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A BIBLIOMETRIC ANALYSIS OF BLOCKCHAIN TECHNOLOGY AND VIRTUAL REALITY IN ENHANCING ACADEMIC INTEGRITY: FOCUS ON DIGITAL ASSESSMENT TOOLS IN THE EDUCATION SECTOR

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Abstract

This paper performs a bibliometric review of blockchain technology and virtual reality (VR) in the education industry, and how the two particular technologies can improve academic honesty by utilizing digital assessment instruments. It will provide an overview of the existing research field, reveal its major trends, and will indicate gaps in knowledge in the newly developing field. This study employs bibliometric analysis technique to examine research articles, conference proceedings, and book chapters downloaded via the Scopus database. The relevant publications were retrieved using keywords, including "blockchain technology," "virtual reality," "academic integrity," and "digital assessment tools" and the education sector. Analysis will be done using co-citation, co-authorship, and key words co-occurrence to determine influential authors, Institution, journals, and themes emerging. The review demonstrates that the desire to implement blockchain technology and VR in education, namely, in improving academic integrity, is gaining interest. Blockchain tech is mainly researched in the area of safe credentialing and transparent recording, whereas VR is researched in terms of immersive and trustworthy assessment activities. The digital assessment tools can become a crucial domain where blockchain and VR are related to enhance academic integrity. The study shows the most prominent contributors, collaboration networks, and high-impact publications advancing the research in this area. The bibliometric results are informative to the researchers, educationists, and policymakers. The scholars can find the under researched gaps, including the combination of blockchain and VR with adaptive assessment systems. Investors can use the insights to inform funding and policy formulation to encourage educational technologies innovation. The presented bibliometric analysis gives a clear picture of the research scape of blockchain technology, VR, and digital assessment tools in education. It points to the overlapping nature of all these technologies towards ensuring academic integrity and provides a starting point to subsequent studies and implementations.

Keywords: Blockchain technology, Virtual reality, Academic integrity, Digital assessment tools, Bibliometric analysis, Education sector, Research trends, Co-citation analysis

1. Introduction

Academic assessment integrity is a principled component of educational systems across the globe and addresses the fact that assessment procedures are sound, clear, and represent actual student performance (Silaghi and Popescu 2025). But with the growing trend of education in digital territories, academic honesty has become a complicated issue to uphold. The large scale use of online learning environment and digital assessment instruments has allowed education to become more scalable and accessible but created new points of vulnerability (Juan and Lopez 2025). The problem of impersonation, plagiarism, cheating and credentials fakery have also risen in digital education, pushing institutions to

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consider new technological options (Learning et al. 2025). Some of the most promising of those include blockchain technology and virtual reality (VR) that have the unique potential to improve the credibility and reliability of the assessment process by managing assessment data security and providing an immersive assessment experience (Paper et al. 2025).

Honesty, trust, fairness, respect and responsibility, which are the traditional values of academic integrity, are challenged by the digital era (Ta et al. 2025). Although digital assessment tools have a few benefits associated with them; they are quick, flexible, and effective in analyzing the data assessed, they have major threats in terms of authenticity, data security and verification of the identity of the people using them (Saxena and Researcher 2024). With schools and universities administering more and more tests online, security issues are of great concern unless additional measures are taken (Banfes, Nazari, and Vahidi 2024). Despite the fact that blockchain technology and VR were initially created with utterly different aims in mind, they have currently proven themselves as the game-changing technologies capable of dealing with these issues (Ramani et al. 2024). Their meeting point in educational sector is a promising area of concern that is already attracting the attention of researchers, educators and policymakers in an attempt to enhance academic integrity by incorporating more sophisticated digital systems (Kaur 2024).

The blockchain technology, characterized by decentralized and immutable ledger system, offers strong solutions to secure records storage, data transparency, and authenticity checking (Ojog 2024). Educational uses of blockchain could be used to store educational academic credentials: degrees, certifications, grades, attendance records, etc. in a tamper-evident manner that can be verified over a long time span (Villegas-ch and García-ortiz 2024). This characteristic of the blockchain records as immutable assists in overcoming one of the fundamental issues of digital assessment, which is the simplicity with which academic records may be altered or forged (Jagatheesaperumal, Ahmad, and Member 2024). Keeping educational outcomes in transparent, tamper-proof systems, blockchain enables the creation of trust-based digital environments where institutions and individuals can validate and share academic Information without involving centralized intermediaries (Batra 2024). Furthermore, smart contracts on the blockchain could be used to automate processes associated with assessment, including grade publication, assignment uploads and plagiarism checking, which would both raise efficiency and limit the possibility of malpractice (Elkhodr et al. 2024).

Virtual reality provides an additional strong aspect of improving academic honesty through creating immersive and controlled academic settings (Rane 2024). Compared to the conventional online evaluation instruments, which can be easily bypassed, VR settings immerse the students in the interactive and realistic simulation, in which knowledge, skills, and behaviors could be assessment in real-time (Samarai 2023). Assessments may be more tailored to the real world in these environments, e.g. laboratory experiments, mechanical tasks, or group projects, in which dishonest work is harder to perform or to hide (Iyer 2023). In addition, VR assessment experiences can incorporate motion tracking, gaze-watching, and interaction analytics features that serve as an extra set of data layers to examine the performance and behavior of students in a real manner (Supriadi et al. 2023). In this way, VR is not simply a delivery medium of the tests but an active and reactive learning and assessment space. Its ability to minimize cheating and maximize engagement earns it the status of a perfect match to blockchain on the quest to achieve safer and more dependable assessment activities (Sustainable et al. 2023).

Digital assessment tools are the important connector between technological advances and teaching methods (Kistaubayev et al. 2023). The combination of blockchain and VR into these tools present a synergistic approach to much of the problems of academic integrity

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today (Zhao et al. 2023). As an example, a digital assessment system would use blockchain to verify student identity securely and store the result of assessments and VR to deliver complex tests that are interactive and difficult to manipulate (Rustemi, Dalipi, and Atanasovski 2023). Such a combination enables an end-to-end confidence in the assessment workflow, between the test administration and the delivery of final grades or certifications (Wang et al. 2023). Nevertheless, as the interest in the technologies grows, the current state of research is still fragmented and does not share a common vision of how blockchain and VR can work together to improve academic integrity (Aithal and Aithal 2023). Herein lies the importance of systematic method applied to research landscape mapping, key contributor's identification, and emergent trends along with knowledge gaps revelation (Haque et al. 2023).

In response to this requirement, bibliometric analysis has a proven and statistically sound framework to analyze the output of scholarship in this cross-disciplinary field (Bjelobaba, Savi, and Toši 2023). Bibliometric methods can produce Information on the structure and development of academic research over time, through analysis of patterns of publication, citation, and collaboration (Fidas et al. 2023). In particular, co-citation analysis, keyword co-occurrence mapping, and co-authorship network analysis may assist in the identification of influential authors, institutions, and research themes. These reflections are pure gold to researchers that want to grasp the dynamics of a fast-moving field and practitioners that wish to embrace best practices achievable by the best scientific evidence (Mourtzis, Angelopoulos, and Panopoulos 2023). Bibliometric analysis is especially effective in studying new research fields whose literature quantity is already growing but is not yet consolidated (Mohammad and Vargas 2022). Bibliometric tools can be used to synthesize the current knowledge in the case of blockchain and VR in education as well as to reveal under researched gaps and the overall direction of future research (Bjelobaba et al. 2022).

The rationale of the proposed research is the necessity to urgently realize how blockchain and VR are studied as the tools to maintain academic honesty in the education market. Through the systematic analysis of academic literature, retrieved through the Scopus database, with the search queries including the terms like "blockchain technology," "virtual reality," "academic integrity," "digital assessment tools," and the term Education sector this study will attempt to construct a scholarly activity map in this field. The study aims to find out leading players, including most cited authors and major institutions, and collaborative networks that are influencing research agenda. Also, the analysis will identify thematic clusters according to the associations of key words and provide information about the ways various concepts and technologies are interconnected in academic discourse.

The results of the present bibliometric study are likely to bear important implications on various stakeholders. Researchers can also see in the results an awakening of underdeveloped research fields, including blockchain and VR in conjunction with artificial intelligence, adaptive learning systems, or ethics-based assessment systems. The insights allow educators to embrace or promote technologies that support evidence-based best practices in digital assessment. To the policymakers, the study will offer empirical evidence that they can use when making decisions regarding funding, strategic plans, and how to regulate the emerging education technologies. Notably, the research also provides the insight regarding the usefulness of interdisciplinary cooperation in ensuring the solution of complicated issues associated with academic integrity, stating that a combined effort including education, computer science, ethics, and instructional design needs to be found.

The novelty of this research is represented by the fact that, through a bibliometric analysis of the academic integrity/blockchain and academic integrity/VR overlap, it explores a field that is, nonetheless, crucial yet insufficiently researched. This article can serve as the foundation of future studies and practical applications because the author creates a

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comprehensive picture of the contemporary research field. The knowledge produced as a result of such examination will not only assist in consolidating the scattered literature, but also will form the basis of designing coherent technological schemes that enhance academic honesty by providing safe and engaging online evaluations.

In its presentation, the article has a systematic layout that starts by giving the methodology used in its collection and analysis of the bibliometric data. It next moves on to provide some important findings in terms of trends of publication activity, author networks, and thematic trends. The discussion section provides the interpretation of these findings regarding the technological development and contemporary issues in the sphere of education, providing practical implications and recommendations. At the end of the article, the authors summarize major contributions, adhere to limitations, and propose future research directions. In so doing, this study will leave a significant impact on the growth of academic integrity in digital education by demonstrating the life-changing power of blockchain and virtual reality in case of their careful inclusion in the process of assessment.

2. Materials and Methods

In this paper, a bibliometric analysis will be used to conduct a research on the convergence of blockchain technology, virtual reality (VR), academic integrity, and digital assessment tools in the education sector (Savelyeva and Park 2022). Bibliometric analysis, a quantitative approach to the assessment of scientific publications, is especially well adapted to the study of research trends, intellectual frameworks and collaboration patterns in an interdisciplinary and changing field like educational technology (Review 2022). The research process deployed in the examined paper follows the triggers of solid bibliometric workflow and is aimed at the coherent gathering, processing, and explanation of the corresponding scientific literature (Kuleto et al. 2022).

The first step was taken by developing clearly definable research scheme that would define the direction of the study and methodological rigor (Alshareef 2022). Research questions were aimed at determining the amount and trends of academic production in the area of blockchain and VR in education, its most prolific authors, and future directions that will correspond to the promotion of academic integrity with the help of digital assessment (Khan et al. 2021). Scopus database was chosen as the main source of data because it covers wide range of peer-reviewed journal articles, conference proceedings, and book chapters in various fields (Dash et al. 2021).

The search strategy was applied through combining the pertinent keywords, namely, blockchain technology, virtual reality, academic integrity, digital assessment tools, and education sector. The search query was refined using Boolean operator and truncation to make it relevant and precise. The study was restricted to the English language publications and up to the year 2024. The search initially brought a wide pool of documents, which were narrowed down by relevance to the topic of research through screening of titles and abstracts (Raimundo 2021). Duplicates, non-academic articles and those that did not fit into the thematic scope established were removed. The resulting dataset consisted of peer-reviewed articles that either discussed blockchain or VR in educational assessments specifically and their implication to academic integrity in particular (Kuleto, Ili, and Simion 2021).

The extracted bibliometric data contained in the Scopus were processed with the help of the R-based software package Bibliometric and the web interface to it Biblioshiny. This software was selected because of its powerful features to perform different bibliometric analyses, such as descriptive statistics, citation analysis, co-citation analysis, keyword co-occurrence mapping, and network visualizations. The major bibliometric indices including the total number of publications, citations, h-index, g-index, and m-index were determined to

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measure the impact and productivity of the authors, journals, and institutions (Palma, Pereira, and Martina 2019).

In addition, co-authorship analysis served to studying patterns of collaboration between researchers and institutions, and co-occurrence analysis of keywords allowed to define thematic clusters and research trends in the data. Thematic mapping and trend topic analysis helped to understand the way in which the research focus has changed throughout the years, especially according to the development of technologies and new issues in the sphere of education. Knowledge maps, collaboration networks, and thematic evolution graphs were created with visualization tools incorporated in Biblioshiny.

Overall, this methodological approach will guarantee a thorough yet systematic review of the literature. This methodology allows not only revealing the important contribution and tendencies but also identifies the gaps and promising directions of future research, particularly, regarding how to integrate blockchain and VR technologies to maintain academic honesty in online education space.

3. Five-Step Process of Bibliometric Analysis

In this article, a systematized five-stage bibliometric workflow inherent in (Zhao et al. 2023) is followed to be able to provide a structured and methodical way of collecting, analyzing, and interpreting the scholarly literature. The framework is especially well cut out to investigate new and interdisciplinary areas like blockchain technology and virtual reality in education (Review 2019). It will start with outlining research aims and developing guiding questions as the selected tools and methods should be related to the intersection of blockchain, virtual reality, academic integrity, and digital assessment tools as the focus of the study. The following stage is the gathering of academic literature that is stored in the Scopus database with the help of specifically designed key combinations (Williams and Williams 2019).

The dataset is cleaned by applying filters on language, type of document and thematic relevance and eliminating duplicates and irrelevant records. The third step is to import the cleaned data into bibliometric analysis packages, in particular Bibliometric and its web interface Biblioshiny (Zhao et al. 2023). They allow the examination, e.g. co-authorship networks, keyword co-occurrence mapping, citation patterns, to identify influential contributions and areas of research. The fourth step, the analytical results are displayed using network maps, thematic diagram, and trend plot, which provides a clear picture of the generated themes and collaboration framework. Lastly, the findings are discussed to provide meaningful conclusions, which indicate gaps in knowledge, the direction of their evolutionary research and practice, and practical implications that may be used in future studies and improvements in the educational technology environment.

4. Scheme of Study

The outline of the proposed research is the investigation of the overlap between blockchain technology, virtual reality (VR), academic integrity, and digital assessment tools in the education sector through a systematic bibliometric methodology. It will attempt to chart the current research terrain, locate key works, reveal gaps in knowledge, and reveal thematic patterns which will shed light on the role of these novice technologies in stimulating academic honesty (Samarai 2023).

Firstly, the research was envisioned using three main research questions: (1) What is the present situation of the research regarding blockchain and VR in digital education, and specifically in regard to academic integrity? What are the most powerful authors, institutions and sources in this field? (3) Which are the predominant topics and possible research gaps in the literature? These were the guide questions that made the exploration of the topic focused and systematic.

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The study then located the important tools and techniques that can be used to complete the bibliometric analysis. Scopus database has been chosen as the main literature source because of thorough indexation of peer-reviewed academic materials regardless of the field (Jagatheesaperumal et al. 2024). The R-based software Bibliometric and its user-friendly web interface Biblioshiny were used to conduct a bibliometric analysis and allow a large variety of analytical and visualization options. With these tools, it was possible to process big amounts of bibliographic information and to guarantee the methodological solidity and interpretive facility (Rustemi et al. 2023).

Some major bibliometric techniques, namely the co-citation analysis, key-word co-occurrence, and collaboration network mapping, were chosen in order to cover the intellectual, social, and conceptual maps of the research area. By doing so, this strategy allowed the study to provide descriptive (e.g., publication trends, citation impact) and conceptual knowledge (e.g., emerging themes, research directions) that formed a substantive and evidence-based basis of assessing the role of blockchain and VR in enhancing academic integrity with the use of digital assessment tools.

5. Objectives, Tools, and Techniques

The main aim of the investigation is to review the developing situation regarding research devoted to the use of blockchain technology and virtual reality (VR) in improving academic honesty in the education industry, specifically concentrating on digital assessment instruments. To do so, the proposed research will use a bibliometric analysis, a systematic way of mapping and interpreting scientific publications that allows revealing trends, thematic densities, and research gaps (Elkhodr et al. 2024).

The research is motivated by two large objectives: to 1) offer a topical overview of significant scholar contributions within this interdisciplinary domain; and 2) uncover the intellectual architecture, developing topics, and cooperative trends that embody the research discussion. In this regard, the present analysis is performed using the R programming language and the Bibliometric package with a web-based interface Biblioshiny. Such tools enable the running of more advanced bibliometric capabilities, such as citation analysis, co-citation mapping, and keyword co-occurrence, author productivity measures (like h-index, g-index, and m-index), and Bradford's law of source concentration (Haque et al. 2023).

On the one hand, the keyword co-occurrence and thematic mapping were used to analyze conceptual and thematic structures, identify the key topics, and possible subjects of further investigation. Revealing high-frequency keywords and keyword-plus terms, the research demonstrates areas of interest dominance and how these areas change across the time. The identified methodological approach helps to understand better how blockchain and VR technologies contribute to the creation of secure, transparent, and immersive educational space.

6. Composing of Bibliometric Data

To compile the bibliometric data pertaining to this study, Scopus database was used as it offers a vast coverage in terms of peer-reviewed scholarly publications. The polished search strategy was utilized with the help of the following keywords: blockchain technology, virtual reality, academic integrity, digital assessment tools, and education. The databases were searched in the titles, abstracts, and keywords, and the desired publications were those published in the period 2001-2025.

The total amount of references was 37,990 and the final dataset consisted of 485 documents collected by 146 journals, books, and conference proceedings. The data showed that the average age of the documents was 4.93 years, the average number of citations per document was 246.8, and the annual growth rate was insignificant, which evidenced a stable yet very influential body of literature. This analysis covered 2076 Keyword Plus entries and

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1584 author-defined keywords, and this furnished a comprehensive foundation of conceptual mapping.

This body of work was produced by a total of 1425 authors, showing a high level of collaboration with 39 single-authored documents and 3.64 co-authors per document. Also, 50.31 percent of the publications had international co-authorship, which demonstrates the international applicability of the topic and interdisciplinary interest in it. The literature was peer-reviewed, and all the documents in the dataset were identified as articles. This extensive data base facilitates solid bibliometric analysis, which can be used to understand the trends in publications, key players, conceptual evolution, and collaboration structure in the area of blockchain, VR and digital integrity in education.

7. Bibliometric Analysis and Visualization

As revealed in the first search query at the beginning of the current study, a total of 540 scholarly records were identified as related to the blockchain technology, virtual reality, academic integrity, and digital assessment tools in the education sector. After sifting through a vast pool of screened records, a filtered data set of 485 very relevant articles was found, all published between 2001 and 2025 and indexed in 146 academic resources, such as journals, books, and conference proceedings. These articles were chosen because of their explicit relevance in integration of emerging technologies in educational assessment practices with a view of enhancing academic integrity (Dash et al. 2021).

The bibliometric analysis was performed with the help of the ‘Biblioshiny’ R package which is a very powerful tool that facilitates a thorough bibliometric analysis via a user-friendly interface. This tool permitted multidimensional analysis of six major structures including source structure (journals), document records (articles), authorship patterns, conceptual themes, social collaboration network and intellectual influence. The data contained 37,990 references, 2076 Keywords Plus and 1584 author-assigned keywords, which enabled thorough thematic research.

A total of 1425 contributors wrote the articles, of which 39 were single-authored articles and the remaining articles had a co-authorship of 3.64 on average, indicating a highly cooperative research climate. Also, 50.31 percent of the publications had international co-authorship, underlining the interdisciplinary and international appeal of this area.

The time-based publication output demonstrated that the academic interest is constantly growing since 2016, with a sharp rise predicted between 2019 and 2023, reaching its highest point in 2021 with 98 articles. This sudden expansion underlines the increased academic interest in how blockchain and VR may help solve problems of trust, transparency and fairness in digital assessment.

In geographical distribution, the United States had the highest number of total citations (TC = 24,473), second was United Kingdom (17,519), and third was China (15,319). Canada is interestingly the country with the highest average number of citations per article (353) which may indicate high impact of less, more influential publications. Germany, Australia, India, France are also the other significant contributors. These figures depict a widespread global interest in using blockchain and VR to improve the learning experiences and academic honesty.

The keywords that occur most often in this corpus are blockchain, virtual reality, academic integrity, digital assessment and education technology. Those terms indicate the interdisciplinary character of the field as it touches upon computer science, pedagogy, ethics and educational management. Notable institutional affiliations noted in the data set are technology oriented universities and research institutions, which further highlights the technical advanced nature needed in this area of research.

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This is the most extensive bibliometric analysis that not only traces the historical growth of the area but also gives us the idea about intellectual, collaborative, and thematic organization that determines future trends. The international scope and the repudiation of the process of publications support the disruptive capacity of blockchain and VR in the area of securing and improving academic procedures by means of digital innovation.

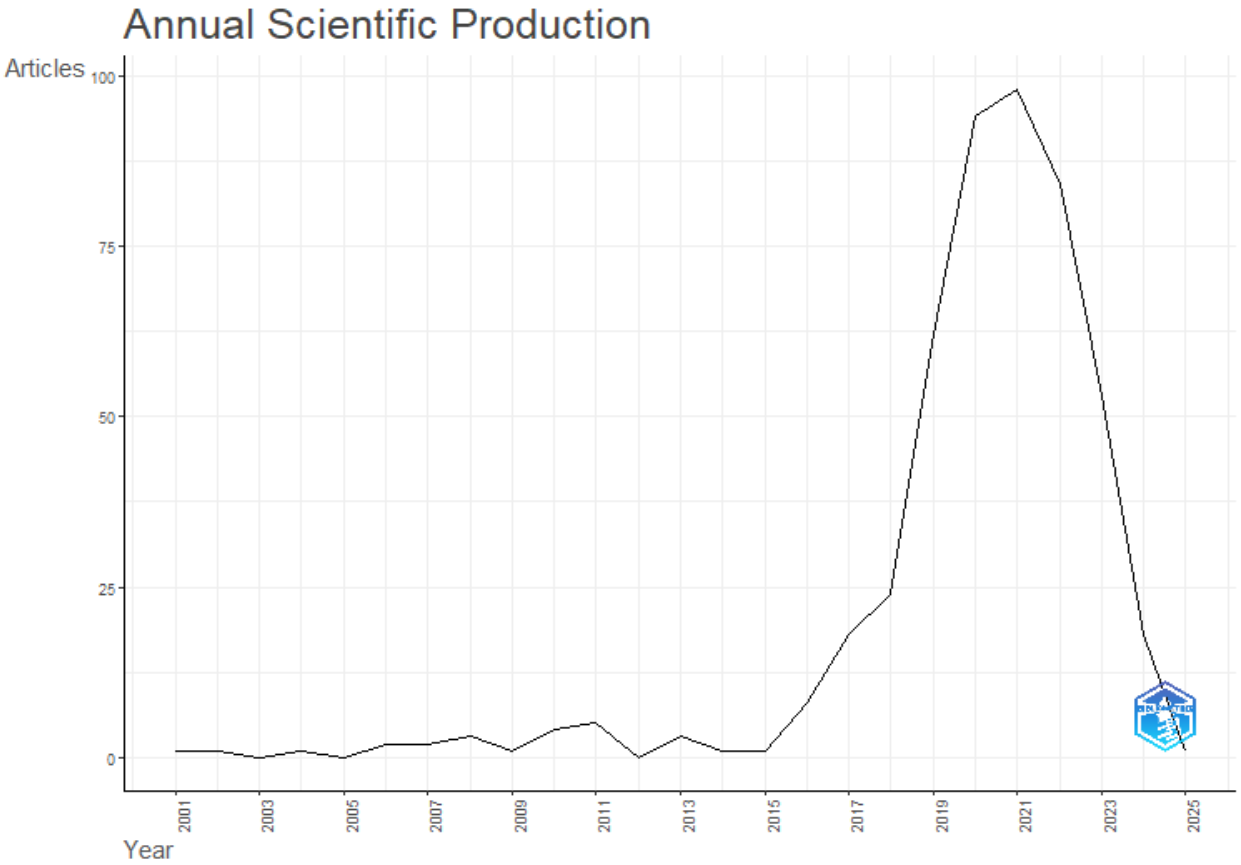

Figure 7.1 Annual Scientific Production

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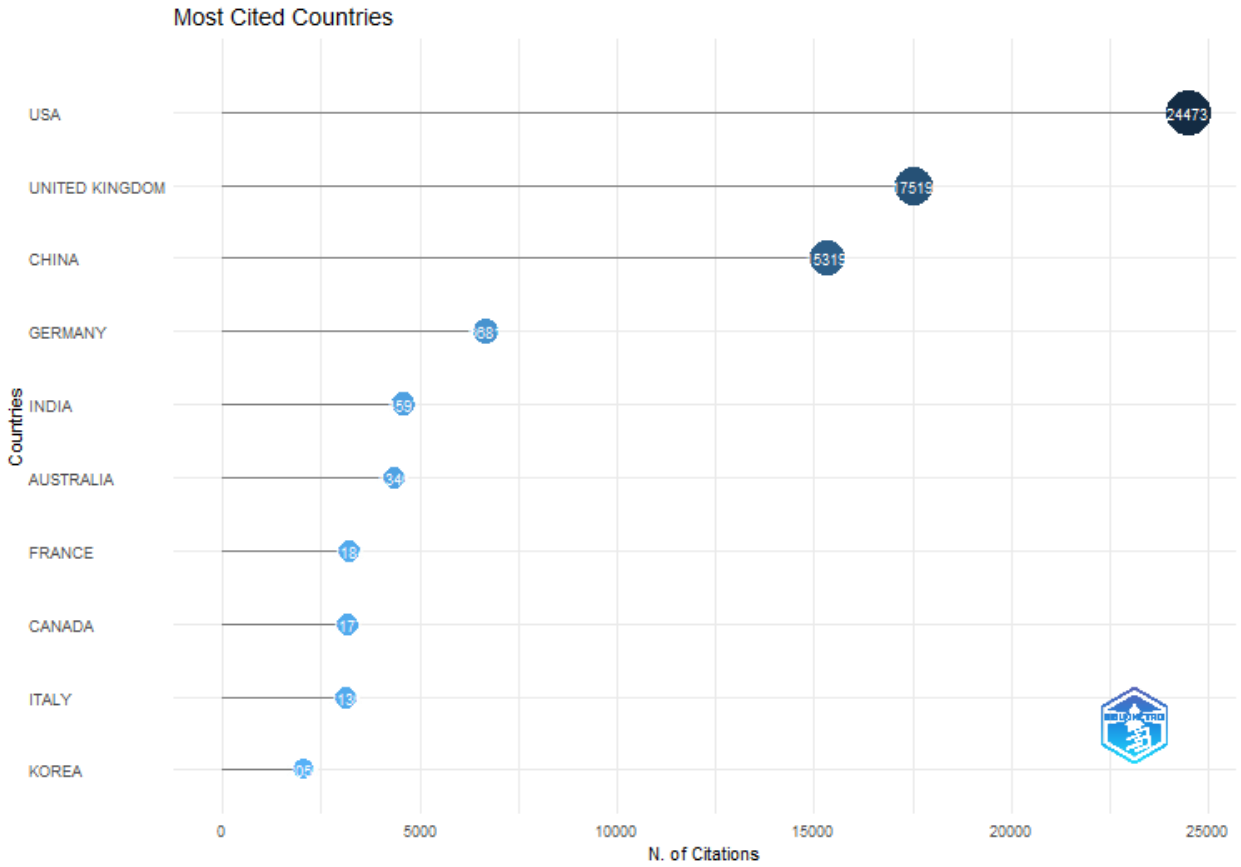

Figure 7.2 Most Cited Countries

7.1 Influential Aspects of Blockchain and VR Research on Academic Integrity

7.1.1 Core Journals

Based on the Bradford Law of Scattering, the Bradford method was used to find the most significant journals that were used in the research concerning the combination of blockchain technology, virtual reality, academic integrity, and digital assessment in the education field. The Law suggests that journals can be separated into three productivity zones: Zone 1 (core journals containing the most relevant articles), Zone 2 (moderately productive journals) and Zone 3 (less productive journals) developed by Bradford. Such stratification aids in revealing the most influential publication sources within the sphere and assists researchers in focusing on the essential sources to submit their works and review later.

Zone 1 comprises the most prolific journals that are at the forefront of this interdisciplinary field based on how regularly they are published. The highest-ranking journal, Technological Forecasting and Social Change, issued 42 articles, which highlights its leading position in the field of research concerning the technological change and its social aspects. Next are the International Journal of Production Research with 28 publications, and the Journal of Cleaner Production with 27, which are related to bridging technology implementation and sustainable practices, which is also a pertinent theme to consider in the context of integrity in educational systems with the use of digital innovations.

The other well-known Zone 1 journals are International Journal of Information Management and Journal of Business Research (both with 24 articles) and Transportation Research Part E: Logistics and Transportation Review (with 21 publications). These outlets point to an increasing level of curiosity in the scholarly implications of blockchain and VR technologies by a variety of research spheres, including everything from information systems to logistics and business innovation.

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Just a little less prolific, zone 2 journals, however, show an impressive interest in the subject matter. These are Business Horizons (15 articles), International Journal of Production Economics (14), Journal of Retailing and Consumer Services (14), subsequently Tourism Management (13) and IEEE Transactions on Engineering Management (10). The other journals that are prominent in this zone are Technology in Society, MIS Quarterly: Management Information Systems, and Production Planning and Control.

It is also worth noting that the presence of Business Strategy and the Environment with 7 publications in Zone 2 indicates even more the growing intersection of environmental strategy, ethics, and educational technologies. The journals have been spread over these zones because the topic is multidisciplinary in nature with contributors in the field of engineering, management, environmental studies, information systems and education (Kuleto et al. 2022).

Table 7.1 Journals Ranking

SO	Rank	Freq	cumFreq	Zone
TECHNOLOGICAL FORECASTING AND SOCIAL CHANGE	1	42	42	Zone 1
INTERNATIONAL JOURNAL OF PRODUCTION RESEARCH	2	28	70	Zone 1
JOURNAL OF CLEANER PRODUCTION	3	27	97	Zone 1
INTERNATIONAL JOURNAL OF INFORMATION MANAGEMENT	4	24	121	Zone 1
JOURNAL OF BUSINESS RESEARCH	5	24	145	Zone 1
TRANSPORTATION RESEARCH PART E: LOGISTICS AND TRANSPORTATION REVIEW	6	21	166	Zone 1
BUSINESS HORIZONS	7	15	181	Zone 2
INTERNATIONAL JOURNAL OF PRODUCTION ECONOMICS	8	14	195	Zone 2
JOURNAL OF RETAILING AND CONSUMER SERVICES	9	14	209	Zone 2
TOURISM MANAGEMENT	10	13	222	Zone 2
IEEE TRANSACTIONS ON ENGINEERING MANAGEMENT	11	10	232	Zone 2
TECHNOLOGY IN SOCIETY	12	10	242	Zone 2
MIS QUARTERLY: MANAGEMENT INFORMATION SYSTEMS	13	8	250	Zone 2
PRODUCTION PLANNING AND CONTROL	14	8	258	Zone 2
BUSINESS STRATEGY AND THE ENVIRONMENT	15	7	265	Zone 2

Source: Own Contribution

As revealed by the trend analysis, the number of articles appearing in leading journals has increased drastically since 2016, indicating that the academic community is gaining interest in the potential of blockchain and VR to transform assessment processes and ensure

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the maintenance of academic standards. Particularly, such journals as Technological Forecasting and Social Change, Journal of Cleaner Production, and Journal of Business Research have risen, establishing themselves as principal outlets of scholarship in this novel discipline (Rane 2024).

The present journal ranking analysis will provide strategy to academics who intend to publish or read influential literature, and it will inform both the publication and retrieval of superior research on the topic of digital transformation in instruction.

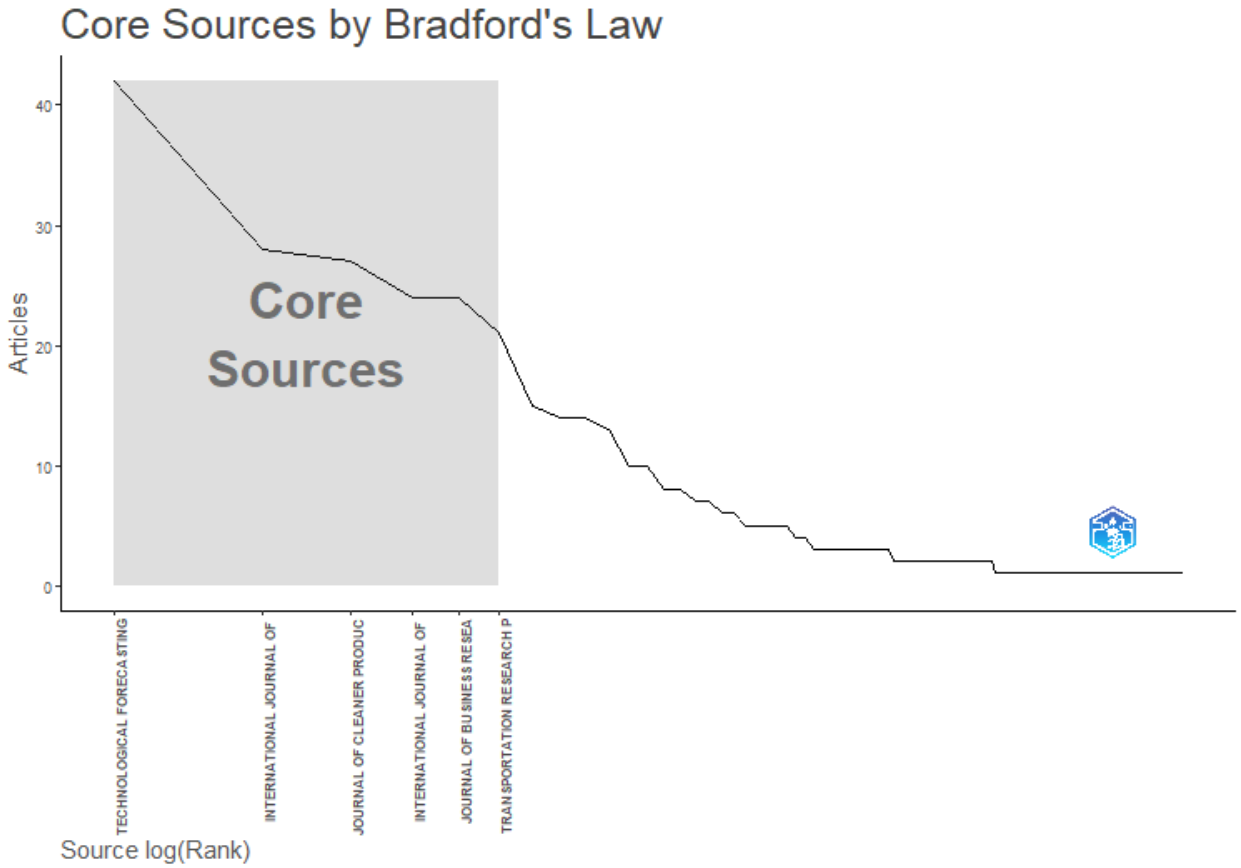

Figure 7.3 Bradford's Law

7.1.2 Core Articles and Highly Cited Publications

To gain additional insights into the intellectual basis of the research field under consideration that deals with blockchain technology, virtual reality, and academic integrity in digital education, we examined the most cited articles in our corpus. These books are some of the major works that have hugely impacted the discussion in digital transformation, system of trust, and innovation, in education and organization (Jagatheesaperumal et al. 2024). The most-cited works are given in table A3 in the appendix, according to the total number of citations, the average number of citations per year (TC per Year), and the normalized total number of citations (Normalized TC), which gives an idea of both impact on scholarship and time-correctness (Raimundo 2021).

The most prominent work in the field is the article of Chiu C-M (2006) in Decision Support Systems that has received 2,558 citations, whereas the average number of citations per year is 127.9. Although this paper is not explicitly about blockchain or VR, it has contributed to the generalized knowledge about trust and system-design, which are major tenets in academic integrity technology systems.

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Immediately after are two papers by (Saberi S, 2019) and (Xu LD, 2018) published in the International Journal of Production Research, having 2,267 and 2,187 total citations respectively. The works stand out specifically because of the high yearly citation rates, 323.86 and 273.38, respectively, and excellent normalized impact scores, considering that they are at the center of developing blockchain-related supply chain and information integration technologies, which can be applied easily to the education infrastructure.

One of the fastest influential works is (Dwivedi YK, 2022) whose article in the International Journal of Information Management has received 1,271 citations in a brief period, citation rate of 317.75 per year, and the top normalized TC score of 8.66 in the data set. This implicates high potential relevance development of information systems and VR combination in the educational and management sciences.

Work by Ivanov D stands out, in particular, with three distinct articles ranked in the first echelons, two in International Journal of Production Research and one in Transportation Research Part E. The collective body of his works demonstrates the intersection of simulation modeling, digital logistics, and blockchain-based resilience frameworks with the real-time decision-making environment, which is the basis of secure digital assessment systems in academia.

Additional high-impact articles are Warner KSR (2019) (1,457 citations) and (Guttentag DA, 2010) (1,064 citations), where the latter emphasizes the uses of VR in tourism education, which is a field closely related to immersive assessment strategies. In the meantime, the seminal articles by (Piccoli G, 2001) and (Bhattacherjee A, 2002) represent one of the first contributions to the area of system trust and user acceptance, giving theoretical foundation to the subsequent advances in the sphere of educational technology.

On the whole, this cohort of well-cited studies demonstrates the interdisciplinary character of the field-decision sciences, production research, transportation systems, management information systems (Rustemi et al. 2023). Taken together, these articles prove the conceptual and practical value of blockchain and virtual reality as the means not only of innovation, but also of increasing integrity, transparency, and trust in digital educational environment.

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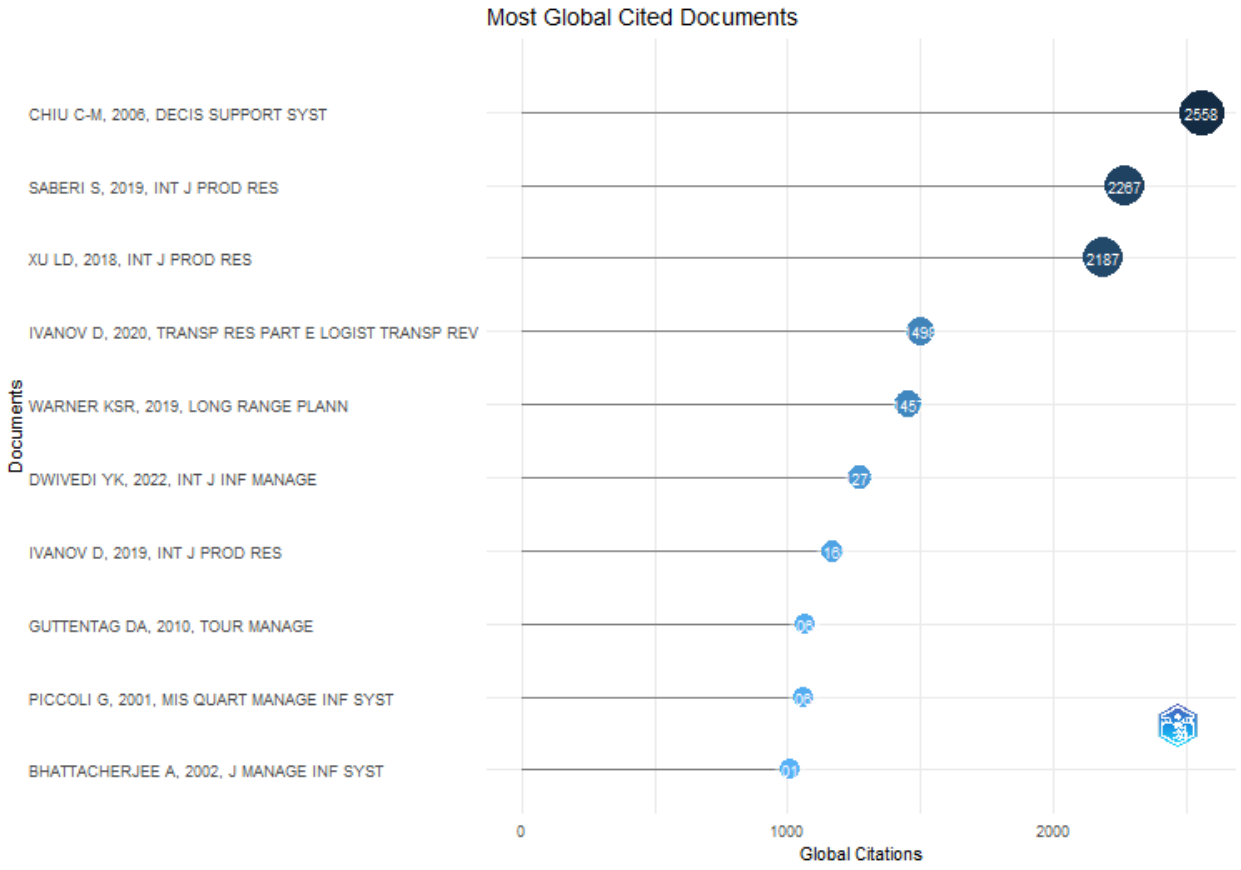

Figure 7.4 Global Cited Documents

7.2 Core Words

The thematic analysis of the dataset based on keywords offers important information on the thematic concentrate and research priorities in the literature on blockchain and virtual reality in educational technology. The keyword that occurs most often is blockchain (128 occurrences), which once again confirms its leading position in the discourse of secure and transparent digitization infrastructures academia credentialing and assessment systems (Elkhodr et al. 2024).

Very close are supply chains (76 occurrences) and virtual reality (72 occurrences). were established in the context of supply chains (thus showing the broader application heritage of the technology), at the same time their popularity highlights the similarity of the necessity of integrity, traceability, and data checking, which are the main strengths that can be compared to the requirements of the education sector. The overlap of this thematic overlap is further confirmed by the terms: “supply chain management” (63) and its hyphenated form: “block-chain” (55).

Table 7.2 Core Words

Words	Occurrences
blockchain	128
supply chains	76
virtual reality	72
supply chain management	63
block-chain	55
technology adoption	54
sustainable development	36

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decision making	29
industry 4 0	29
artificial intelligence	26

Source: Own Contribution

The phrase technology adoption (54) indicates that the research has a keen interest in the reception and implementation of new technology into the institutional system, such as blockchain and VR. In the meantime, the presence of such concepts as sustainable development (36), decision making (29), industry 4.0 (29), and artificial intelligence (26) shows that the topics of research overlap with those of the digital transformation in general.

Figure 7.5 Word Cloud

The presented keyword landscape demonstrates the existence of a multidisciplinary knowledge base and shows how the concepts of blockchain and VR are disseminated not only as technological novelties but as the means of future-proof, integrity-based education systems.

7.3 Trend Topics

The trend topic analysis shows the dynamic development of the research topics in the field of blockchain, virtual reality, and other directions. It is also interesting to note that two themes, namely, blockchain and virtual reality, are prevailing with high frequencies of 128 and 72, respectively, making them the central concepts of the contemporary academic discussion.

The term virtual reality already appeared in 2013, but became particularly widespread by 2019 and is expected to reach its peak in 2021 as more and more learning institutions make use of immersive virtual reality learning and assessment experiences. Likewise, the term "block-chain" and associated concepts, including a "smart contract," "traceability," and "food supply chain," have also registered growing interest, particularly after 2021, following the overall digitalization of education and the industry (Haque et al. 2023).

The other themes such as technology adoption, innovation, and risk assessment imply a high level of preoccupation with the implementation of advanced technologies in operational and learning environments. The mention of words like marketing, retailing and tourism management implies the extension of blockchain and VR uses into areas of business and experience, rather than essential education or use in a technical sense (Learning et al. 2025).

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Table 7.3 Trend Topics

Term	Frequency	Year (Q1)	Year (Median)	Year (Q3)
block-chain	55	2021	2022	2023
smart contract	9	2023	2023	2023
food supply chain	7	2022	2023	2023
traceability	7	2022	2023	2023
tourism management	9	2015	2019	2022
blockchain	128	2020	2020	2022
risk assessment	22	2020	2020	2022
supply chains	76	2020	2021	2022
supply chain management	63	2020	2021	2022
technology adoption	54	2020	2021	2022
innovation	21	2020	2022	2022
food supply	20	2021	2022	2022
virtual reality	72	2013	2019	2021
marketing	22	2016	2020	2021
retailing	6	2018	2019	2020

Source: Own Contribution

In general, the time distribution of these keywords indicates the transition to a more practical and interdisciplinary application of foundational technologies, in particular, during 2020-2023. Such outcomes highlight the applicability of the emerging technologies in relation to future research agendas having increasing focus on implementation, traceability, and user-centered innovation (Dash et al. 2021).

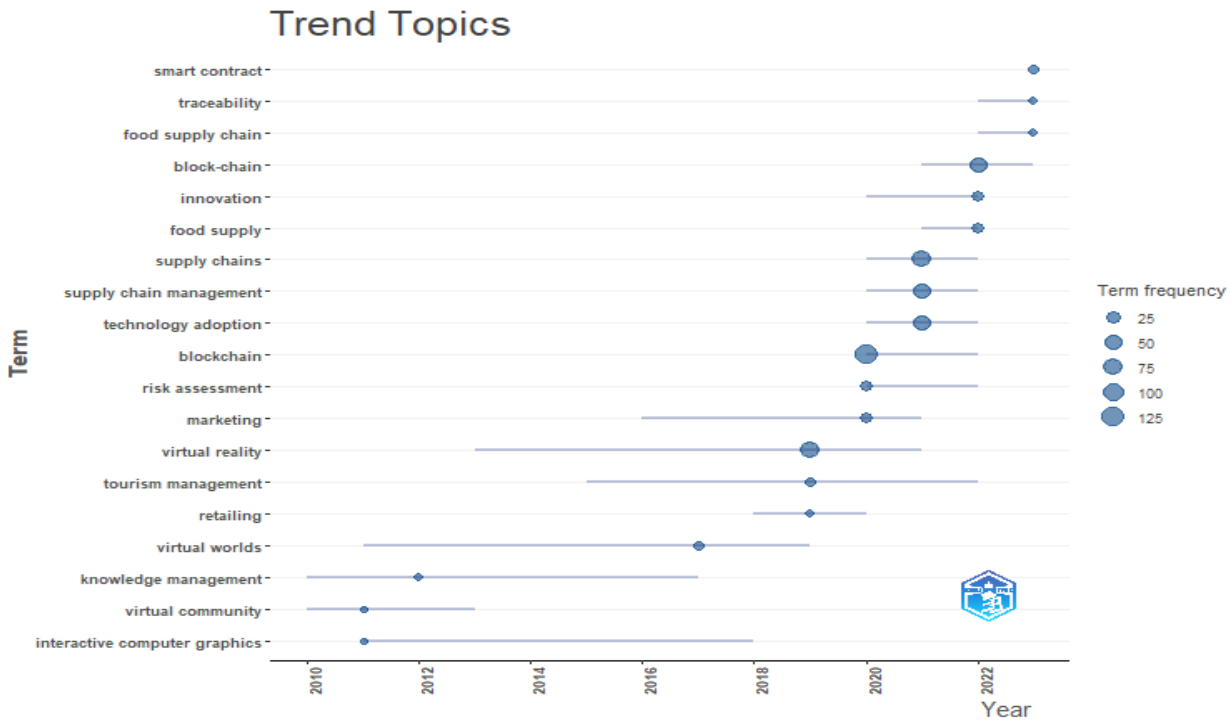

Figure .7.5 Trend Topics

7.4 Country Scientific Production

An analysis of the frequency of publication by region shows the international interest in the research of blockchain technology, virtual reality, and digital assessment.

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United States is way ahead of others with 300 publications indicating its strong research base and focus on technology in education. China (236) and the United Kingdom (220) are close behind, which highlights their smart investments in educational technology and digitalization.

India (124) is also showing great academic activity in the field of implementing immersive technologies and blockchain solutions into scalable education. Delegations of Germany (91) and Australia (83) also make a significant contribution, which is indicative of the presence of active research communities studying educational innovation and academic integrity. Such countries as France (64) and Italy (63) demonstrate an equal approach, being involved in the general European move to digitized and secure learning space.

Smaller but significant contributors are Spain (35), Malaysia (33), Canada (32), and South Korea (31), each of them representing new interests and an ascending research impetus. This is also evidenced by the presence of other countries like the Netherlands (29), Austria (27), and Finland (23) pointing to a high degree of geographic diversity and interdisciplinary cooperation in the given research area.

The given regional analysis serves as the evidence of the worldwide significance of the issue and outlines the possibilities of cross-national cooperation and comparison to promote the advancement of educational technology and academic integrity systems (Kuleto et al. 2022).

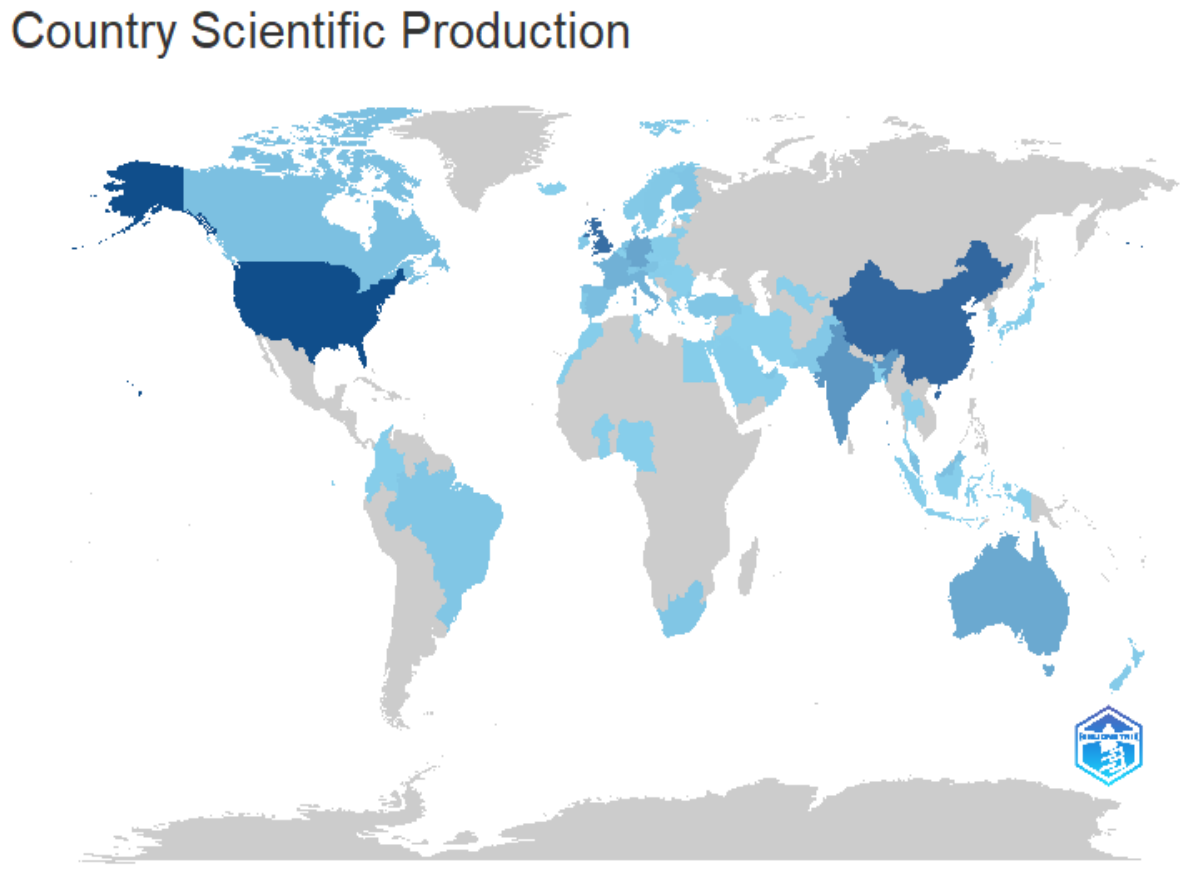

Figure 7.6 Country Scientific Production

7.5 Co-Occurrence Network

The co-occurrence network diagram allows visualizing the interrelation of important concepts in the field of blockchain and supply chain management. The term "blockchain" has the highest betweenness, closeness, and PageRank centrality values,

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indicating its overall centrality in the relation of other topics. Other closely related phrases such as supply chains, supply chain management, and block-chain also exhibit high centrality measures, revealing their high and widespread correlation with blockchain. There are upcoming technologies, like so-called "industry 4.0," "artificial intelligence," the "internet of things," implying integration tendencies in the framework of digital and smart supply chains (Rane 2024).

Moreover, such nodes as sustainable development and sustainability indicate emerging issues of environmental and ethical concerns in supply chain networks. The words like food supply, sales, and manufacture are the dead giveaways of certain areas of application in which blockchain is being pursued. Altogether, the network presents a close group of ideas around the idea of the strategic value of blockchain in making contemporary supply chains more transparent, efficient, and sustainable (Haque et al. 2023).

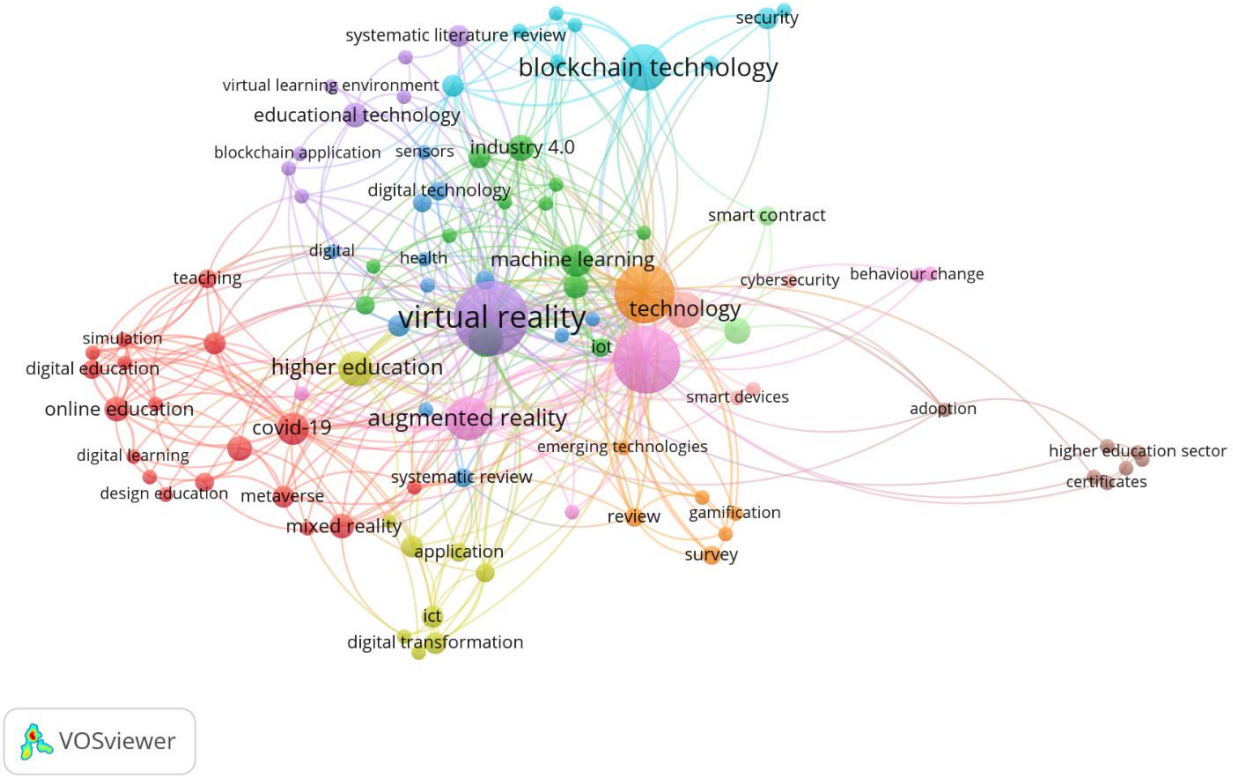

Figure 7.7 Co-occurrence network

7.6 Thematic Map

In order to get a global view of the academic scenery on virtual reality on education, a thematic map was created based on (Cobo et al., 2011) framework, where the emerging themes in research were classified according to centrality (x-axis) and density (y-axis) aspects. The use of this approach allowed distinguishing four large quadrants, such as motor themes, niche themes, emerging/declining themes, and basic/transversal themes (Ojog 2024).

The upper-right quadrant (motor themes) identifies three themes (well developed and interconnected) including virtual reality, marketing, and COVID-19. The themes are the dynamos of the area, which have a principal part to play in reforming digital evaluation plans after the pandemic. They mirror the metamorphosis of immersive technologies as hyped ideas into conventional teaching and learning instruments that boost interactivity and honesty in

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online space (Supriadi et al. 2023). The upper-left quadrant (niche themes) contains such topics as psychology, social media and retailing. They are highly developed but less central, which means specialized interest. To take just one example, VR + psychology points to deeply researched perception and behavioral measurement of the learner, which, although not yet mainstream, has great internal consistency.

Conversely, the lower-left quadrant (emerging or dying themes) includes knowledge management, virtual community as well as information and communication technology. Such areas could be either picking up or becoming obsolete depending on the dynamics of educational platforms. They are less dense and central, indicating a lack of present incorporation with central themes, which may indicate possibilities of re-exploration especially to enable decentralized and collaborative learning environments through VR (Samarai 2023).

Lastly, the lower-right quadrant (basic or transversal themes) consists of the basic topics which include information technology, conceptual frameworks and research work. These serve as conceptual anchors tying together various threads of investigation, and as the foundation stones of more specialized uses of VR in education. Their ever-presence substantiates their applicability in various sub-fields of educational technology.

7.7 Thematic Evaluation

The thematic framework based on co-word analysis offers a slightly different insight into the process of introducing virtual reality into the educational environment. Topics such as consumption behavior, internet, and China show a rising interest in the global community and contextual diversity regarding the application of VR in different groups of learners and various online platforms (Banfes et al. 2024).

In the perspective of trajectory analysis, the field is moving towards the end of conceptual exploration to more application-oriented research. Previous debate on internet architecture and study design has been shifted to explore student behaviour, perception and immersive marketing strategy in virtual learning environment. The interest to use VR in remote learning and secure assessments has particularly jumped due to the COVID-19 pandemic, bringing it to the fore as a motor theme (Iyer 2023).

This review confirms the increased impact of VR on online evaluation methods and its possibility to ensure academic honesty. Underdeveloped intersections, as a combination of VR and adaptive AI systems, blockchain to verify credentials, and cross-cultural educational design, are ripe areas of potential future research (Ramani et al. 2024). All in all, the thematic mapping will provide guidance to researchers and educators intending to use the full potential of VR in the creation of transparent, reliable, and engaging educational systems.

8. Discussion

This paper contains a bibliometric review of virtual reality (VR) and blockchain technology as applied to digital assessment and academic integrity in education. The results indicate an increased overlap of these technologies in promoting trust, transparency and engagement by the learners. The first takeaway is the overwhelming predominance of VR as a motor theme, in particular, as a response to the pivot to remote learning prompted by the COVID-19 pandemic. VR with its immersive and interactive qualities is being considered an increasingly transformative technology that can develop secure, behaviorally rich assessment environments. Less central, but complementary in its strengths, to the analysis is Blockchain in secure data management and credential authentication.

According to thematic mapping, there are vast possibilities in the topic and especially in underdeveloped fields like how VR can be integrated with blockchain, artificial intelligence, and adaptive assessment systems. Such terms as knowledge management, virtual community and information and communication technology are either emergent or

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transitional themes, and they suggest directions in which future efforts may be directed to enhance interactivity, collaboration and data integrity within educational ecosystems.

As per the ongoing trends, however, the future studies must focus on how VR and blockchain convergence can create end-to-end secure assessment systems - immersive test environments to non-tamper able grading systems. Furthermore, the cross-cultural, ethical, and psychological aspects of immersive learning should be discussed in studies, in particular regarding the international scope and the wide variety of uses of such technologies.

Last but not least, interdisciplinary approaches integrating the knowledge of educational science, computer science, behavioral psychology, and ethics are urgently required. This will guarantee that the technological solutions are not only strong, but also match pedagogical ambitions and institutional credence. By eliminating these research gaps, scholars and practitioners will have a chance to contribute to a more open, robust, and fair educational environment, where academic honesty can be maintained with the help of safe, engaging, and responsive online experiences.

9. Future Directions

Prospective studies must employ longitudinal design in monitoring how the idea of combining virtual reality (VR) and blockchain technology in digital assessment system changes and performs over time. Overtime research can present in-depth views on the role of these technologies in defining the academics in terms of practices, effects on learning, and upholding academic honesty. There is also a need to carry out cross-institutional and cross-cultural comparative studies to determine the sectorial challenges and best practices in various educational contexts.

More specifically, researchers ought to focus on expectations, perceptions, and experiences of the main stakeholders, such as educators, students, and administrators, in the adoption of immersive and safe digital tools. The consideration of these dynamics may provide a comprehensive picture of the reception and use of VR and blockchain in various settings.

Further, comparative studies on the regulation, the level of technology preparedness and pedagogical congruence across the regions must be examined. Future directions must focus on the incorporation of complementary technology like artificial intelligence and adaptive learning system that can make assessment even more personalized and secure. With such research Interdisciplinary research collaborating ideas and concepts of education, computer science, psychology, and ethics will be essential to finding solid, scalable, and equal solutions. Finally, this kind of research must influence practice and policymaking as well as academic excellence and integrity in the digital era.

10. Conclusion

The present research is a Bibliometric review offering an in-depth examination of the overlap of virtual reality, blockchain technology, digital assessment tools, and academic integrity within the education industry. Three areas of importance are identified through review of existing literature and thematic trends, including how VR can be used in immersive assessment and assessment integrity, the usefulness of blockchain in secure credentialing, and how the two can be combined to ensure assessment integrity.

In the analysis, the emphasis is on the fact that VR is emerging as an interactive medium that aids real time behaviour-based learning assessment, and blockchain can guarantee authenticity, transparency, and tamper-free data storage. The combination of these technologies has the potential to become an effective answer to the topical problem of misbehaviour in online learning.

Even though these things look promising, there are still issues with the smooth introduction of these innovations into the current educational system. Such problems like user

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resistance, infra-structure constraints and ethical issues need to be resolved. That being said, this paper highlights the increasing awareness that new technologies can completely transform educational testing, increase confidence, and safeguard academic integrity.

This research can guide educators, researchers, and policymakers since it established vital contributory factors, emerging themes, and knowledge gaps. It affirms the significance of both collaboration and innovation in achieving the potential of secure, immersive and integrity-based educational systems, wholly. Exploration of these technologies further will play a critical role in creating a more equal, open, and future-proof academic space.

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