Mapping the Knowledge Structure of University-Industry-Research Collaboration and Its Implications for Student Learning Outcomes: A Bibliometric Analysis

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ABSTRACT

In the context of the knowledge economy and innovation-driven higher education reform, University–Industry–Research (UIR) collaboration has become an important mechanism for promoting knowledge transfer, talent development, and educational quality enhancement.

However, existing studies remain scattered across innovation studies, technology transfer, management, and higher education, and limited attention has been given to the overall knowledge structure of UIR collaboration in relation to Student Learning Outcomes (SLOs) and Quality Assessment Models.

Therefore, this study aims to systematically map the research landscape, intellectual foundations, collaboration patterns, and thematic evolution of this field.A bibliometric analysis was conducted based on 124 English-language publications retrieved from the Web of Science Core Collection from 1983 to 2026. Excel, CiteSpace, and VOSviewer were used for data cleaning, standardization, and visualization.

The analysis covered annual publication growth, core authors, core journals, country-level distribution and collaboration, keyword co-occurrence, keyword clustering, and keyword time evolution.The findings show that research in this field remained limited in the early stage but increased significantly after 2010, indicating growing academic attention.

Thailand and China were identified as major contributors in terms of publication output, while countries such as England, Spain, and the United States showed relatively strong citation influence. The core journal analysis indicates that the intellectual foundation of the field is mainly rooted in innovation studies, technology transfer, management, and public policy.

Keyword analyses further reveal that innovation, knowledge transfer, firms, collaboration, social capital, stakeholders, research projects, and education and skills systems constitute the major research themes.

This study demonstrates that UIR collaboration research has gradually developed into an interdisciplinary field integrating innovation management, collaborative governance, knowledge transfer, and higher education development. The findings provide a systematic reference for future studies on student learning outcomes, educational quality enhancement, and assessment-oriented UIR collaboration.

Keywords: Bibliometric Analysis; University Industry Collaboration; Student Learning Outcomes; Higher Education; VOSviewer

INTRODUCTION

In recent years, with the development of the knowledge economy and the advancement of innovation-driven strategies, collaboration among universities, industries, and research institutions, commonly referred to as University–Industry–Research (UIR) collaboration, has gradually become an important approach for promoting technological innovation and talent cultivation.

UIR collaboration not only facilitates the transformation and application of scientific research outcomes but also plays an increasingly significant role within higher education systems.

From an educational perspective, UIR collaboration provides students with practice-oriented learning environments, such as industrial internships, collaborative projects, and interdisciplinary research activities.

These experiences effectively enhance students' comprehensive abilities, including problem-solving skills, practical competence, and employability, thereby contributing positively to Student Learning Outcomes (SLOs). At the same time, with the continuous development of Outcome-Based Education (OBE), increasing attention has been paid to Quality Assessment Models in higher education.

However, there is still a lack of comprehensive research examining how UIR collaboration systematically influences student learning outcomes and how such impacts can be evaluated through scientific assessment models.

Bibliometrics, as an important scientometric approach, enables researchers to quantitatively analyze academic literature in order to reveal research trends, hotspots, and knowledge structures within a specific field. Through visualization tools such as VOSviewer, bibliometric analysis can further identify collaboration relationships and evolutionary patterns among countries, authors, and journals.

This study addresses the following research questions:

1. What characteristics are reflected in the country-level collaboration network of UIR collaboration research?
2. What are the intellectual foundations and core journal structures within this field?
3. Has the author collaboration network formed a stable core research group?

METHODOLOGY

Data Source

Figure 1.Knowledge Graph Flowchart

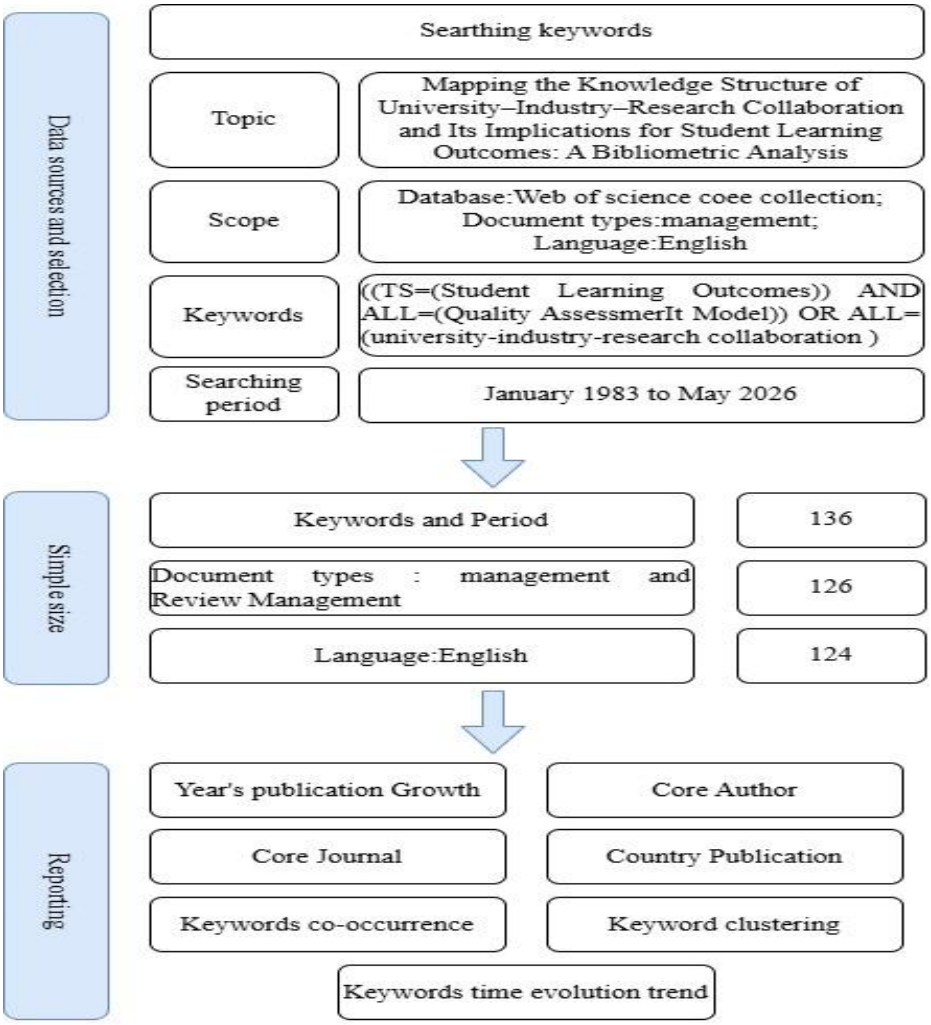


Figure 1 presents the overall workflow of data collection, screening, and analysis in this study. The research framework consists of three main stages: data source selection, sample refinement, and bibliometric analysis**.**

The Web of Science Core Collection (WoSCC) database was selected as the primary data source due to its wide coverage of high-quality and peer-reviewed academic publications. The topic of this study is defined as "Mapping the Knowledge Structure of University–Industry–Research Collaboration and Its Implications for Student Learning Outcomes: A Bibliometric Analysis."

To ensure comprehensive retrieval, a structured keyword strategy was developed. The search query combines key concepts related to student learning outcomes, quality assessment, and university–industry–research collaboration using Boolean operators:

TS = ("Student Learning Outcomes") AND ALL = ("Quality Assessment Model") OR ALL = ("University–Industry–Research Collaboration")

The time span of the data collection ranges from January 1983 to May 2026, allowing for a long-term perspective on the evolution of the research field. Only publications written in English were included to maintain consistency and comparability.

A multi-step filtering process was conducted to ensure the relevance and quality of the dataset.The initial retrieval based on keywords and time period yielded 136 records. After limiting the document types to articles and review papers within the management domain, the dataset was reduced to 126 records. Further restricting the language to English resulted in a final sample of 124 publications.This stepwise screening process ensures that the dataset is both methodologically rigorous and thematically aligned with the research objectives.

Based on the refined dataset, a comprehensive bibliometric analysis was conducted to systematically examine the development and structure of the research field. The analytical framework integrates multiple complementary dimensions to provide a holistic understanding of the domain. Specifically, annual publication growth analysis was employed to reveal the temporal evolution and overall development trends of the field. Core author analysis was conducted to identify influential scholars and uncover underlying collaboration patterns, while core journal analysis helped determine the principal publication outlets shaping the intellectual foundation of the research area. In addition, a country-level analysis was carried out to explore the global distribution of research activities and to map international collaboration networks. To further capture the thematic landscape, keyword co-occurrence analysis was used to identify major research hotspots, and keyword clustering analysis was applied to uncover the underlying thematic structures within the field. Finally, keyword time evolution analysis was utilized to trace the dynamic progression of research topics over time. Taken together, these analytical components enable a systematic and in-depth exploration of the knowledge structure, research evolution, and collaboration patterns within the field, thereby providing a robust foundation for interpreting its current state and future development trajectories.

Data Cleaning

The exported data were cleaned and standardized using Excel and CiteSpace. During this process, author names and institutional affiliations were normalized to eliminate inconsistencies caused by different spelling formats. In addition, synonymous or semantically similar keywords were merged to improve the consistency of keyword analysis. After the standardization process, duplicate records were carefully identified and removed to ensure the uniqueness and reliability of each bibliographic entry.

Data Analysis Methods

This study adopts a bibliometric approach to analyze the preprocessed literature data using CiteSpace and VOSviewer. These visualization tools are widely applied in bibliometric research to explore knowledge structures, research hotspots, and evolutionary trends within a specific academic field. In particular, CiteSpace is an effective scientific mapping tool that facilitates the identification of intellectual structures and emerging developments in scholarly research.

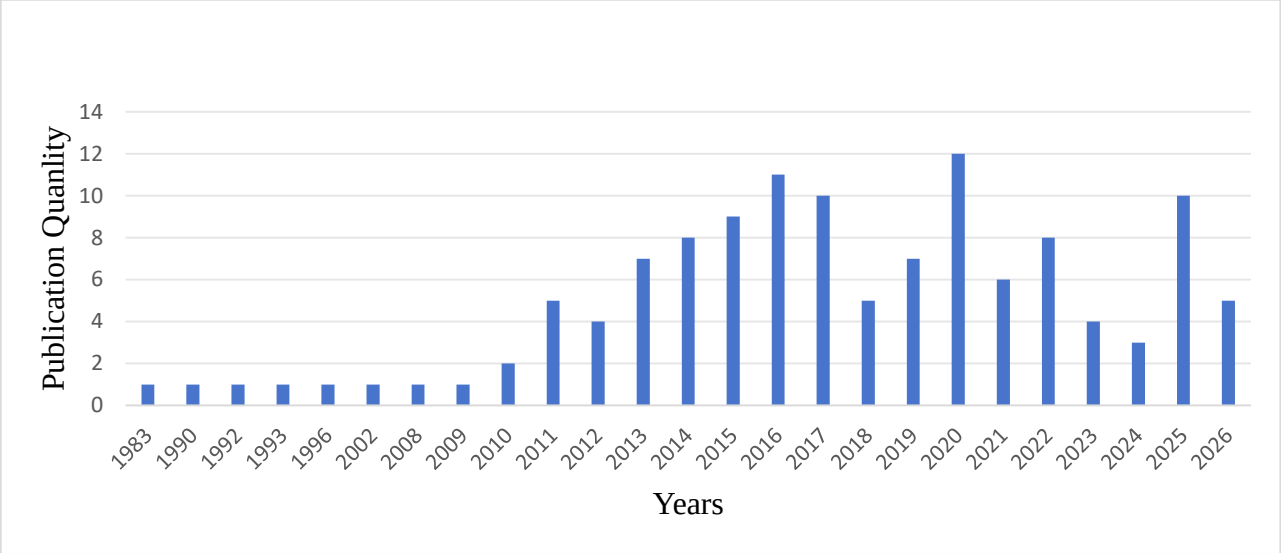
RESULT

Descriptive Statistics

The 124 papers utilized in this study were authored by 360 researchers from 180 institutions across 32 countries, published in 97 journals, with citations sourced from 2,671 journals across 5,172 references.

Figure 2 presents the annual publication distribution in the field of university–industry–research (UIR) collaboration, student learning outcomes, and quality assessment models from 1983 to 2026. Overall, the publication trend shows a gradual increase followed by rapid growth, indicating rising academic attention to the field over time. During the early stage (1983–2009), the number of publications remained relatively low, suggesting that the field was still in an exploratory phase. From 2010 onwards, publication output increased significantly, reaching major peaks in 2016 and 2020, which reflects the growing global emphasis on innovation-driven education, university–industry collaboration, and outcome-based learning in higher education. Although slight fluctuations can be observed after 2020, the overall trend remains active, indicating that research related to UIR collaboration, student learning outcomes, and quality assessment continues to develop as an important interdisciplinary research area.

Figure 2.Distribution Diagram of Paper Publication Time



Bibliometric analysis of the author

Through the analysis of authorship patterns, it is possible to identify the representative scholars and core research groups within a specific field. Price (1963) proposed the well-known Price's Law, which states that approximately 50% of the publications in a given research field are produced by the square root of the total number of authors in that field. This theory has been widely applied in bibliometric studies to determine whether a relatively stable core author group has been established within a research domain.

In the formula, n(x)represents the number of authors who have published xxx papers, while $I=n_{max}$ refers to the number of publications produced by the most productive author in the field. According to the CiteSpace analysis, the maximum number of publications by a single author was six, where N represents the total number of authors and mmm denotes the minimum number of publications required for a core author. Based on Price's Law, the minimum publication threshold for identifying core authors can be calculated as $m=0.749\times\sqrt{6}\approx2$. Therefore, authors with two or more publications were identified as core authors in this study. A total of 60 core authors were identified, accounting for 48.38% of all authors, which is close to the 50% standard proposed by Price's Law. The calculated results generally conform to the theoretical expectations of Price's Law, indicating that research on university–industry–research collaboration has gradually formed a relatively stable core author group. Table 1 presents the highly productive authors with more than four publications in this field.

Table 1. Bibliometric analysis of the author

Author	Documents	Citations	Average Citation/Publication
hemmert, martin	6	280	47
abramo, giovanni	5	165	33
d'angelo, ciriaco andrea	5	165	33
kopermsub, phikunthong	5	106	21
utama-ang, niramon	5	106	21
pechyen, c.	4	85	21
thakeow, prodpran	4	78	20
ummartyotin, s.	4	85	21
bstieler, ludwig	3	246	82
okamuro, hiroyuki	3	227	76

Table 1 presents the most productive and influential authors in the field of university–industry–research (UIR) collaboration, student learning outcomes, and quality assessment research. According to Price's Law, the field has gradually formed a relatively stable core author group. Among the identified scholars, Hemmert Martin ranks first with six publications and a total of 280 citations, indicating both high productivity and strong academic influence. Abramo Giovanni and D'Angelo Ciriaco Andrea each published five papers with 165 citations, demonstrating consistent contributions to the field. In terms of average citation per publication, Bstieler Ludwig achieved the highest impact with an average of 82 citations per paper, followed by Okamuro Hiroyuki with 76 citations per publication, suggesting that their studies possess substantial scholarly influence despite a relatively smaller number of publications. Overall, the results indicate that the field is characterized by a combination of highly productive authors and high-impact scholars, reflecting the emergence of an increasingly mature and influential research community.

Bibliometric analysis of the journal

Through the analysis of journal distribution characteristics, it is possible to identify the core journals and their academic influence within a specific research field. In bibliometric studies, Bradford's Law is widely applied to classify journals into core, secondary, and peripheral zones, thereby revealing the relative importance of different journals in knowledge dissemination. Based on this theory, researchers can further determine which journals play a dominant role in supporting scholarly development within a particular academic discipline.

Table 2. Bibliometric analysis of the journal

source	Documents	Citations	Average Citation/Publication
journal of technology transfer	9	254	28
chiang mai journal of science	5	10	2
science and public policy	4	42	11

carbohydrate polymers	2	87	44
technology analysis & strategic management	2	80	40
technovation	2	203	102
industrial and corporate change	1	144	144
international entrepreneurship and management journal	1	106	106
journal of economic geography	1	261	261
scientific world journal	1	145	145

Table 2 presents the core journals contributing to the research field of university–industry–research (UIR) collaboration, student learning outcomes, and quality assessment. Among the listed journals, the Journal of Technology Transfer ranks first in publication output with nine documents and 254 citations, indicating its central position and strong academic influence within the field.

The Chiang Mai Journal of Science follows with five publications, although its citation impact remains relatively limited. Journals such as Science and Public Policy and Technology Analysis & Strategic Management also demonstrate notable influence, reflecting the growing intersection between innovation policy, technology management, and higher education research.

In terms of citation impact, Journal of Economic Geography recorded the highest average citation per publication (261), despite publishing only one article within the dataset, suggesting that its contribution has significant scholarly influence. Similarly, Technovation and Industrial and Corporate Change exhibit exceptionally high average citation rates, highlighting their importance as foundational journals in innovation and collaboration studies.

Overall, the journal distribution indicates that the field is strongly interdisciplinary, integrating perspectives from technology transfer, innovation management, public policy, and higher education research.

Bibliometric analysis of the country

Table 3. Bibliometric analysis of the country

country	Documents	Citations	Average Citation/Publication
thailand	42	716	17
peoples r china	16	98	6
usa	11	490	45
italy	7	320	46
england	6	469	78
south korea	6	280	47
japan	5	275	55
spain	4	359	90

france	4	100	25
norway	4	117	29

Table 3 presents the country-level distribution of publications in the field of university–industry–research (UIR) collaboration, student learning outcomes, and quality assessment. The results indicate that Thailand is the most productive country, contributing 42 publications with a total of 716 citations, demonstrating its dominant position in terms of research output. China ranks second with 16 publications; however, its average citation per publication remains relatively low, suggesting that although research productivity is increasing, the international academic influence of the publications is comparatively limited.

In contrast, several Western countries exhibit stronger citation impact despite lower publication output. England recorded an average of 78 citations per publication, while Spain achieved the highest average citation rate of 90 citations per paper, indicating the high quality and academic influence of their research contributions. The United States, Italy, South Korea, and Japan also demonstrate substantial citation performance, reflecting their important roles in advancing research related to innovation collaboration and higher education development.

Overall, the findings reveal an uneven global distribution of research productivity and academic influence. Asian countries, particularly Thailand and China, dominate in publication quantity, whereas European countries tend to achieve higher citation impact, suggesting differences in research visibility, international collaboration, and scholarly influence across regions.

Figure 3. international collaboration network

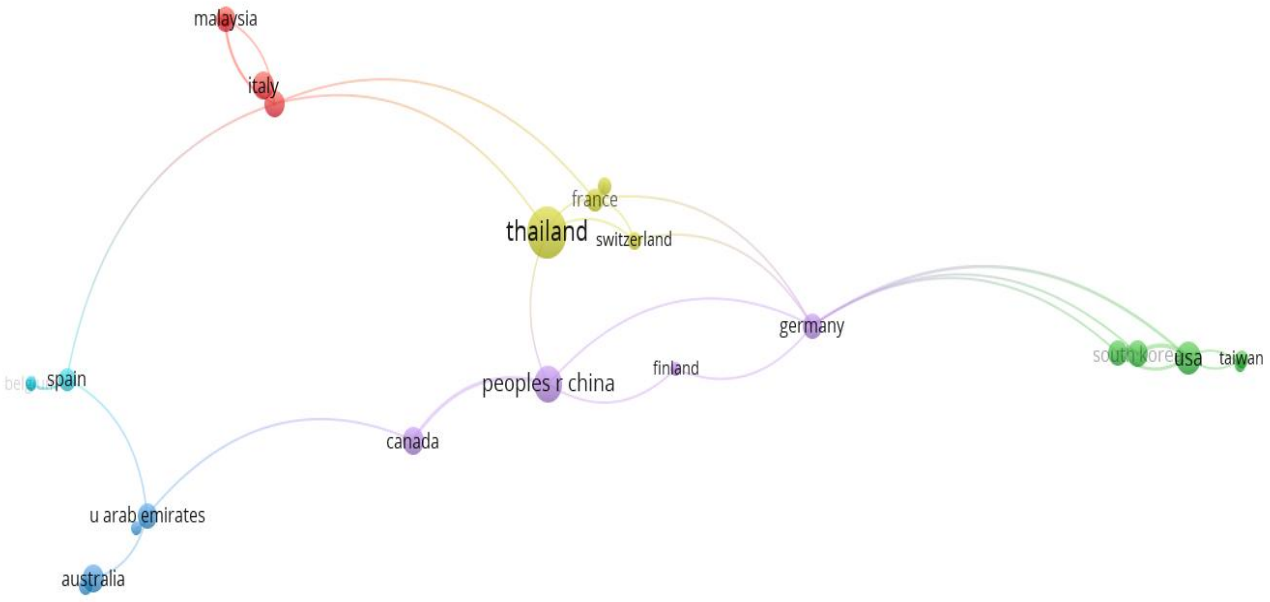


Figure 3 illustrates the international collaboration network in the field of university–industry–research (UIR) collaboration, student learning outcomes, and quality assessment. Each node represents a country, while the size of the node reflects the level of research participation and publication activity. The links between nodes indicate collaborative relationships among countries, with thicker and denser connections representing stronger collaboration intensity.

The network demonstrates a clear pattern of regional clustering and uneven global collaboration. Thailand appears as one of the most prominent nodes in the network, indicating its significant contribution and active

participation in this research area. Thailand maintains strong collaborative relationships with several European countries, particularly France and Switzerland, suggesting its important role in connecting Asian and European research activities.

China also occupies a central position within the collaboration network. Its connections with Germany, Finland, and Canada indicate increasing international engagement and expanding academic cooperation. Germany functions as an important bridging node linking European and Asian research groups, thereby enhancing international knowledge exchange within the field.

Another notable collaboration cluster is formed by the United States, South Korea, and Taiwan, reflecting strong regional cooperation in East Asia and North America. Meanwhile, countries such as Italy and Malaysia, as well as Australia and the United Arab Emirates, form smaller collaborative subnetworks, indicating the presence of localized research partnerships.

Keyword Analysis

Keyword Co-occurrence Relationships

Figure 4.Keyword Co-occurrence network

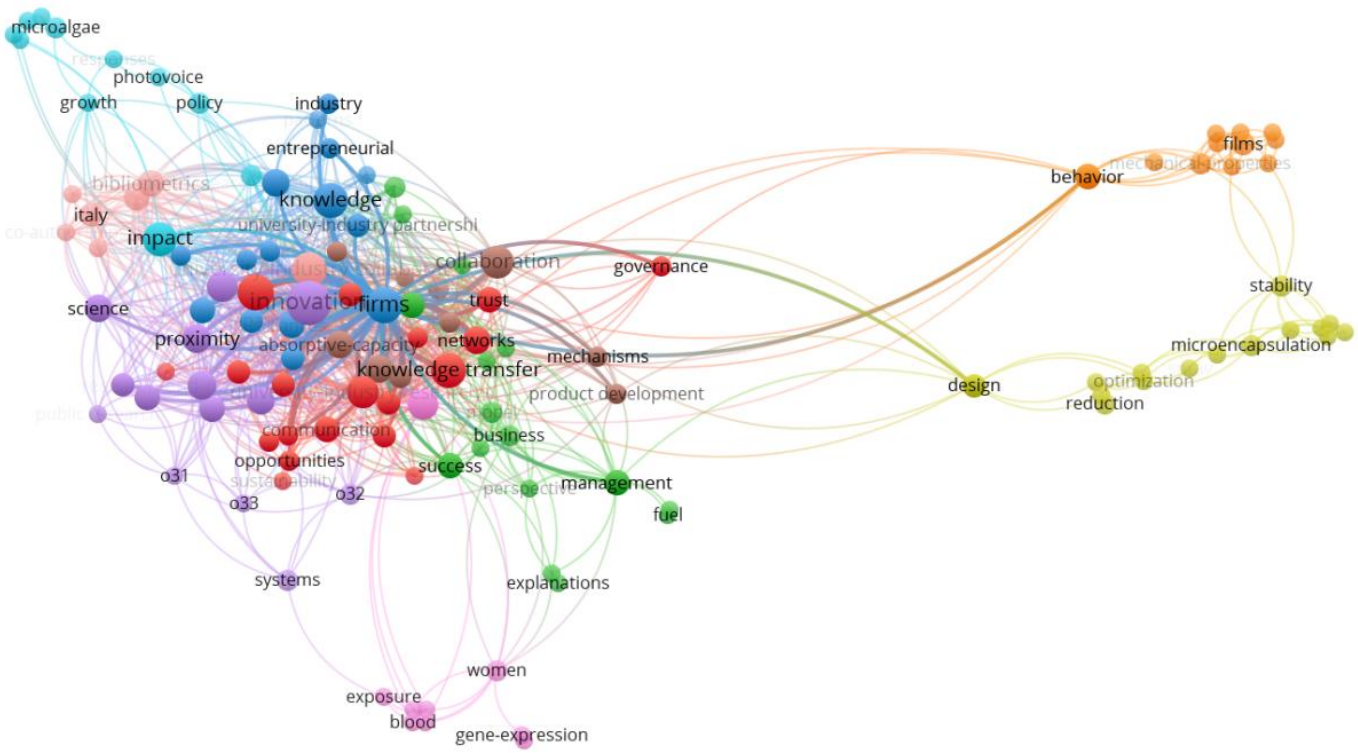


Figure 4 presents the keyword co-occurrence network of research related to university–industry–research (UIR) collaboration, student learning outcomes, and quality assessment. The size of each node reflects the frequency of keyword occurrence, while the links between nodes indicate the strength of co-occurrence relationships. Different colors represent distinct thematic groups within the research field.

Table 4. Keyword co-occurrence relationships

Keyword Node	Node Characteristics	Academic Role
Innovation	The largest node in the network, located at the center and strongly connected with multiple keywords, showing high centrality.	Indicates that "innovation" is the core theme of the research field and serves as the conceptual foundation linking university collaboration, knowledge transfer, and organizational cooperation.
Knowledge Transfer	Closely connected with keywords such as "innovation," "firms," and "networks," functioning as a core bridging node in the network.	Reflects the importance of knowledge sharing and technology transfer among universities, industries, and research institutions, serving as a key mechanism for collaborative innovation and capability enhancement.
Firms	A high-frequency node forming dense connections with innovation-, collaboration-, and management-related keywords.	Demonstrates that firms play a significant role in university–industry–research collaboration and contribute substantially to innovation performance and talent development.
Knowledge	Located in the core region of the network and strongly associated with keywords such as "industry" and "entrepreneurial."	Highlights the central value of knowledge production, knowledge flow, and knowledge application in collaborative innovation systems, reflecting the trend toward knowledge-driven development.
Networks	Strongly linked with keywords such as "trust," "collaboration," and "knowledge transfer."	Indicates that collaborative networks and inter-organizational relationships are essential for resource sharing, collaborative innovation, and long-term partnership development.
Trust	Broadly connected within the network and positioned between organizational collaboration and knowledge transfer.	Suggests that trust mechanisms form an important social capital foundation for maintaining the stability and efficiency of university–industry–research collaboration.
Governance	Closely associated with keywords such as "mechanisms" and "management," forming a management-oriented thematic group.	Reflects increasing scholarly attention to governance structures, coordination mechanisms, and institutional design in collaborative partnerships.
Management	Forms cluster relationships with keywords such as "business," "success," and "mechanisms."	Indicates that management strategies and organizational coordination capabilities are critical factors influencing collaboration performance.

Impact	Strongly co-occurs with keywords such as “innovation,” “science,” and “policy.”	Demonstrates growing academic concern regarding the impact of university–industry–research collaboration on innovation performance, educational quality, and social development.
Policy	Positioned at the intersection of knowledge and industrial research, linked with keywords such as “industry” and “growth.”	Highlights the important role of government policies and institutional support in promoting collaborative development among universities, industries, and research institutions.
Collaboration	Connected with multiple thematic clusters and exhibiting strong bridging characteristics.	Reflects that cross-organizational collaboration has become an important approach for promoting knowledge innovation, scientific development, and talent cultivation.
Absorptive Capacity	Closely related to “innovation,” “firms,” and “knowledge transfer.”	Emphasizes that the ability to absorb, integrate, and apply external knowledge plays a vital role in determining the effectiveness of collaborative innovation.

Keyword co-occurrence relationships reflect the internal connections and knowledge structure among different research topics within a specific field. The keyword co-occurrence network shows that terms such as “Innovation,” “Knowledge Transfer,” “Firms,” “Knowledge,” and “Networks” occupy central positions in the network, with large node sizes and dense connections, indicating that these themes constitute the core focus of current research on university–industry–research (UIR) collaboration.

Among them, “Innovation” serves as the central node and demonstrates strong connections with high-frequency keywords such as “Knowledge Transfer,” “Collaboration,” and “Impact,” suggesting that innovation-driven development and knowledge transfer are the key theoretical foundations driving the evolution of the field.

At the same time, keywords such as “Networks,” “Trust,” and “Social Capital” form closely connected relationships, indicating increasing scholarly attention to collaborative networks, trust mechanisms, and social capital in promoting collaborative innovation among universities, industries, and research institutions. This suggests that UIR collaboration research has gradually expanded beyond technological innovation and resource sharing toward organizational relationships, governance structures, and collaboration efficiency.

In addition, keywords such as “Governance,” “Management,” and “Policy” constitute a management- and institution-oriented research theme, reflecting a shift in research focus from purely innovation performance toward collaborative governance, policy support, and organizational coordination mechanisms. Meanwhile, the emergence of themes related to “Education and Skills System” indicates growing concern regarding student learning outcomes, skills development, and higher education quality enhancement.

Keyword clustering relationship

Figure 5.Keyword clustering network

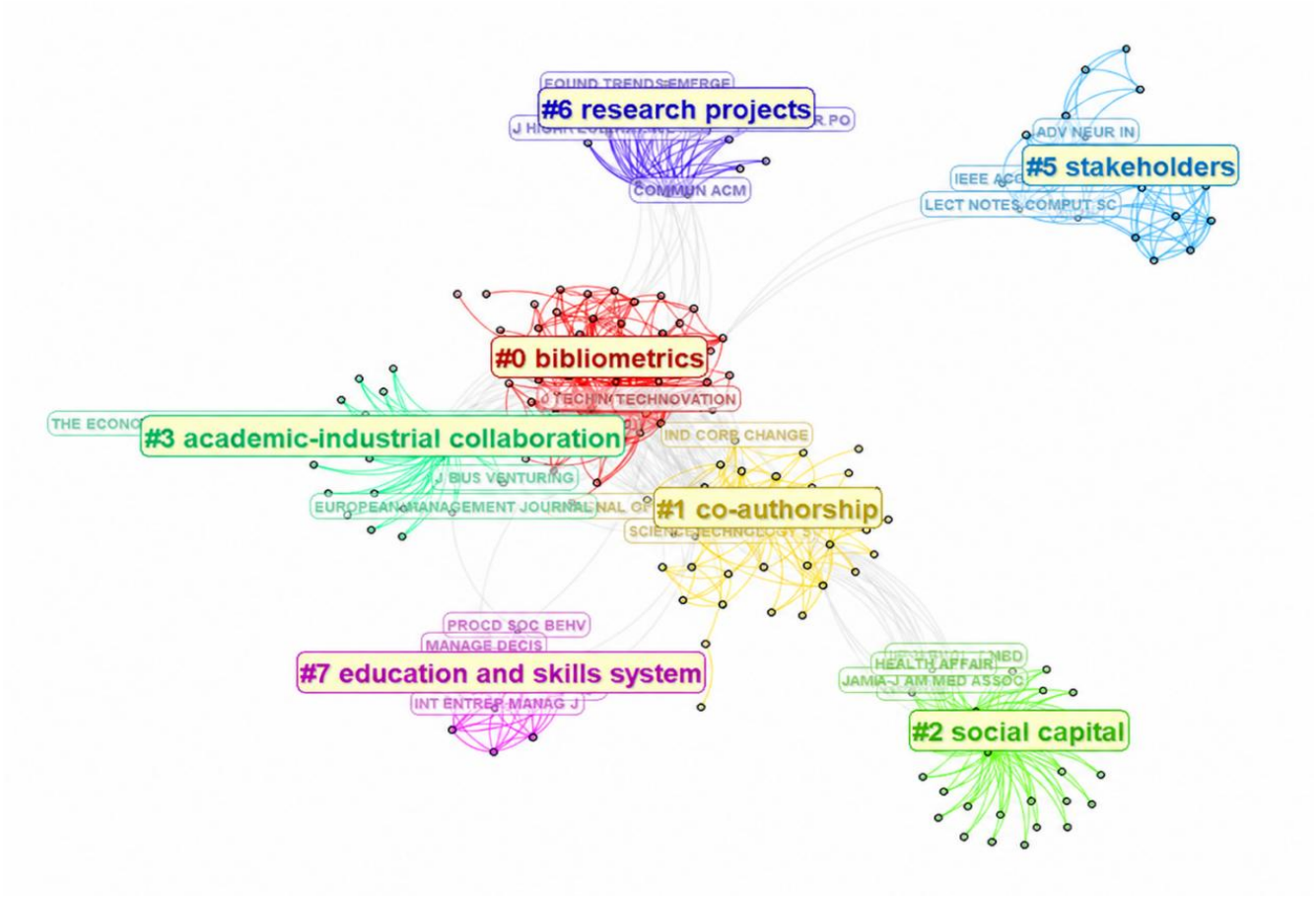


Figure 5 presents the keyword clustering network generated by CiteSpace, which reveals the major thematic structures and intellectual foundations of research on university–industry–research (UIR) collaboration, student learning outcomes, and quality assessment. The clustering results demonstrate a relatively high level of network consistency and thematic concentration, indicating that the field has developed several interconnected yet distinct research directions.

This figure presents eight major keyword clusters, labeled from #0 to #7, with each cluster representing a specific research theme or direction. The name of each cluster is identified by the keyword that shows the strongest association within the cluster, thereby representing the thematic core of that particular research area.

Table 5. Keyword clustering relationship

Cluster ID	Cluster Theme	Cluster Description
#0	Bibliometrics	This cluster mainly focuses on bibliometric analysis and knowledge mapping, emphasizing the use of visualization tools such as CiteSpace and VOSviewer to analyze the knowledge structure, research hotspots, and development trends of the UIR collaboration field. It reflects the increasing importance of systematic and visualized scientific knowledge analysis in this research area.

#1	Co-authorship	This cluster mainly involves co-authorship networks and scientific collaboration relationships, focusing on collaboration patterns, knowledge sharing, and research productivity among scholars. It highlights the importance of institutional and international cooperation within the research field.
#2	Social Capital	This cluster emphasizes the role of social capital in university–industry–research collaboration, focusing on how organizations improve innovation capability and collaboration efficiency through resource sharing, relationship building, and social connections.
#3	Academic-Industrial Collaboration	This cluster represents one of the core themes in the research field, mainly focusing on collaborative relationships between academia and industry, including knowledge transfer, technological innovation, partnership development, and innovation ecosystem construction.
#5	Stakeholders	This cluster focuses on the participation of multiple stakeholders, including universities, enterprises, governments, and social organizations in university–industry–research collaboration. It emphasizes the importance of collaborative governance and multi-actor cooperation.
#6	Research Projects	This cluster mainly centers on collaborative research projects, highlighting project-driven innovation practices, cooperative research, and cross-organizational collaboration mechanisms. It reflects the significant role of project-based collaboration in promoting knowledge innovation.
#7	Education and Skills System	This cluster focuses on education systems and skills development, emphasizing student learning outcomes (SLOs), talent cultivation, employability, and practical skill development. It reflects the application value of university–industry–research collaboration in higher education and competency development.

The keyword clustering results reveal that research on university–industry–research (UIR) collaboration has developed into a diversified and interdisciplinary knowledge structure. The major clusters focus on bibliometric studies, academic–industrial collaboration, co-authorship networks, social capital, stakeholders, research projects, and education and skills systems. Among these, academic–industrial collaboration and knowledge transfer constitute the core themes of the field, highlighting the importance of innovation, collaborative networks, and organizational cooperation. At the same time, clusters related to social capital and stakeholders indicate increasing attention to trust, governance, and multi-actor participation in collaborative innovation systems. In addition, the emergence of the "education and skills system" cluster reflects a growing research interest in student learning outcomes, employability, and talent development within higher education contexts. Overall, the

clustering results demonstrate that the field has gradually evolved from traditional innovation and industry-oriented research toward a broader framework integrating innovation management, educational development, collaborative governance, and knowledge-sharing systems.

Time Evolution Trend of Keywords

Figure 6.Time Evolution Trend of Keywords

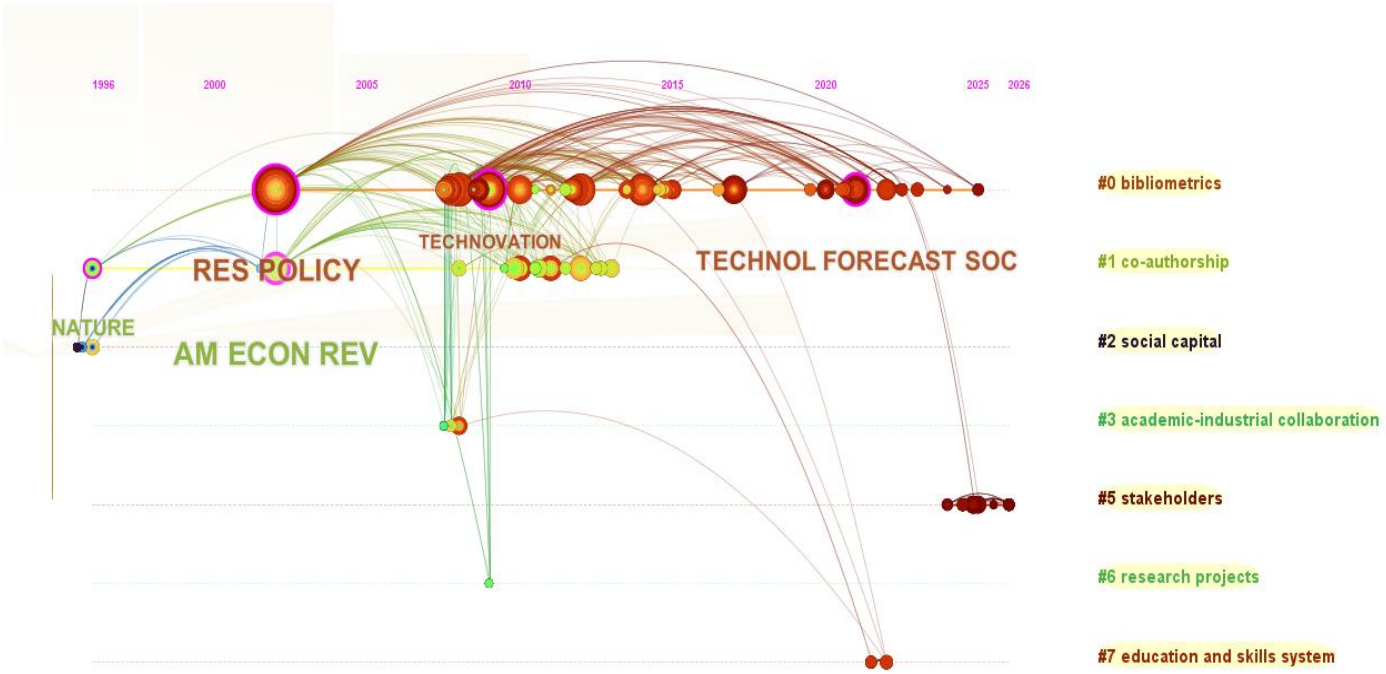


Figure 6 illustrates the temporal evolution of research topics in the field of university–industry–research (UIR) collaboration, student learning outcomes, and quality assessment from 1996 to 2026. The timeline visualization reveals a clear shift in research focus from traditional innovation and policy-oriented studies toward more collaborative, interdisciplinary, and education-centered themes.

During the early stage (1996–2005), the field was primarily dominated by foundational journals and themes such as Research Policy, Nature, and American Economic Review, indicating that early studies mainly concentrated on innovation systems, economic development, and science policy. Between 2005 and 2015, research attention gradually expanded toward themes related to technology transfer, academic–industrial collaboration, and co-authorship networks, reflecting increasing interest in collaborative innovation and knowledge exchange mechanisms.

After 2015, the field entered a more diversified and interdisciplinary development phase. Topics related to bibliometrics, stakeholders, and research projects became increasingly prominent, suggesting that scholars began to focus not only on collaboration outcomes but also on governance structures, partnership management, and scientific collaboration networks. At the same time, the emergence of the "education and skills system" cluster indicates growing attention to talent cultivation, employability, and student learning outcomes within higher education contexts.

In recent years, the timeline demonstrates that research has become more interconnected and application-oriented, with stronger integration between innovation management, educational development, and collaborative governance. Overall, the evolution trend suggests that the field has gradually matured from a relatively narrow

innovation-focused domain into a comprehensive interdisciplinary research area emphasizing knowledge transfer, stakeholder collaboration, and educational quality enhancement.

The keyword clustering network reveals strong interconnections among different research themes, indicating that university–industry–research (UIR) collaboration has developed into an increasingly interdisciplinary field. Among all clusters, "#0 bibliometrics" occupies the central position and connects closely with other clusters, suggesting that bibliometric methods play an important role in analyzing collaboration patterns and knowledge structures. A strong relationship can also be observed between "#3 academic-industrial collaboration" and "#1 co-authorship," indicating that university–industry cooperation is closely associated with scientific collaboration and knowledge-sharing networks. In addition, "#2 social capital" is strongly linked to collaboration-related clusters, highlighting the importance of trust and relational networks in promoting effective cooperation. The connection between "#7 education and skills system" and collaboration clusters further suggests that educational development, employability, and student learning outcomes have become important components of UIR research. Overall, the close relationships among clusters demonstrate that the field has gradually evolved from a narrow focus on university–industry partnerships toward a broader framework integrating innovation, governance, social capital, and educational development.

DISCUSSION AND IMPLICATIONS

Discussion

The bibliometric findings provide important insights into the development patterns, intellectual structure, and collaboration characteristics of research on university–industry–research (UIR) collaboration, student learning outcomes, and quality assessment. Overall, the results indicate that the field has gradually evolved into an interdisciplinary and increasingly internationalized research area, although several structural imbalances remain evident.

Regarding the country collaboration network, the findings reveal that the field is characterized by clear regional concentration and unequal distribution of academic influence. Asian countries, particularly Thailand and China, dominate in terms of publication output, indicating the growing attention given to UIR collaboration and innovation-oriented higher education within developing and emerging economies. However, countries such as England, Spain, and the United States demonstrate higher average citation impact, suggesting stronger international visibility and academic influence. The collaboration network further shows that international cooperation mainly occurs within regional clusters rather than through globally integrated partnerships. This suggests that although the field has become increasingly internationalized, cross-regional academic collaboration remains relatively limited and fragmented.

In terms of intellectual structure and core journal distribution, the results demonstrate that the field is strongly rooted in innovation and technology management research while gradually expanding toward education and policy studies. Core journals such as Journal of Technology Transfer, Technovation, and Science and Public Policy occupy central positions within the citation network, indicating that knowledge transfer, innovation systems, and collaborative governance constitute the main theoretical foundations of the field. At the same time, the emergence of clusters related to education and skills systems reflects a gradual shift toward student-centered perspectives, particularly concerning employ ability, learning outcomes, and quality enhancement in higher education. This finding suggests that the research field is moving beyond traditional economic and industrial concerns toward a more comprehensive understanding of the educational implications of UIR collaboration.

The author collaboration analysis further indicates that the field has formed a relatively stable core group of influential scholars. Consistent with Price's Law, a small number of highly productive authors contribute a substantial proportion of the research output. Core authors such as Hemmert Martin and Abramo Giovanni occupy central positions within the collaboration network, reflecting their strong academic influence and contribution to knowledge development. Nevertheless, the collaboration network also reveals that cooperation among researchers remains concentrated within several relatively small clusters, with limited large-scale international collaboration. This pattern suggests that although the field is becoming increasingly mature, research collaboration still lacks broader global integration and interdisciplinary connectivity.

Importantly, while the bibliometric results successfully map the knowledge structure, thematic evolution, and collaboration patterns of the field, they do not directly explain the underlying mechanisms through which UIR collaboration influences student learning outcomes or contributes to educational quality enhancement. For example, the emergence of themes such as "education and skills system," "stakeholders," and "academic–industrial collaboration" indicates growing scholarly concern with the educational value of UIR cooperation, but bibliometric evidence alone cannot determine how specific collaborative practices—such as industry-embedded projects, enterprise mentoring, internship arrangements, or co-designed curricula—translate into measurable student outcomes. Therefore, the findings should be understood as providing a macro-level research landscape that identifies important directions for deeper theoretical and empirical investigation.

Implications

The bibliometric results demonstrate that research on UIR collaboration, student learning outcomes, and quality assessment has experienced continuous expansion and thematic diversification over time. The field has gradually developed from an innovation-oriented research area into a broader interdisciplinary domain integrating innovation management, governance, collaboration networks, educational development, and quality assessment. These findings not only reveal the current research landscape but also highlight several directions for future inquiry.

First, future research should strengthen cross-national and interdisciplinary collaboration in order to address the currently fragmented structure of the field and develop a more globally integrated understanding of UIR related educational practices. Second, as the educational implications of UIR collaboration are becoming increasingly visible in the literature, further studies should move beyond descriptive mapping and examine the actual pathways through which UIR collaboration affects student learning outcomes, employ ability, and educational quality. In this regard, future research would benefit from combining bibliometric findings with qualitative, quantitative, or mixed-method empirical approaches. Qualitative case studies and interviews could be used to explore how different stakeholders perceive the educational value of UIR collaboration, while survey-based or longitudinal empirical studies could test the relationships among UIR mechanisms, learning processes, student outcomes, and quality assessment indicators. Such integration would enable researchers to move from identifying research trends to explaining causal processes and evaluating practical effectiveness.

Overall, combining bibliometric mapping with in-depth qualitative or empirical investigation would provide a more comprehensive understanding of the field. It would not only clarify the intellectual development of UIR collaboration research but also generate stronger evidence for designing student-centered quality assessment frameworks and improving the educational effectiveness of university–industry–research partnerships.

CONCLUSION

This study applied bibliometric methods to analyze the research landscape of university–industry–research (UIR) collaboration, student learning outcomes, and quality assessment based on data retrieved from the Web of Science Core Collection. Using VOSviewer and CiteSpace, the study examined publication trends, country collaboration networks, core authors, influential journals, keyword co-occurrence, and thematic evolution.

The findings indicate that the field has experienced continuous growth and increasing academic attention, particularly after 2010. The results also reveal that research in this area is highly interdisciplinary, integrating innovation studies, technology transfer, collaborative governance, and higher education research. In addition, the collaboration network demonstrates regional concentration, while the author and journal analyses identify several influential scholars and core publication outlets shaping the field's intellectual foundation.

Overall, the study provides a systematic overview of the knowledge structure and development trajectory of UIR collaboration research. The findings contribute to a better understanding of emerging research trends and offer useful directions for future studies related to educational quality enhancement, innovation collaboration, and student learning outcomes.

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