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Global research trends on lifelong learning framework in posthuman education: A bibliometric approach

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Abstract: The present study investigates international research trends regarding lifelong learning frameworks through bibliometric methods. This study examines academic publications indexed in the Dimensions database between 2014 and 2024 to determine major trends, significant works, and networks of collaboration that define the discussion on lifelong learning. The study shows a clear upward trend in research output over the last decade, with an impressive increase in studies on digital literacy, micro-credentials, and policy-oriented approaches to lifelong learning. As expected, education systems, curriculum, and pedagogy appear as two of the most prominent research categories, suggesting an overemphasis on practical implementation approaches. However, gaps remain in more granular issues such as education policy or the socio-cultural aspects of lifelong learning. Although providing important insights, this study has limitations. Its dependence on the Dimensions database may not capture relevant literature indexed in other databases like Scopus or Web of Science. Furthermore, limiting articles exclusively to open access may have restricted the breadth of analysis, possibly missing vital findings published in subscription-based journals. We encourage future research to incorporate multiple databases and non-open access literature for a more comprehensive investigation. In addition to bibliometric analysis, interdisciplinary qualitative methods such as expert interviews and case studies are recommended to better understand the motivations behind research and collaboration dynamics. This approach would allow greater attention to policy implications and comparative analyses of different education systems. Addressing these knowledge gaps will help provide a more comprehensive view that will be valuable for researchers, policymakers, and educators as they strive to develop appropriate lifelong learning initiatives. This study underscores the growing importance of lifelong learning as a tool to address challenges in education worldwide and calls for additional interdisciplinary and inclusive research initiatives to shape the future of education.

Keywords: *Bibliometric analysis, Digital literacy, Education frameworks, Lifelong learning, Policy analysis, Posthuman education, Research trends.*

1. Background of Study

Lifelong learning frameworks are structured approaches designed to promote continuous education and skill development throughout an individual's life. These frameworks are designed to accommodate the formal, non-formal and informal experiences of learning in order to prepare individuals for lifelong learning, aiming to be adaptable to the latest demands of the labor market, technological developments and social challenges [1, 2]. While traditional educational models place much greater emphasis on education during the early years of life, lifelong learning frameworks endorse the idea of education as a continual process extending beyond formal schooling. It promotes adaptability, resilience, and self-regulation, enabling people to stay competitive in a fluctuating world. In other areas, such as journalism and teacher education, lifelong learning frameworks have been used to promote professional competencies and develop the capacity to deal with quick changes in their field [1, 2]. Teachers have to constantly renew their skills, adding new pedagogical ideas and new technologies, while journalists

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have to stay on the cutting edge of a changing media environment and new digital practices. In addition to professional growth, lifelong learning frameworks are congruent with larger societal objectives, like sustainable development. These frameworks also align with the realization of the United Nations' Sustainable Development Goals as they provide individuals with the knowledge and skills to tackle global challenges such as environmental sustainability and digital inequality [3, 4].

In the context of industry 4.0, lifelong learning frameworks are crucial to building a workforce that can engagement with emerging technologies. The need for continuous skill development is heightened by the fast pace of technologies innovation, especially in the fields of artificial intelligence, data analytics, and digital literacy [5]. When industries transition, the need for equipped workers is evident in the ability to adjust to innovative tools and practices, highlighting the need for continuous education for economic competitiveness and personal fulfilment [6]. From a posthumanist perspective in particular, lifelong learning reaches beyond human potentially suspicious discourses towards becoming an opened connected knowledge that foregrounds new ways of knowing that depend, not only upon human thinking, but also technological, ecological and material encounters. Learning models that take into consideration the integration of human and no-human agents reshaped by platforms powered by artificial intelligence, digital ecosystems, and intelligent environments. This posthumanist approach defies strict delineations between formal and informal education to advocate for an ethical cohabiting with technology and nature that fully embraces sustainability, inclusivity and collective intelligence. By incorporating posthumanist insights, lifelong learning frameworks become not static pathways to professional success, but also living, evolving constructs that prepare students to ethically navigate an unpredictable future.

Global educational trends like digital transformation and workforce upskilling underscore the growing significance of lifelong learning. Digitalization in education means that one method is no longer universally useful, as tools such as Ai, data analytics, and online learning require an ongoing familiarization [7, 8]. To bridge intergenerational gaps, educators need to model digital literacy and cultivate a culture of lifelong learning for students [9, 10]. This trends were further accelerated by the COVID-19 pandemic, which forced many workers and students into remote work and online learning which, in turn, has emphasized the need for flexible and technology-driven learning pathways [8, 11]. The demand for re-skilling and up-skilling has increased due to workforce demands driven by automation and globalization. Lifelong learning has been recognized by the World Economic Forum as the key to ensuring employability in ever evolving job market [12]. It is increasingly taxing for universities and educational institutions to respond the those demands with novel programs like micro-credentials that challenge the divide between formal education and workplace training [12]. These adaptable learning routes are crucial for preparing people with the competencies they need to succeed in their professional lives, as conventional educational structures might not adequately prepare them for the nuances of contemporary workplaces.

In addition, we have seen growing links between lifelong learning and sustainable development. The world is facing pressing challenges — be it climate change, social equity, or technology disruption that impact our societies, institutions, and lives — and lifelong learning frameworks provide a means for individuals in our communities to tackle these challenges head on. Thwe and Kalman [13] sustain that lifelong learning is key to delivering on the United Nations' Sustainable Development Goals, in particular the pursuit of quality education and environmental sustainability. Cultivating a culture of ongoing learning, through this individual/community pathway, serves to build informed and participatory citizens working towards sustainable solutions.

As a result, national strategies and lifelong education has now become a priority for educational institutions and policy makers to develop resilient societies ready for the future of work. National policies also acknowledge the need and significance of lifelong learning such as in Malaysia where more resources were devoted by the policymakers to earlier stages of lifelong learning in the education system [14]. Likewise, Thwe and Kalman [13] highlight that educational settings must sustain lifelong learning, by facilitating opportunities for learners to participate in continuous education beyond

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conventional curriculums. It is fundamental to be able to prepare people to face complexities of the modern world and help them make constructive strides in society.

Along with the urgent of identifying the trends of lifelong learning frameworks in posthuman era, bibliometric analyses become valuable research approach that applies quantitative methods to measure the properties of a body of research in a certain domain. From the angle of lifelong learning, this method of tracking growth of research is vital in identifying touchstone works and gaps in the literature. Bibliometric studies offer a systematic approach to exploring the academic discourse, the research contributions, and the broader landscape of lifelong learning research through analysing publication data. It can identify trends in research output over time, which is one of its key benefits. Bibliometric analysis, according to Yilmaz and Tuzlukaya [15] can be used to follow citation trends, or even find the most-cited papers in a subject area, and provide a quantitative overview of the scientific and scholarly landscape. This ability allow researchers to perceive trends in academia such as new topics coming into the scene and once popular areas that have lost traction. Historians of science often map out trends such as these, allowing them to trace the arc of research and predict what will come next.

Bibliometrics also supports the identification of key scholars and works contributing in the domain. Watrianthos et al. use bibliometric methods to examine vocational education research in Indonesia and how this type of analysis can highlight the contributions of particular authors and institutions. Tapping into the key players provides a means to identify leading researchers as well as a pathway for collaborations and networking opportunities within the academic community. If you know who the influential authors are, it can help new researchers to select mentors or collaborators that have a strong influence in their future discipline. Moreover, the bibliometric analysis helps identify the gaps in literature. Kokol, et al. [16] states that the incorporation of quantitative elements into qualitative research adds academic rigor to studies which may help them identify elements that may need further exploration The highlighting of such under-researched topics or emerging areas of interest is informative for funding agencies and policymakers about potentially fruitful avenues for investment and development. It is particularly important in fast-paced industries like technology and health sciences where novel challenges and opportunities constantly appear.

Bibliometric analysis is even further aided by visualization tools such as VOSviewer, which can provide visual representations of research networks and collaborations. These tools help in assessing research orientations and development trends that have been discussed by Murnaka, et al. [17] providing an overview of the academic landscape. Such visualization can be extremely useful for those exploring a multifaceted field, as it allows the user to quickly pick out the relevant literature and potential collaborators. Bibliometric analysis is a data-driven approach for developing future research and practice in lifelong learning. Bibliometric analysis increases the quality and pertinence of the academic investigation by yielding quantitative information regarding publications patterns, citation impacts, and research networks. This information will be crucial for researchers, policymakers, and funding agencies at a time when lifelong learning has become increasingly critical; innovations in this space will emerge and will need to be effectively funded to mitigate the costs associated with developing relevant skills for the future of work.

Informed by this view of lifelong learning, this study will aim to connect and understand how current global trends would respond to the embedding of technology in the lifelong learning agendas. In this regard, the research is aimed to answer the following questions:

1. How has the volume of research on lifelong frameworks evolved over the past decade (2014 – 2024)?
2. What are the dominant research categories in lifelong learning framework studies?
3. What are the most frequently occurring keywords trends?
4. Which journals publish the most influential studies based on citation impact?

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2. Literature Review

2.1. Conceptual Framework of Lifelong Learning

Lifelong learning (LLL) is a multifaceted concept that encompasses the continuous, voluntary, and self-motivated pursuit of knowledge, skills, and competencies throughout an individual's life. It transcends traditional educational boundaries, occurring in formal, non-formal, and informal settings, and is driven by the need to adapt to rapid societal, technological, and economic changes [18]. The theoretical foundations of lifelong learning are rooted in two key frameworks: human capital theory and constructivism.

Becker [19] human capital theory describes building up of one's human capital, considering the investment in the education and training of an individual as a way to boost one's economic potential, and, consequently, hirability. From the point of view of this theory, lifelong learning is a part of the strategy to develop the workforce, as it helps employees remain competitive irrespective of the rapid changes in the labor market. According to Leyretana and Trinidad [20] the need for lifelong learning is economically motivated as it helps workers gain in-demand skills. Yet, the pressure to treat lifelong learning as a way to bring economic value per se may potentially lead to the neglect of other aspects, such as personal attractiveness and social well-being [21].

On the other hand, the learning theory known as constructivism postulates the active learning process, where a learner builds their own ideas with experience acquired through the socialization process. This theory views the self-directed learning, metacognition, and critical thinking applied at each step during lifelong learning. For example, Mohammed and Kinyó [22] claim that although MOOCs have become widely popular, they allow people to create individual learning paths, treating the formal and informal trends as complementary. Thus, these two theories start to promote the same value system. This assumption is based on the works by integrated scholars, such as Berduzco Torres, et al. [23] who suggest combining two views into a unity. This encourages holistic education, which, ideally, should consist of creating new skills alongside the reflection and cooperation. Indeed, such a bi-directional approach is best suitable for modern challenges, such as technology changes, politics, and promoting environmental sustainability [24].

Lifelong learning as an idea has changed quite a bit in the last hundred years, from being largely adult education with the academic literature on adult education to a holistic approach that is now viscerally felt and embedded in global educational agendas. A milestone in this evolution was the Faure, et al. [25] commissioned by UNESCO, which broadened the definition of education as a lifelong process. Published in 2030, The Delors Report emphasized equity, democracy and humanistic values, and set lifelong learning as a response to technological change and a vehicle for social cohesion [26] This was followed by the Delors [27] that proposed the "four pillars of education" (learning to know, do, live together, and be). These pillars extended the definition of lifelong learning beyond vocational training to civic and personal development, signifying a more robust vision of education [13].

In the 2000s, the digital revolution transformed lifelong learning once again, when online platforms such as Coursera and edX democratised access to education by allowing individuals to learn at their own pace from anywhere in the world. Assefa, et al. [28] emphasise how higher education institutions have adapted to become centres of continuous learning, providing micro-credentials, and hybrid courses to accommodate the varied requirements of learners. The COVID-19 pandemic accelerated this transition, revealing the importance of digital literacy and resilience. Neves and Henriques [29] state that with businesses pressured to adapt quickly to new technologies, workers are likely left with skills that could be obsolete, reinforcing the need for lifelong education.

This evolution indicates a paradigm shift from learning as a classroom and deterministic element to lifelong systemic process. Its role as a core concern in contemporary educational visions is underscored by European Union policies, such as the European Skills Agenda and the European Council [30] where lifelong learning appeared as one of nine mandates [31]. Such policies promote general and equitable access to lifelong learning opportunities since it can improve employability, social inclusion and personal satisfaction.

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2.2. Lifelong Learning Frameworks in Education

Lifelong learning frameworks are contextualized and purposeful models that drive consensus for the application of lifelong learning principles in education policy and practice. The most notable ones are UNESCO's four pillars of education and the European Union's Key Competences for Lifelong Learning.

The four pillars of education outlined in the Delors [27] by the United Nations Educational, Scientific and Cultural Organization (UNESCO) provide a holistic foundation for lifelong learning. And then we have the first pillar, learning to know, which focuses on getting a proper foundation of knowledge and critical thinking. Learning to do, the second pillar of Education for All, is about acquiring the technical and vocational skills needed to play a productive role in society. The third pillar is about learning to live together, fostering intercultural understanding, cooperation and social cohesion. The fourth pillar, learning to be, emphasizes the necessity of personal development and self-realization, acknowledging that education must cultivate the entire individual [32].

The eight Key Competences for NESCO Institute for Lifelong Learning [33] set out within the European Union complement the above pillars of education, highlighting the specific competences individuals must possess to successfully function in a knowledge-driven society. These refer to being able to communicate in the mother tongue and in foreign languages, mathematical competence, digital competence, learning to learn, social and civic competences, sense of initiative and entrepreneurship, and cultural awareness and expression. Flexible learning is not a goal in itself; it is about acquiring competence, enabling learners to use knowledge effectively in practical situations [13]. In this sense, the "learning to learn" competence is closely related to constructivism — it is about the application of metacognitive strategies that have practical application to guide lifelong learning journeys.

Such frameworks have been operationalized in unique fashion across context. E.g. the Educational and Training 2020 strategy of the EU does require member states to introduce their national curricula to address the Key Competences. A good example of this is Ministry of Education and Culture [34] which provides free upskilling courses for all adults to contribute to continuous learning and training [35]. Likewise, conditioned both by digital platforms like Coursera and national initiatives such as Germany's KL-Campus, accessible, modular learning experiences are emerging that resonate with UNESCO's "learning to do" pillar [8]. The concept of learning cities, for example, is a solution that can be explored for a community-based approach to the realisation of lifelong learning frameworks. For example, the Italian city of Lucca has adopted a co-design approach in involving schools, businesses and NGOs co-design lifelong learning programmes that are based around local needs and that build social cohesion [36]. Ultimately, the right and broader elements behind a lifelong learning context is to allow most of the collective learners needed for workforce 2.0 the ability to better contribute and be part of a whole workforce.

Even so, there are still challenges to implementing lifelong learning frameworks. As 9 [37] explains, resource constraints in low-income regions can often limit access to digital tools and learning opportunities, resulting in exacerbated inequalities [37]. Neoliberal critiques also note that a focus on employability neglects the social and personal aspects of lifelong learning [38]. In order to tackle these challenges, the needs of economic, social and personal development goals require balanced efforts.

2.3. Instruments of the Study

Existing bibliometric and review studies provide valuable insights into the trends, themes, and gaps in lifelong learning research. For example, Thwe and Kalman [13] conducted a systematic review of 120 studies on lifelong learning in educational contexts and found three significant themes: digital learning, competency assessment, and policy analysis. With these findings, they underscore the increasing role of digital technologies in lifelong learning and the necessity for standardized frameworks to measure and validate lifelong learning skills. But the research also highlights a striking fragmentation in terminology, with terms like "lifelong learning skills," "competencies" and "tendencies" used in interchangeable ways, complicating comparisons across studies.

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Assefa, et al. [28] is another noteworthy work who validated the four pillars of education from the UNESCO perspective in higher education settings in their Lifelong Learning Measurement Scale (LLMS). Based on this two-dimensional analysis, it uncovers four latent constructs of lifelong learning (learning to know, learning to do, learning to live together, and learning to be), and finds that institutional support strongly correlates with learner motivation. Lasting impacts in the study may prove to be a useful measurement for lifelong learning outcomes, yet the study concedes that although these measures may prove beneficial tools, they also present a significant issue for practical application across contexts of education.

Nguyễn, et al. [39] reported a bibliometric analysis of continuing education research in Asia with a clear emphasis on workforce development and vocational training. But their analysis also uncovers major gaps, like less focus on informal learning and sustainability. This highlights the need for a broader study that investigates all aspects of lifelong learning engagement and its effects on society.

Despite these advances, there remain several gaps in the literature. Firstly, it lacks critical assessments of the applicational contexts of lifelong learning frameworks applied in different contexts. For example, Kuzior, et al. [24] do not look at the practical barriers to creating lifelong learning systems across a range of contexts, though they discuss links between lifelong learning and national competitiveness. Second, although some bibliometric studies provide insight into the trends in educational technology or vocational training, no large-scale bibliometric analysis has been conducted on lifelong learning framework specifically. This restricts our ability to discern authorship trends, thematic transitions, and global research agendas relevant to this field. Lastly, the research on lifelong learning is disproportionately centered on high-income contexts, leaving gaps in knowledge on the implications posed by the low-income settings that are essential for propelling the discipline and monitoring the integration of lifelong learning framework into education systems globally.

2.4. Importance of Bibliometric Analysis

The bibliometric studies are important in the realm of research trends, cooperation and thematic evolution in the literature of lifelong learning. Bibliometric analyses use quantitative approaches to explore publication data that can help to understand how knowledge is created, communicated, and used over time. The tracking of the trends of research represents one of the main contributions of bibliometric studies. For example, in the study by Thwe and Kalman [13] authors note the attention granted to digital learning and competency assessment in lifelong learning research, which echoes trends in society towards technology-enabled learning. Similarly, Nguyễn, et al. [39] find cross-border partnerships and knowledge exchanges in continuing education and vocational training educational research.

Another important dimension in bibliometric studies is thematic evolution. This can be done by looking at keywords and subject categories to understand how the thematic trends of lifelong learning have changed over time. To illustrate, more recent bibliometric analyses have underscored the growing focus on digital learning approaches and learner-centered methodologies within the domain of lifelong learning [39]. These shifts also mirror societal trends, including the surge of technology in education and the demand for flexible learning approaches to meet global pressures.

There are several reasons for why there is a necessity for a bibliometric analysis specifically focusing on lifelong learning frameworks. Firstly, despite the growing literature on lifelong learning, there is a clear lack of meta-analyses of the systematic frameworks which inform the field. A specific bibliometric study would allow for insights into the use of various frames, e.g. UNESCO's four pillars and the EU's Key Competences in research and practice. Analysis of frameworks from different countries and regions would not only increase the knowledge of the frameworks themselves but would also provide policymakers and educators with pointers toward successful adaptation of lifelong learning principles.

Second, relevant bibliometric research typically fails to include the relationship of lifelong learning with recent topics like digitalization and global competitiveness. For example, Kuzior, et al. [24]

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highlights the connection between lifelong education and national competitiveness, and suggests better performance of a nation in terms of adult education would enhance economic competitiveness and contribute to sustainable development. This bibliometric approach enables researchers to pinpoint essential gaps and possible ways forward in the study of Lifelong Learning.

Lastly, a bibliometric assessment of lifelong learning frameworks should allow for identification of leading research and impactful studies. Through citation mapping and publication pattern analysis, researchers can better identify the most important works in the field of lifelong learning, encouraging future research efforts and collaborations. Such knowledge is critical for developing an active academic community that meets the changing paradigms of learners and society.

3. Methodology

This study used a bibliometric approach to systematically analyse the research on lifelong learning frameworks within education. Bibliometric analysis is a quantitative methodology for exploring trends, impact, and collaboration patterns in a field using publication, citation, and authorship data. This offers a permanent and impartial grounding for exploring past and current research in education. This research used the Dimensions database as the main data source for bibliometric analysis, which provides comprehensive interdisciplinary coverage of scholarly publications. Its subject coverage allows for detailed analysis of research trends and citation/networking in the field of education [14, 40, 41].

3.1. Search Strategy

The dataset was extracted by applying a systematic search strategy in the Dimensions database. The process involved the use of the keyword "lifelong learning frameworks" along with a series of filters designed to ensure relevance and quality. The filters applied were as follows:

1) Publication year : 2014 to 2024
2) Document Type : Journal Articles
3) Access Type : Open Access
4) Research Field : Education (including relevant subfields)

This search strategy yielded a dataset of 597 articles, ensuring a focused and comprehensive collection of literature specifically related to lifelong learning frameworks in education.

3.2. Inclusion and Exclusion Criteria

To further refine the dataset and maintain the quality of the analysis, the following criteria were applied:

1) Inclusion Criteria:
a) Peer-reviewed journal articles
b) Open access publications
c) Studies explicitly related to lifelong learning frameworks in education
2) Exclusion Criteria:
a) Non-English articles
b) Non-open access materials
c) Studies outside the field of education

These criteria were established to ensure that the analysis remains concentrated on high quality, accessible, and directly relevant literature.

3.3. Bibliometric Tools and Metrics

The study employs both visualizations and analytical tools to process the bibliometric data. The following tools and metrics were used:

1) Tools

a) VOSviewer: Used for mapping and visualizing relationships such as keyword cooccurrence, co-citation networks, and international collaboration patterns.

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b) Microsoft Excel: Employed for data management and analysis of trends, including the calculation of annual publication growth.

2) Metrics

a) Publication Trends: Analysis of the annual growth in publication numbers to track research evolution over time.

b) Keyword Co-occurrence: Identification and visualization of prominent research themes and their interrelationships.

c) Influential Journals: Determination of journals that have a significant impact in the field.

Collaboration Networks: Examination of co-authorship patterns \, particularly among authors from different countries, to understand the dynamics of international research collaboration.

4. Results and Discussion

4.1. Publication Trends

The publication trends from 2014 to 2024 indicate a significant upward trajectory in research output related to the lifelong learning framework, starting from no publications in 2014 and culminating in130 publications by 2024. The data reveals a gradual increase in the number of publications, with notable growth beginning in 2015, where 13 publications were recorded. This initial rise suggests a burgeoning interest in lifelong learning concepts, likely influenced by emerging educational policies and practices.

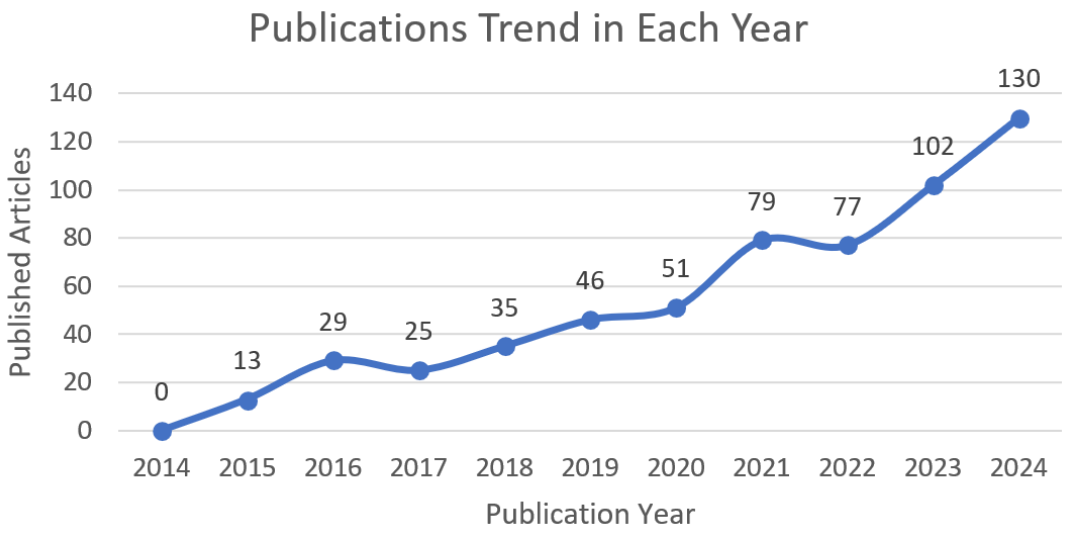

Figure 1.
Publication Trend of Lifelong learning Framework in Education in Each Year.

The most pronounced growth occurred between 2019 and 2020, where the number of publications jumped from 46 to 50, reflecting a growing urgency in addressing educational challenges, particularly in light of the COVID-19 pandemic. The peak year appears to be 2024, with 130 publications, indicating a sustained interest and possibly a response to ongoing global discussions about the importance of lifelong learning in adapting to rapidly changing job markets and societal needs.

4.2. Dominant Research Categories

The dataset on lifelong learning framework research highlights a clear hierarchy in scholarly focus, with Education Systems (309 publication) and Curriculum and Pedagogy (292 publications) collectively dominating the literature, reflecting a strong emphasis on practical, implementation-driven aspects such

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as institutional structures, management strategies, and instructional methods tailored to lifelong learners. This prioritization likely stems from the urgency to address operational challenges in adapting educational frameworks to diverse, evolving learner need. In contrast, Education Policy, Sociology, and Philosophy (166 publications) and Specialist Studies in Education (86 publications) occupy smaller shares, suggesting that foundational policy debates, societal impacts, and niche areas like edtech or special education remain comparatively underexplored, potentially due to their theoretical nature or narrower applicability.

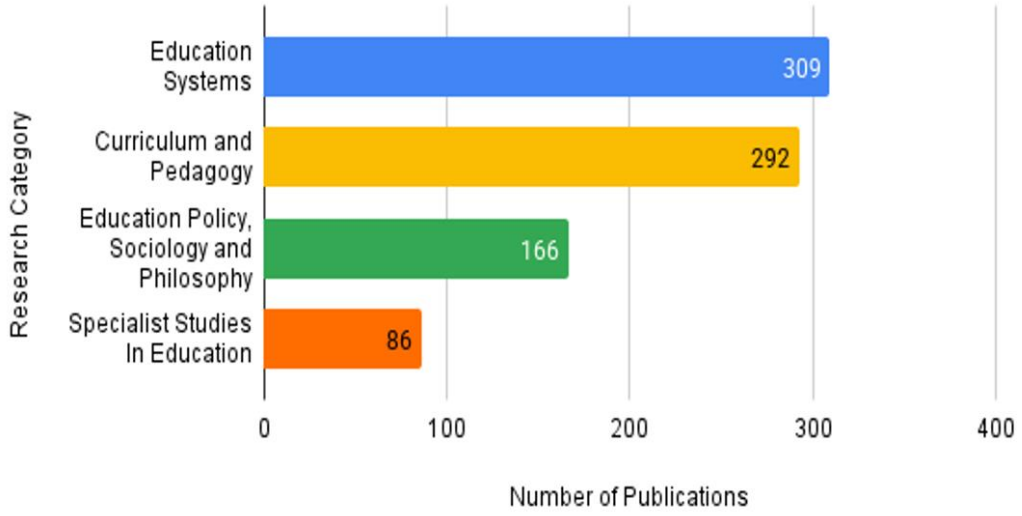

Figure 2.
Distribution of Publication of Lifelong Learning Framework in Education by Research Category.

4.3. The Most Frequent Keyword

The most frequent keywords in lifelong learning research based on the density visualization from VOSViewer are "sustainable development goal (SDG)." "Digital literacy," and "policy micro credential" which highlight a focus on global sustainability agendas, technological adaption, and flexible education systems. Over time, thematic clusters have evolved from conceptual discussions on equity and institutional frameworks (early 2010s) to actionable strategies like digital competency assessments and micro-credentials (post-2015). This shift reflects growing alignment with SDGs and labor market demands, emphasizing scalable, technology-driven solutions. Meanwhile, persistent clusters on pedagogical challenges (e.g., "classroom," "teaching structure") reveal unresolved gaps in translating macro-policies into localize practices.

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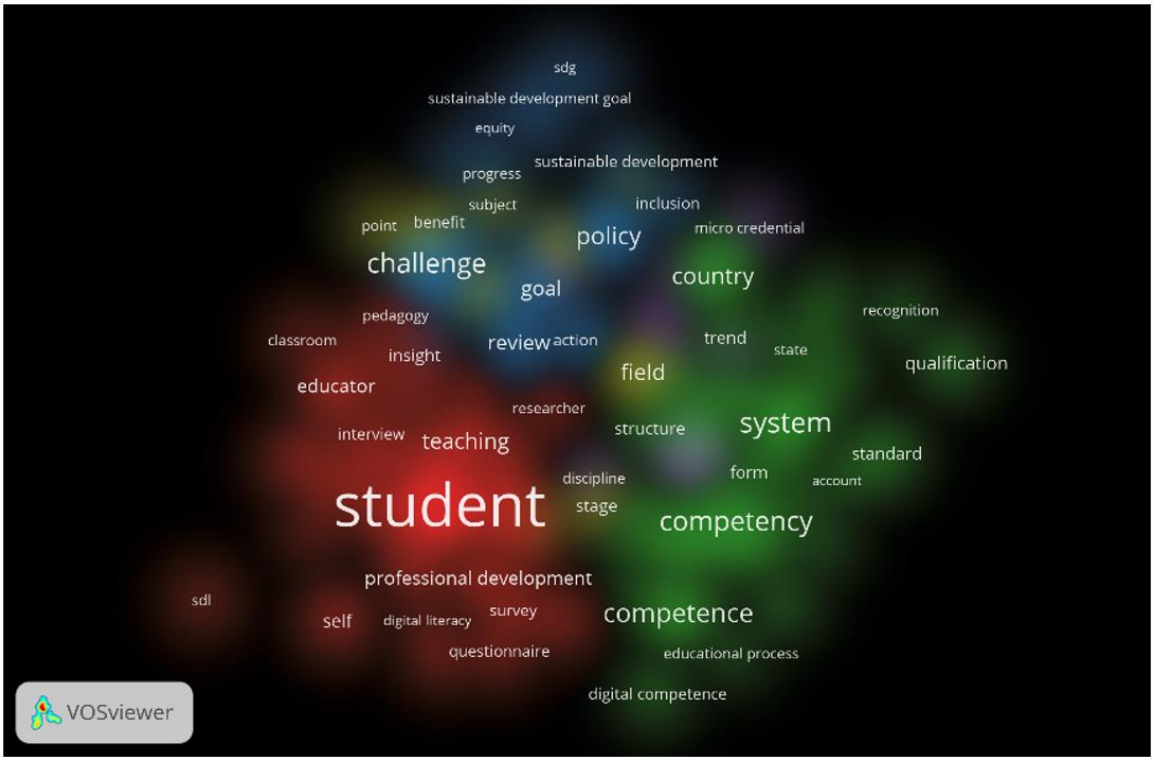

Figure 3.
Density Visualization of Keyword Clusters based on Co-Occurrences.

Emerging themes include micro-credentials driven by post-pandemic digital transformation and personalized learning needs. Conversely, traditional classroom-centric models and isolated policy debates are declining, signalling a move toward decentralized, skill-based learning and systemic barriers (e,g., resource disparities) remain underexplored. The field now faces a critical need to bridge high -level policy goals with practical, learner-cantered approached to ensure lifelong learning frameworks are both inclusive and adaptable to diverse context.

4.4. Influential Journals

The dataset reveals Sustainability as the most prolific journal with 18 publications, indicting robust research output, though its citation impact (72 total citations, 4 citation/publication) is overshadowed by Widening Participation and Lifelong Learning, which dominates citation impact with 611 total citations (152.75 citations/publication) despite only 4 publications, suggesting its niche influence in addressing critical societal or educational equity topics.

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Table 1.
Influential Journal based on the Number of Articles and Citations.

No.	Journal	Articles	Citations
1	BMC Medical Education	13	7
2	Education Sciences	5	169
3	Frontiers in Education	4	1
4	International Journal of Lifelong Education	7	25
5	International Review of Education	8	2
6	Pacific Journal of Technology Enhanced Learning	6	92
7	Society Integration Education Proceedings of The International Scientific Conference	5	155
8	Sustainability	18	72
9	The Education and Science Journal	4	2
10	Widening Participation and Lifelong Learning	4	611

High-impact journals like Education Sciences (169 citations) and Society Integration Education Proceeding of The International Scientific Conference (155 citations) likely benefit from interdisciplinary focus or collaborative frameworks, as seen in conference proceedings. While authorship and institutional data are absent, trends imply that journals prioritizing quality over quantity (e.g., Widening Participation) or leveraging open-access models (Sustainability) achieve broader reach, The disparity between publication volume and citation impact underscores the importance of thematic relevance and strategic dissemination in driving scholarly influence, with high-impact journals often aligning with pressing global or interdisciplinary agendas.

4.5. Co-authorship Patterns Among Countries

The co-authorship analysis reveals the United Kingdom as the most influential country, leading in publication (29), citations (511), and collaboration strength (17), followed by the Netherlands (14 documents, 546 citations) and Australia (19 documents, 418 citations), indicating robust international networks. While the U.S. and Spain show high output (24 and 26 documents), their collaboration strength lags (4 and 5), suggesting siloed efforts.

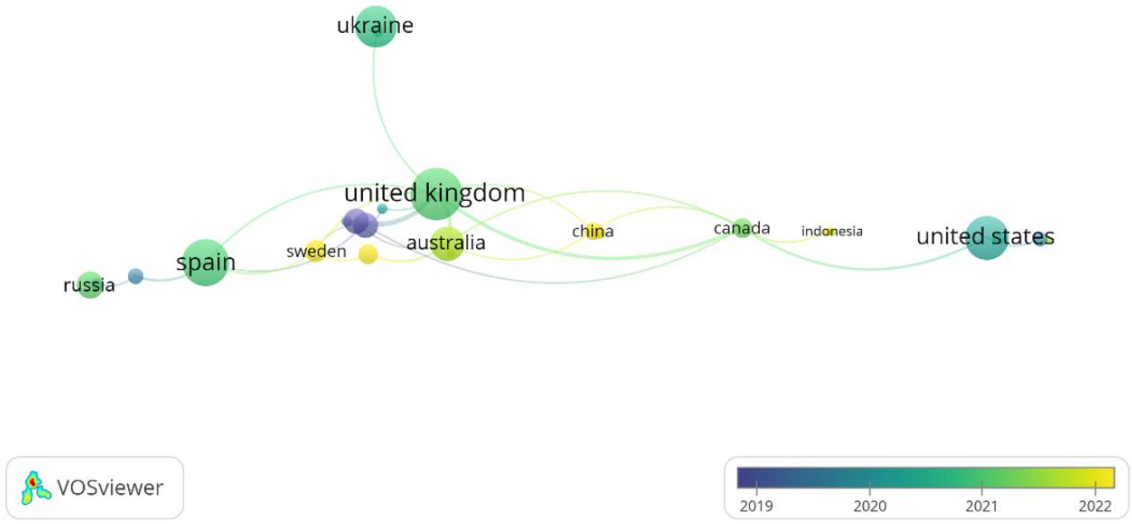

Figure 4.
Co-Authorship Network based on Countries Collaboration

Emerging contributions like Ukraine (23 documents) and Russia (15) have low citations and weak links signalling limited global engagement. Countries like Hungary, India, and Turkey show minimal collaboration (0 ink strength), highlighting regional disparities. This underscores opportunities for

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fostering partnerships to bridge gaps between high-output and under networked regions.

4.6. Discussion

The findings of this bibliometric study reveal a dynamic and evolving landscape in the research on lifelong learning frameworks. The analysis indicates a significant increase in research output over the past decade. Starting from no publication in 2014 and reaching 130 articles in 2024, the trend demonstrates a rising interest in continues education. The notable increase in the number of publications, particularly the surge between 2019 and 2020, suggests that global disruptions such as the COVID-19 pandemic have accelerated scholarly attention on this topic. This growth may be attributed to the pandemic's influence on educational practices, which necessitated rapid adaptation and digital transformation in learning environments. Such developments align with previous observations by Hamburg [8] and Kölemen [11] who have emphasized the need for continuous learning in response to unprecedented educational challenges.

Along with the overall increase in publications, the study notes significant differences in research emphases within the domain. The dominant categories were Education Systems and Curriculum and Pedagogy, with 309 and 292 publications, respectively. This emphasis on maintaining the ecological validity of lifelong learning has implications for the ways in which researchers are, importantly, defining frameworks they feel can be implemented across a variety of institutions to accommodate the needs of learners in the future. This focus aligns with the literature that highlights the need to reform teaching practices and intuitional policies to cope with quickly evolving technological changes and labor markets [1, 2]. On the other hand, it seems like other fields such as Education Policy, Sociology, and Philosophy and Specialist Studies in Education seem to be less highlighted. This discrepancy illustrates a potential gap in the literature where existing literature on operational strategies and similar aspects need to be complemented with foundational debates on policy and societal impact [3, 4].

The analysis of keywords also illustrates the evolution of thematic concerns over time, as discussed in the previous section. A clear prevalence of words like "sustainable development goal (SDG), "digital literacy" and "policy micro credential" reveals that recent studies have more and more been in line with the global agendas, digital transformation, and digital transformation initiatives. Earlier works were focused on the concepts considering equity and institutional models; more recent pieces have been more about operational strategies such as digital competency assessments and micro-credentials. This thematic evolution parallels global trajectories of infusing sustainable development and digital skills within lifelong learning, as advocated by Sulak, et al. [7] and Lang [12]. While these results indicate that there is a growing emphasis on digital innovation and flexible, skills-based education systems, the persistence of traditional classroom-centered themes indicates that there remains a long way between broad policy goals and local practice [9, 10].

Understanding the balance between publication volume and citation impact within influential journals offer further complexity in understanding the field. Given that Sustainability is also a leader in terms of the number of published papers, its general impact (in terms of citation) remains rather low, especially compared to Widening Participation and Lifelong Learning. Despite the fact (or maybe because of it, given topical relevance and purposeful dissemination of one's work drive citation) that the latter has only four publications, it holds 611 citations. Other reasons that lead to many citations, as in journals like Education Sciences and international scientific conference proceedings, are trans disciplinarity and collaboration. These results suggest that both the quality of the articles and alignment with urgent global issues matter to a greater extent than the volume of research that is published [2, 3].

The study of co-authorship patterns also enhances the understanding of the research landscape. However, the United Kingdom, the Netherlands, and Australia are key contributors with strong networks that have had a high number of publications and citations. This indicates the importance of collaboration when leading deep innovative national trends which international countries can build their alpha scholarly recipes through global partnerships. However, while the United States and Spain

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reflect high volumes of output, they also experience relatively strong insular potentials in their collaboration strengths. Research institutions play a key role in establishing international cooperation, particularly for areas where emerging research profiles exist like Ukraine and Russia where the total output shows a high volume of documents but a weak international profile with lower citation counts and collaborative links. The phenomenon of notable international scientific collaboration was absent in nations such as Hungary, India, and Turkey, highlighting regional differences which roof that establishing global research networks generated by broader participation of scholars might lead to improvement of the quality and revolting power of lifelong learning research as a whole [15, 42].

The study provides a nice, comprehensive look at the emerging research around lifelong learning frameworks. The sector clearly indicates that there is increased research output, there is a paradigm shift toward more actionable and technology-enabled stages of education, and there are already some sectors that already demonstrate the efforts in bridging international collaboration between organizations and by implementing CVET schemes. In the dynamic landscape of contemporary education amidst the transformative forces of technology and labor market evolution, finding the intersection of policy, practice, and research becomes imperative. Future study should therefore combine the operational strategies pervasive in earlier studies and analysis at higher levels of analysis (policy and sociocultural) to provide both acceptable capacity for lifetime learning initiatives and theoretical validation. Scholars can also work on lifelong learning frameworks to address not only the immediate educational needs but contribute to sustainable and equitable development in health, education, and research globally [13, 43] by advocating for more inclusive processes of collaborative research [13].

5. Conclusion and Suggestion

5.1. Conclusion

This research offers new insights into the lifelong learning framework research environment as it grows and develops. Nonetheless, specific caveats need to be recognized. The analysis relied only on Dimensions database which may miss relevant literature to the topic. Moreover, the exclusion of non-open access articles may restrict the range of the study, thus potentially missing an influential work in subscription-based journals. These limitations highlight that while our findings provide an important snapshot of trends and collaborations in research, they may not capture the global body of research on lifelong learning frameworks.

5.2. Suggestion

The analysis could be further improved by considering the inclusion of additional data sources, providing a more comprehensive overview of publications. It could improve the bibliometric approach of this domain by expanding the dataset to different databases and non-open access literature. In addition, qualitative approaches could complement bibliometric methods and enable us to better comprehend the underlying reasons behind research trends. This may involve, for instance, conducting in-depth case studies or interviews with major figures within the field to investigate how particular publications were arrived at, or how major networks were formed. Sociocultural and policy dimensions of lifelong learning; and comparative studies across different educational systems are other aspects that could add value. With such a robust, wholistic picture of the teacher preparation field, which would serve students fully as the rays of this sun prepare to enter the education system, both academic inquiry and practical applications in education policy and practice can be better informed through variation and interplay amongst all components in the system.

Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

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