

# University–industry linkages and agendas for future studies: a systematic literature review and bibliometric analysis

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## Abstract

**Purpose** – This study aims to theoretically and experimentally investigate the literature on university–industry linkages (UILs) through a systematic literature review and bibliometric analysis. Seven research questions were addressed in the present study: (1) descriptive characteristics of the literature on UIL, (2) trends of annual scientific publications on UIL, (3) the most relevant and high-impact sources on UIL, (4) the most globally cited articles on UIL, (5) the most relevant countries on UIL, (6) outcomes of Bradford's Law of Scattering and Lotka's Law of scientific productivity and (7) the trending research areas and avenues for future studies on UIL.

**Design/methodology/approach** – Systematic literature review and bibliometric analysis mapping techniques were applied to the present study to analyze 907 articles extracted from the Scopus database. Analysis tools used were Biblioshiny software and VOSviewer software.

**Findings** – Findings show that the UIL is a progressively growing discipline with a record of a 5.71% average annual growth rate in scientific production each year from 1970 to 2023. The United States, China and the United Kingdom were the most productive countries in the field of UIL in terms of total scientific production and citations. Academic entrepreneurship, industrial ecology, social network analysis, active learning, engineering education, health economics, public health, university–industry relationships, communication, causal layered analysis and competitiveness are the potential avenues for future researchers in the field of UIL based on the thematic map of keywords analysis.

**Originality/value** – This study contributes to the debate on UIL by offering a comprehensive literature review. The findings of the current study will benefit graduates, universities, industries and the community at large.

**Keywords** Biblioshiny, Bibliometric analysis, Industry, Systematic literature review, University–industry linkages

**Paper type** Literature review

## 1. Introduction

Collaborations between academia and industry are attracting the attention of researchers and policymakers in various sectors. Multiple gains are generated by university–industry linkage (UIL) in terms of technology, innovation, economic growth and development as a result of the synergy effect (Outamha and Belhcen, 2020). UILs are bidirectional connections between universities and industries designed to enable the dissemination of creative ideas, skills and



people to develop mutual value over time (Zavale and Langa, 2018). Universities are important in creating and sharing knowledge. The creation of university–industry collaborations is crucial in enabling information transfer from academia to industry (Olvera *et al.*, 2018). Collaboration between academia and business is essential because academia is where knowledge is developed while business is where it is put into practice to produce goods and services for society and the country (Sengupta and Rossi, 2023). The term UIL is called for university–industry collaborations, university–business ties, university–industry alliances and university–business partnerships in diverse contexts and disciplines in the world (Sá, 2020). Proper and effective interactions with the industry generate mutual benefits.

Additionally, in the context of emerging markets and business development, UILs are primary sources of external knowledge and technology for industries (Kleiner-Schaefer and Schaefer, 2022). The industry is seen as the second most significant stakeholder after the university in terms of its ability to effectively contribute to the skill development of graduates through appropriate university–industry interactions (Etzkowitz, 2002). Ashraf *et al.* (2018) explained that collaborative consultancy activities, collaborative training and educational activities and collaborative contract research create competitive advantages that affect graduate employability. Universities are now expected to use their research to advance the boundaries of knowledge as well as to help commercialize discoveries and breakthroughs for the benefit of society as a whole (Sengupta and Rossi, 2023). Consequently, universities are beginning to collaborate with outside stakeholders to participate in numerous types of impact-driven initiatives.

However, studies across the globe have found gaps in available studies and a sufficient number of novel investigations on UILs, including the ones in Australia (Jones and de Zubielqui, 2017), Africa (Outamha and Belhacen, 2020), Malaysia (Ismail *et al.*, 2022), the Netherlands (Bodas Freitas and Verspagen, 2017), Nigeria (Alli and Dada, 2023), Pakistan (Malik *et al.*, 2021), Sri Lanka (Wickramasinghe and Malik, 2018), Thailand (Intarakumnerd and Jutarosaga, 2023), Turkey (Kleiner-Schaefer and Schaefer, 2022), the United Kingdom (Johnston, 2021) and the United States (Mendoza and Öcal, 2022). Accordingly, the lack of effective UILs is a global issue faced by both developed and developing nations around the world.

This study attempts to deliver refined empirical research using an integrated strategy that includes bibliometric analysis and a systematic literature review for a comprehensive literature review. Accordingly, this study responds to the following seven research questions (RQs) in the light of a thorough examination.

- RQ1. What are the descriptive characteristics of the refined empirical research on UIL?
- RQ2. What are the trends in annual scientific publications on UIL?
- RQ3. What are the most relevant and high-impact sources on UIL?
- RQ4. What are the most globally cited articles on UIL?
- RQ5. What are the most relevant countries in the UIL field?
- RQ6. What are the outcomes of Bradford's Law of Scattering and Lotka's Law of Scientific Productivity?
- RQ7. What are the trending research areas and avenues for future research on UIL?

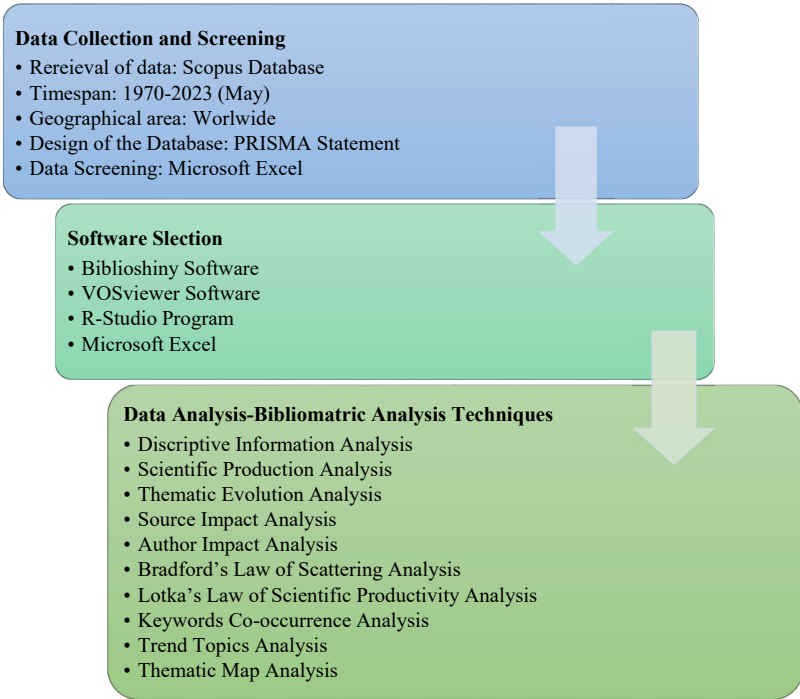
## 2. Materials and methods

The present investigation included both a bibliometric analysis and a systematic literature review (SLR). SLR is a repeatable, transparent strategy that has been found to reduce authors' subjectivity by establishing an objective baseline that omits superfluous papers because traditional reviews are vulnerable to author subjectivity (Tranfield *et al.*, 2003). Accordingly,

sophisticated electronic databases and technological improvements allow for quick and systematic evaluations by academics, which may reduce the risk of subjectivity in using SLR. The data collection and screening, software selection and data analysis stages constitute the methodology of the current study. [Figure 1](#) presents a summary of the methodology used in the current study, which involves three sections.

2.1 Data collection and screening

The importance of this stage lies in its ability to help choose the optimal bibliometric analysis method and, in turn, the appropriate data format that is required ([Donthu et al., 2021](#)). There are many subcategories of bibliometric databases in multidisciplinary and specialized databases. Multidisciplinary databases include; CrossRef, Dimensions, Microsoft Academic, Web of Science and Scopus while specialized databases include ArXiv, Cochrane, EconBiz, IEEE Explore and PubMed. The Scopus database contains the greatest number of indexed journal-published articles out of all of the different types of bibliometric databases ([Visser et al., 2021](#)). Accordingly, data were extracted for the present study using the Scopus database search engine. The Scopus database is one of the largest databases for scholarly abstracts and citations with approximately 50 million articles published since 1823 ([Alzard et al., 2022](#)). The keyword “university-industry linkages” was initially found in 928 records published between 1970 and 2023 worldwide in the articles’ titles, abstracts and keywords. Out of the retrieved 928 articles, 907 (97%) were written in English. As non-English studies were a criterion for exclusion, 21 non-English papers were discovered and eliminated. Finally, 907 articles were included in the SLR and Bibliometric analysis. Accordingly, as per the Scopus



**Figure 1.**  
Summary of the  
methodology

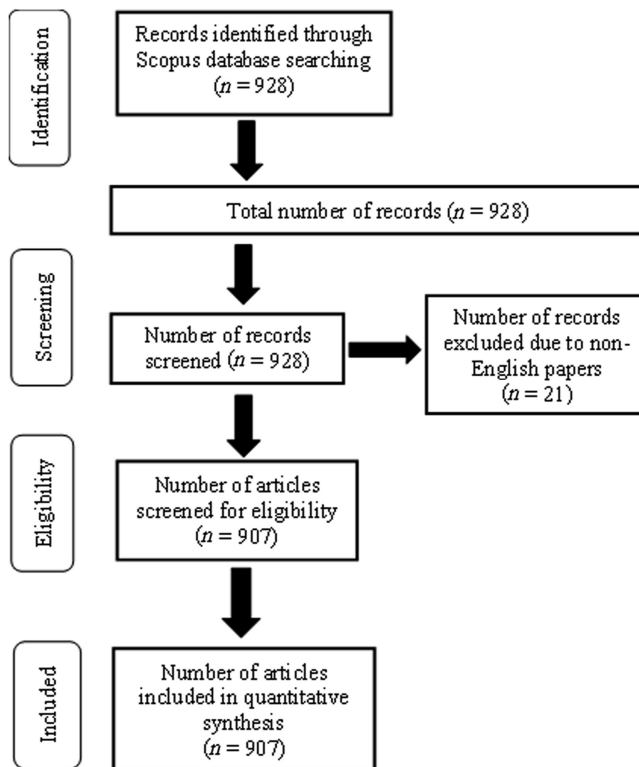
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refined results, the query of the database relevant to the present research was (TITLE-ABS-KEY (University-Industry Linkages) AND (LIMIT-TO (LANGUAGE, "English")))).

The present study used the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement to describe the study design. The PRISMA statement is intended to aid authors in improving the reporting of systematic literature reviews and meta-analyses (Sarkis-Onofre *et al.*, 2021). The study design of the present research that utilizes the PRISMA statement is shown in Figure 2. Furthermore, the diagram demonstrates the record "identification, screening, eligibility, and inclusion" process. Subsequently, systematic extraction was performed on a collection of documents that were chosen based on the inclusion and exclusion criteria (Moher *et al.*, 2009).

## 2.2 Software selection

Compatible software is required to perform accurate bibliometric analysis. Several software and tools are capable of conducting bibliometric analysis including content analysis, quantitative analysis and visualizations or enabling both simultaneously exist such as "Bibliomatrix," "Vosviewer," "Citespace," "Gephi," "HistCite," "Pajek," "N Vivo," "Maxqda" and "Bibexcel." The current research utilized the most recent version of the Bibliometrix R package, utilizing the web application, Biblioshiny and VOSviewer software. The Bibliometrix R package is an open-source tool developed by Aria and Cuccurullo (2017).



Source(s): Figure Courtesy of Moher *et al.* (2009)

**Figure 2.**  
PRISMA statement

Biblioshiny is a web application that enables entry via R-Studio. Bibliometric software offers quick analysis and creates data matrices for the evaluation of performance and scientific visualization of the bibliographic collection, which are features that distinguish it from other alternative software solutions (Alzard *et al.*, 2022). Compared with other bibliometric tools, the Biblioshiny software and VOSviewer are easier to utilize due to user-friendly interfaces (Srivastava and Sivaramakrishnan, 2022). Microsoft Excel was also used in conjunction with Bibiloshiny to create several graphs and perform data quality assessments.

### 2.3 Data analysis

Both quantitative and qualitative analysis methods were applied in the current study. The descriptive characteristics analysis of the refined empirical data, analysis of annual scientific publications, author impact analysis and source impact analysis are the quantitative bibliometric analysis techniques applied in the present study. Thematic evolution analysis, Bradford's Law of Scattering analysis, Lotka's Law of scientific productivity analysis, keywords co-occurrences analysis, trend topics analysis and thematic map of keywords analysis were the qualitative analysis techniques used in the present study. The researchers meticulously organized the retrieved data into a CSV form.

## 3. Results and discussion

### 3.1 Descriptive characteristics of the extracted data

Based on the findings, 907 papers by 2060 authors from 553 sources, published between 1970 and 2023, were retrieved from the Scopus database. Compared with the 255 single-authored publications, there were 652 papers with multiple authors. The authors' collaboration index was 19.85%. The retrieved documents comprised 39,810 total references, and the average number of citations per document was 24.96. Table 1 displays the descriptive analysis.

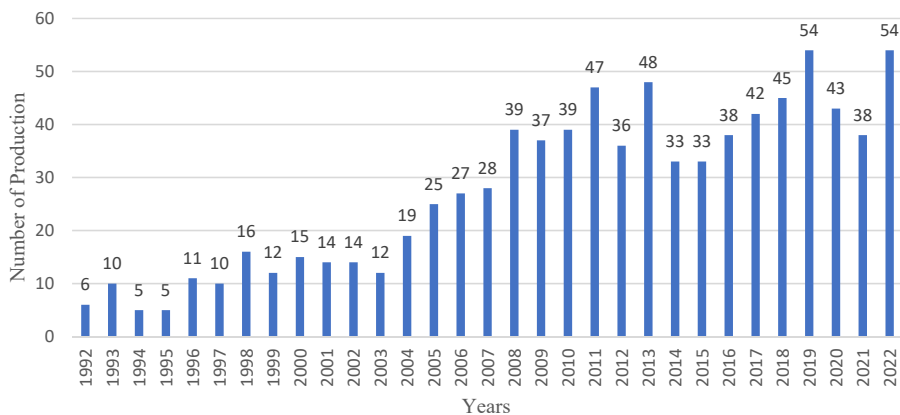
### 3.2 Publications trends of annual scientific publications in the field of UIL

The findings indicated that, as observed in the overall progressive increase in publishing patterns, the body of literature improved significantly during the preceding year. Annual scientific production in the field of UIL during the preceding 3 decades (1992–2023) has significantly increased. Further, as depicted in Figure 3, the amount of scientific production on UIL marginally improved up to 1995. Starting in 2004, scientific research on UIL has significantly increased capturing the researcher's interest and recording the highest number of research publications (54 publications) in both 2019 and 2022. The annual growth rate of scientific production was 5.71%. Figure 3 shows the annual scientific production during the preceding 3 decades (1992–2022) based on the findings.

Figure 4 displays the thematic evolution of the UIL phenomenon over the previous 5 decades from 1970 to 2023. The thematic evolution described the multiple evolutionary associations that represented the field's development and recognized the thematic substance, intensity and organizational structures of the study field's thematic deviations (Ogunsakin *et al.*, 2022). Accordingly, the Sankey diagram in Figure 4 visualizes the conversion and evolution of the concept of UIL in four distinct periods between 1970 and 2023. The nodes in the Sankey diagram represent a subject, and the size of the node corresponds to the number of keywords that make up the subject. The evolving focus of the research issue is shown by the line connections among the nodes and diverse themes are distinguished by colors. The number of shared keywords is indicated by the line's width; the wider the line, the more important the two topics are.

The remarkable shifts in the study themes in UIL during four subperiods—1970–1998, 1999–2007, 2008–2016 and 2017–2023—are shown in Figure 4. In the first subperiod, 1970–

<i>Description of documents</i>		1970–2023	UIL and agendas for future
Timespan			
Documents	907		
Sources (journals, books, etc.)	553		
Annual growth rate (%)	5.71		
Single-authored documents	255		
Multiple-authored documents	652		
Document average age	12.1		
<i>Types of documents out of 907</i>			
Articles	609		
Conference papers	168		
Book chapters	60		
Reviews	42		
Books	09		
Conference review	06		
Editorials	05		
Notes	05		
Short surveys	03		
<i>Description of authors and collaborations of authors</i>			19
Authors	2,060		
Authors of single-authored documents	235		
Authors of multiple-authored documents	1825		
Co-authors per document	2.57		
International co-authorships (%)	19.85		
<i>Citations and references</i>			Table 1. Descriptive characteristics of the extracted data
Average citations per document	24.96		
References	39,810		
Source(s): Authors own creation based on Output of Biblioshiny Software			

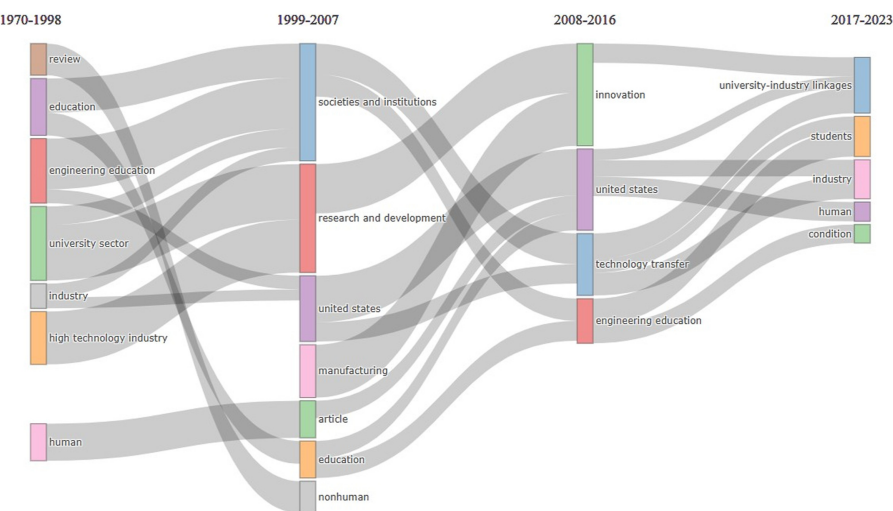


Source(s): Output of Biblioshiny Software

Figure 3.  
The annual scientific  
publications  
1992–2022

1998 thematic evolution analysis recognizes seven research themes in the field of UIL; review, education, engineering education, university sector, industry, high technology industry and human. The “education” and “university sector” themes can be distinguished as the basic

Figure 4.  
Thematic  
evolution map



Source(s): Output of Biblioshiny Software

themes that evolved up to 2023 with extended connected lines across the subperiods. Further, “engineering education,” “technological transfer” and “innovation” themes have evolved as trendy research themes in the field of UIL by 2023. Accordingly, the investigation of thematic evolution shows that the number of multiple themes and articles in the field of UIL has progressively increased over time.

3.3 Most relevant and high-impact sources in the field of UIL

This study incorporated 553 diverse and reliable sources. Table 2 illustrates the most relevant sources in the field of UIL in terms of the total number of publications. The *Research Policy* journal has published the highest number of scientific research publications in the field of UIL. Additionally, out of 907 papers, 18% were published in the top 10 most pertinent sources.

As presented in Table 3, high-impact sources in the field of UIL were ranked based on the  $h\_index$ ,  $g\_index$  and  $m\_index$  status of the sources. The H-index is the highest value of  $h$  for

Table 2.  
Most relevant top ten  
sources

Rank	Sources	Published articles
1	<i>Research Policy</i>	26
2	<i>Journal of Technology Transfer</i>	25
3	<i>Science and Public Policy</i>	20
4	<i>Industry and Higher Education</i>	19
5	<i>Technovation</i>	19
6	<i>Scientometrics</i>	15
7	<i>ASEE Annual Conference and Exposition, Conference Proceedings</i>	13
8	<i>Journal of Economic Geography</i>	09
9	<i>Technological Forecasting and Social Change</i>	09
10	<i>International Journal of Technology Management</i>	08

Source(s): Output of Biblioshiny Software

**Table 3.**

Top ten high-impact  
sources

Rank	Source	h_index	g_index	m_index	TC
1	<i>Research Policy</i>	24	26	0.667	5,311
2	<i>Journal of Technology Transfer</i>	20	25	0.87	1,178
3	<i>Technovation</i>	16	19	0.372	1,279
4	<i>Science and Public Policy</i>	11	20	0.393	494
5	<i>Scientometrics</i>	11	15	0.524	330
6	<i>Journal of Economic Geography</i>	9	9	0.45	2,348
7	<i>Technological Forecasting and Social Change</i>	8	9	0.211	198
8	<i>Industry and Higher Education</i>	7	9	0.25	96
9	<i>Science, Technology, and Society</i>	7	8	0.389	96
10	<i>Economic Geography</i>	6	6	0.316	245

**Source(s):** Output of Biblioshiny Software

which a particular author/journal has published at least  $h$  papers, each of which has been cited a minimum of  $h$  times. [Hirsch \(2005\)](#) created the  $h$ -index to quantify the scientific output. The  $h$ -index is also known as the Hirsch number or Hirsch index. The  $h$ -index is the highest value of  $h$  for which the given author/journal has published a minimum of  $h$  papers, each of which has been cited at least  $h$  times ([Norris and Oppenheim, 2010](#)). The  $g$ -index was proposed by Leo Egghe in 2006, and that is the unique greatest number such that the highest  $g$  articles together received at least  $g^2$  citations ([Egghe, 2006](#)). Highly cited articles were assigned greater weight using the  $g$ -index. As depicted in [Table 3](#), the *Research Policy* journal has the highest impact journal in the field on UIL in terms of the  $h$ -index,  $g$ -index,  $m$ -index and cumulative citations.

### 3.4 Most globally cited articles

Identifying the most significant publications that have created new potential in the field of UIL requires highly cited papers. As a result, papers with the greatest impact value may also have the highest number of citations. Researchers have commonly cited and used research articles with a large number of citations as trustworthy sources. [Table 4](#) displays a list of articles that have been cited the most that contain pertinent information in the UIL research area. The article titled “University–Industry Linkages in the UK: what are the Factors Underlying the Variety of Interactions with Industry?” by [D’Este and Patel \(2007\)](#) published in the *Research Policy* journal is the highest globally cited article in the discipline of UIL, achieving 914 cumulative citations.

### 3.5 Most relevant countries

Contextual evaluations may enhance researchers’ understanding of UIL at the national level, allowing for more robust comparisons and inferences that can lead to an assessment of contextual research gaps for subsequent investigations. [Figure 5](#) demonstrates the scientific production of countries within the range of 0–440 in the UIL field.

The countries in [Figure 5](#) that are colored blue are those that have studied UIL. Among the blue countries, dark blue nations have published an extensive number of publications on UIL while light blue countries have investigated UIL less frequently. Additionally, countries indicated in gray have no publications on UIL. Accordingly, no research has been conducted in many countries in Eastern Europe, sub-Saharan Africa, South Asian region, Southeast Asian and Oceanian regions. Furthermore, only 68 out of 195 countries in the world have published research on UIL from 1970 to 2023. Thus, only 35% of nations worldwide have at least one research publication in the discipline of UIL.

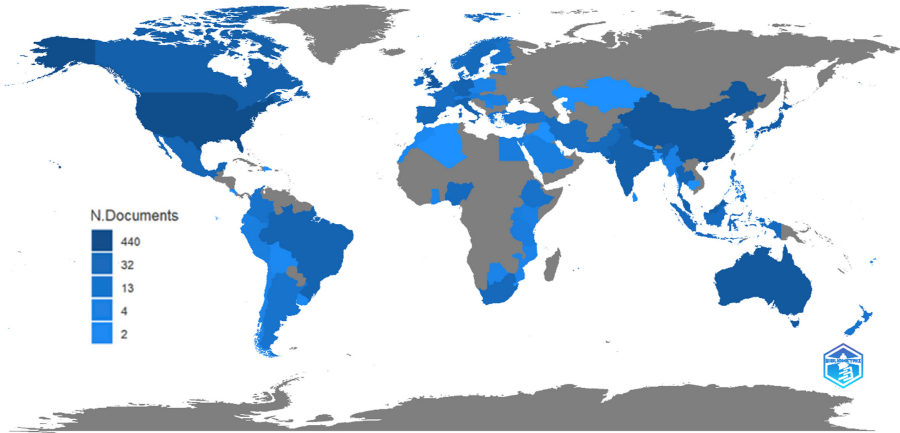


**Table 4.**  
Top ten globally cited  
articles

Rank	Authors	Year	DOI	Source	TC
1	D'Este and Patel	2007	10.1016/j.respol.2007.05.002	<i>Research Policy</i>	914
2	Narin, Hamilton and Olivastro	1997	10.1016/S00487333(97)00013-9	<i>Research Policy</i>	788
3	Etzkowitz	1998	10.1016/S0048-7333(98)00093-6	<i>Research Policy</i>	763
4	Mudambi	2008	10.1093/jeg/lbn024	<i>Journal of Economic Geography</i>	746
5	Sturgeon, Van Biesebroeck and Gereffi	2008	10.1093/jeg/lbn007	<i>Journal of Economic Geography</i>	521
6	George, Zahra and Wood Jr	2002	10.1016/S0883-9026(01)00069-6	<i>Journal of Business Venturing</i>	394
7	Whittington, Owen-Smith and Powell	2009	10.2189/asqu.2009.54.1.90	<i>Administrative Science Quarterly</i>	381
8	Bridge	2008	10.1093/jeg/lbn009	<i>Journal of Economic Geography</i>	370
9	Balconi, Breschi, and Lissoni	2004	10.1016/S0048-7333(03)00108-2	<i>Research Policy</i>	358
10	McMillan, Narin and Deeds	2000	10.1016/S0048-7333(99)00030-X	<i>Research Policy</i>	342

**Source(s):** Output of Biblioshiny Software

Country Scientific Production



**Figure 5.**  
Scientific productions  
of the countries

**Source(s):** Output of Biblioshiny Software

The top ten countries with the greatest number of UIL publications are presented in [Table 5](#), along with the articles' classification as single country publications (SCPs) and multiple country publications (MCPs) based on the authors' country of origin and the total number of citations earned by the nation. In terms of the total number of research publications, the United States, China and the United Kingdom are the top three contributing nations. Furthermore, the top three nations in terms of overall citations of research papers on UIL are the United States, the United Kingdom and Italy.

**Table 5.**Top ten countries  
contributed to the  
scientific publications

Rank	Country	Articles	SCP	MCP	TC	Average article citations
1	United States	149	127	22	7327	49.17
2	China	52	38	14	556	10.69
3	United Kingdom	50	37	13	3,424	68.48
4	Australia	40	30	10	518	12.95
5	India	28	28	0	164	5.86
6	Japan	28	22	06	389	13.89
7	Canada	27	21	06	556	20.59
8	Italy	24	17	07	1,315	54.79
9	Malaysia	23	20	03	148	6.43
10	Korea	16	14	02	725	45.31

**Source(s):** Output of Biblioshiny Software

### 3.6 Outcomes of Bradford's law of scattering and Lotka's law of scientific productivity

Bradford's law estimates the gradually diminishing returns of searching for references in scientific journals. Bradford's law, which was introduced in 1934, explains how the literature on a specific topic is dispersed or spread throughout journals. One formula states that if journals in a subject are divided into three groups based on the number of articles they include, with each group containing around one-third of all articles, the number of publications in each category will be proportional to 1:  $n: n^2$  (Bradford, 1934). According to Bradford's law, all journals were arranged in descending order based on the number of articles on the associated topic. As a result, all publications were split into three categories; core, intermediate and outlying zone of journals. The core zone includes journals that regularly publish articles in the field, the intermediate zone includes journals that focus on the area and the outlying zone includes journals that specialize in topics unrelated to the researcher's area of interest (Shenton and Hay-Gibson, 2009). Consequently, the core zone can be used to find the most pertinent articles that are frequently produced in the pertinent field.

Table 6 displays the number of journals and articles included in each zone of the UIL discipline based on the findings. Accordingly, one-third of the articles (303 articles) in the field of UIL have been published in 36 frequently published productive journals from 553 sources.

Lotks' law was used to determine an author's productivity by considering the total number of published papers. Lotka introduced Lotka's law in 1926. Consequently, Lotka's law specifies how frequently authors publish in a particular field (Lotka, 1926). Table 7 shows the outcomes of Lotka's Law of Scientific Productivity. Accordingly, 1866 (90.6%) authors out of 2060 total authors have written only one article by each author, and 147 (7.1%) authors have written two articles by each author in the field of UIL.

### 3.7 Trending research areas and avenues for future research in the field of UIL

The essence and overview of a research article's key ideas are represented using keywords. Discovering research hotspots, themes, trends and directions can be aided by keyword analysis. The present study used a keywords clustering technique and keywords density

Zones	Number of cumulative articles	Number of sources
Core zone (Zone 1)	303	36
Intermediate zone (Zone 2)	304	218
Outlying zone (Zone 3)	300	299
Total	907	553

**Source(s):** Output of Biblioshiny Software**Table 6.**  
Outcomes of  
Bradford's law of  
scattering

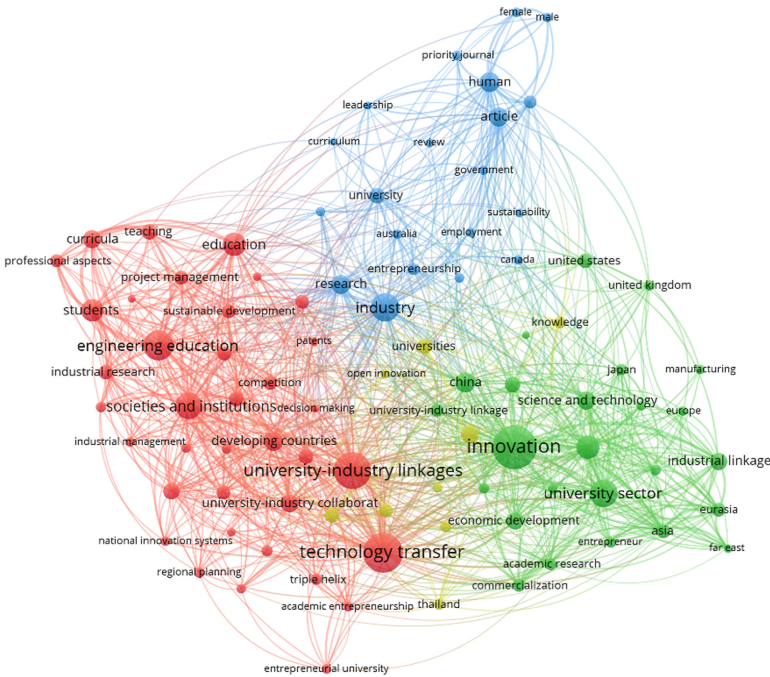
**Table 7.**  
Outcomes of Lotka’s  
law of scientific  
productivity

visualization technique under the keywords co-occurrence analysis using VOSviewer. The primary objective of keyword co-occurrence analysis is to evaluate the association between keywords in a collection of papers to identify trending topics and aid scholars in better understanding the current scientific issues in the field of UIL. The keywords co-occurrence analysis of the current study was performed with VOSviewer. Overall, 4,724 keywords were recognized, 91 of which occurred more than ten times.

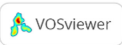
Figure 6 shows the map of keyword clusters based on the keyword co-occurrence analysis. Circles in different colors represent different types of keyword clusters, the size of the circle indicates the occurrences of keywords and the thickness of the connected lines depicts the level of relationship between two keywords. As a result of keywords cluster analysis, the

Articles written	Number of authors	Percentage of authors
1	1,866	90.6%
2	147	7.1%
3	28	1.4%
4	11	0.5%
5	4	0.2%
6	3	0.1%
9	1	0

**Source(s):** Output of Biblioshiny Software

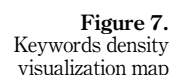


**Figure 6.**  
Map of keyword  
clusters

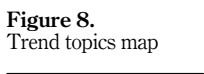


**Source(s):** Output of VOSviewer Software

Figure 8 depicts the trending topics in the field of UIL which has been studied since 2011. In particular, the blue-filled circle on the right side of the figure shows the topic recurrence from 20 to 60; the wider the circle, the greater the frequency of topic occurrences. On the other hand, all the topics on the left side of the figure have been recognized as trending topics in the field of UIL since 2011. These trending topics can be suggested as potential research areas for future researchers in the field of UIL. Based on the trending topic analysis, the most frequently occurring trending topics in the field of UIL are innovation, universities, technology transfer, knowledge transfer, UIL, education and sustainability which are showing comparatively wider circles in Figure 8.



**Source(s):** Output of VOSviewer Software

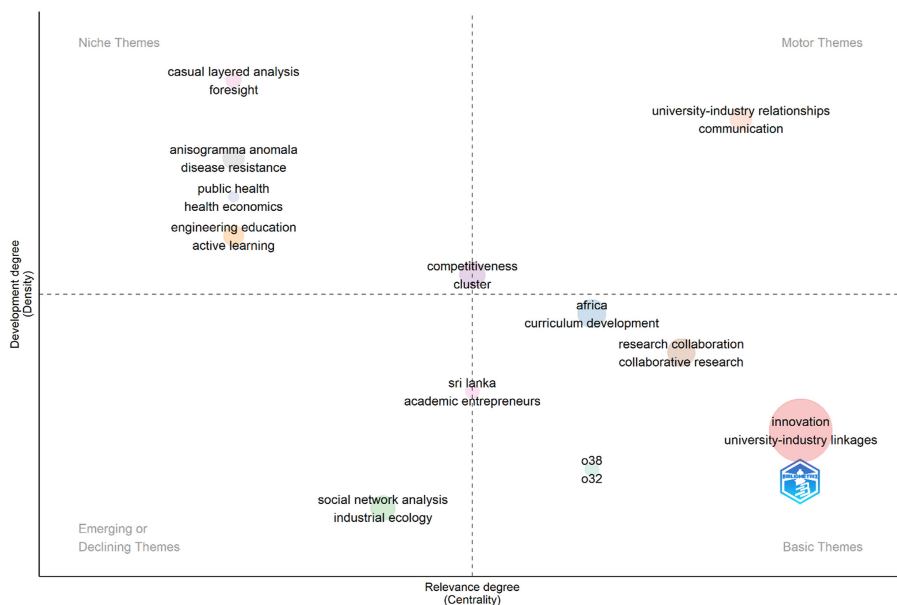


The thematic map of keywords in the discipline of UIL is depicted in Figure 9. A thematic map enables the visualization of four distinct theme typologies based on density and centrality, two dimensions. Centrality is the strength of external linkages to other subjects by using the authors' keyword field, while density is the intensity of internal relationships among all the keywords used to describe the study theme (Xiao *et al.*, 2022). A thematic map comprises four basic themes; niche, motor, emerging or declining and basic. The thematic map of keywords on UIL has been generated using "Walktrap" clustering as that is the best clustering algorithm (Lancichinetti and Fortunato, 2012).

In the right bottom quadrant of the thematic map, the basic themes indicate well-established research themes that are more pertinent to the specific field. Emerging or declining themes in a given topic area are indicated by the themes in the left bottom quadrant of the thematic map. Emerging or declining themes are determined by the researchers based on previous literature. Accordingly, academic entrepreneurship, industrial ecology and social network analysis can be recognized as emerging themes and potential areas for further investigations in the field of UIL. The keywords under niche themes have a growing number of studies that are not highly relevant to the main field of study. Further studies of the motor themes are emphasized because they have not been sufficiently investigated in prior studies (Dissanayake *et al.*, 2022). The keywords in the motor themes quadrant are more relevant and trending in a particular discipline. Accordingly, future researchers are suggested to address the themes under the niche and motor themes including active learning, engineering education, health economics, public health, university-industry relationships, communication, causal layered analysis and competitiveness based on the thematic map of keywords analysis.

#### 4. Conclusion

The scope of UIL is a broad concept that encompasses various subject areas. Therefore, a thorough and quantitative literature evaluation is required to comprehend its development



Source(s): Output of Biblioshiny Software

**Figure 9.**  
Thematic map of  
keywords

and current state, highlight the most productive research areas and predict its future directions. In the present study, a Scopus database for the years 1970–2023 was searched for relevant articles on UIL, which were analyzed using the Biblioshiny software and VOSviewer software. There were 907 articles on UIL by 2060 authors from 553 reputable sources. Research on UIL has grown steadily, with a notable uptick occurring since 2004. The highest number of scientific productions on UIL was recorded in the years 2019 and 2022 with 54 publications produced each year. Based on the level of density and centrality of the thematic map of keywords analysis, academic entrepreneurship, industrial ecology, social network analysis, active learning, engineering education, health economics, public health, university–industry relationships, communication, causal layered analysis and competitiveness are the suggested pathways for future researchers in the field of UIL.

The present study had several limitations. Compared to conventional narrative review approaches, the systematic review procedure has several drawbacks, despite its high transparency and objectivity (Hakala, 2011). The selection of keywords determines the size and nature of the literature database. Only the keywords in the title, abstract and keywords were searched for the current study. If the keyword searches could cover the content of the full article, additional results would have been available in the database. The analysis in the present study depends exclusively on the Scopus database. Scopus is among the best sources for bibliometric publications. However, relying entirely on this database may have made it difficult to locate certain significant ones. Web of Science, Google Scholar database, IEEE and ProQuest are suggested as options for data collection in future research for better investigation.

Moreover, this study considered articles in the English language only. Concentrating only on English-language articles would have missed important contributions provided by articles in other languages. Furthermore, only Biblioshiny software and VOSviewer software were utilized as the primary data analysis tools in the present study. However, alternative tools, such as Bib Excel, Gephi and HistCite, can permit an identical analysis that offers better visualization and can be taken into consideration in future studies. Furthermore, future researchers can use a range of scientific mapping analysis software, such as Cite Space, Sci2tool, SciMat and CiteNet Explore, to gain a clearer understanding of networks between various units of analysis and to describe papers in terms of their popularity and reputation. Despite the aforementioned drawbacks, the current research is regarded as an extensive review of the literature on UIL. This study is extremely beneficial to graduates, practitioners, academics and policymakers in the higher education sector and helps develop the discipline of study.

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