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Integrating Artificial Intelligence in E-Learning for Organizational Well-Being through Orange Technology Mapping

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ABSTRACT

This study conducts a bibliometric analysis of Artificial Intelligence (AI) in e-learning, emphasizing its role in organizational well-being and educational transformation. Using Scopus as the primary database and VOSviewer for visualization, 557 articles published between 2020 and 2025 were analyzed across country, organization, source, author, document, and keyword networks. **The results reveal** that the United States, United Kingdom, and Germany act as central contributors, while India, Saudi Arabia, Singapore, Hong Kong, and Egypt are rapidly growing in influence. Source analysis identifies leading journals that shape the discourse alongside new outlets that diversify the field. **Author and document coupling highlight** key works that connect immersive learning environments with pedagogy, while keyword analysis identifies three major clusters related to ethics and governance, motivation and technology enhanced learning, and AI tools such as ChatGPT and generative AI. Overall, **the findings** show that AI in e-learning has evolved from experimental initiatives into a multidimensional, evidence-based domain. **The study concludes** by emphasizing how Orange Technology and TRAIVIS frameworks can operationalize ethics by design, support adaptive tutoring, and align AI-driven learning ecosystems with sustainable, well-being-centered educational goals.

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1. INTRODUCTION

Scientists and practitioners are now increasingly interested in Artificial Intelligence (AI) in online learning, as it has become a key driving force behind educational innovation, with a strong emphasis on creating cutting-edge tools [1]. Based on each learner's context and needs, AI systems can recommend the most appropriate activities, thereby personalizing the learning process and enhancing student engagement. The COVID-19 pandemic accelerated this transformation by forcing educational institutions to adopt online learning and digital assessments at scale, while simultaneously highlighting the importance of adaptive AI applications that tailor learning activities by analyzing students prior knowledge and digital environments [2]. From a technical perspective, this study is grounded in computational systems engineering utilizing VOS viewer as a visual-

ization engine to perform large-scale bibliometric network analysis and integrating the Orange Technology and TRAIVIS frameworks as system level architectures that operationalize AI-driven e-learning ecosystems. These approaches reflect the domain of computer aided systems design, algorithmic analysis, and applied artificial intelligence. This marks a decisive shift from traditional e-learning models toward data-driven, AI-enabled ecosystems that can optimize learning trajectories and support broader educational resilience. As technologies develop, AI usage in education is growing in popularity as a means of enhancing academic performance but it needs students holistic requirements how to maintain student's wellbeing instead of academic pressure, stress, and disengagement [3].

This study adopts the Orange Technology framework, which emphasizes health, happiness, and care (H2O triad) as the foundation for integrating AI into e-learning ecosystems. The framework advances beyond traditional performance metrics by positioning well-being as a measurable educational outcome. In line with the Sustainable Development Goals (SDG 3 and SDG 4), Orange Technology highlights how AI-enabled systems contribute to both learning quality and mental health resilience, forming a balanced, human centered paradigm [4].

The present study situates its perspective within the framework of Orange Technology, which emphasizes the triad of health, happiness, and care or H2O triad moves beyond performance metrics to create learner-centered environments that enhance both academic outcomes and organizational well-being. Orange Technology provides a human-centered paradigm in which digital innovation is not only evaluated by technical performance but also by its contribution to well-being. In alignment with the United Nations' Sustainable Development Goals (SDGs), Orange Technology directly supports SDG 3 (Good Health & Well-Being) and SDG 4 (Quality Education), ensuring that AI-driven educational systems improve not only learning outcomes but also mental health, motivation, and holistic student development [5].

Researchers explores how education institution respond to advanced technology designs, focusing on behavioural plasticity and novel innovations like AI and social media platforms. Cognitive discrepancy theory enables the application of AI technology for question-crafting, scoring, and feedback providing [6]. Within this broader framework, TRAIVIS (Training Vision) has emerged as an integrative educational e-learning platform that seeks to combine game-based learning, blockchain technologies, and artificial intelligence into a structured ecosystem encompassing colleges, universities, professional training facilities, and accreditation bodies. Through this platform, students are positioned not only as learners but also as future organizational and business actors who can apply technology, resilience, AI, value, innovation, and sustainability core dimensions of TRAIVIS as supporting tools of Orange Technology [7]. Beyond this descriptive integration, the analytical role of Orange Technology and TRAIVIS is reflected in how the bibliometric clusters (ethics–governance, motivation–learning, and AI tools) map onto their structural dimensions. Orange Technology provides the system-level lens linking ethical AI deployment to organizational well-being, while TRAIVIS represents the functional model operationalizing these principles through adaptive, AI-enabled learning systems. This analytical mapping bridges the conceptual frameworks with empirical network findings, demonstrating that the technical and social aspects of AI-driven education are mutually reinforcing. This integration offers a practical model for implementing AI in e-learning as a transformative educational approach, thereby enhancing organizational well-being in alignment with the principles of Orange Technology [8].

To operationalize this theoretical integration, the study defines a structured model composed of four actionable layers. The first is the data acquisition and preprocessing layer, where institutional and learner-related data are collected and cleaned to feed AI models. The second is the algorithmic intelligence layer, which uses machine learning and bibliometric mapping algorithms to analyze learning behavior and institutional trends. The third is the adaptive learning and feedback layer, where TRAIVIS serves as the operational platform enabling blockchain-based assessment, gamification, and personalized learning pathways. The fourth is the ethical and well-being governance layer, guided by the principles of Orange Technology, ensuring that every AI-driven interaction supports health, happiness, and care (H2O triad). Together, these layers form a procedural model that links theoretical frameworks with practical system implementation.

Given the growing scholarly and practical attention to Orange Technology and its applications illustrated by emerging initiatives such as TRAIVIS there is a pressing need to deepen research into the implementation of AI in e-learning. This bibliometric study addresses that need by systematically exploring how AI in e-learning has been conceptualized and developed within the academic literature, and how this perspective can guide its role as a platform for sustainable, well-being-oriented organizational transformation.

To strengthen the link between conceptual aims and applied outcomes, this study connects each re-

search question to measurable bibliometric and technical deliverables such as visualization maps generated through VOSviewer, network strength indicators, and framework alignment with AI-driven educational systems (TRAIVIS and Orange Technology). This ensures that the analysis not only describes publication trends but also provides practical insights into system architecture, algorithmic mapping, and organizational integration.

In pursuit of this objective, the following research questions are proposed.

- What are the global publication trends, collaboration patterns, and knowledge networks in the field of AI and e-learning, and how do they reflect contributions to organizational well-being and system-level implementation of AI-driven learning frameworks?
- Which thematic clusters and intellectual structures emerge from bibliometric mapping (e.g., author coupling, document coupling, and keyword co-occurrence) in AI and e-learning research and how can these clusters be translated into computational insights that inform the development of scalable AI-learning systems?

2. RESEARCH METHOD

Figure 1. Steps to conduct a bibliographic study of Artificial Intelligence and e-Learning [9]

Figure 1 shows the steps in this bibliometric analysis as follows: The first step is keyword investigation. Based on the Scopus database and using the queries (TITLE-ABS-KEY(”online education” OR ”e-learning” OR ”digital learning”) AND TITLE-ABS-KEY(”student well-being” OR ”digital well-being” OR ”academic performance”), a total of 2,505 articles were collected. The second step is the reduction of the initial search through classification, focusing only on problematic keywords in the 2020–2025 period and limiting the dataset to journal articles, reviews, and conference proceedings. The refinement reduced the dataset to 1,550 articles, which were then searched with the keywords (TITLE-ABS-KEY(”online education” OR ”e-learning” OR ”digital learning”) AND TITLE-ABS-KEY(”student well-being” OR ”learning outcomes”)) AND PUBYEAR $>$ 2019 AND PUBYEAR $<$ 2025 AND (LIMIT-TO (DOCTYPE , ”ar”) OR LIMIT-TO (DOCTYPE , ”cp”) OR LIMIT-TO (DOCTYPE , ”re”) OR LIMIT-TO (DOCTYPE , ”cr”)) AND (LIMIT-TO (LANGUAGE , ”English”) obtained 557 articles. To ensure data quality and minimize selection bias, each record was subjected to a multi-stage verification process. This included duplicate elimination using Scopus metadata cross-checking, relevance validation through title–abstract screening, and exclusion of papers with incomplete bibliographic information [10]. Non-English or non-peer-reviewed entries were filtered out to maintain consistency and reliability. Additionally, a manual bias review was conducted to confirm that disciplinary overrepresentation (e.g., social sciences vs. engineering) was balanced, ensuring that the final dataset accurately reflects the interdisciplinary nature of AI and e-learning studies. The third step is the manual selection reduction, which ensures that only the most relevant and high-quality works were retained for subsequent analysis [11].

The fourth step involves the preparation of initial statistical images to group the data into topic descriptions. This stage uses VOS viewer analysis to construct country-coupled bibliographies, organization-coupled

bibliographies, source (journal)-coupled bibliographies, author-coupled bibliographies, document-coupled bibliographies, and keyword co-occurrence bibliographies. Finally, the fifth step is data interpretation in an analytical narrative, where the visualization results are explained in detail to identify intellectual structures, thematic patterns, and emerging research directions. This step provides the analytical foundation for interpreting how AI in education and e-learning are connected with student engagement, well-being, and learning outcomes [12].

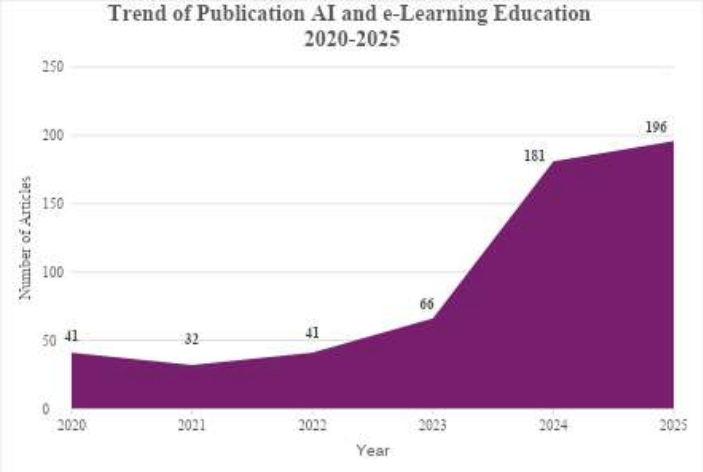

Figure 2. Publication Trend in 2015 – 2025 of article artificial intelligence and e-learning education

The graph at Figure 2 illustrates three distinct phases in the evolution of research output. The initial growth period (2020–2022) is marked by relatively modest activity, with publications fluctuating between 32 and 41 articles per year. This stage reflects the early exploration of AI in education, where researchers were beginning to articulate conceptual frameworks and pilot studies around technology-enhanced learning, student engagement, and well-being. The steady yet cautious pace indicates that the field was still in its formative phase, laying the theoretical and methodological foundations for subsequent expansion [13].

The second phase, the growth period (2023), shows a clear acceleration with publications rising to 66. This shift signals a transition from exploratory studies to broader adoption of AI applications in educational practice. Scholars increasingly investigated applied themes such as AI-driven tutoring systems, optimization algorithms, and the role of chatbots like ChatGPT in learning environments, reflecting growing academic confidence in the utility of these tools [14]. The third and most striking phase is the exponential growth period (2024–2025), where output surged to 181 and then 196 articles. This dramatic rise underscores the field's maturation, characterized by large-scale empirical validations and a diversification of topics including ethical implications, personalized learning, and sustainable digital pedagogy [15, 16]. Together, these phases illustrate how AI in e-learning has rapidly evolved from a niche interest into a mainstream research frontier, aligning with global shifts toward digital transformation in education [17].

3. RESULTS AND DISCUSSION

3.1. Analysis of country-couple bibliometric

The VOSviewer country-couples map in Figure 3 highlights five dominant clusters that structure global collaboration. The red cluster (India, Saudi Arabia, Indonesia, Thailand) is anchored by India's and Saudi Arabia's citations, forming a dense regional hub of strategic management and sustainability research. This cluster links strongly with the cyan group where partnerships reflect South–South academic exchange and applied domains such as digital resilience and organizational strategy [18]. In contrast, the blue cluster led by the United Kingdom and Australia demonstrates mature scholarly strength, with transnational corridors extending to Ireland, Norway, and Japan, reflecting innovation-oriented collaborations in higher education and well-being studies [19].

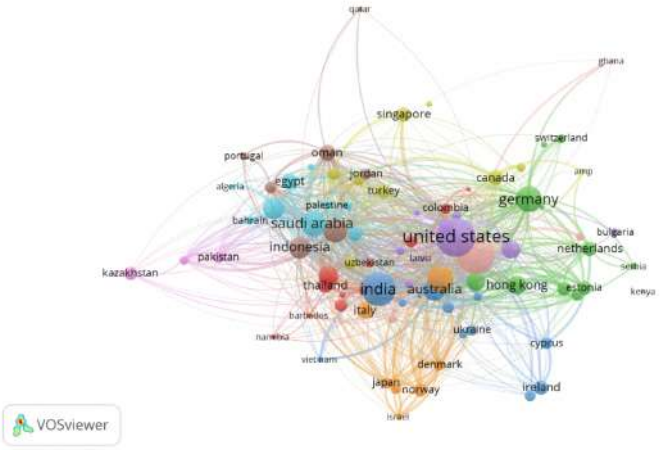

Figure 3. The network visualization of country-coupled bibliography of artifial intelligence and e-learning education

The green cluster (Germany, Netherlands, Canada, Hong Kong, Singapore) exhibits high citation density and methodological influence, reinforcing Europe-Asia linkages in strategic and technological management. At the core of the network, the United States dominates as the global knowledge broker, bridging Asia, Europe, and the Middle East. Its extensive connections with India, Germany, and the UK underscore the U.S.'s role in intellectual brokerage, while the UK and Germany further strengthen intra-European and Asia-Pacific synergies. Collectively, the configuration reveals a shifting yet interconnected ecosystem, where traditional Western centres retain influence but rising nodes in Asia and the Middle East reshape the geography of collaboration and scholarly impact [20].

These collaborative dynamics have direct implications for institutional decision-makers and policymakers. The emergence of cross-regional research hubs signals opportunities for universities and research institutions to establish strategic partnerships that leverage shared AI infrastructures and training systems. For policymakers, these bibliometric linkages highlight the necessity of developing standardized frameworks for AI governance, ethical compliance, and data interoperability across countries. Furthermore, the dominance of nodes such as the United States, the United Kingdom, and Germany indicates that leadership in AI-based e-learning innovation correlates with strong institutional investment in digital infrastructure and data analytics capabilities. For developing institutions, understanding these network configurations can guide funding allocation, academic collaboration, and the adoption of AI tools aligned with organizational well-being and sustainability goals.

In practical terms, institutions can implement these findings by using the TRAIVIS platform for adaptive learning analytics and blockchain-based evaluation, while educators apply Orange Technology principles to embed health, happiness, and care (H2O) values in AI-based curricula. Organizational leaders are also encouraged to establish AI ethics policies and cross-sector collaborations to ensure sustainable, well-being-oriented digital transformation.

Table 1. Country Cluster Summary

Cluster	Country	Documents	Citations
Blue	United Kingdom	30	454
	Australia	20	277
	Ireland	9	111
	Norway	8	69
	Japan	5	50
Cyan	Oman	12	55
	Egypt	10	69
	Kuwait	5	111
Green	Germany	29	200
	Hong Kong	15	501
	Canada	10	151
	Singapore	9	95
	Netherlands	9	230
Purple	United States	66	555
	Italy	12	67
	Cyprus	6	236
	Ukraine	5	55
Red	India	51	271
	Saudi Arabia	28	325
	Indonesia	20	71
	Thailand	10	76

Source: VOSviewer analysis (2025)

The country-cluster summary at table 1 shows distinct regional strengths. The blue cluster (Australia) emphasizes Asia–Pacific leadership, while the green cluster (Germany, Canada) reflects Europe–North America influence in methodological and sustainability studies. The purple cluster (Cyprus) achieves high citation impact despite lower output, and the cyan cluster (Egypt) signals the rising visibility of Middle Eastern scholarship. Together, the data highlight both established Western hubs and emerging regional contributors [21].

3.2. Bibliometric organizational-couple analysis

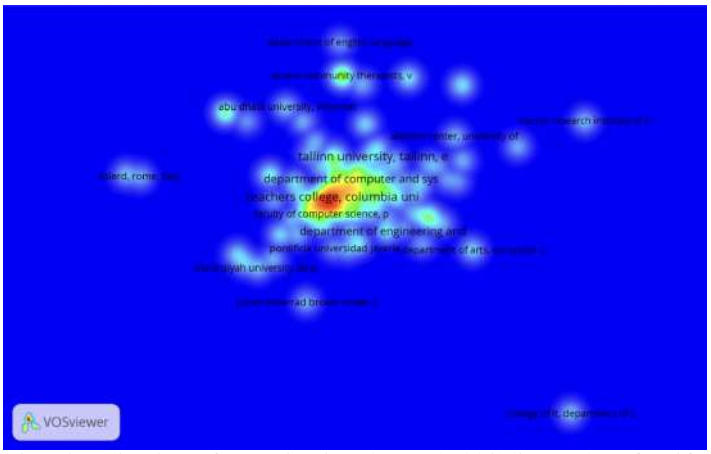

Figure 4. The density visualization of organizational-coupled bibliography of artifial intelligence and e-learning education

Figure 4 shows that the heatmap of publication outlets in AI and e-learning research reveals dense scholarly activity around high-impact sources such as Education and Information Technologies, Communications in Computer and Information Science, and ACM International Conference Proceedings. These venues

dominate the field by clustering at the "hot zone" of the map, reflecting their central role in disseminating work on digital pedagogy, interactive learning environments, and AI-driven educational strategies. [22] underscore how AI-driven personalized learning environments have rapidly gained traction in Lecture Notes in Computer Science, evidencing the strong interdisciplinary link between computer science and education research. Similarly, [23] highlight in Mathematics Education Journal how adaptive AI systems enhance both engagement and learning outcomes, thereby reinforcing the journal's positioning in the knowledge network.

Peripheral yet emerging nodes such as JMIR Formative Research and Information (Switzerland) illustrate expanding applications of AI in health-related education and data-driven pedagogy, suggesting a diversification of outlets beyond traditional educational technology journals. This aligns with [24], who emphasizes the importance of synthesizing AI integration across education and information science to foster long-term innovation ecosystems. Together, the network shows how core outlets anchor the discipline while niche journals create new thematic pathways. The co-evolution of established and emergent sources suggests that AI in e-learning is not only consolidating around key platforms but also branching into specialized applications that broaden its relevance and impact [25, 26].

3.3. Bibliometric author-couple analysis

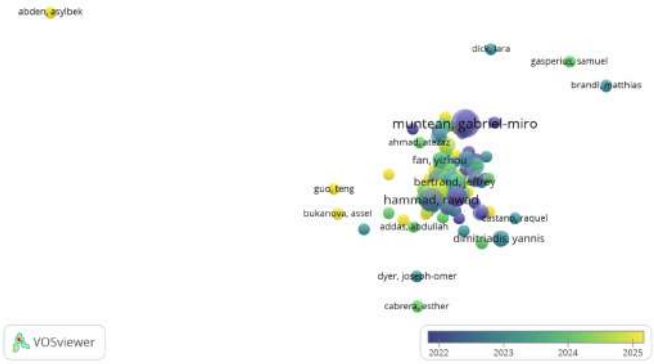

Figure 5. The overlay visualization of author-coupled bibliography of artificial intelligence and e-learning education

Figure 5 shows the overlay visualization of the co-authorship network in AI and e-learning research illustrates the temporal dynamics of scholarly collaborations. Larger nodes such as Muntean Gabriel-Miro, Hammad Rawad, and Dimitriadis Yannis dominate the map, signifying their role as central intellectual anchors in the field. The blue–green tones surrounding Dimitriadis and Muntean reflect foundational contributions between 2022 and 2023, which shaped the discourse on interactive and adaptive learning environments. For instance, [27] emphasized how integrating AI tools such as ChatGPT into educational systems enhances pedagogical innovation and engagement, a perspective closely aligned with [28] body of work. Similarly, [29] positioning within the core cluster highlights how mid-stage research continues to reinforce methodological rigor while extending into applied domains such as real-time learning analytics. More recent yellow nodes, including [30] indicate novel contributions emerging in 2024–2025. These newer authors focus on cutting-edge applications, such as AI-supported usability and human-centered design, echoing [31], Who examined the efficacy of AI-driven tools in enhancing learner experience. Peripheral but connected figures suggest diversification of collaboration into interdisciplinary niches, linking psychology, information sciences, and digital education. The overall trajectory, from foundational blue-green works to innovative yellow contributions, highlights a field in active expansion. The temporal layering of scholarship demonstrates how early conceptual frameworks provide the scaffolding for subsequent specialized research that integrates AI into e-learning ecosystems.

3.4. Bibliometric source-couple analysis

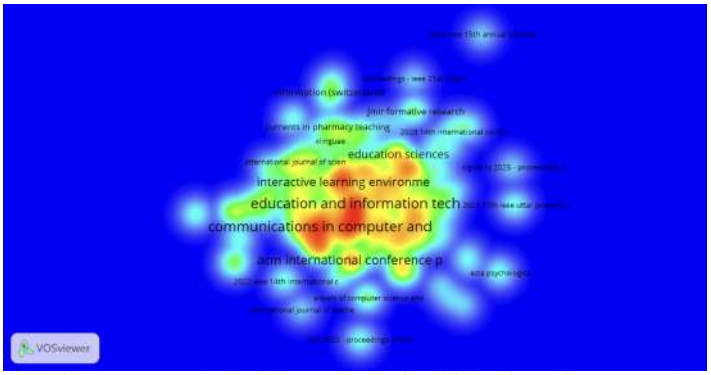

Figure 6. The density of source-coupled bibliography of artificial intelligence and e-learning education

The density visualization of source bibliographies in Figure 6 highlights several red–yellow hotspots, indicating highly influential publication venues in AI and e-learning research. Education and Information Technologies emerge as the most prominent source with 17 documents and 776 total link strength (TLS), positioning it as a central hub for discussions on technology-enhanced learning and AI-driven pedagogy. Other leading outlets include Computers and Education: Artificial Intelligence (285 citations, 336 TLS) and Interactive Learning Environments (215 citations, 186 TLS), both of which play a pivotal role in connecting theoretical innovation with applied educational practice.

By contrast, cooler green–blue zones indicate peripheral yet emerging sources that diversify the field. Journals such as Education Sciences (137 citations, 358 TLS) and Frontiers in Education (56 citations, 109 TLS) provide alternative platforms that emphasize empirical studies and interdisciplinary perspectives, thereby expanding the thematic boundaries of AI in e-learning. Similarly, Journal of Computer Assisted Learning (78 citations, 228 TLS) showcases a steady contribution to methodological advances and applied case studies, aligning with recent works such as [32], who examined the integration of ChatGPT into digital pedagogy. These sources, although less dense in citation hotspots, contribute to the diversification of scholarship and provide pathways for specialized applications, ranging from adaptive tutoring to ethical and well-being considerations in AI-enabled education. Collectively, the density map underscores a dual dynamic: core sources anchor the field with high visibility, while emerging journals broaden its reach into new pedagogical, ethical, and organizational well-being domains [33].

3.5. Bibliometric document-couple analysis

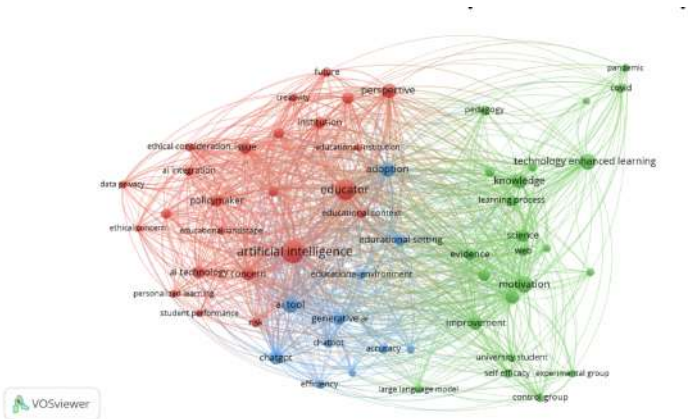

Figure 7. The network of keyword co-occurrence bibliography of artificial intelligence and e-learning education

The document-coupling network map reveals a highly interconnected structure of AI and e-learning scholarship, where several documents form dense clusters through shared references. At the core lies [34] with 616 citations and TLS of 73, underscoring its foundational influence in linking immersive learning environments with cognitive and affective outcomes. Closely associated works such as [35] with 128 documents and [36] with 209 citations further reinforce this intellectual hub, focusing on virtual classrooms, student engagement, and technology-mediated learning. These documents not only act as anchors in the network but also provide theoretical and methodological reference points for subsequent contributions. Their centrality highlights the growing maturity of the field, as immersive technologies and adaptive learning models become widely adopted in education research [37, 38].

Surrounding this core, additional clusters illustrate thematic diversification and emerging directions. [39] represent applied extensions into curriculum design and personalized e-learning systems, while [40] emphasize practical integrations of AI tools for scalable digital education. These contributions reflect the translation of foundational concepts into more practice-oriented innovations, echoing the findings of [41], who examined optimization algorithms in higher education. At the periphery, documents such as [42] appear with lower TLS values but indicate niche or emerging sub-fields, including collaborative learning ecosystems and generative AI applications [43]. Collectively, the document-coupling map illustrates a layered intellectual landscape: core works consolidate theoretical foundations, mid-tier documents extend into applied innovations, and peripheral studies introduce specialized or experimental approaches to AI in education.

Table 2. Top 10 Document Cluster Summary

Document	Citations	Total link strength
[27]	616	73
[44]	209	68
[45]	195	79
Document	**Citations**	**Total link strength**
[46]	166	13
[47]	129	45
[48]	128	97
[48]	125	51
[49]	110	95
[50]	103	79

Source: VOSviewer analysis (2025)

3.6. Keyword Co-occurrence Analysis

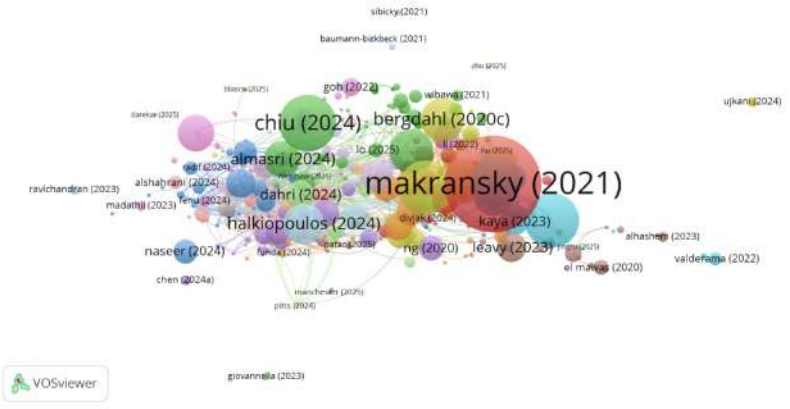

Figure 8. The network of keyword co-occurrence bibliography of artificial intelligence and e-learning education

The co-occurrence keyword visualization reveals three prominent clusters that define the intellectual

core of AI and e-learning research. The red cluster, centred on artificial intelligence (188 occurrences) and educator (156 occurrences), captures foundational debates around AI integration into education. Keywords such as ethical consideration (30 occurrences), data privacy (22 occurrences), and policymaker (55 occurrences) reflect ongoing concerns about regulation, institutional governance, and ethical deployment of AI systems. This cluster highlights how educational institutions are negotiating the promises of AI with its social and ethical risks, aligning with studies like [51], who explored systemic challenges in AI adoption within universities. The frequent co-location of adoption (73 occurrences) and perspective (77 occurrences) underscores the strategic tension between innovation-driven optimism and cautious implementation, a theme reinforced by [52], who examined institutional readiness in AI-driven pedagogy.

The green cluster emphasizes applied learning processes and outcomes, with high-frequency terms such as motivation (101 occurrences), knowledge (86 occurrences), and technology-enhanced learning (88 occurrences). These terms reveal a strong research orientation toward pedagogical effectiveness and evidence-based approaches. Studies like [53] illustrate this trajectory by showing how AI tools improve conceptual understanding in digital classrooms, while [54] demonstrates the role of optimization algorithms in enhancing academic performance. The blue cluster complements this by focusing on AI tool (88 occurrences), ChatGPT (66 occurrences), generative AI (49 occurrences), and efficiency (29 occurrences), reflecting a more technical strand of inquiry into specific technologies driving educational innovation. Together, these clusters show how ethical debates, pedagogical applications, and technological advancements intersect to shape the evolving landscape of AI in education, where connectivity between clusters signals a maturing but contested field [55].

Building on these analytical patterns, this study proposes the "Hybrid AI Orange Technology TRAIVIS Model." The model integrates three operational layers: an algorithmic intelligence layer applying bibliometric computation and AI mapping, a system architecture layer represented by TRAIVIS connecting adaptive learning and blockchain, and a human-centered ethics and well-being layer grounded in Orange Technology [56]. Together, these layers offer a system-level blueprint for implementing AI-driven learning ecosystems that combine technical computation with human-oriented sustainability, representing the paper's core original contribution [57, 58].

4. CONCLUSION

This bibliometric study provides an integrated map of AI in e-learning and clarifies how the literature supports organizational well-being under the Orange Technology paradigm. Scopus served as the authoritative corpus to ensure quality and comparability manual screening privileged, strengthening validity of trends, networks, and source influence. Articles fit the artificial intelligence and e-learning between 2020 until 2025 are 557 articles.

The bibliometric analysis using VOS viewer reveals a polycentric research network, with the United States, United Kingdom, and Germany acting as central contributors, while India, Saudi Arabia, Singapore, Hong Kong, and Egypt emerge as rapidly advancing contributors. Cross-regional bridges highlight opportunities for multi-stakeholder collaboration and knowledge transfer. Organizational analysis points to leading universities and laboratories specializing in adaptive learning, analytics, and ethics/privacy, with influential outlets such as Education and Information Technology, Communications in Computer and Information Science, and ACM International Conference Proceedings channelling research visibility and resources.

Source analysis confirms a core set of journals including Education and Information Technologies, Computers and Education: Artificial Intelligence, and Interactive Learning Environments that anchor the field, while emerging venues broaden thematic diversity without fragmenting the discourse. Author and document coupled analyses emphasize foundational works that collectively form the intellectual backbone linking immersive learning environments to pedagogy and learning analytics. Keyword co-occurrence maps consolidate into three clusters describing ethics, governance, and educator adoption, motivation, knowledge, and technology-enhanced learning, as well as AI tools such as ChatGPT and generative AI. Together, these clusters indicate a maturing but contested research agenda. Importantly, the findings underscore the potential of Orange Technology and TRAIVIS as practical platforms for embedding ethics, scaling adaptive tutoring, and aligning educational transformation with SDG 3 (Good Health & Well-Being) and SDG 4 (Quality Education).

5. DECLARATIONS

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5.2. Author Contributions

Conceptualization: AR; Methodology: AS, SA and AN; Software: AS and SA; Validation: AR and AS; Formal Analysis: SA and AN; Investigation: AR, SA, and AN; Resources: AN; Data Curation: SA; Writing Original Draft Preparation: AN; Writing Review and Editing: SA, and AN; Visualization: AR; All authors, AR, AS, SA, and AN, have read and agreed to the published version of the manuscript.

5.3. Data Availability Statement

The data presented in this study are available on request from the corresponding author.

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5.5. Declaration of Conflicting Interest

The authors declare that they have no conflicts of interest, known competing financial interests, or personal relationships that could have influenced the work reported in this paper.

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