barriers

This term refers to the study of the various limitations that hinder university-industry collaboration. Following Bruneel, D'Este and Salter (2010), barriers can be linked, on the one hand, to the orientations and norms that regulate the practices of universities and companies, for example, regarding the public or private nature of knowledge. On the other hand, obstacles may be related to economic transactions and their political-administrative dimensions.

- Outputs

Refer to the study of achievements, impacts and outcomes of linkages, mostly examined through the analysis of quantitative data.

Along with these 4 categories called "university-industry collaboration topics" (UIC topics), Cordeiro Bastos et al. (2021) identify another 7 "research trends" based on the analysis of international articles searched in Scopus on university-industry collaboration. These trends include UIC topics (motivation, channels, barriers, outputs), engineering education, societies and institutions, knowledge or technology transfer, entrepreneurial university, sustainability and developing countries (Cordeiro Bastos et al., 2021). In this research, some of these trends were included in the topic categorization along with the 5 topics described in the paragraph above. Namely:

- Innovation

This theme focuses on industrial innovation, understood as a competitive advantage for companies (Schumpeter, 1934) in line with both Cordeiro Bastos et al. (2021) and the focus of articles on the topic.

- Technology Transfer

Under this theme, articles studying the use of knowledge produced in the university or produced between the university and productive institutions were categorized.

- Entrepreneurial University

This category focuses on the role of the university in fostering and creating new businesses. It includes works focused on institutional areas oriented to entrepreneurial support, known as technology transfer offices (TTOs), as well as the creation of university spin-offs.

Additionally, three other categories were incorporated:

- Policy and Management of Science and Technology

This theme involves academic reflection on university-industry collaboration from the perspective of both public policies and institutional policies in the field.

- Absorptive Capacities

This topic is focused on the conditions in which companies find themselves to build and incorporate scientific and technological knowledge. Thus, it encompasses both physical infrastructure capabilities and knowledge-related capabilities of work teams.

- Extension

This topic, expressed with the term extension, refers to outreach, one of the substantial functions of universities in Latin America, along with teaching and research. The articles categorized here refer to the study of the social commitment of universities with actors in their socio-productive environment and refer to perspectives of participatory action research and environmental protection. Extension began to be practiced in the early 20th century in Argentina and expanded to other countries (Lázaro and Davyt, 2010, Ortiz-Riaga and Morales-Rubiano, 2011). According to Sutz (2010), it is considered an heir to the University Reform Movement of 1918.

The following graph illustrates the results obtained in the analyzed bibliographic corpus. As mentioned, the categories are not exclusive since different works address more than one topic.

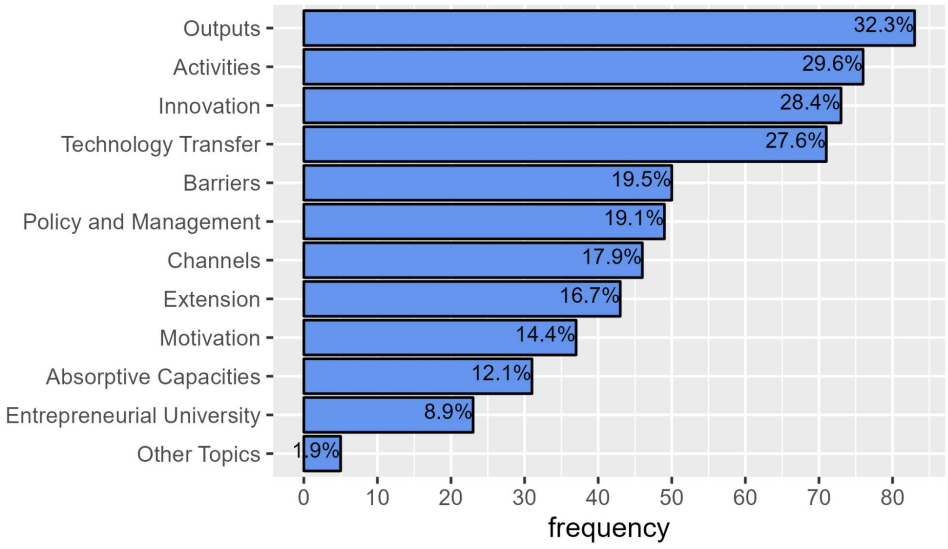

Figure 6. Articles by topic. 1993-2022. (Multiple Response).

As observed in Figure 6, the themes addressed by the articles are, firstly, the outputs of linkage processes (32.3% of the articles); secondly, activities (29.6%); thirdly, innovation (28.4%); and fourthly, technology transfer (27.6%). Barriers to university-industry collaboration appear in fifth place (19.5%), followed by topics of policy and management (19.1%), channels (17.9%) and extension (16.7%). In ninth place are motivations (14.4%), in tenth are the absorptive capacities of

companies (12.1%) and finally, the entrepreneurial university with 8.9%. Only 1.9% of the works refer to other research topics.

These results can be grouped into three categories based on their numerical relevance. Within the most representative group of themes, it is worth noting that the "UIC themes" or "Central Measures" found by international reviews are present in Latin American publications on the subject. Thus, the two main trends in Latin America identified in this research are outputs and activities, followed by innovation and transfer. These four themes emerge as the most studied in Latin America in the period 1993-2022.

In the second group, there is a set composed of barriers and channels (UIC themes) and policy and management. This latter addition aims to account for the place that questions about the orientations of sectoral and institutional policies occupy in the works of the region. Thus, many of these works contain a normative perspective on the proposed study topic, aimed at reflecting on how to improve practices and the frameworks that regulate them.

In the third group, there are works on extension, which, as mentioned, account for a historical peculiarity of Latin America. This group also includes the UIC theme motivation and the notion of absorptive capacities. The relevance of this theme was understood, first, as a finding related to the difficulties of small and medium-sized enterprises in the region to incorporate knowledge, as it is not mentioned in the cited international reviews (Ankrah and Al-Tabbaa, 2015; Cordeiro Bastos et al., 2021; Nsanzumuhire and Groot, 2020; Vick and Robertson, 2017). However, Tarazona et al. (2024) and Lerena et al. (2018) identify that this topic is an expanding trend at a general level. Finally, this group is integrated by the theme of the entrepreneurial university.

In summary, the most relevant themes are outputs, activities, innovation and transfer. It is also noteworthy that in the analysis of Latin American literature, extension and the absorptive capacities of companies emerge as themes absent in international systematic reviews (Ankrah and Al-Tabbaa, 2015; Cordeiro Bastos et al., 2021; Nsanzumuhire and Groot, 2020; Perkmann et al., 2013; Vick and Robertson, 2017)].

Perkmann et al. (2013) argue that it is necessary to build consensus on central measures to increase the comparability of studies. This challenge is relevant also for Latin America where the variety of themes and the polysemy of terms used to refer to different types of linkages hinder the

possibility of having data for comparative analysis. The consideration of this diversity gave rise to the methodological proposal of the Ibero-American Manual of Linkage Indicators of the University with the Socioeconomic Environment - Valencia Manual (RICYT-OEI 2017) (Estébanez, 2020).

4. Discussion

The relationship between the university and the socio-productive environment is increasingly discussed in Latin America academia. Notably, this topic has emerged in the region five to ten years later than globally. The fields of knowledge studying the topic—management, economics, business, social sciences, and to a lesser extent, engineering—differ from international findings where engineering plays an equally prominent role. Regarding methodological proposals, it was found that qualitative approaches predomain and that this happens because the access to quantitative data is a difficult problem in the region, and particularly for this topic where multiple university actors are involved and informal engagement is prevalent.

The discussion of the specific theoretical perspectives adopted by the articles requires a reflection on the statement of ascribing to some theoretical-conceptual approach that appears in 72% of the works. The mention of authors and reference perspectives does not generally imply an effective application of the mentioned perspectives in empirical work. This leads to a dual reflection on research practice and on the adequacy of available perspectives as conceptual frameworks for empirical analysis and studies of Latin American countries. The gap between theoretical perspectives and empirical work presents a qualitative challenge for future research.

As mentioned, 58% of the works declare adopting meso-institutional perspectives. Among the most adopted conceptual approaches within this group are the National Innovation System (NIS), Regional Innovation System (RIS) and Sectoral Innovation Systems (SIS), accounting for 29% of the works and the Triple Helix model, which is used in 24% of the works. In the case of NIS, RIS and SIS perspectives, they are observed to be the most adopted. Thus, Innovation System perspectives are still referred to by those adhering to some kind of network theory to address the institutional analysis level (Confraria et al., 2019). As Di Bello (2013) points out, interactive perspectives do not account for the processes of change in universities. Therefore, both perspectives

are complementary as they allow addressing the two levels of analysis involved in these processes. Arocena and Sutz (1999) indicate that the concept of NIS can be productive for studying innovation processes and policies in Latin American countries, providing a "southern" mediation that adapts tools to the realities of peripheral countries. In most of the critical studies this concept is attributed to be normative for those realities. As has been said, the university is a complex and unique subject of study. In the Science, Technology and Society field, it is frequently analyzed without adequately addressing the internal dynamics of these institutions. Higher Education Studies overlap with several STS areas and there are still challenges in creating effective dialogue between these two fields.

A critical finding of the study is that 28% of the analyzed articles do not mention any theoretical perspective. This result calls for reflection on the reasons behind the absence of conceptual perspectives in the study of university-industry collaboration.

The analysis of research trends indicated that the most studied topics are as follows (using numbers to indicate the order of relevance of each topic): 1. the outputs of linkages, 2. various types of linkage activities and 3. innovation understood from the perspective of firms' competitiveness. These topics are followed by 4. technology transfer and 5. barriers to collaboration related to norms and institutional arrangements hindering knowledge circulation. It was also observed that the topics referred to as University-Industry collaboration (UIC) or central measures by international literature are present in Latin American works, occupying the mentioned positions 1, 2, 5, along with 7. channels of knowledge transfer and 9. actors' motivation to engage. Furthermore, it was necessary to work with other categories that account for relevant topics in the region. These are: 6. science and technology policy and management, which has a normative character aimed at proposing best practices for collaboration at the level of offices dedicated to these activities or the regulations governing the sector. In position number 8. extension, which refers to one of the substantive functions of universities in Latin America, related to social engagement with the environment and 10. companies' absorptive capacities, which, while emerging in recent international studies (Lerena et al., 2018)], acquires specificity in the region due to the prevalence of small and medium-sized firms.

In summary, there are two points posing challenges for the study of the subject in Latin America. One refers to the theoretical-conceptual dimension of existing analyzes and the other to the methodological issue regarding access and generation of data on the topic. Conceptual issues involve the articulation between the micro-interactional and meso-institutional levels, undoubtedly

surpassing the boundaries of this research, as conducted in this initial phase. How to study the place of institutional statements in the case studies that constitute 56% of Latin American works? How can we operationalize these perspectives to close these gaps, especially in the field of social sciences? We will continue to delve deeper into how the use of institutional and interactional perspectives can allow us to address the two levels of analysis involved in a triangulated manner.

Methodological problems relate to the availability of comparable quantitative data. Solutions to this issue are more advanced in international works, yet they still emphasize the need to reduce conceptual polysemy to promote comparative studies. In Latin America, the availability of data and financial resources for their construction presents deeper challenges.

This work provided a methodological and descriptive foundation for analyzing the literature on university-industry collaboration in Latin American countries. Future research will delve deeper into the various dimensions and advance towards analyzing their relationships. In closing, it is worth considering a set of questions to guide the research process:

- Are there distinct national or regional publication patterns within Latin America?
- Regarding research topics, conceptual approaches and theoretical perspectives, what trends are observed during the analyzed period?
- How do research topics vary across disciplines?
- What are the differences between the publications in Scopus and those in Latin American databases concerning disciplinary fields, methodological approaches, conceptual approaches and main research topics?

Finally, it should be noted that the article introduces results that represent a contribution to what was previously analyzed in the literature on the link between the university and the productive sectors in the Latin American region. In fact, to date there is little precedent that analyzes this literature taking into account this geographic focus. Moreover, the existing studies do not track the variables as proposed in this article, which aims to facilitate comparison with international reviews. Even so, much remains in the analysis of the variables studied with the aim of allowing answers to the questions posed.

Acknowledgements: This work benefited from the valuable collaboration of Marina Borrel and Laura de San Miguel from the Reference Division of the BIBHUMA Professor Guillermo Obiols Library at the Faculty of Humanities and Educational Sciences - UNLP. We are also grateful to the reviewers for their insightful feedback and constructive suggestions.

Author Contributions: All authors have contributed equally.

Funding: This research was funded by Project Universidad Nacional de La Plata (UNLP) H862, titled "Recent Transformations in the Production and Social Use of Scientific and Technological Knowledge: The University Institution and Its Relationship with the Socio-Productive Environment." It was also supported by the PICT 2001-GRF-TI 00446, titled "The Transfer and Use of Social and Productive Knowledge: Characterization and Analysis of the Linkage Actions of the National Universities (UUNN) of Buenos Aires Province (PBA)."

Conflicts of Interest: The authors declare no conflict of interest.

Data Availability / Supplementary Materials Statement: Data will be made available on from the corresponding author on reasonable request.

References

Ankrah, S. & Al-Tabbaa, O. (2015). Universities-Industry Collaboration: A Systematic Review. SSRN *Electronic Journal.* 10.2139/ssrn.2596018. http://dx.doi.org/10.2139/ssrn.2596018

Arocena, R. & Sutz, J. (1999). Looking at National Systems of Innovation from the South. Paper presented at the Conference "National Systems of Innovation, Industrial Dynamics, and Innovation Policies", organized by the Danish Research Unit on Industrial Dynamics (DRUID) in Rebild, Denmark, June 9-12, 1999.

Arza, V. (2016). Interactions between companies and public research organizations: Ideas about the relationship between channels, benefits, and risks in Latin America. In Barletta, F., Yoguel, G., Robert, V. (Eds.), *Topics of neo-Schumpeterian evolutionary theory of innovation and technological change (Volume 2*. Chapter: 13). Miño y Dávila Editores. https://doi.org/10.3152/030234210X512043

Beigel, F.; Packer, A.; Gallardo, J.; Salatino, J. (2022) OLIVA: La producción científica indexada en América Latina y el Caribe. Diversidad disciplinaria, colaboración institucional y multilingüismo en SciELO y Redalyc (1995-2018). *Dados*; 67; 1; 12-2022; 1-39. https://doi.org/10.1590/dados.2024.67.1.307

Braczyk, H.-J., Cook, P. & Heidenreich, M. (Eds.). (1998). *Regional Innovation Systems: The Role of Governance in a Globalized World.* Routledge, London. https://doi.org/10.4324/9780203330234

Breschi, S. & Malerba, F. (1997). Sectoral innovation systems: Technological regimes, Schumpeterian dynamics, and spatial boundaries. *Systems of Innovation: Technologies, Institutions and Organizations*, (1), 130-156.

Bruneel, J., D'Este, P. & Salter, A. (2010). Investigating the factors that diminish the barriers to university-industry collaboration. *Research Policy, 39*, 858-868. https://doi.org/10.1016/j.respol.2010.03.006

Caldelari, M., & Funes, P. (1997). Escenas reformistas: La reforma universitaria, 1918–1930. Buenos Aires, Argentina: Universidad de Buenos Aires.

Callon, M. (2001). Techno-economic networks and irreversibility. *Redes, 8*(17).

Casas, R. (2001). El enfoque de redes y flujos de conocimiento en el análisis de las relaciones entre ciencia, tecnología y sociedad. *Kairos, 8*(2).

Clark, B. (1998). *Creating Entrepreneurial Universities: Organizational Pathways of Transformation*. Oxford: IAU Press and Pergamon.

Compagnucci, L. & Spigarelli, F. (2020). The Third Mission of the university: A systematic literature review on potentials and constraints. *Technological Forecasting and Social Change, 161*, 120284. https://doi.org/10.1016/j.techfore.2020.120284

Confraria, H. & Vargas, F. (2019). Scientific systems in Latin America: performance, networks, and collaborations with industry. *The Journal of Technology Transfer*, *44*(3), 874-915. https://doi.org/10.1007/s10961-017-9631-7

Cordeiro Bastos, E., Rossales Sengik, A., & Tello-Gamarra J. (2021). Fifty years of University-industry collaboration: a global bibliometrics overview. *Science and Public Policy, 48*(2), 177–199. https://doi.org/10.1093/scipol/scaa077

Di Bello, M. E. (2013). *Una ciencia que sirva… ¿A quién? La construcción de la utilidad social de conocimientos científicos: grupos de investigación académicos y problemas sociales.* Doctoral dissertation. University of Buenos Aires, Buenos Aires.

Dutrénit, G. & Arza, V. (2010). Channels and benefits of interactions between public research organizations and industry: comparing four Latin American countries, in Science and Public Policy, 37(7), pp. 541–553. https://doi.org/10.3152/030234210X512043

Estébanez, M. E. (2020). Vinculación de las instituciones de educación superior con el entorno socioeconómico: conceptos, enfoques y experiencias recientes en Iberoamérica. In Consejo de Aseguramiento de la Calidad de la Educación Superior (Ed.), *Educación Superior y Sociedad, ¿Qué pasa con su vinculación?* Quito: CACES.

Etzkowitz, H. & Leydesdorff, L. (Eds.) (1997a): *Universities and the Global Knowledge Economy. A Triple Helix of University-Industry-Government Relations*. Pinter, London.

Etzkowitz, H. & Leydesdorff, L. (Eds.) (1997b): "Introduction to special issue on science policy dimensions of the Triple Helix of university-industry-government relations", in *Science and Public Policy, 24*(1), pp. 2-6.

Etzkowitz, H. & Leydesdorff, L. (Eds.) (2000): The dynamics of innovation: from National Systems and "Mode 2" to a Triple Helix of university-industry-government relations. Introduction to a special issue of Research Policy on the 'Triple Helix', *in Research Policy, 29*, pp 109-123. https://doi.org/10.1016/S0048-7333(99)00055-4

Etzkowitz, H. & Webster, A. (1998): "Entrepreneurial science: The second academic revolution", in Etzkowitz, Henry, Andrew Webster, & Peter Healy (Eds.) *Capitalizing Knowledge: New Interactions of Industry and Academy*, SUNY Press, Albany, NY.

Freeman, C. (1987) *Technology Policy and Economics Performance: Lessons from Japan*. London: Pinter.

Gibbons, M.; Limoges, C.; Nowotny, H.; Schwartzman, S.; Scott, P. & Trow, M. (1994): *The New Production of Knowledge: The Dynamics of Science and Research in Contemporary Societies*, Sage Publications, London.

Haidar, H.; Evrard Samuel, K.; Boujut, J. (2019). Influential factors of initiating open innovation collaboration between universities and SMEs: Systematic Literature Review. *Exploring the Future of Management*, Jun 2019, Lisbon, Portugal. ⟨hal-02184337⟩

Latour, B. (2008) *Reassembling the Social: An Introduction to Actor-Network-Theory.* Buenos Aires: Manantial.

Lázaro, M. & Davyt, A. (2010). La enseñanza CTS y la integración de las funciones universitarias: reflexiones desde una facultad de ciencias. *Redes, 16*(31), 145-161.

Lerena, O.; Minervini, M. & Yoguel, G. (2018) Comunidades temáticas en el estudio de la relación universidad-empresa: redes bibliométricas y minería de textos. Ciudad Autónoma de Buenos Aires: CIECTI, 2018. Digital book, pdf.

Lugones, G. E.; Codner, D.; Becerra, P.; Pellegrini, P.; Rossio Coblier, P.; Martin, D.; Kababe, Y.; Pizzarulli, F.; Bazque, H.; Giudicatti, M. & Gutti, P. (2015) *Dinámica de la transferencia tecnológica y la innovación en la relación Universidad-Empresa.* Buenos Aires: CIECTI.

Lundvall, B.-Å. (1985). *Product Innovation and User- Producer Interaction.* Aalborg: Aalborg University Press.

Lundvall, B.-Å. (1988) Innovation as an Interactive Process from User-Producer Interaction to National Systems of Innovation. In *Technology and Economic Theory*, edited by Dosi, G. (ed.). London: Pinter.

Lundvall, B. Å., & Freeman, C. (1988). *Small countries facing the technological revolution*. Pinter Publishers.

Miguel, S. (2011). Revistas y producción científica de América Latina y el Caribe: su visibilidad en SciELO, RedALyC y SCOPUS. Revista Interamericana de Bibliotecología, vol. 34(2), 2011, 187-199 Universidad de Antioquia Medellín, Colombia. Available in: https://www.redalyc.org/articulo.oa?id=179022554006

Niembro, A. (2018). Los sistemas regionales de innovación y el desarrollo económico de las provincias argentinas. Available at https://repositoriodigital.uns.edu.ar/handle/123456789/4535

Nsanzumuhire, S. U. & Groot, W. (2020). Context perspective on University-Industry Collaboration processes: A systematic review of literature. *Journal of cleaner production*, *258*, 120861. https://doi.org/10.1016/j.jclepro.2020.120861

Olvera, C., Berbegal-Mirabent, J. & Merigo, J. M. (2018). A Bibliometric Overview of University-Business Collaboration between 1980 and 2016. *Computación y Sistemas, 22*(4), 1171–1190. http://dx.doi.org/10.13053/cys-22-4-3101

Ortiz-Riaga, M. C. & Morales-Rubiano, M. E. (2011). University Extension in Latin America: Conceptions and Trends. *Educación y Educadores, 14*(2), 349-366. http://dx.doi.org/10.5294/edu.2011.14.2.6

Perkmann, M., Tartari, V., McKelvey, M., Autio, E., Broström, A., D'este, P. & Sobrero, M. (2013). Academic Engagement and Commercialization: A Review of the Literature on University–Industry Relations. *Research Policy, 42(2),* 423-442. https://doi.org/10.1016/j.respol.2012.09.007

Perkmann, M., Salandra, R., Tartari, V., McKelvey, M. & Hughes, A. (2021). Academic Engagement: A Review of the Literature 2011-2019. *Research Policy, 50*(1), 104114. https://doi.org/10.1016/j.respol.2020.104114

Rodrigues, R.S. & Abadal, E. (2014). Ibero-American journals in Scopus and Web of Science. Learned Publishing, 27: 56-62. https://doi.org/10.1087/20140109

Sabato, L. & Botana, N. (1970). La ciencia y la tecnología en el desarrollo de América Latina. En Herrera, A. (Ed.) América Latina: ciencia y tecnología en el desarrollo de la sociedad. Chile: Editorial Universitaria.

Schumpeter, J. (1934). *The Theory of Economic Development*. Cambridge, MA: Harvard University Press.

Shinn, T. (2002). The Triple Helix and New Production of Knowledge: Prepackaged Thinking on Science and Technology. *Social Studies of Science, 32(4),* 599-614. https://doi.org/10.1177/0306312702032004004

Sjöö, K. & Hellström, T. (2019). University–Industry Collaboration: A Literature Review and Synthesis. *Industry and Higher Education, 33(4),* 275–285. https://doi.org/10.1177/0950422219829697

Slaughter, S. & Leslie, L. L. (1997). *Academic Capitalism: Politics, Policies and the Entrepreneurial University*. Baltimore: Johns Hopkins.

Slaughter, S. & Rhoades, G. (2004). *Academic Capitalism and the New Economy: Markets, State and Higher Education.* Baltimore, MD: The Johns Hopkins University Press.

Stubrin, L. (2022). Un análisis del crecimiento de la actividad biotecnológica en la Argentina en clave sistémica (1982-2022). *Desarrollo Económico, 62*(236), 50–78. https://www.jstor.org/stable/48695945

Sutz, J. (2010). La integralidad de las funciones universitarias como espacio de preguntas recíprocas. *Cuadernos de Extensión 1*.

Tarazona, R., García-Hurtado, D., Devece, C. & Hoffmann, V-E. (2024). Industrial cluster and knowledge creation: a bibliometric analysis and literature review. Multidisciplinary Journal for Education, Social and Technological Sciences, 11(1), 127-150. https://doi.org/10.4995/muse.2024.21344

Tranfield, D.; Denyer, D. & Smart, P. (2003). Towards a Methodology for Developing Evidence-Informed Management Knowledge by Means of Systematic Review. *British Journal of Management, 14*, 207–222. https://doi.org/10.1111/1467-8551.00375

Tuunainen, J. (2013). Science Transformed? Reflections on Professed Changes in Knowledge Production. Organizations, *People and Strategies in Astronomy, 2*(1), 43-71.

Vick, T. E. & Robertson, M. (2018). A Systematic Literature Review of UK University–Industry Collaboration for Knowledge Transfer: A Future Research Agenda. *Science and Public Policy, Volume 45*, Issue 4, August 2018, Pages 579–590. https://doi.org/10.1093/scipol/scx086

Wolfswinkel, J. F.; Furtmueller, E. & Wilderom, C. P. M. (2013). Using Grounded Theory as a Method for Rigorously Reviewing Literature. *Eur. J. Inf. Syst., 22*(1), 45-55. https://doi.org/10.1057/ejis.2011.51

Zabala, J. P. (2004). La utilidad social de los conocimientos científicos como problema sociológico. In Kreimer P. and Thomas H. (eds.) Producción y uso de conocimiento: Estudios de Sociología de la Ciencia y la Tecnología en América Latina. Bernal: UNQ.

Appendix.

The following bibliographic searches were conducted in the Titles, Abstracts and Keywords of the articles:

1. (collaboration OR interaction) AND (university) AND (industry OR company)
2. (cooperation OR relationship) AND (university) AND (industry OR company)
3. (collaboration OR interaction) AND (university) AND (business OR firm)
4. (linkage OR transfer) AND (university) AND (company OR socio-productive environment OR socio-productive actors)
5. (collaboration OR interaction) AND (university) AND (company OR socio-productive environment OR socio-productive actors)
6. (co-production OR co production) AND (university) AND (company OR socio-productive actors)
7. (agreement OR joint research) AND (university) AND (company OR socio-productive environment OR socio-productive actors)
8. (collaboration OR interaction) AND (academy) AND (industry OR company)
9. (collaboration OR interaction) AND (academy) AND (business OR firm)
10. (collaboration OR interaction) AND (academy) AND (company OR socio-productive environment OR socio-productive actors)