

ANALYSIS OF EVOLUTIONARY PROCESS IN HIGHER EDUCATION QUALITY IN THE CONTEXT OF TRANSFORMATION ECONOMY

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Annotation. The development level of higher education is a significant indicator of a country's development strength and potential, as well as a crucial support for the promotion of economic transformation and upgrading. To achieve a more profound understanding of higher education quality in the context of transformation economy, this paper analyses a total of 1,616 papers retrieved from the Web of Science (WoS) from multiple perspectives. The present study analyses the evolution of the common keywords in order to identify hot topics in different periods. By combining citation network analysis and burst detection methods, this study identified the core literature and knowledge diffusion pathways in the research field. The characteristics of centralisation and diversification in higher education research topics were examined by employing strategic analysis. Finally, the study discussed the limitations of current research and the proposed directions for future exploration. This paper provides scholars with an overview of the development process in the higher education domain under transformation economy background, thereby facilitating a comprehensive grasp of the state-of-the-art research.

Keywords: transformation economy, higher education, keywords, burst analysis, strategic analysis.

JEL classification: I21, I23, P2.

Introduction

Higher education is a form of education conducted on the basis of secondary education, aimed at cultivating talents with advanced capabilities, innovative thinking, and a sense of social responsibility through its functions of teaching, research, and societal service. Higher education is not only critical for individual development but also serves as a key driver of national and socio-economic progress (Hannum, Buchmann, 2005). Teaching in

higher education is a vital activity for nurturing high-level professionals, advancing knowledge innovation, and promoting social progress. Its essence lies in achieving the transmission of knowledge, the development of skills, and the shaping of values (Filippakou, Tapper, 2008). Higher education is characterised by complexity, dynamism, and a practice-oriented approach. It involves not only the optimisation and updating of teaching content but also continuous innovation and development in teaching methods and philosophies. In recent years, with the rapid changes in the socio-economic and technological environment, the philosophy of higher education teaching has undergone a significant transformation, shifting from knowledge transmission to a focus on capability development and holistic growth (Frank, Meyer, 2007). Modern teaching theories increasingly emphasise student-centred approaches and the cultivation of innovation and practical abilities. Meanwhile, innovations in higher education teaching methods are increasingly grounded in learners' individualised needs and technological support, evolving into adaptive, technology-driven teaching models. This process adheres to the fundamental principles of scientific rigor, interactivity, and sustainability (Rajnoha *et al.*, 2019).

Against the backdrop of economic transformation, the reform of higher education has become an inevitable trend. The digital economy, driven by information technology, has accelerated the development of a knowledge society, leading to profound changes in educational models, resource allocation, and learning methods (Gries, Naudé, 2010; Shi, Wei, 2024; Zhang *et al.*, 2024). As critical hubs for knowledge production and dissemination, universities must adapt to this trend by innovating teaching methods and optimising educational systems to cultivate high-quality talents capable of meeting the demands of a digital and intelligent society (Zeng *et al.*, 2022). However, this transformation faces numerous challenges, including the deep integration of technology and pedagogy, the enhancement of equity and efficiency in educational resource distribution, and the redefinition of the role of educators. Therefore, exploring the pathways for higher education reform and identifying key research priorities in the context of the digital economy hold significant theoretical and practical value (Martin, 2016; Dmitrovic, Vida, 2010).

Bibliometric analysis has become a fundamental method in academic research, widely used in fields such as finance and psychology to systematically review the development of research areas, identify emerging trends, and reveal thematic structures (Xia *et al.*, 2023; Díaz-García *et al.*, 2022). This method enables a comprehensive mapping of the intellectual landscape, revealing the evolution of academic topics over time. The primary techniques of bibliometric analysis include keyword analysis, timeline analysis, and burst detection. Keyword analysis helps identify the central themes within a research field and the relationships between these themes. For example, Xia *et al.* (2023) applied keyword analysis to track the rise of topics such as “digital transformation” and “artificial intelligence” in the context of the digital economy. Timeline analysis traces the chronological development of research topics, allowing for a better understanding of how academic attention shifts over time. Yu *et al.* (2022) used timeline analysis to determine the evolution of keywords in the field of intuitionistic fuzzy. Burst detection identifies sudden increases in the frequency of specific topics or papers, highlighting emerging research trends. Vanani and Jalali (2017) conducted an analytical evaluation of emerging scientific trends in business intelligence using the burst detection algorithm.

This paper aims to systematically review and analyse the research progress and development trends in the field of higher education teaching in the context of digital transformation. It seeks to address the following key questions:

(1) Based on bibliometric methods, what are the characteristic keywords in the higher education field in the context of the transformation economy, and what are the trending topics? Bibliometric methods offer a systematic approach to mapping the key themes in higher education research, helping to identify the most relevant keywords and topics that reflect the ongoing impact of economic reforms on education. By examining

the frequency and co-occurrence of keywords in the literature, it is possible to uncover the critical areas of focus and track the emerging trends within this evolving field.

(2) How have the trending topics in this field evolved from a dynamic perspective? Understanding how research topics evolve over time allows the identification of the shifting priorities within higher education research. In response to economic reforms, the focus of higher education research has likely moved from expanding access to education to addressing issues related to quality, innovation, and the integration of digital technologies.

(3) By integrating strategic analysis and burst detection, what are the key themes in higher education research under the influence of the digital economy? Strategic analysis and burst detection are tools that can help pinpoint the emerging themes and sudden shifts in research activity. These methods allow to identify new and rapidly developing topics that are gaining attention in the context of economic reforms. By applying these tools, the present study aims to uncover the core areas of research that are shaping the future of higher education in the digital economy.

(4) What challenges do current studies face, and what are the potential directions for future development? Despite the growing body of research in this area, there still are significant challenges, including balancing the commercialisation of higher education with its social responsibilities, bridging the digital divide, and ensuring that educational policies align with the evolving needs of the economy. Future research should focus on innovative models, exploring how educational systems can remain inclusive, adaptable, and responsive to the demands of a rapidly changing world.

Therefore, this paper not only provides a comprehensive analysis of the field of higher education teaching, but also offers scientific guidance for teaching reforms in universities in the context of the digital economy. It also serves as a valuable reference for future research and practice.

The introduction outlines the research motivation, objectives, and key questions addressed in this study. Section 1 presents the literature review, which is divided into two parts: an overview of the connections between higher education and transformation economies, and a discussion on the application of bibliometric methods in higher education research. Section 2 describes the methodology, including data sources and the bibliometric approach employed for analysis. Section 3 focuses on the evolution of hot topics in this field, offering both a thematic overview and dynamic analysis. Section 4 delves into strategic analysis, examining the evolution of themes and conducting staged strategic evaluations. Section 5 provides citation and burst analysis, shedding light on citation trends and identifying emerging research topics. Finally, Section 8 discusses the findings, and is followed by the conclusions where the challenges and potential directions for future research are proposed, as well as the key insights of the analysis are summarised.

1. Literature Review

The development level of higher education is not only a crucial indicator for measuring a nation's development potential but also a core driving force for economic transformation and upgrading (Brennan and Teichler, 2008). With the deepening processes of globalisation and digitalisation, research in higher education has gradually acquired multidimensional and interdisciplinary characteristics. The application of bibliometric methods has provided new perspectives for uncovering research trends, hot topics, and knowledge dissemination pathways in the field of higher education.

1.1 Higher Education and Transformation Economy

Higher education serves as a critical pillar in driving economic transformation, with its roles in cultivating high-level talents, promoting social mobility, and advancing technological innovation receiving widespread attention.

Existing research on the relationship between higher education and economic transformation can be broadly categorised into three main perspectives: the role of higher education in knowledge production, its integration with socio-economic systems, and its function as an innovation driver in collaboration with industry and government.

From the perspective of knowledge production, higher education is seen as the backbone of the knowledge economy. Shi and Wei (2024) emphasised that higher education not only undertakes the core tasks of knowledge production and dissemination but also facilitates societal structural transformation and enhances national competitiveness. Frank and Meyer (2007), for instance, highlighted the cultural and theoretical role of universities, asserting that higher education lays the foundation for rethinking societal goals and economic paradigms. Similarly, the *Global Education Monitoring Report* reinforced the view that universities are pivotal in producing knowledge that supports sustainable development goals and equips nations to respond to economic restructuring (Elmassah *et al.*, 2022).

A second area of research focuses on the integration of higher education into socio-economic systems, exploring how universities align with regional and national economic objectives. For example, Etzkowitz and Leydesdorff's Triple Helix model (Etzkowitz, Leydesdorff, 2000) underscores the interconnectedness of universities, industry, and government, arguing that higher education institutions have become essential actors in regional innovation systems. In China, for instance, studies by Han *et al.* (2023) highlight how initiatives such as the "Double First-Class" programme are designed to align top-tier universities with regional economic strategies, facilitating industrial transformation and talent cultivation. Similarly, research on European higher education emphasises the role of universities in driving regional development through collaboration with local governments and businesses (Melnikas, 2008; Raszkowski, Bartniczak, 2018).

The third perspective examines higher education as an innovation driver through collaboration with industry and government. Universities increasingly function as hubs of technological and social innovation, creating ecosystems that accelerate knowledge transfer and entrepreneurial activities. For example, Karahan (2024) proposed the concept of the "entrepreneurial university", which describes the transformation of universities into proactive participants in economic growth. In the United States, Stanford University and its ties to Silicon Valley have been widely studied as a model of how higher education can catalyse regional innovation (Smilor *et al.*, 2007). Similar patterns are observed in Europe, where universities are integrated into regional smart specialisation strategies to promote innovation (Goddard *et al.*, 2013).

Together, these perspectives provide a comprehensive understanding of the multidimensional roles of higher education in economic transformation. The interplay between knowledge production, socio-economic integration, and innovation capacity highlights the dynamic contributions of universities to addressing contemporary challenges, such as globalisation, technological disruption, and regional inequality.

1.2 Application of Bibliometrics in Higher Education

Early studies often relied on simple quantitative statistical methods, such as publication volume statistics and high-frequency keyword extraction. While these methods can reveal general trends in research fields, they exhibit significant limitations in capturing dynamic changes and field structures. Brennan and Teichler (2008) identified the emergence of themes such as "education quality" and "technological innovation" through keyword frequency statistics but lacked in-depth exploration of the relationships and evolutionary pathways among keywords. To address this limitation, co-word analysis has gradually become a mainstream method. This approach focuses not only on the frequency of keywords but also on their co-occurrence relationships, thereby revealing the structure and interactions of research themes. For example, Jiang *et al.* (2020) employed time-

segmented co-word analysis to map the thematic evolution of research on higher education and economic transformation.

As research focus shifts from static descriptions to dynamic processes, burst detection has emerged as an important tool. This method identifies anomalies in the high-frequency occurrence of publications or keywords within specific time periods, thereby uncovering the formation and decline of research hotspots. Karahan (2024) utilised burst detection to reveal the increasing significance of the theme “entrepreneurial universities” in the context of economic transformation, reflecting the evolving role of universities as innovation hubs. Similar to burst detection, the strategic diagram method constructs a strategic coordinate map of research themes, categorising them into core themes, emerging themes, basic themes, and marginal themes. This approach provides a global perspective on the structural characteristics of research fields. For instance, Zawacki-Richter *et al.* (2019) employed this method in the field of online education to identify the dual characteristics of “technology-driven teaching” and “social equity” as current core themes.

With the advancement of data processing capabilities, integrated approaches have gradually become a research trend (Xu, Cai, 2010). The combination of dynamic keyword analysis and strategic analysis not only reveals the evolutionary pathways of hot topics, but also evaluates their strategic positions within the broader research field. Additionally, the integration of burst detection and citation analysis (Hummon, Dereian, 1989) has further deepened the understanding of the role of key literature in knowledge diffusion. For example, Bergmann *et al.*'s (2016) study employed burst detection to identify the significance of the Triple Helix model in the fields of higher education and innovation, while citation network analysis was used to trace the developmental trajectory of related research.

A review of the evolution of different methodologies reveals a progression from static to dynamic approaches and from localised to holistic analyses, reflecting the growing need within academia for analysing complex systems. This development not only broadens the perspective of higher education research but also provides more robust tools for understanding its multifaceted role in economic transformation.

2. Methodology

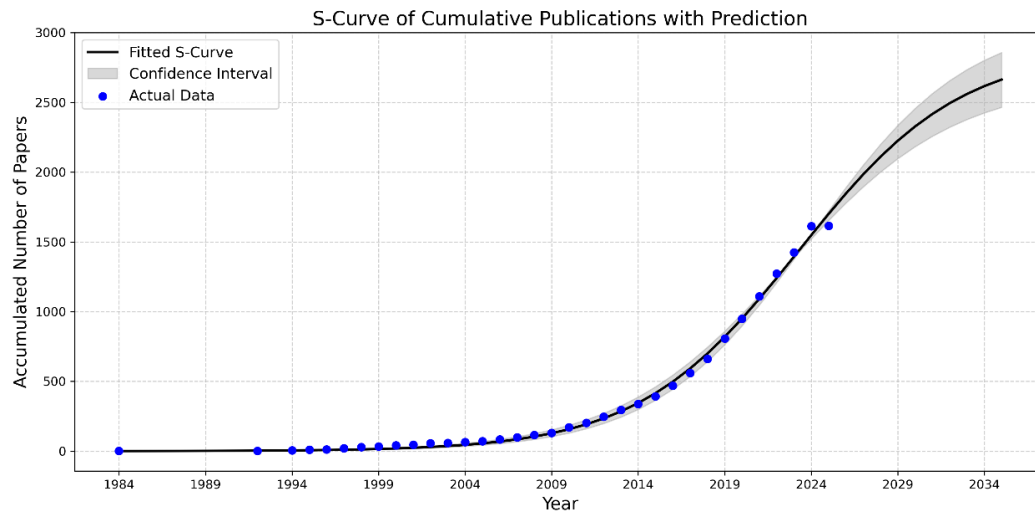
2.1 Data Source

The *Web of Science Core Collection* within the WoS database as the data source was selected for this study. A search was conducted using the thematic keywords “higher education” and “transformation* economic*”, where the asterisk (*) serves as a wildcard to expand the query to include related phrases such as transformation economy and transformation economic. This approach enhances both the comprehensiveness and accuracy of the search. The search was completed on 13 December 2024, with no restrictions on language or document type, resulting in a total of 1,616 relevant articles.

This study employs the S-curve model proposed by Meyer *et al.* (1999) to illustrate the growth trends of publications in the field of higher education. As shown in *Figure 1*, the growth curve fits well, demonstrating the phased characteristics of cumulative publications within the higher education field under transformation economy. The model fitting indicates that the midpoint of the growth curve is approximately in 2023, suggesting that research in the field of higher education is currently in the late stage of rapid growth. Based on the trend of cumulative publications, it can be inferred that research hotspots have already formed, and related research activities are continuously intensifying.

It is expected that after 2023, as the research field gradually matures, the growth rate will stabilise, and the cumulative number of publications will reach a plateau. According to model predictions, the total number of publications may approach approximately 3,000 in the near future. This trend indicates that the field of higher

education will continue to attract widespread attention from researchers in the coming years, but the growth rate will gradually decline, entering a phase of steady development.

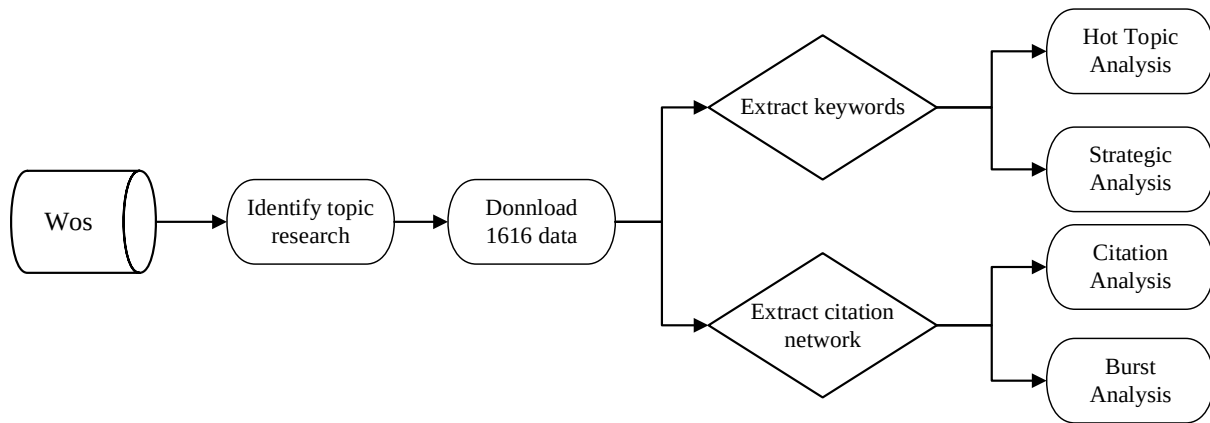


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Figure 1. The Growth Trend of Papers

2.2 Bibliometrics

The research process is illustrated in Figure 2. Firstly, the entire time span was divided into four stages to analyse the evolution of hot topics in the field of higher education over the past four decades in the context of economic transformation. Secondly, a co-occurrence network analysis of keywords from the literature was conducted to uncover the core themes of the field and their interrelationships. Combined with burst analysis, research hotspots in different time periods were identified. By measuring the concentration of specific publications or keywords being cited or used within a short timeframe, burst analysis reflects the changing trends of dynamic research priorities. In addition, utilising a Strategic Analysis using the SciMAT software, a strategic diagram was generated to classify themes based on their centrality and density into foundational themes, mature themes, niche themes, and emerging themes. This approach further explains the evolution and development pathways of research themes across different stages. By employing these integrated analytical methods, this study systematically presents the trajectory of changes in the knowledge structure of the higher education research field and identifies potential future development directions.



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Figure 2. The Research Process

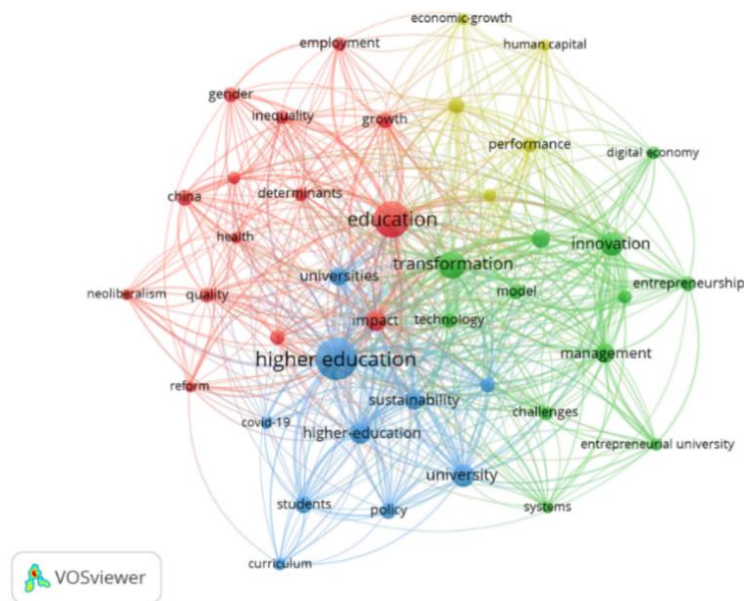
3. The Evolution of Hot Topics

3.1 Hot Topics

Through the analysis of the keyword co-occurrence network, it can be clearly observed that the hot topics within the research field and their interrelationships. As depicted in *Figure 3*, it is evident that “education”, “higher education”, and “transformation” are the core keywords in the field, characterised by the largest nodes and the most extensive connections. This indicates that these topics occupy a central position in the research. The strong connections among these keywords reflect the close relationships between multiple themes within the research field, revealing the significant association between education and the development of higher education in the context of a transforming economy.

From the clustering structure of the network, the research field exhibits distinct thematic distribution characteristics. The red cluster focuses on social issues, including keywords such as “gender”, “inequality”, and “health”, highlighting the perspective of social equity and sustainable development in higher education research. The green cluster revolves around “transformation”, “innovation”, and “entrepreneurship”, indicating the central role of technological advancement, innovation models, and entrepreneurial spirit in driving educational research and practice. The blue cluster, centered on “higher education”, “students”, and “policy”, emphasises more traditional aspects of higher education, such as policy-making, student needs, and curriculum design. These clusters reflect the diversity and interdisciplinary nature of research in higher education.

Additionally, certain keywords such as “digital economy” and “COVID-19” are located at the periphery of the network but exhibit strong connections to the core keywords. This indicates that these topics are emerging hotspots in recent years and are gradually integrating into the mainstream of the research field. Meanwhile, the high frequency of “management” and “sustainability” further reflects the sustained focus on management studies and sustainable development goals in higher education research. Notably, the strong connection between “education” and “innovation” highlights the prominent role of educational innovation in current studies, while the high-frequency co-occurrence of “higher education” and “policy” suggests that policy research remains a cornerstone of higher education studies.



Source: created by authors.

Figure 3. Keyword Network with Frequency Greater than 20

Network analysis reveals that research in higher education field under transformation economy encompasses both traditional topics, such as higher education policy and curriculum design, and emerging themes related to modern technology and social issues, such as the digital economy and social equity. The distribution of keywords not only highlights the diversity and interdisciplinarity of research hotspots within the field but also provides clear directions and insights for future studies.

3.2 Theme Analysis

3.2.1 Overall Analysis

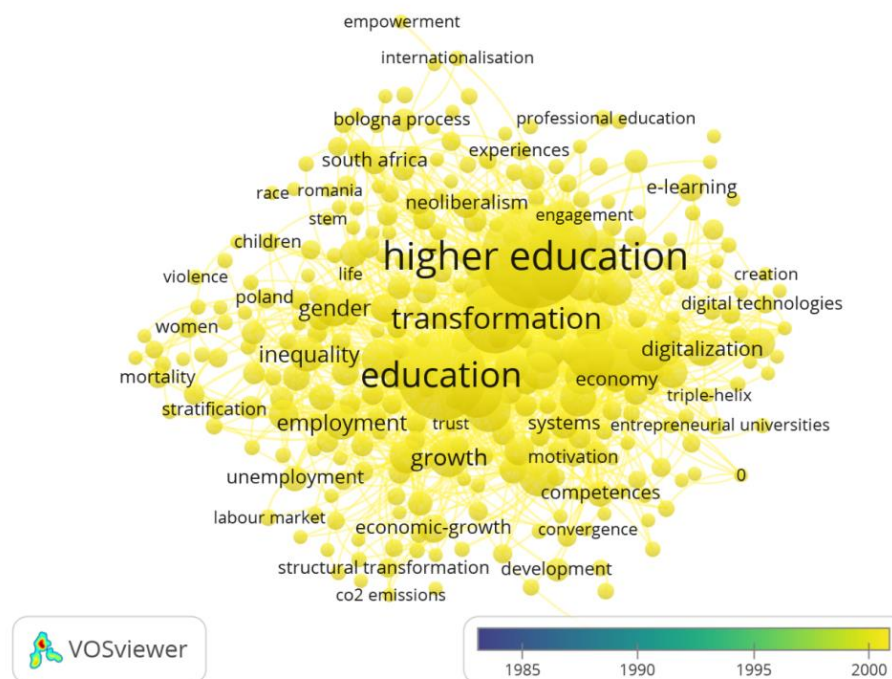
Through the temporal analysis of keywords in the research field (see Figure 4), the dynamic trends of hot topics in higher education within the context of a transforming economy can be clearly observed. The color of the keywords represents their activity levels over different years, with blue indicating keywords that appeared earlier and yellow representing those that have gradually become hotspots in recent years.

As presented in *Figure 4*, it is evident that core keywords such as “higher education”, “education”, and “transformation” span the entire temporal dimension, indicating that these topics represent foundational issues in the research field. Blue keywords (e.g., “gender”, “inequality”, and “employment”) are primarily concentrated before 2016, reflecting an early focus on issues such as social equity, labour markets, and employment.

3.2.2 Dynamic Analysis

(1) 1984–2000

According to Figure 5, the research in the field of higher education during 1984–2000 was in the theoretical foundation stage. The scale of research was relatively small, but core themes had already begun to take shape. From the distribution of keywords, core concepts such as “higher education”, “education”, and “transformation” occupied central positions, reflecting the focus of this period on the fundamental theories and frameworks of higher education. Meanwhile, the emergence of keywords such as “gender”, “inequality”, and “employment” indicates an initial academic exploration of topics related to educational equity, social mobility, and labour markets. Keywords such as “economic growth” and “structural transformation” gradually surfaced, suggesting that the relationship between higher education and economic transformation was beginning to gain attention.



Source: created by authors.

Figure 5. 1984–2000 Keyword Co-Occurrence Overlay Visualisation

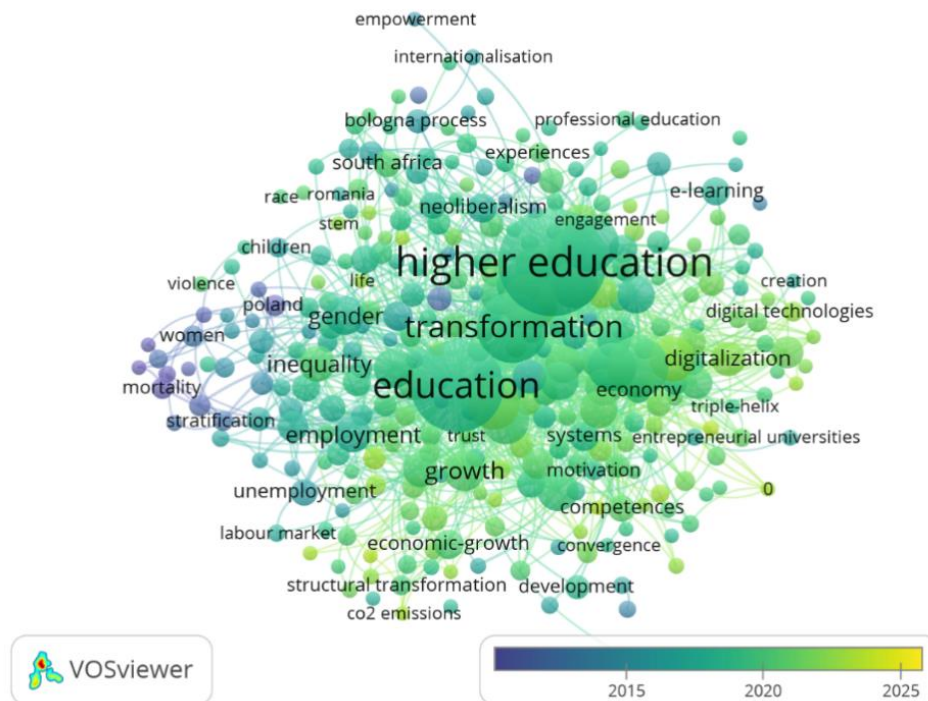
Although the annual number of publications during this period was relatively low, research hotspots were highly focused and with minimal dispersion. Overall, the field was still in the stage of theoretical exploration. Nevertheless, the studies conducted during this phase laid a significant theoretical foundation for the subsequent in-depth exploration of higher education and economic transformation and gradually established a preliminary research framework.

(2) 2001–2010

Between 2001 and 2010, research in the field of higher education entered a phase of thematic focus. The annual number of publications steadily increased, research topics became more concentrated, and research hotspots

(3) 2011 to Present

From 2011 to present, higher education research has entered a phase characterised by technology-driven innovation and diversified expansion. This period represents a peak in the growth of publications, with the annual number of articles rapidly increasing to over 100 (see *Figure 7*). During this time, research themes have become highly focused while also demonstrating significant expansion. Core keywords such as “higher education”, “education”, and “transformation” continue to dominate, but their associated networks have grown denser, reflecting the deepening and interdisciplinary broadening of research content.



Source: created by authors.

Figure 7. 2011 to Present Keyword Co-Occurrence Overlay Visualisation

Technological innovation has become a significant driving force in higher education research. Keywords such as “digital technologies”, “e-learning”, and “digitalization” have continuously emerged, highlighting the trend of deep integration between technology and education in the context of the digital economy. Such keywords as “entrepreneurial universities” and “performance” further emphasise the critical role of higher education in enhancing system efficiency and driving innovation-led development. Meanwhile, research themes have gradually expanded to include socio-economic development and equity issues. Keywords such as “employment”, “inequality”, and “sustainability” reflect the significant impact of higher education on labour market adaptation, social equity improvement, and sustainable development. In addition, the emergence of keywords like “growth”, “competences”, and “economic growth” highlights the central role of higher education in supporting economic transformation and regional development.

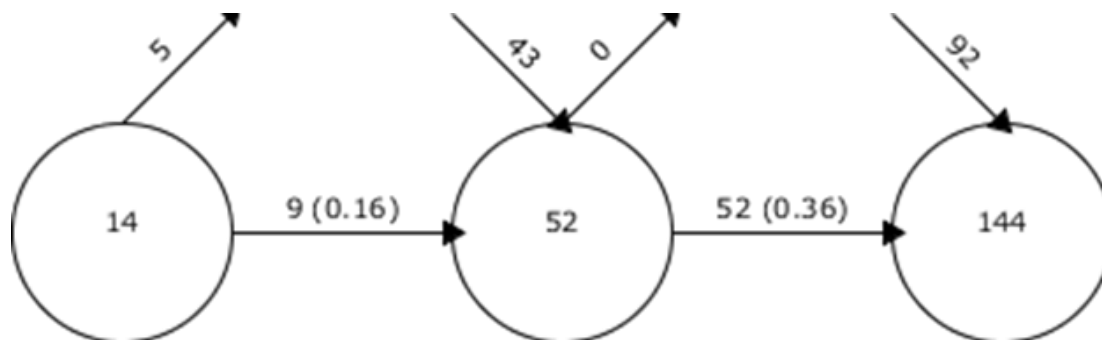
Since 2011, research in the field of higher education has flourished under the drive of technological innovation, with diversified expansion of research content. The focus has been on both the systemic optimisation and

innovation within higher education itself, as well as its critical role in promoting economic development, social equity, and technological advancement. This period marks the gradual maturation of the higher education research system and its comprehensive development across interdisciplinary and multidimensional perspectives.

4. Strategic Analysis

4.1 Theme Evolution Analysis

As shown in *Figure 8*, the visualisation results in the overlapping map reveal the retention, emergence, and disappearance of keywords in higher education research themes across three stages: 1984–2000, 2001–2010, and 2011 to present. In the map, the size of the circles represents the number of keywords, the direction of the arrows indicates the inheritance relationships of themes between different stages, and the numbers denote the specific quantities of keywords.



Source: created by authors.

Figure 8. Overlapping Map

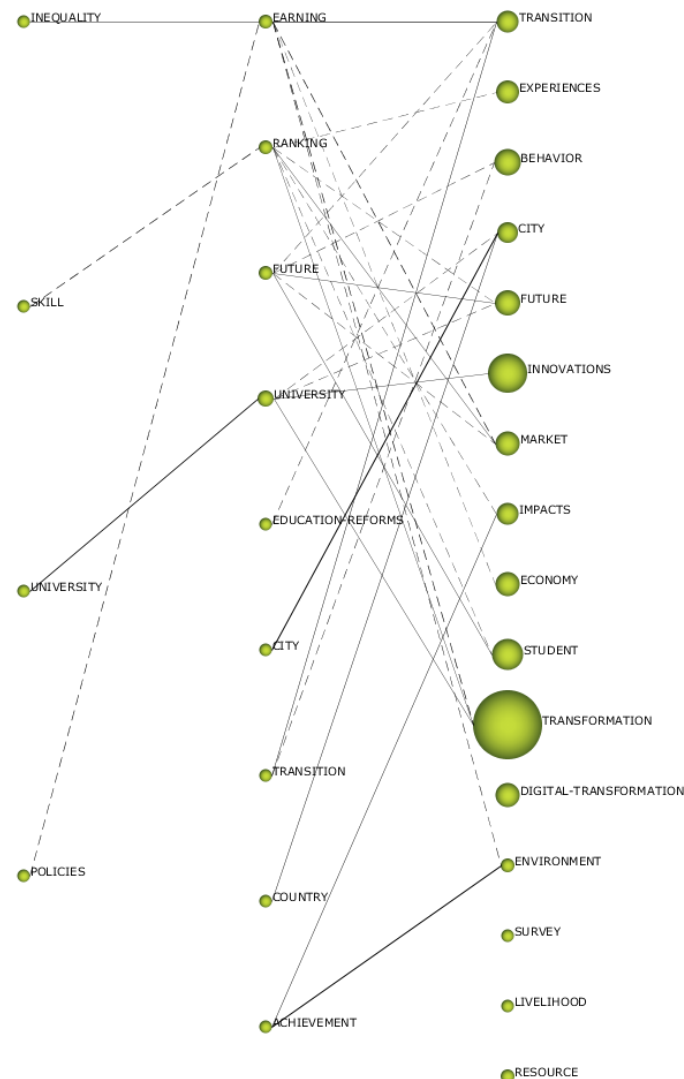
From 1984 to 2000, the number of research keywords was relatively small, indicating that higher education research during this phase primarily focused on foundational core themes such as “higher education” and “education”. These keywords laid the groundwork for research in the field of higher education, reflecting a concentration of topics but also a limited expansion of the research domain.

Entering the period from 2001 to 2010, the number of keywords increased significantly. The retained keywords from this phase indicate that higher education research began to establish connections with external themes such as societal and economic transformation. For example, new keywords emerged from the foundational keywords of the previous phase, including terms related to digitalisation and innovation in educational models. The notable expansion of research during this phase reflects the growing trend of integrating technology with education and the response to societal demands.

From 2011 to the present, the number of keywords has reached its peak. The retained keywords dominate, indicating that existing research themes have been further deepened and extended, while the emergence of new keywords reveals the current hotspots in the field. These include a stronger focus on topics such as “digital economy” and “sustainability”, which are closely related to technology-driven initiatives and social equity. Moreover, the strong inheritance of keywords from the previous two phases demonstrates the high degree of systematisation and continuity in higher education research during this stage.

As observed in the thematic evolution map in *Figure 9*, the evolution trends of research themes across different time periods are clearly visible. In the early stage (1984–2000), research themes were relatively scattered, with

smaller node sizes, indicating that the field was still in an exploratory phase. During this period, the number of research publications was low, and systematic core themes had yet to emerge.



Source: created by authors.

Figure 9. Theme Evolution Map

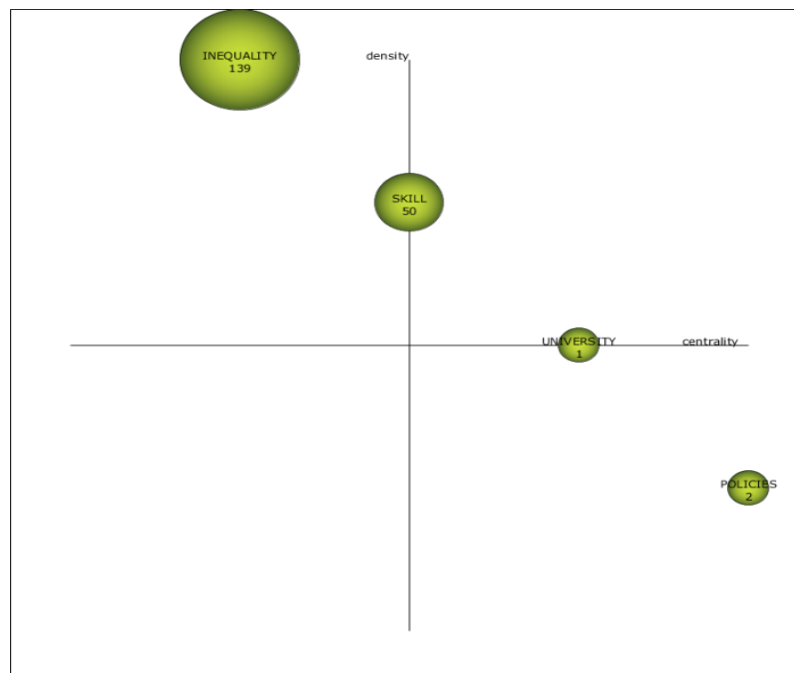
In the 2001–2010 phase, research themes became more concentrated and began to exhibit core areas such as “higher education” and “transformation”. The increased node sizes of these themes reflect a significant growth in the number of publications, marking the initial formation of research hotspots. Additionally, some emerging themes began to appear, though their continuity was not yet evident. From 2011 to the present, the research field has entered a phase of rapid development. The map shows a significant increase in the size of multiple nodes, with “higher education” and “digital economy” emerging as core and highly influential themes. The growing number of connections between these themes indicates enhanced associations, reflecting the

increasing systematisation and comprehensiveness of research. Meanwhile, smaller nodes such as “sustainability” and “innovation” have begun to expand rapidly, signifying the emergence of new and promising research hotspots.

Overall, the thematic evolution in higher education field under transformation economy has transitioned from dispersion to concentration, and from initial exploration to systematic development. The current phase exhibits a strong focus on core themes, while forward-looking topics such as “sustainability” and “innovation” suggest potential breakthroughs in future research directions.

4.2 Staged Strategic Analysis

A quadrant-based strategic analysis to identify the structural roles, developmental trajectories, and interdisciplinary connections of key themes in each phase is provided. The following analysis aims to highlight the dynamic interactions and shifting priorities of research topics across time, offering a deeper understanding of their role in driving the progression of higher education studies.



Source: created by authors.

Figure 10. Strategic Diagram-Period0-Core Documents Sum Citations

(1) 1984–2000

During the 1984–2000 phase, thematic analysis was conducted using the strategic diagram, as shown in *Figure 10*, which categorised themes into different quadrants. The diagram shows that “university” is located in the upper-right quadrant (*motor themes*), exhibiting high centrality and density. This indicates that the theme had already become a core and mature hotspot in the research field during this period, with extensive research content and significant academic influence. “Policies”, positioned in the lower-right quadrant (*basic themes*), displays high centrality but low density, suggesting that while it played a foundational role in the field, it had not yet reached full maturity and still held potential for further development. Meanwhile, “inequality” and “skill” appear in the upper-left quadrant (*niche themes*), characterised by high density but low centrality. These themes indicate intensive exploration within specific subfields but had limited overall influence and reach. Notably, the

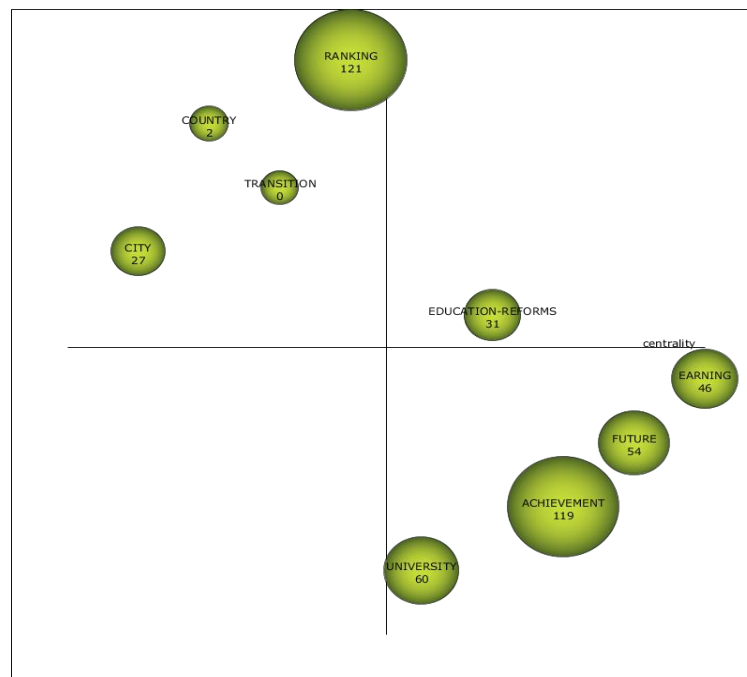
lower-left quadrant (*emerging or declining themes*) does not feature any prominent themes, indicating that during this early stage from 1984 to 2000, there were no significant emerging or declining hotspots. Overall, research attention remained relatively concentrated on a few core themes.

(2) 2001–2010

During the 2001–2010 phase, thematic analysis based on the strategic diagram, as shown in *Figure 11*, reveals that research hotspots gradually emerged and exhibited a trend of diversified development. The diagram shows that “achievement” and “ranking” are located in the upper-right quadrant (*motor themes*), indicating high centrality and density. These themes had become core hotspots of academic research during this period, attracting widespread attention and yielding significant results. Among them, “achievement” has the largest node size, highlighting its particularly prominent influence in the field.

Themes such as “university” and “future” are positioned in the lower-right quadrant (*basic themes*), displaying high centrality but relatively low density. This suggests that while these themes represent foundational research directions with strong central roles in the field, they still have room for further maturity and development. In the upper-left quadrant (*niche themes*), “city” and “country” appear, characterised by high density but low centrality. These themes reflect focused exploration within specific areas, showing considerable depth but with limited overall influence. Additionally, “earning” and “transition-related” are located on the edge of the lower-right quadrant, suggesting that these themes possess developmental potential and are in the early stages of formation, warranting further attention in future research.

During the 2001–2010 phase, research themes became increasingly concentrated, with core themes such as “achievement” and “ranking” standing out. At the same time, foundational research and in-depth exploration within specific areas laid a solid foundation for the continued development of the field.

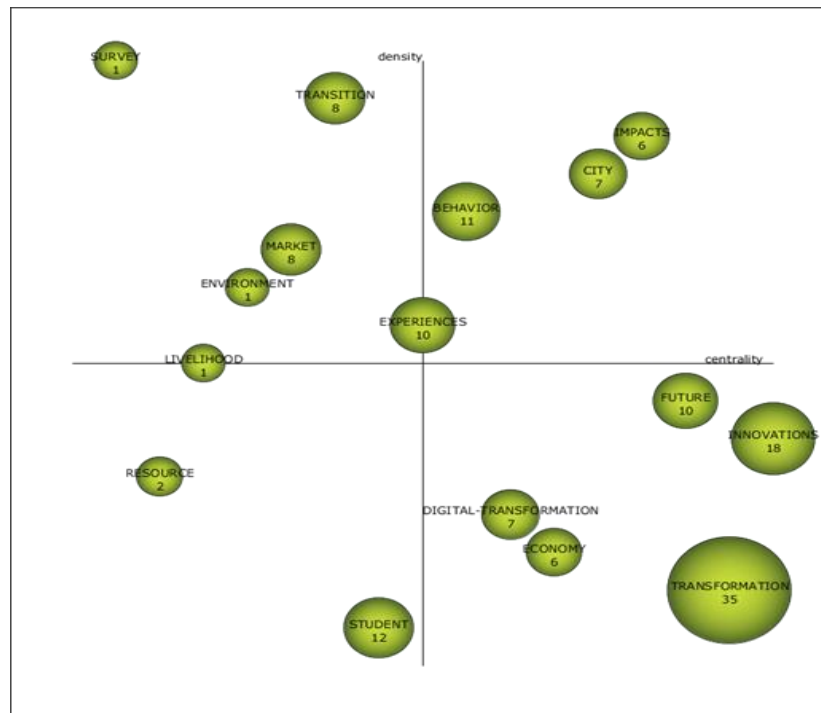


Source: created by authors.

Figure 11. Strategic Diagram-Period1-Core Documents Sum Citations

(3) 2011 to Present

During the phase from 2011 to the present, the strategic diagram shown in *Figure 12* indicates that research in higher education field under transformation economy has entered a phase of rapid development, characterised by the coexistence of thematic diversity and core focus. In the diagram, “transformation” is prominently located in the upper-right quadrant (*motor themes*) with the largest node size, reflecting its status as the core theme of current research. It exhibits extremely high centrality and density, indicating that “transformation” has become a major focus of academic attention during this period, with extensive research and substantial influence. Additionally, “innovation” and “student” appear in the lower-right quadrant (basic themes), showing high centrality. This reflects their roles as foundational and important research directions that support the further development of the field.



Source: created by authors.

Figure 12. Strategic Diagram-Period2-Core Documents Sum Citations

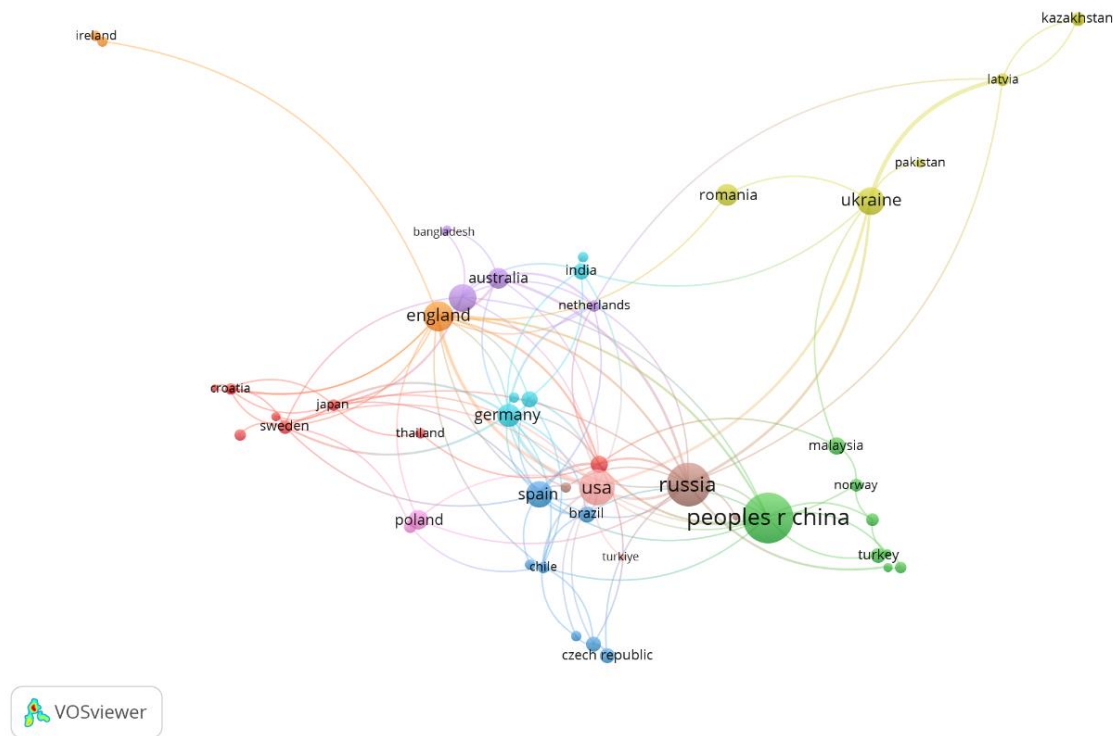
In the upper-left quadrant (*niche themes*), “impacts” and “behavior” exhibit strong density but relatively low centrality. This suggests that these themes are focused on in-depth studies within specific areas, contributing academic value and insights, although their influence has not yet extended across the entire academic field. Notably, in the lower-left quadrant (*emerging themes*), new topics such as “environment” and “survey” have emerged. Although these themes exhibit low centrality and density, they represent potential directions within the field and hold significant room for growth.

Thus, “transformation” has become the dominant theme of the 2011 to present phase, driving the development of the field, while themes such as “innovation” and “student” provide essential support for further progress.

5. Citation and Burst Analysis

5.1 Citation Analysis

Figure 13 illustrates the citation relationship network among countries, with a threshold set at a minimum of five citations, thereby filtering out countries with significant influence. The size of the nodes represents the number of citations for each country, the lines indicate the strength of citation connections between countries, and the node colors represent the clustering distribution of countries within the network.



Source: created by authors.

Figure 13. National Citation Network

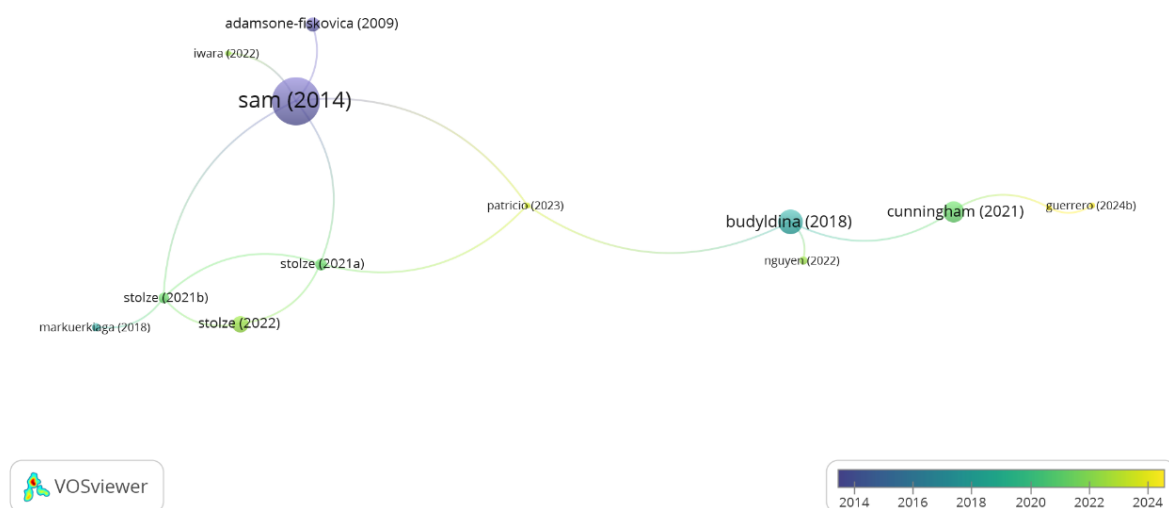
The figure indicates that China (Peoples R China), the United States (USA), and the United Kingdom (England) are the countries with the highest citation counts and the most significant influence in the network. These nodes are larger and positioned at the core of the network, reflecting their central roles in academic research. Additionally, Russia, Germany, and Spain also demonstrate strong citation connections, forming closely linked network structures with the predominant countries.

From the perspective of clustering, China and its associated countries (e.g., Malaysia, Norway, and Turkey) form a green cluster, reflecting active academic collaboration and strong research connections in this region. The United States and Western countries (e.g., the United Kingdom, Germany, and Australia) are grouped into blue and purple clusters, demonstrating extensive citation collaborations among developed countries in academic

research. Eastern European and Central Asian countries (e.g., Ukraine, Romania, and Kazakhstan) form a distinct yellow cluster, but their citation networks are relatively sparse.

In general, developed countries such as the United States, the United Kingdom, and China are predominant within the global academic citation network, exhibiting a tendency towards centralisation. Meanwhile, some developing countries and regions are undergoing a gradual integration into the global academic network, thereby reflecting an expansion and diversification of research collaboration.

Figure 14 illustrates the citation-based document network, where each node represents a publication. The size of the node reflects the number of citations the publication has received, and the lines between nodes represent citation relationships between the documents. The colours of the nodes are differentiated by publication year, covering the period from 2014 to 2024.



Source: created by authors.

Figure 14. Citation Network

As observed, Sam and Van (2014) node occupies the central position in the network, providing a theoretical exploration of the entrepreneurial university model's role in driving the knowledge economy. This model integrates teaching, research, and innovation activities, strengthening the university's function as a driver of the knowledge economy. Sam's (2014) analysis of how higher education achieves societal and economic impact through innovation during economic transformation offers a significant theoretical framework for the field. Its high citation frequency underscores its profound influence on subsequent research. Budyldina (2018) extended this perspective by incorporating a regional economic development lens, revealing how entrepreneurial universities promote local economic prosperity through knowledge production and technology transfer. Meanwhile, Cunningham and Menter (2021), through case studies of high-tech entrepreneurship, demonstrated how higher education institutions effectively respond to changing industry demands and drive technological

innovation during economic transformation. These studies have enriched the theoretical and practical understanding of the interactive relationship between higher education and economic transformation. They also form a systematic knowledge flow with subsequent studies by Nguyen *et al.* (2022) and Guerrero and Menter (2024). Nguyen *et al.* (2022) focused on how Australian universities adapt to emerging economies' industrial demands through entrepreneurship education, while Guerrero and Menter (2024) explored key strategies for universities in fulfilling their "third mission" of serving society from the perspective of dynamic capabilities. Guerrero's work provides new insights into the dual role of higher education in technological innovation and social service.

From a temporal perspective, early studies such as Adamsone-Fiskovica *et al.* (2009) and Sam and Van (2014) laid the theoretical foundation, particularly emphasising the multiple roles of universities during the initial stages of economic transformation. Adamsone-Fiskovica *et al.* (2009) highlighted tasks such as supporting labour market transitions, guiding industrial upgrading, and strengthening social responsibility. In contrast, more recent works, such as Patrício and Ferreira (2023) and Guerrero and Menter (2024), focus on the performance and strategic optimisation of entrepreneurial universities during the phase of high-quality economic development. Patrício employed fuzzy-set qualitative comparative analysis to identify the significant contributions of university entrepreneurial activities to regional economic sustainability. Notably, Stolze's series of studies (Stolze, 2021; Stolze, Sailer, 2021; Stolze, Sailer, 2022) concentrated on the continuous transformation of higher education institutions in the context of economic transition. By applying cross-national comparative research, these studies explored the practical applications of dynamic capability theory, emphasising the central roles of leadership and strategic alignment in university transformation. These studies provide practice-oriented insights into how universities position their core functions and respond to the challenges of emerging industries, particularly in addressing economic uncertainty and societal transformation demands.

5.2 Burst Analysis

The present study conducted burst analysis on highly cited documents. The burst strength reflects the frequency of concentrated citations a document received within a specific time period, providing a quantitative basis for identifying research hotspots and key academic contributions. In *Table 1*, the top 17 documents ranked by burst strength and arranged in chronological order of their burst periods are displayed.

The analysis results indicate that Kreidl (2001) is the earliest document with a burst period starting in 2004 and a burst strength of 1.25. This study primarily explored the legitimacy of social inequality and stratification, particularly its impact during economic transitions, providing a critical reference for subsequent interdisciplinary research between education and sociology. Following closely, Hanley (2001) also exhibited a burst period starting in 2004, with the same burst strength of 1.25. Hanley's research focused on the political dimensions of educational stratification and its effects on social structural transitions, further deepening academic attention to issues of social stratification and educational equity.

Table1. Citation Burst Visualisation

Top 17 References with the Strongest Citation Bursts					
References	Year	Strength	Begin	End	2002 - 2024
KREIDL M, 2001	2001	1.25	2003	2004	
Hanley E, 2001	2001	1.25	2003	2004	
Jessop B, 2017	2017	1.69	2020	2022	
Kholiavko <i>et al.</i> , 2020	2020	4.35	2021	2022	
Cosmulese <i>et al.</i> , 2019	2019	3.86	2021	2022	
Bond <i>et al.</i> , 2018	2018	3.86	2021	2022	
Etzkowitz <i>et al.</i> , 2019	2019	2.89	2021	2022	
Derhaliuk <i>et al.</i> , 2021	2021	1.92	2021	2022	
Franco <i>et al.</i> , 2019	2019	1.69	2021	2024	
Findler <i>et al.</i> , 2019	2019	1.69	2021	2024	
Bygstad <i>et al.</i> , 2022	2022	2.89	2022	2024	
Benavides <i>et al.</i> , 2020	2020	2.8	2022	2024	
Alenezi, 2021	2021	2.4	2022	2024	
Klofsten <i>et al.</i> , 2019	2019	2.4	2022	2024	
Aleixo <i>et al.</i> , 2018	2018	2.24	2022	2024	
García-Morales <i>et al.</i> , 2021	2021	1.92	2022	2024	
Leal <i>et al.</i> , 2019	2019	1.49	2022	2024	

Source: created by authors.

Jessop (2017) exhibited a burst starting in 2022, with a burst strength of 1.69. This paper explored academic capitalism and the diverse models of entrepreneurial universities, shedding light on the functional transformations of higher education institutions in the context of economic globalisation. Nataliia *et al.* (2020), also bursting in 2022, demonstrated the highest burst strength in this dataset at 4.55. This study analysed how higher education adapts to the digital economy environment, particularly during and after the COVID-19 pandemic. Its theme aligns closely with the current global trend of digital transformation. Several other documents also began bursting in 2022. For instance, Cosmulese *et al.* (2019) had a burst strength of 3.86, focusing on the impact of the digital revolution on the EU education system and providing key insights into education digitalisation from a regional perspective. Similarly, Bond *et al.* (2018) also exhibited a burst strength of 3.86, investigating the perceptions and applications of digital media among students and faculty in German higher education, reflecting the widespread practical application of educational technologies. Additional studies related to digitalisation include Bygstad *et al.* (2022), which burst in 2022 with a strength of 2.24. This research examined how dual digitalisation is shaping learning spaces in higher education. Similarly, Benavides *et al.* (2020) and Alenezi (2021) began bursting in 2022 and late 2022, respectively, reflecting the sustained research interest in digital transformation and its role in educational innovation.

Research in the field of sustainable development also holds a prominent position in the burst analysis. The works of Franco *et al.* (2019) and Findler *et al.* (2019) both began bursting in 2022 with a burst strength of 1.69, emphasising the role of higher education in advancing Sustainable Development Goals (SDGs). These studies

highlight that higher education institutions are not only venues for knowledge dissemination but also play a crucial role in policy implementation. The impact of the COVID-19 pandemic on higher education has also garnered significant attention. García-Morales *et al.* (2021), with a burst starting in 2022 and a strength of 1.92, investigated the transformation challenges and future pathways of online education during the pandemic. Similarly, Leal Filho *et al.* (2019) began bursting in 2022, examining how universities integrate SDGs into their curricula, providing strategic directions for higher education in the post-pandemic era.

The burst analysis reveals multiple layers of academic hotspots in the field of higher education, including social stratification during economic transformation, digital transformation and technological applications, sustainable development, and the transformation of educational models under the impact of the pandemic. The concentrated citations of these works not only reflect the profound academic interest in these topics but also provide significant theoretical and practical references for subsequent research.

6. Discussion

In the context of economic transformation, higher education, as a critical driver of socio-economic development, exhibits significant complexity and diversity. Based on bibliometric analysis, this study not only uncovers the dynamic evolution of research hotspots but also analyses the core pathways and developmental trajectories of knowledge diffusion through keyword and citation burst perspectives. However, research in higher education field under transformation economy still faces numerous challenges that require further in-depth exploration.

The complex relationship between higher education and economic transformation necessitates a multidimensional perspective in this field of research. However, many existing studies usually rely on static analyses. The limitation may reduce the accuracy of research findings in predicting future trends. Particularly in the context of accelerated development of technology-driven educational models, how higher education plays a pivotal role in regional economic transformation, labour market adaptation, and improvements in social equity remains to be systematically explored through longitudinal studies.

The rapid development of digital technologies has brought unprecedented opportunities to the field of higher education while also posing challenges related to the equity of educational resources and technological adaptability. Although many studies have revealed the disruptive impact of online education and digital technologies on traditional educational models, the digital divide between regions and institutions remains significant in practice. This not only hinders the widespread accessibility of educational resources, but also raises concerns about the sustainability of deep integration between technology and education. Future research should place greater emphasis on technology-driven pathways for educational transformation, particularly on how artificial intelligence and big data can be leveraged to optimise teaching models. Such efforts are essential to enhance both educational equity and efficiency in the context of economic transformation.

Additionally, the distribution and evolution of research themes in higher education over different periods reflect its close connection with socio-economic contexts. From the theoretical foundation phase (1984–2000) to the thematic focus phase (2001–2010), and then to the technology-driven and diversified expansion phase (2011 to present), higher education research has not only deepened its exploration of foundational theories but also progressively expanded into practice-oriented directions. This phenomenon is particularly evident in the interdisciplinary domains of economics, sociology, and education. However, the integration of policy research and technology studies remains insufficient. Therefore, future research should focus on constructing a more open and collaborative interdisciplinary framework to strengthen knowledge connections and coherence within the field.

The analysis of citation bursts reveals that research hotspots in higher education in the context of economic transformation are primarily focused on areas such as digital transformation, sustainable development, and social stratification. However, the integration of these theoretical studies with practical policy applications still has room for improvement. Future research could further focus on the validation and optimisation of theoretical models in practical contexts to address the complex challenges faced by higher education during the transformation process.

Research on higher education in the context of economic transformation has achieved numerous significant milestones but still faces areas that require breakthroughs. Through broader interdisciplinary collaboration, more refined dynamic research methodologies, and stronger integration with policy practices, future studies can not only deepen the theoretical understanding of higher education functions but also provide robust support for educational system reform in the era of globalisation and technological advancement. The complexity of higher education underscores the importance of its research. This study not only offers a theoretical framework for the development of the field, but it also provides valuable directions and recommendations for future research and practice.

Conclusions

This study provides an in-depth analysis of research on higher education in the context of economic transformation, revealing the current state and evolutionary trends in this field. By analysing 1,616 relevant documents from the *Web of Science* database, this paper identifies research hotspots and key literature, highlighting the multifaceted roles of higher education in driving economic growth and social development.

The analysis of keyword evolution indicates that research priorities have gradually shifted from traditional topics, such as education policy and curriculum design to technology-driven educational innovation and themes of sustainable development. Citation burst analysis uncovers critical theoretical and practical frameworks that have advanced the field, such as digital transformation, sustainable development policies, and the pivotal role of higher education in addressing socio-economic changes. The findings suggest that higher education is not only a significant force for driving innovation and economic transformation but also a key contributor to promoting social equity and diversity. However, challenges such as regional disparities in the integration of educational technologies, the complexity of quality assessment, and uncertainties in policy environments remain unresolved. Future research should focus on fostering interdisciplinary collaboration, employing dynamic research methodologies, and adopting a sustainability perspective to ensure that higher education systems become more adaptive, inclusive, and impactful.

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AUKŠTOJO MOKSLO KOKYBĖS KAITOS ANALIZĖ TRANSFORMACINĖS EKONOMIKOS KONTEKSTE**Jing Fang, Jie Peng, Xinru Cheng, Chonghui Zhang**

Santrauka. Aukštojo mokslo plėtros lygis yra pagrindinis šalies vystymosi stiprumo ir potencialo rodiklis, kuris reikšmingai skatina ekonomikos transformaciją ir modernizavimą. Siekiant įsigilinti į aukštojo mokslo kokybę pereinamojo pobūdžio ekonomikos sąlygomis, iš įvairių perspektyvų buvo išanalizuota 1616 straipsnių, esančių „Web of Science“ (WoS) duomenų bazėje. Siekiant išsiaiškinti aktualias temas skirtingais laikotarpiais, buvo tiriama bendrų reikšminių žodžių raida. Derinant citavimo tinklo analizę ir sprogimo aptikimo metodus, nustatyti pagrindiniai literatūros šaltiniai ir žinių sklaidos keliai. Atlikus strateginę analizę, toliau nagrinėtos aukštojo mokslo tyrimų temų centralizacijos ir diversifikacijos charakteristikos. Aptarti dabartinių tyrimų apribojimai ir siūlomos ateities tyrimų kryptys. Šiame straipsnyje mokslininkams pateikiama aukštojo mokslo srities kaitos transformacinės ekonomikos sąlygomis apžvalga ir padedama kuo geriau suvokti naujausius tyrimus.

Reikšminiai žodžiai: transformacinė ekonomika; aukštasis mokslas; reikšminiai žodžiai; sprogimo analizė; strateginė analizė.