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Artificial Intelligence (AI) and Ethics: The Caveat of Digital Twins in Education

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Artificial Intelligence (AI) and Ethics: The Caveat of Digital Twins in Education

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Abstract: The Fifth Industrial Revolution ushered in curricular revamps across undergraduate university curricula, accelerated by the rapid growth/assimilation of Artificial Intelligence (AI) to facilitate learning for university-enrolled students. The distinguishing feature of AI usage towards Education 5.0 (E.D. 5.0) is the generation of a digital twin, a virtual replica of a real-life physical system. Incorporation of digital twins appears to accelerate multiple attributes of student education, such as immersive and personalized learning, skills development, AI-assisted tutoring, development of problem-solving skills, and enhanced understanding/engagement, which require practical and critical thinking. Large Language Models (LLMs) like ChatGPT, Copilot, Gemini, and DeepSeek often supplement in-person class learning, with students typically using them to solve course tutorials, problem sets, quizzes, etc. But, current AI-assisted LLMs face two major restrictions: (i) search content accuracy depends on the accuracy of the prompt fed to the AI, and (ii) the subsequent creation of a digital twin to personalize learning often comes at the expense of online-platform dependence (where accuracy is unchecked), with progressively lower reliance on reading textbooks on the relevant subject matter. Also, this approach fails to substitute lab-based courses, where learning is experiential and more hands-on. In this work, we perform a comparative assessment of key distinguishing features of E.D. 5.0 vs. E.D. 4.0 by performing a comprehensive bibliometric analysis on Scopus, using rigorous, appropriate Inclusion and Exclusion criteria, from 2017 (the onset of the Fifth Industrial Revolution) to 2025 (present day). Analysis was performed by posing suitable Research Questions (RQs) from a hierarchical perspective, starting with overall trends to narrowed down, engineering-education based STEM (Science, Technology, Engineering, and Mathematics) fields. Our analysis presents definitive impacts of AI on different learning modalities (active/experiential/inquiry-based/project-based) during the current era, which directly appears to impact curriculum development/revamp globally across Higher Education Institutes (HEIs) to meet Industry 5.0 (I.D. 5.0) requirements, in a globally competitive work landscape. This work, notably, strategically identifies current limitations, challenges, and inherent pitfalls while using AI-assisted LLMs platforms, which is useful feedback for instructors and educators. We envision this work to be extremely impactful towards shaping global curriculum revamps and HEI development globally, while introducing educators to the pitfalls associated with AI-based LLMs usage, right from K-12/A-levels/IB, to undergraduate, and even graduate level courses at HEIs.

Keywords: Digital Twin, Artificial Intelligence (AI), Education 5.0 (E.D. 5.0), Industry 5.0 (I.D. 5.0), Pedagogical Innovation, Ethics.

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Introduction & Literature Review: Education 4.0 (E.D. 4.0) evolved from a radical, significant transformation in higher education during the Fourth Industrial Revolution, focusing on the integration of automation and digital technologies into teaching and learning environments. Its focus on tech-efficiency and data-driven tools promoted online learning platforms, learning management systems, and virtual laboratories, aligning education with the rapidly evolving demands of Industry 4.0 (I.D. 4.0) [1,2]. However, as technology progressed, the limitations of E.D. 4.0 became increasingly apparent: digitally enhanced learning improved accessibility and efficiency, but it prioritized technological optimization over humanistic learning, reducing critical thinking and creativity. These shortcomings highlighted a need for a more holistic approach in education that ushered back human values to balance the rapid technological integration [2]. The emergence of the Fifth Industrial Revolution accelerated the field of education towards Education 5.0, a conscious shift focusing on recentering humanist elements within technologically advanced learning ecosystems. Education 5.0 (E.D. 5.0) emphasizes personalized and ethical learning while leveraging artificial intelligence (AI), data, and cyber-physical systems by prioritizing human–AI interactions [1]. A defining characteristic of this paradigm is its alignment with both Industry and Society 5.0. Within this framework, universities and higher education institutions (HEIs) are no longer viewed solely as knowledge transmission hubs, but as formative environments that are more responsible for cultivating ethically aware environments [1,4]. Consequently, curricular revamps under this paradigm shift increasingly emphasize experiential, inquiry-based, project-based, and active learning modes that are supported, not dominated, by digital tools. Both bibliometric and systematic literature reviews further reveal a growing scholarly shift towards research focused on E.D. 5.0, with interests in human-centered design and ethical usage of emerging technologies [1]. However, existing studies additionally highlight issues that reveal fragmentation in the rapidly changing educational landscape, such as privacy, the digital divide, and biases in AI-usage. These gaps underscore the need for a more concrete understanding of both the benefits and limitations of integrating digital tools and a thorough discussion of potential solutions that can further improve the future of education across multiple disciplines [5]. Overall, the transition from E.D. 4.0 to E.D. 5.0 [13] reflects a fundamental, pro-active reorientation of educational priorities, from efficiency-driven digitalization to balancing it with more human-centric and ethically aware learning systems. This evolution provides the conceptual foundation for examining the expanding role of AI and associated ethical implications that will be further explored.

In recent years, AI has emerged as a core enabling technology in the field of education. Early applications of AI within Education 4.0 primarily supported automation, efficiency, and data-driven optimization, such as learning analytics, simulation-based instruction, and decision-supporting tools embedded in the learning management systems themselves. In engineering education, AI was commonly utilized to enhance computational modeling and support regulation-driven curricula to reinforce structured competency development that aligns with the requirements of Industry 4.0 [6]. More recent literature reframes the role of AI within Education 5.0 as a human-centric partner that augments learning rather than simply automating the learning process. Studies have shown that the integration of AI for personalized and adaptive learning highlights how intelligent systems enable individualized learning pathways, real-time feedback, and adaptive pacing tailored to student needs [3]. For example, intelligent tutoring systems are identified as key mechanisms through which AI plays the role as a bridge between instructor intent and student engagement. This supports deeper conceptual understanding while also preserving human oversight throughout the learning process [5]. In smart education, AI has been increasingly functioning as the decision–making engine that combines data from multiple sources to support context-aware tutoring. This is enabled by the convergence of AI with intelligent tutoring systems, robotics, and Internet of Things (IoT) infrastructures that dynamically respond to student behavior and performance. [5] Such learning environments reflect Education 5.0's principles by supporting modes of learning that are experiential and personalized, particularly within engineering and STEM education. [7] AI has also been playing an important role in preparing students for Industry 5.0 by enabling systems thinking and sustainability-oriented decision-making [8]. Studies further indicate a growing emphasis on AI-enabled educational research that prioritizes human-AI collaboration [1]. Overall, the literature views AI as a transformative force in higher education that will continue to bridge educational impact with industrial objectives by enabling personalization, adaptability, and interaction with instructors. However, the transition from an efficiency-driven educational system to the more humanistic system remains an ongoing challenge across multiple disciplines, motivating research into the pedagogical and ethical implications of the AI-assisted learning systems. The integration of AI into higher education introduces significant ethical and pedagogical challenges that must be addressed. Despite exponential advances in AI, literature consistently emphasizes the contingent nature of intentional pedagogical design/construction and the accessibility of AI.

One of the greatest risks associated with AI-enabled learning environments is over-reliance and cognitive offloading. Several studies caution that AI systems are used to generate solutions, explanations, or design outputs, causing students to engage less with problem-solving processes. This can lead to superficial understanding and diminished critical thinking skills. [10] This risk was especially evident in engineering and STEM education, where learning outcomes heavily rely on iterative reasoning. Without adequate instructional scaffolding, AI tools could significantly shift learning from inquiry-based exploration towards answer-seeking behavior [11]. Similarly, the potential erosion of deep and experiential learning in laboratory and project-based educational settings is another risk that AI introduces. Studies emphasize that AI cannot replicate embodied learning experiences, tacit knowledge acquired, or the development of intuition through hands-on learning, collaborative design, and trial and error. [11] Excessive substitution of these learning activities with AI-mediated simulations risks weakening the connection between theory and practice, an important cornerstone in learning. Another ethical concern that must be addressed is the opacity, reliability, and bias of AI systems used in educational contexts. Multiple studies highlighted that many AI-driven tools function as black box systems, providing outputs without transparent reasoning or traceability. [12] This lack of transparency and logical gaps could encourage uncritical trust in AI-generated feedback, even when outputs are incomplete, biased, or incorrect. From a pedagogical perspective, reliance on opaque systems undermines students' ability to evaluate sources, question assumptions, and their epistemic judgement and intuition, skills that are essential for professional practice. Issues of equity, access, and the global AI divide also complicate the ethical landscape of AI-supported education. Research examining global AI adoption demonstrated that access to these tools remains uneven due to disproportionate distribution of infrastructures and funding in the Global North and South. These disparities risk reinforcing existing educational inequities by limiting opportunities for personalized learning in developing regions. Literature argues that without deliberate strategies, AI may rather amplify rather than mitigate systemic inequalities [9]. Collectively, literature consistently stresses the importance of utilizing AI systems merely as a supportive tool in reflective learning and instructor oversight rather than as an autonomous decision-making tool or efficiency-driven learning device. These findings emphasize that although AI holds substantial potential to further advance the objectives of Education 5.0, the integration of AI must be guided by the educational values rather than solely by technological capabilities [7].

Analysis Methodology: To investigate our proposed hypotheses, a set of Research Questions (hereafter referred to as RQs) was formulated, as summarized in **Table 1**. All RQs were subjected to a rigorous Inclusion & Exclusion criterion, and the search was restricted to 2015-2025, *i.e.*, the last decade. This choice of timeline is not random, and in fact, exactly coincides with the onset of the impact of AI on accelerating the world towards the Fifth Industrial Revolution. The search was restricted to STEM (Science, Technology, Engineering, and Mathematics) fields, namely Computer Science, Engineering, Mathematics, Decision Sciences, Environmental Science, Materials, Chemical Engineering, Economics, Chemistry, Earth Sciences, Biochemistry, Medicine, Business, Physics, Sociology, and Energy. The search was conducted on the Scopus database and was limited to only fully published works (articles, conference proceedings, reviews, chapters, books). We repeated the process several times to ensure full reproducibility of the data. The resulting data file was analyzed to eliminate any duplicate entries (none were found). For each RQ, the analysis led to the generation of a co-citation network obtained via bibliometric analysis on VOS viewer, with key attributes and keywords linked to each other. The stronger the link between any two keywords in a map, the stronger the link (higher link strength) and the larger the keyword bubble. Colors in each sub-section of the co-citation map correspond to a thematic sub-research domain within the studied field. Temporal and subject/country-specific trends were analyzed using MS-Excel; these data are summarized in **Appendix A**. The emergence of country-specific markers for each article matching our search criteria is based on the affiliation of authors. A total of six RQs are analyzed and studied, with each RQ building on the previous one. The intention (in general) was to make every successive search even more rigorous, to ensure meticulous and accurate extraction of results. In the next section, we present the results for each RQ and complement it with our own discussions and interpretation, from an academic and global geopolitical and economic lens.

Results & Discussion: We now present the results and findings of each of our RQs and analyze the broader context of our results. The data presents an undeniable shift towards Society 5.0, as

AI/ML-assisted DSAI-led innovations pave the way towards bridging the AI-implementation gap, and uniting the E.D. 5.0-I.D. 5.0 framework. It must be noted that the choice of the six RQs posed in this work is not arbitrary but is rather derived via a comprehensive assessment of the relevant pedagogical/engineering education over the last decade. Additionally, the RQs aim to also capture the impacts of educational frameworks like Bloom's and Fink's learning taxonomies.

Table 1: Summary of search criteria implemented on Scopus for our proposed RQs.

RQ	Scopus Search Prompt
RQ_1	Artificial Intelligence OR AI AND Digital Twin
RQ_2	Artificial Intelligence OR AI AND digital twin AND university OR Higher Education Institute
RQ_3	Artificial Intelligence OR AI AND digital twin AND university OR Higher Education Institute AND undergraduate
RQ_4	Artificial Intelligence OR AI AND digital twin AND university OR Higher Education Institute AND undergraduate AND engineering education
RQ_5	Artificial Intelligence OR AI AND digital twin AND pedagogy OR pedagogical innovation
RQ_6	Artificial Intelligence OR AI AND digital twin AND curriculum revamp OR curriculum

$\mathbf{RQ_1}$**:** The search was initially kept in a broad context and was kept incorporating the effects of AI and digital twin. 164613 articles met our search criteria, and the co-citation network for this is shown in **Figure 1**. The search returns the most relevant keywords as Artificial Intelligence (AI), Machine Learning (ML), digital twin, learning systems, human (i.e., the AI-human interaction), sustainable development, reinforcement/deep-reinforcement learning, Internet of Things (IoT), Industry 4.0 (I.D. 4.0). Notably, other keywords that are reflective of current geopolitical and geo-economic scenarios also arise (lithium-ion batteries, network security, dynamics, uncertainty, forecasting, multiobjective optimization, metaverse, smart power grids, energy policy, etc.), showing the broad expanse of the impacts of AI and the digital twin phenomenon. The fields where these changes are most notable are in Computer Science (26%, 42945 articles), Engineering (25%, 41004 articles), Mathematics (8%, 12363 articles), Energy (5%, 8094 articles), and Social Sciences (5%, 7453 articles). In terms of countries leading these changes, China emerges at the top (23%, 24064 articles), followed by the United States (8%, 8627 articles), India (8%, 8346 articles), the United Kingdom (5%, 5378 articles), and Germany (5%, 4788 articles). Clearly, we see that the Global South emerges as the key driver of the AI-digital twin revolution; China overwhelmingly outperforms all economies in this aspect. This is then followed by India, while Saudi Arabia (the third Global South economy is ranked 12th. Therefore, it is only China and India that are driving this change from the Global South. From the Global North perspective, the United States is the largest contributor, followed by the United Kingdom and Germany. Publication trends in this area show a cubic increase with time ($N \sim t^3$), with a strong regression coefficient ($R^2 = 0.998$). This shows the tremendous importance and impact of this research and proves that this research on examining the impact(s) and consequence(s) of AI on digital twins is both timely and impactful. These results are summarized in **Figure 2** in **Appendix A**.

$\mathbf{RQ_2}$**:** The search is now narrowed down to examine the specific impacts of AI and the digital twin phenomenon, specifically in the context of universities and Higher Education Institutes (HEIs). The search returned 138589 articles – notice that this is lower than the previous RQ's search results because of making the search criteria more stringent. The co-citation networks (**Figure 3**) are centered around the keywords of Artificial Intelligence, Machine Learning, learning systems, digital twin, human, article, sustainable development, IoT, decision-making, digital transformation, and predictive analytics. These appear to be the key themes along which education transformation is currently being executed across HEIs to refine the AI-digital twin phenomenon. Fields demonstrating the most alignment are Computer Science (26%, 36239 articles), Engineering (25%, 34516 articles), Mathematics (7%, 10191 articles), Energy (5%, 6767 articles), and the Social Sciences (5%, 6448 articles). From a country-specific lens, China again emerges as the top player (24%, 22253 articles), followed by the United States (8%, 7473 articles), India (7%, 6109 articles), the United Kingdom (5%, 5104 articles), and Germany (4%, 3695 articles). We again see the same players from the Global North and the Global South before, and China emerges (not surprisingly) as the key nation driving such changes across its universities. Publication trends again show a cubic trend (a third-order polynomial best fits the data) and are reinforced by a strong regression coefficient ($R^2 = 0.998$), as presented in **Figure 4**. We expect these growth trends to continue; in particular, India is poised to emerge as a global leader, with the International Monetary Fund (IMF) having just upgraded India's predicted growth rate from 6.6% to 7.3% for the 2025 – 2026 fiscal year. In fact, India has been classified as the third most vibrant ecosystem, after the US and China, in Stanford's 2-25 Global AI Vibrancy Index. It surpasses major tech nations such as the UK and Japan.

$\mathbf{RQ_3}$**:** Recent pedagogical literature shows that curriculum revamp to meet Education 5.0 (E.D. 5.0) competencies primarily at the undergraduate level. The search is further refined by adding the additional search keyword "undergraduate" to RQ_2. 2034 articles matched our search and the co-citation network in **Figure 5** captures the most important keywords arising from the search, namely, education, engineering education, teaching, students, AI, human, digital twin, e-learning, Virtual Reality (VR), deep learning, higher education, sustainable development, virtual environments, and adversarial machine learning. This provides qualitative evidence that within the context of HEIs, digital twin and AI-led effects are most likely impacting pedagogical transformation in classrooms, primarily at the undergraduate level. It is in these environments that various pedagogical learning modalities (active, experiential, flipped-classroom, inquiry-driven, project-driven) may also be observed, transforming classroom environments, to enable the learning and retention of E.D. 5.0 competencies by students, which will cultivate in them (in future years)

I.D. 5.0 skillsets. Top performing fields in this RQ are Computer Science (24%, 495 articles), Engineering (17%, 351 articles), Social Sciences (15%, 305 articles), Business, Management and Accounting (6%, 114 articles), and Mathematics (5%, 93 articles). Most of these fields are also domains where e-learning environments are typically obtained, where AI-digital twins can change learning environments and student retention for students. Countries leading these changes are the United States (12%, 173 articles), China (11%, 160 articles), India (7%, 105 articles), the United Kingdom (5%, 72 articles), and Malaysia (5%, 68 articles). Between these five economies, nations from the Global North published 245 articles, while those from the Global South published 333 articles. Therefore, the Global South appears to outperform the Global North by 1.36 times (at least for the top five countries). Publication trends for this RQ show a cubic increase, evidenced also by a high correlation coefficient ($R^2 = 0.981$). These results are summarized in **Figure 6**.

$\mathbf{RQ_4}$**:** We now decided to expand the search even further and specifically wanted to see the effects of the previous RQ within the context of engineering education. 893 articles matched our search, and the co-citation network for this RQ, as summarized in **Figure 7**, is engineering education, education computing, VR, IoT, ML, emerging technologies, computer-aided instruction, I.D. 4.0, digital transformation, emerging technologies, current, immersive, metaverse, and laboratories. Top disciplines matching our search are Computer Science (24%, 218 articles), Engineering (20%, 180 articles), Social Sciences (19%, 168 articles), Business, Management and Accounting (5%, 44 articles), and Mathematics (3%, 31 articles). Countries excelling in the implementation of this RQ are the United States (13%, 80 articles), China (10%, 60 articles), India (5%, 31 articles), the United Kingdom (5%, 30 articles), and Malaysia (4%, 27 articles). Again, the expected players of the Global North and Global South power blocs emerge as top nation-wise performers. As shown in **Figure 8**, temporal publication trends again demonstrate a cubic increase, a claim that is further strengthened by a strong regression coefficient ($R^2 = 0.966$). We therefore expect to see further curriculum revamps implemented using appropriate pedagogical and engineering education-based frameworks in future years, as AI and digital twins continue to transform the E.D. 5.0 landscape.

$\mathbf{RQ_5}$**:** We now directed our search towards examining the effects of pedagogy and pedagogical innovation on the AI-digital twin phenomenon. 1835 articles met our search criteria, and the co-citation network resulting from this is shown in **Figure 9**. The keywords are centered around AI, digital twin, VR, students, learning systems, teaching, e-learning, curricula, higher education, metaverse, immersive learning, federated technology, adaptive learning, collaborative learning, personalized learning, digital transformation, and sustainability. These keywords clearly show that the direct impact of pedagogy and pedagogical innovation is observed via the adoption of various, context-specific learning modalities (federated, adaptive, collaborative, personalized, etc.). The primary subject disciplines leading these changes are Computer Science (23%, 426 articles), Social Sciences (20%, 367 articles), Engineering (16%, 286 articles), Business, Management, and Accounting (7%, 130 articles), and Environmental Science (5%, 87 articles). When assessed by countries leading this change, the Global South leads these initiatives, without any doubt. India occurs at the top of our search (10%, 129 articles), followed by China (9%, 118 articles), the United

States (7%, 93 articles), the United Kingdom (5%, 63 articles), and Malaysia (4%, 57 articles). Thus, India and China again emerge as major contributing economies to the AI-digital twin-led digital transformation phenomenon. Temporal trends in publication, as shown in **Figure 10**, reveal a cubic increase in articles, supported by a strong regression coefficient ($R^2 = 0.964$).

$\mathbf{RQ_6}$**:** Our final search was limited to capturing the direct impact of AI and digital twins on the global curriculum revamp map. The search led to 4300 articles matching our criteria, and the co-citation network arising out of our analysis is presented in **Figure 11**. Keywords are prominently centered around AI, engineering education, VR, curricula, education computing, computer-aided instruction, deep learning, ML, IoT, I.D. 4.0, information management, deep learning, I.D. 5.0, deep learning, reinforcement learning, adversarial ML, sustainability, Augmented Reality (AR), education, metaverse, and learning algorithms. The search, therefore, maps out the methods and domains where curriculum revamps are currently being observed. In fact, these keywords are relevant beyond undergraduate/graduate education levels and likely also impact K-12/A-levels/IB and school-learning environments for students. Subjects most relevant to our search are Computer Science (25%, 1096 articles), Engineering (21%, 888 articles), Social Sciences (12%, 524 articles), Business, Management and Accounting (6%, 252 articles), and Mathematics (5%, 234 articles). Top nations leading these changes are China (15%, 442 articles), the United States (9%, 277 articles), India (9%, 258 articles), the United Kingdom (4%, 132 articles), and Germany (3%, 100 articles). Again, it is the Global South that leads these initiatives, primarily led by China and India. Finally, as shown in **Figure 12**, publication trends again reveal a cubic increase in growth, with a strong regression coefficient ($R^2 = 0.986$). We expect these trends to continue in 2026 and beyond, as AI and digital twins successively transform the E.D. 5.0 global landscape across HEIs.

Conclusions: The effects of AI and digital twins were comprehensively explored via bibliometric analysis. Our results clearly demonstrate the rising impact of this field, especially from a global context, shaped by current global economics, geopolitics, and technical innovation/transformation. The Global South leads these changes, despite lower infrastructural facilities; however, it is primarily China, India, and Malaysia leading these changes. From the Global North, the United States, the United Kingdom, and Germany emerge as the top three nations executing these changes. This is further evidence confirming the AI implementation gap currently existing between the Global North and the Global South [9], and it is India and China that are propelling innovations in the Global South. However, for a truly AI-equitable global landscape, other nations (especially those from the Global South) need to progress towards success in these fields. Publication trends show a cubic increase, suggesting that this field is likely to grow in future years, which is therefore identified as an emergent research landscape for engineering education and pedagogical innovation/transformation research. The strength of our method is further reinforced by the fact that our bibliometric analysis procedure assumes no data a priori, and therefore, the results obtained are globally applicable. The top fields leading these changes are STEM-centric fields and the Social Sciences, and this trend is likely to be observed across future years. In summary, AI-induced digital twins continue to transform the HEI and university landscape.

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Appendix A: Bibliometric analysis and trends obtained for the posed RQs.

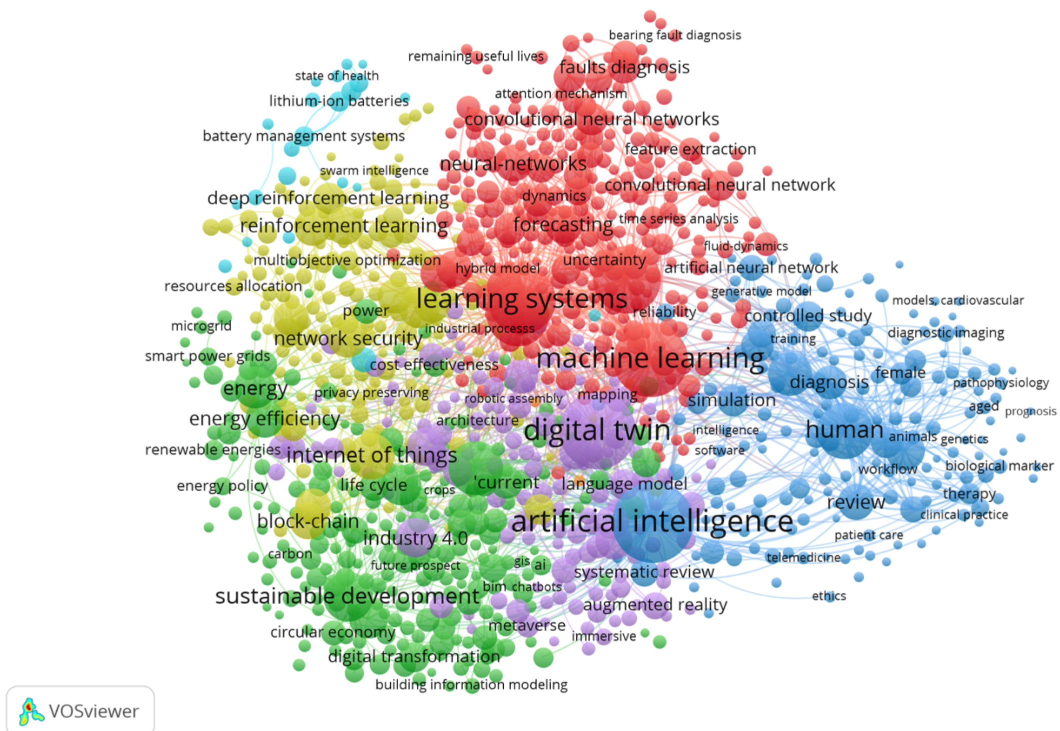
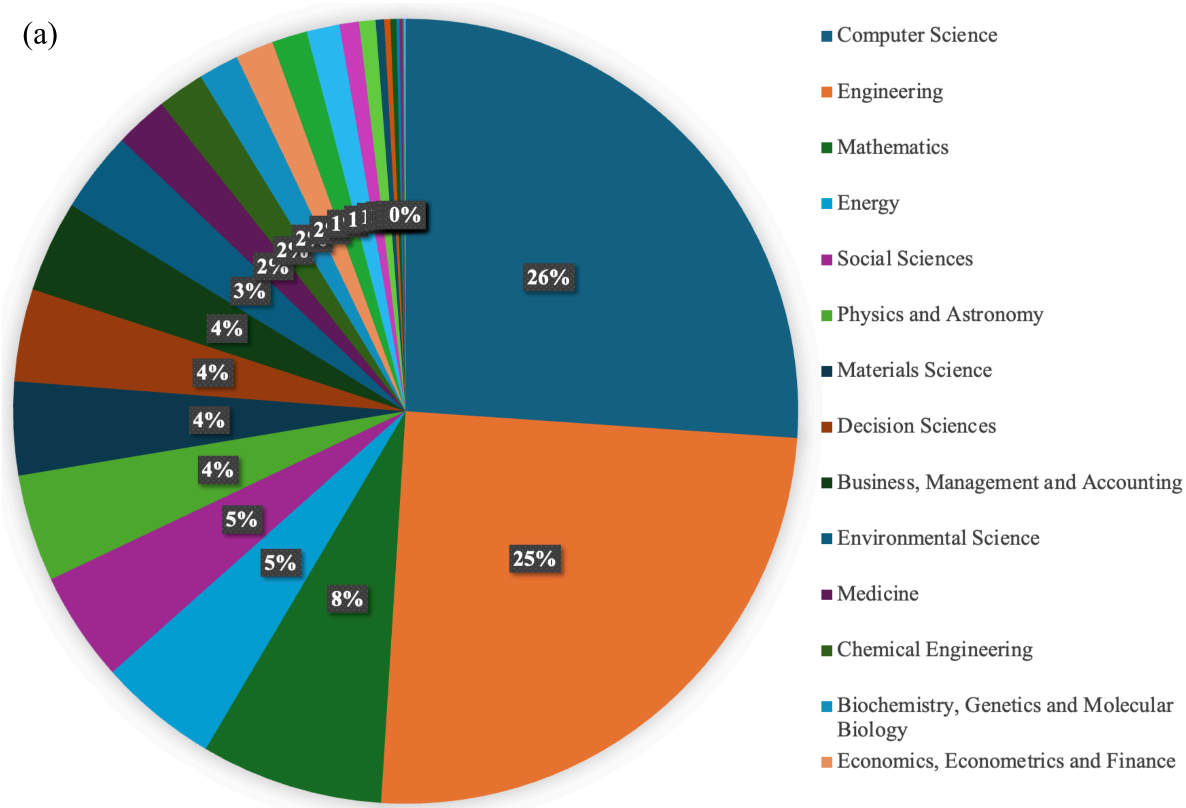


Figure 1: The co-citation network generated for RQ_1.

(a)



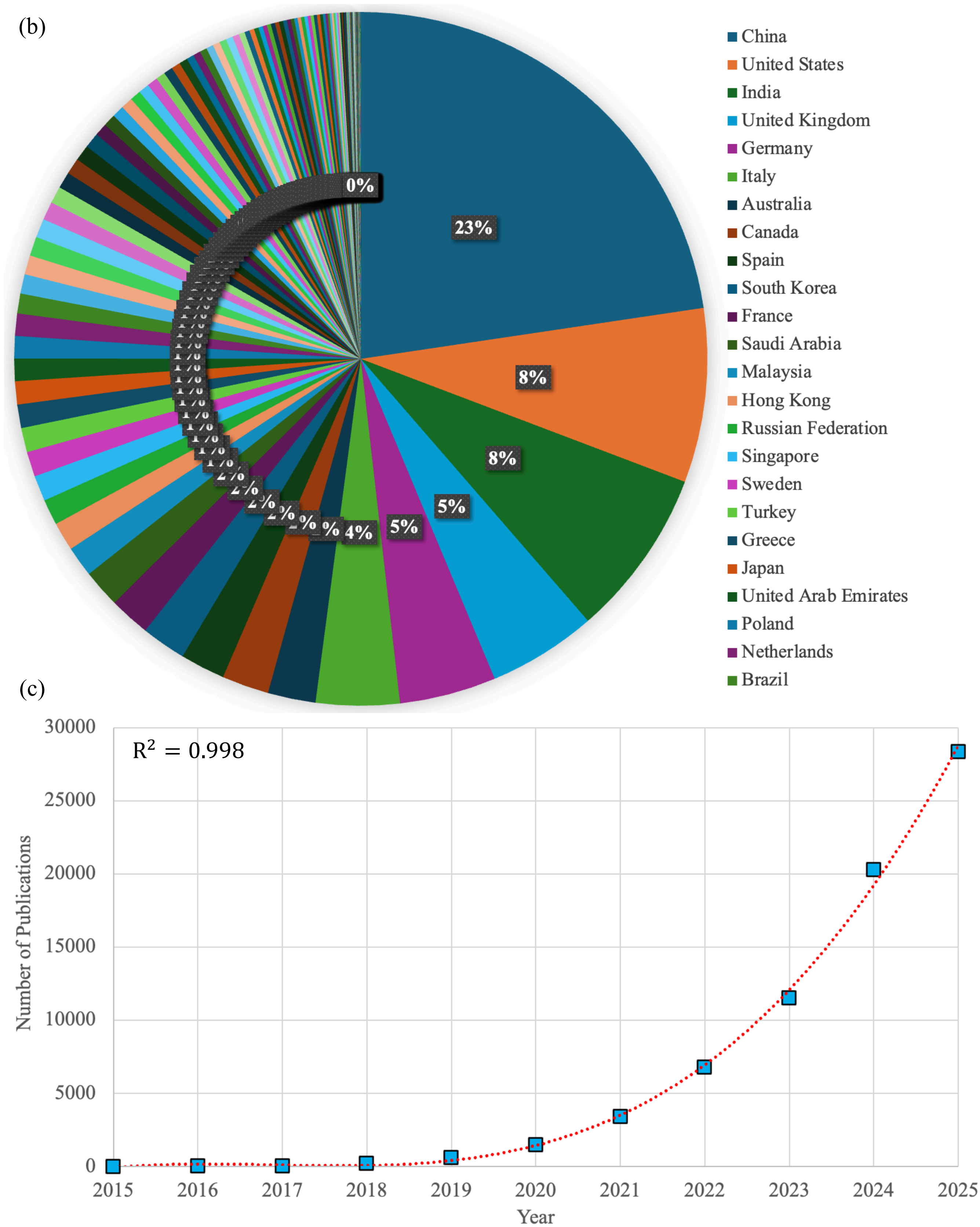


Figure 2: RQ_1 trends by (a) discipline, (b) countries, and (c) publication trends over the last decade.

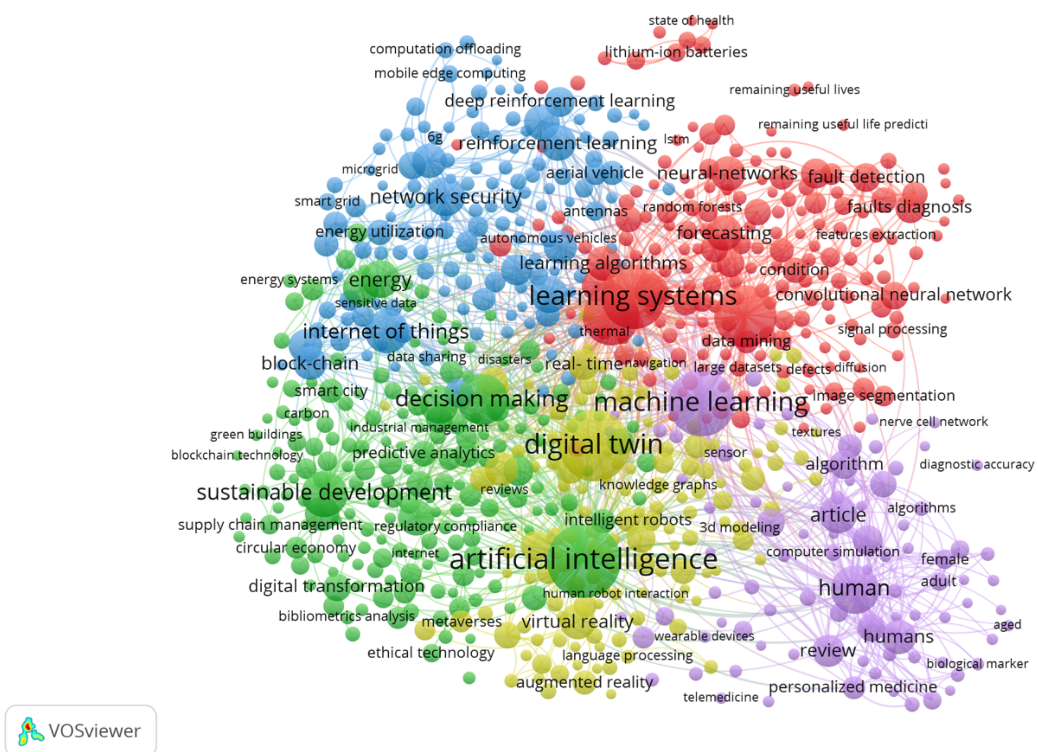
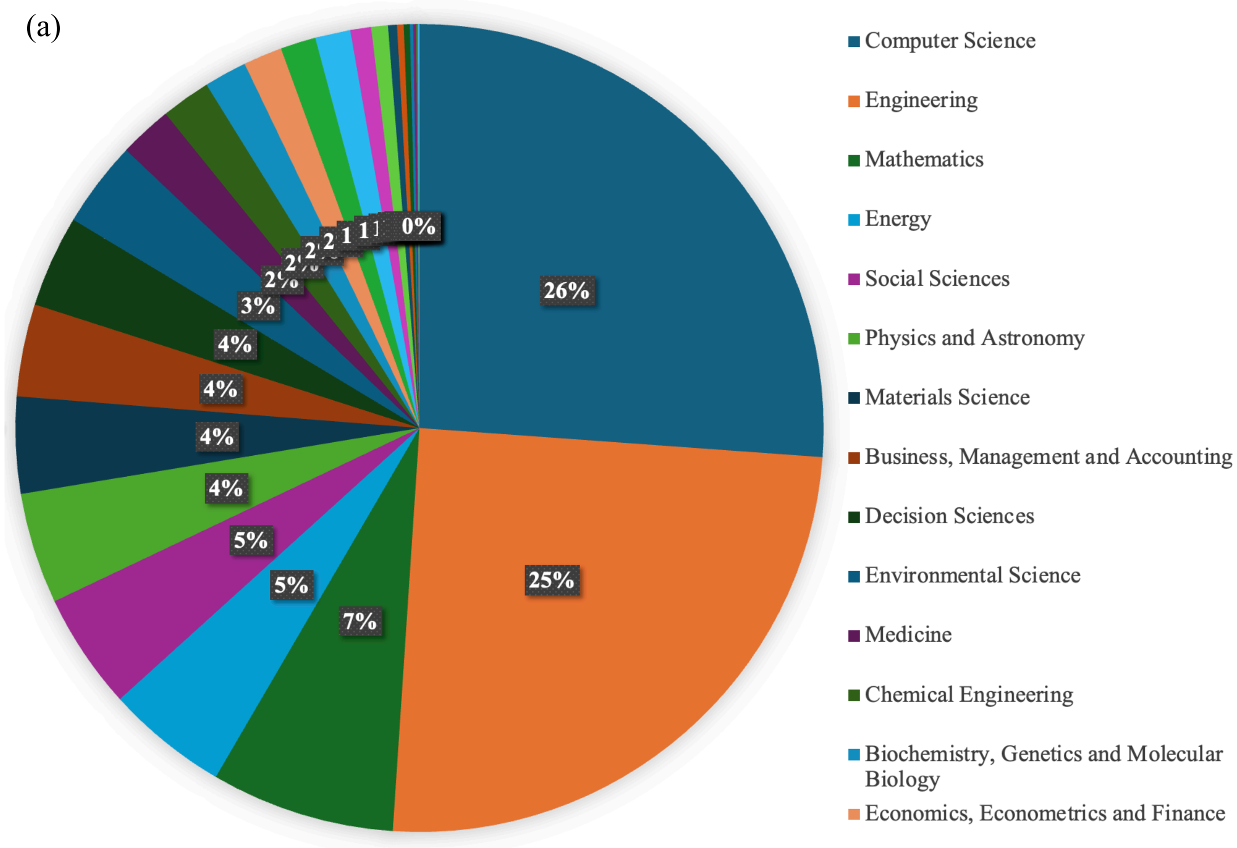
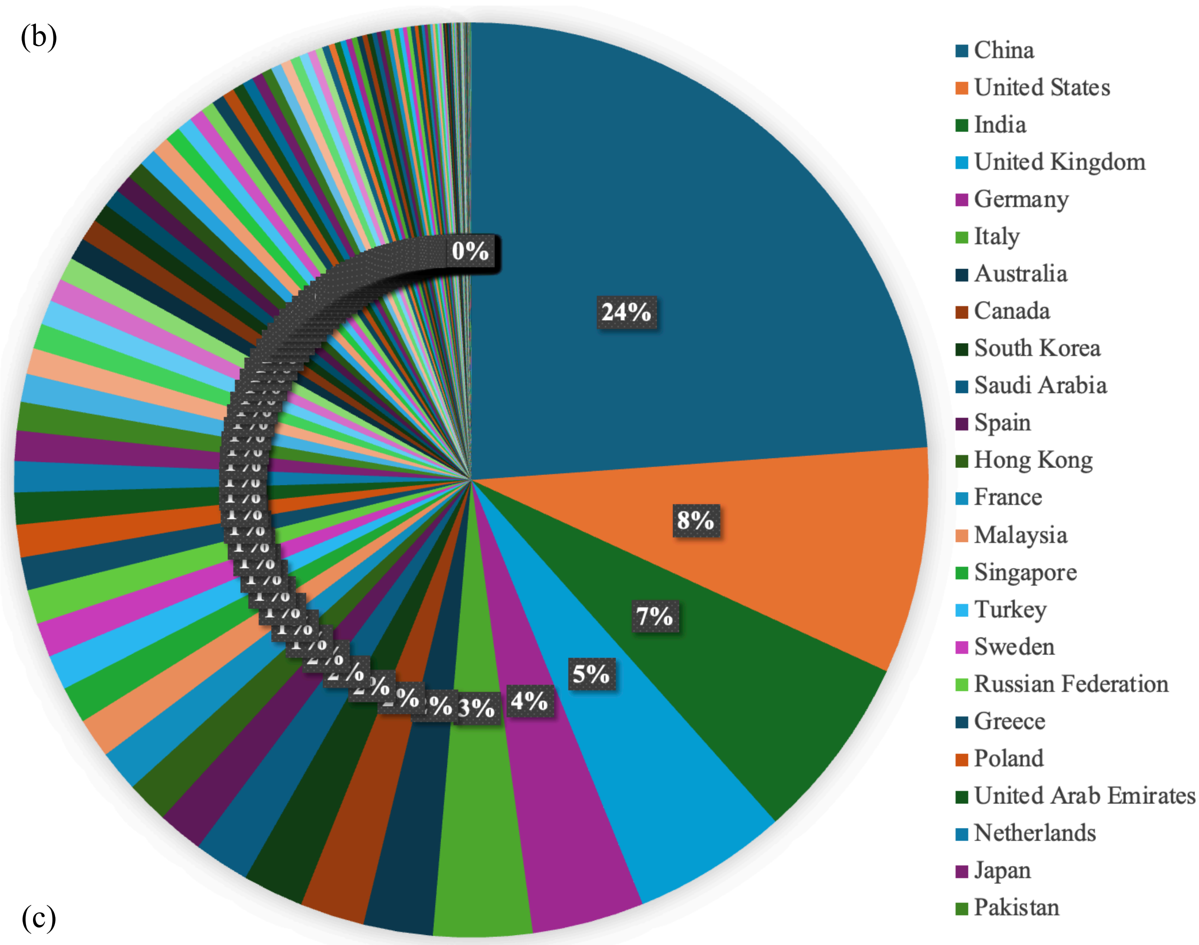


Figure 3: The co-citation network generated for RQ_2.

(a)



(b)



(c)

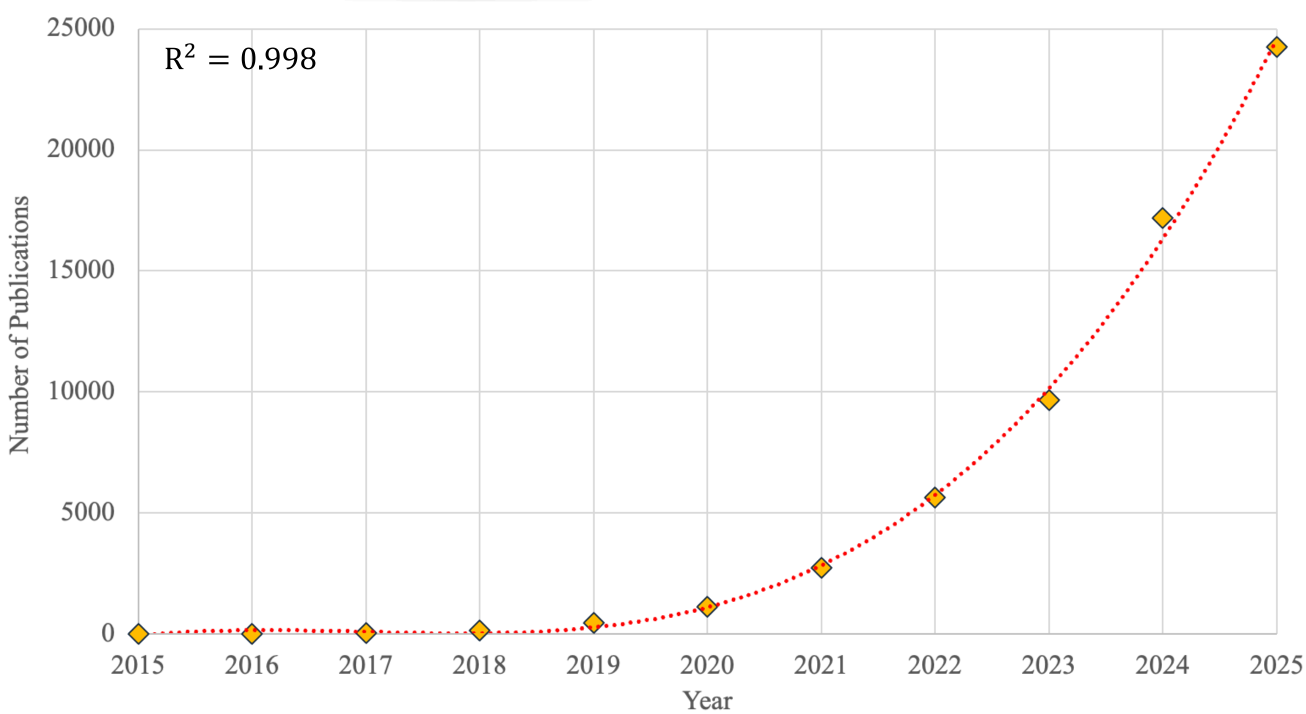


Figure 4: RQ_2 trends by (a) discipline, (b) countries, and (c) publication trends over the last decade.

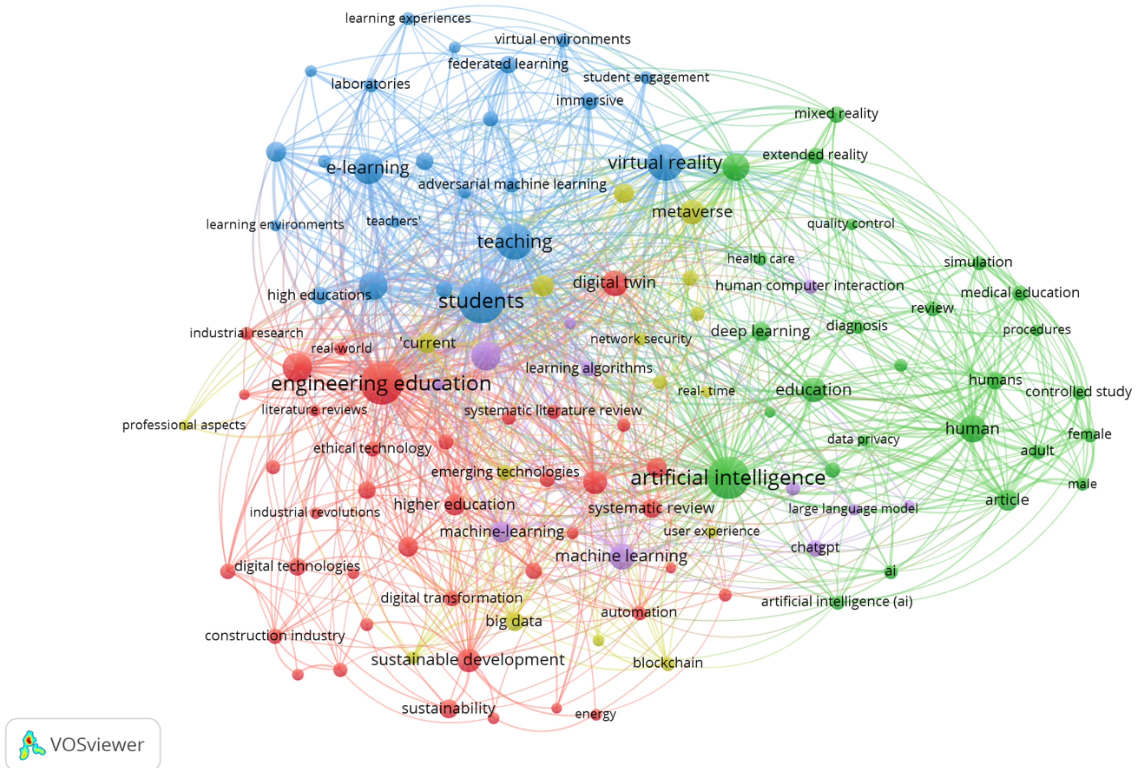
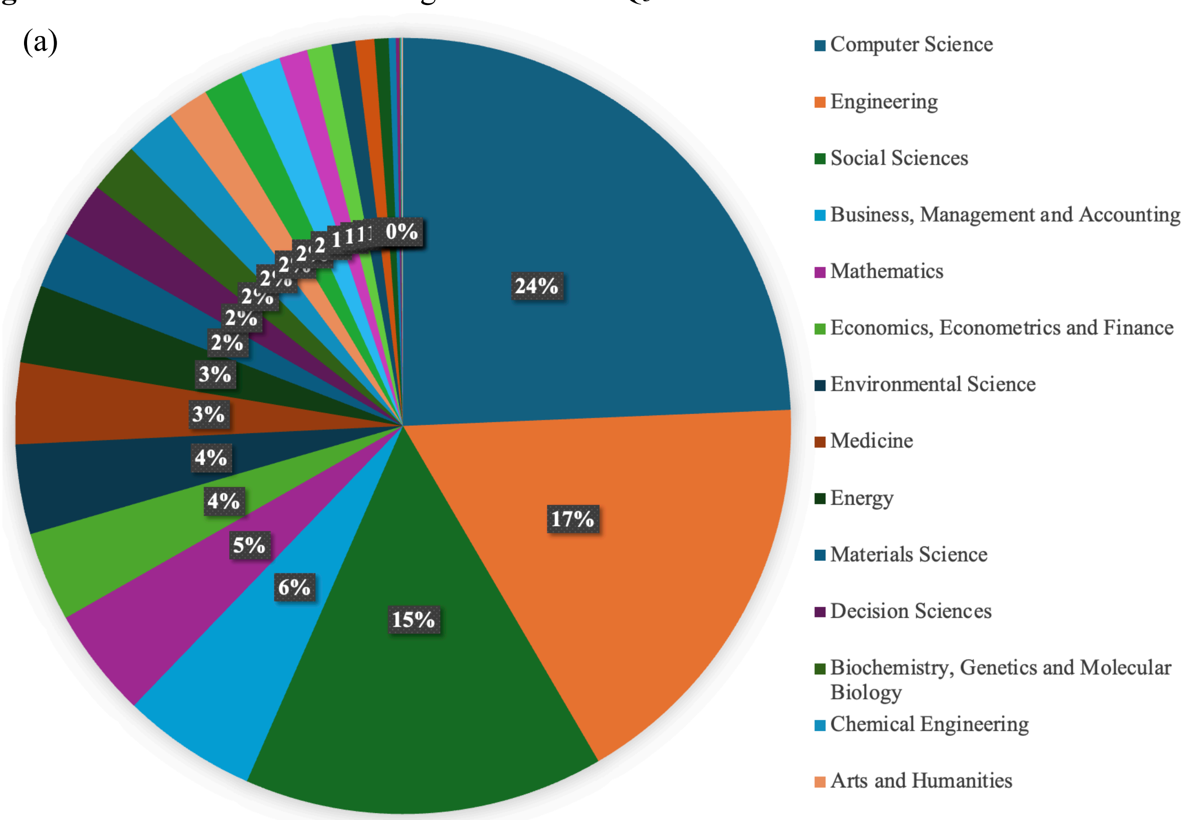
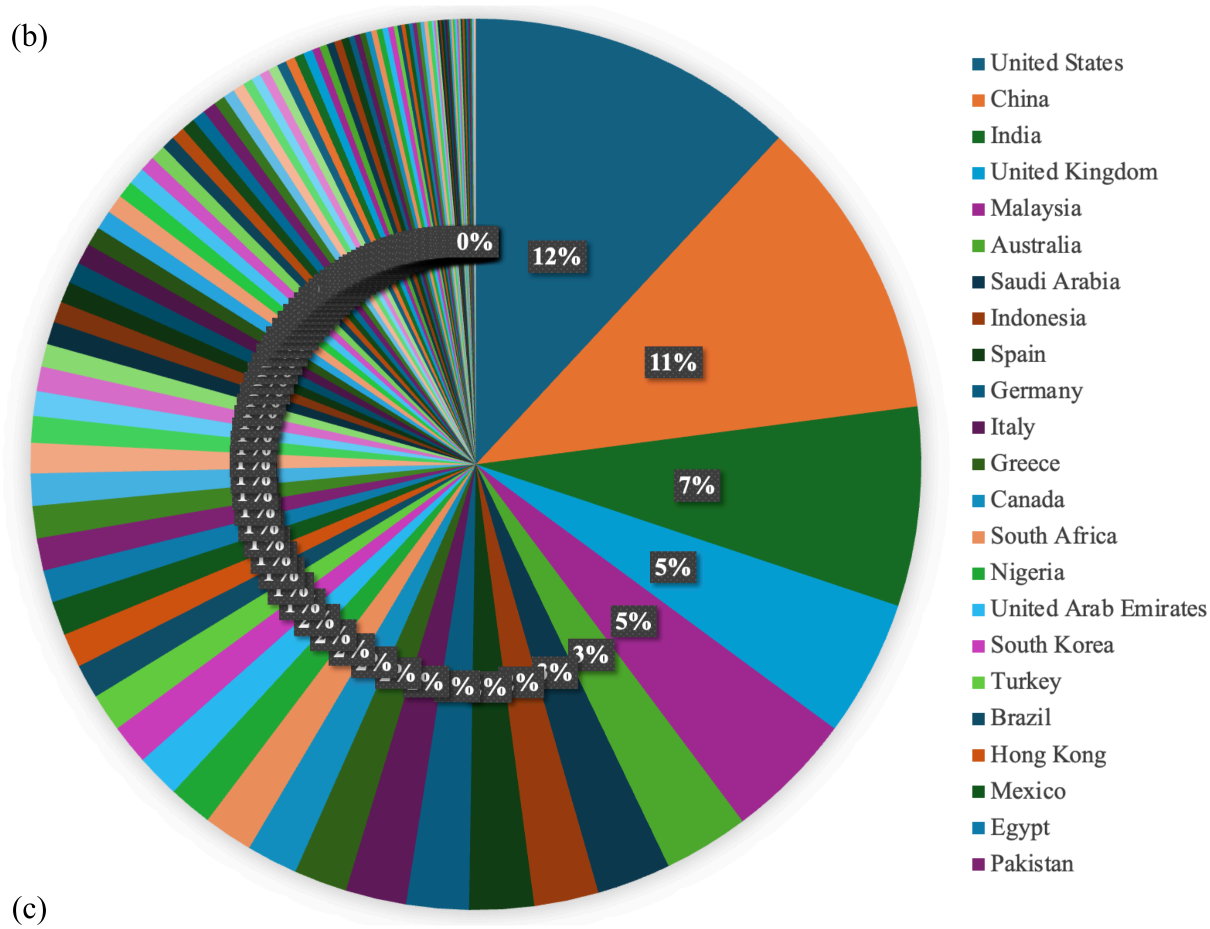


Figure 5: The co-citation network generated for RQ3.

(a)



(b)



(c)

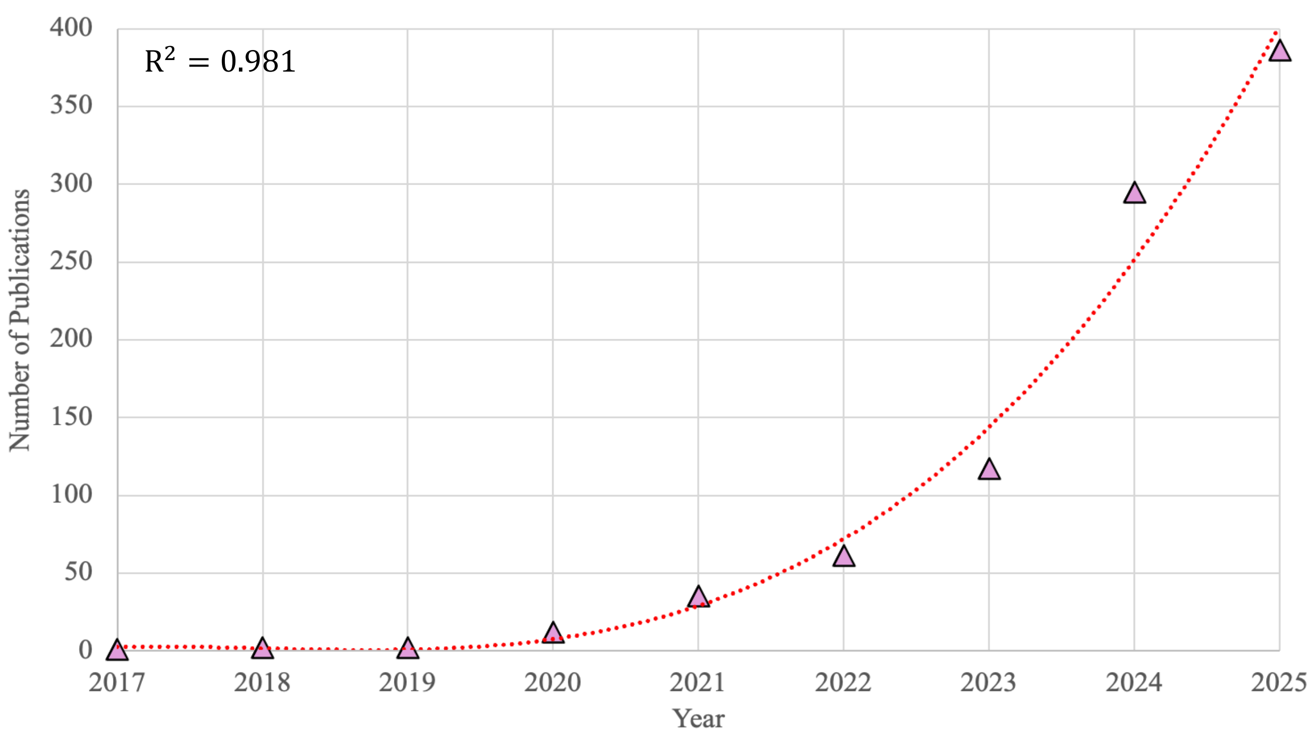


Figure 6: RQ_3 trends by (a) discipline, (b) countries, and (c) publication trends over the last decade.

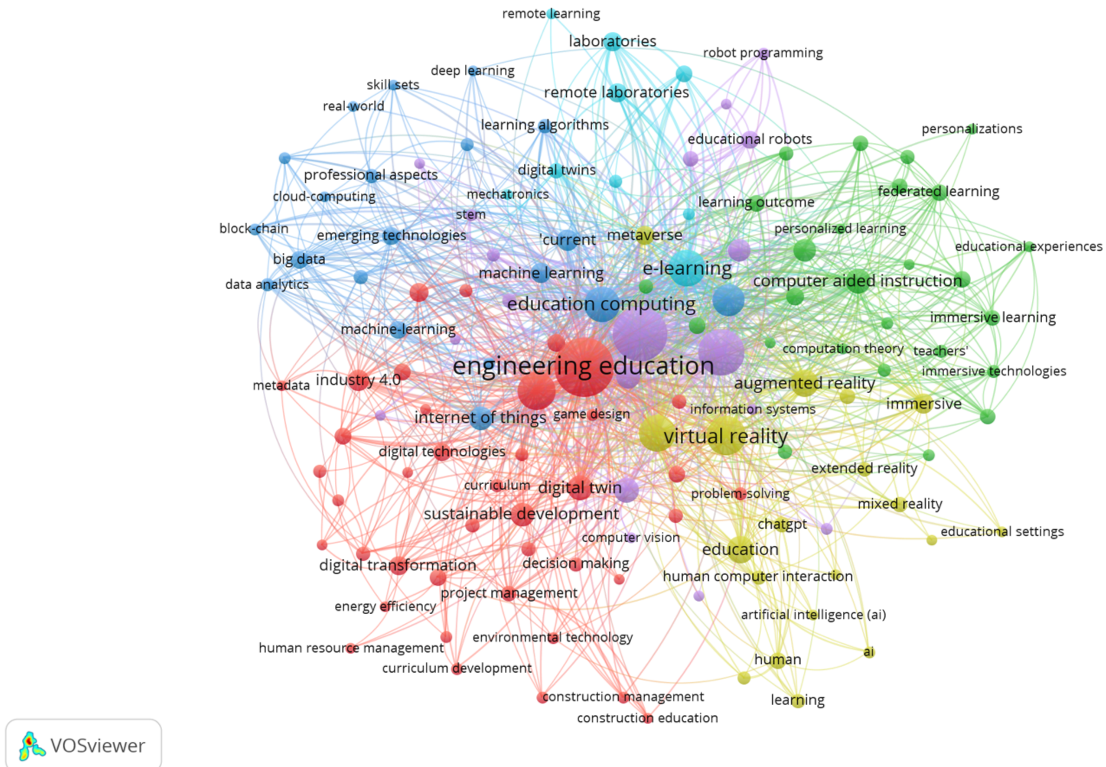
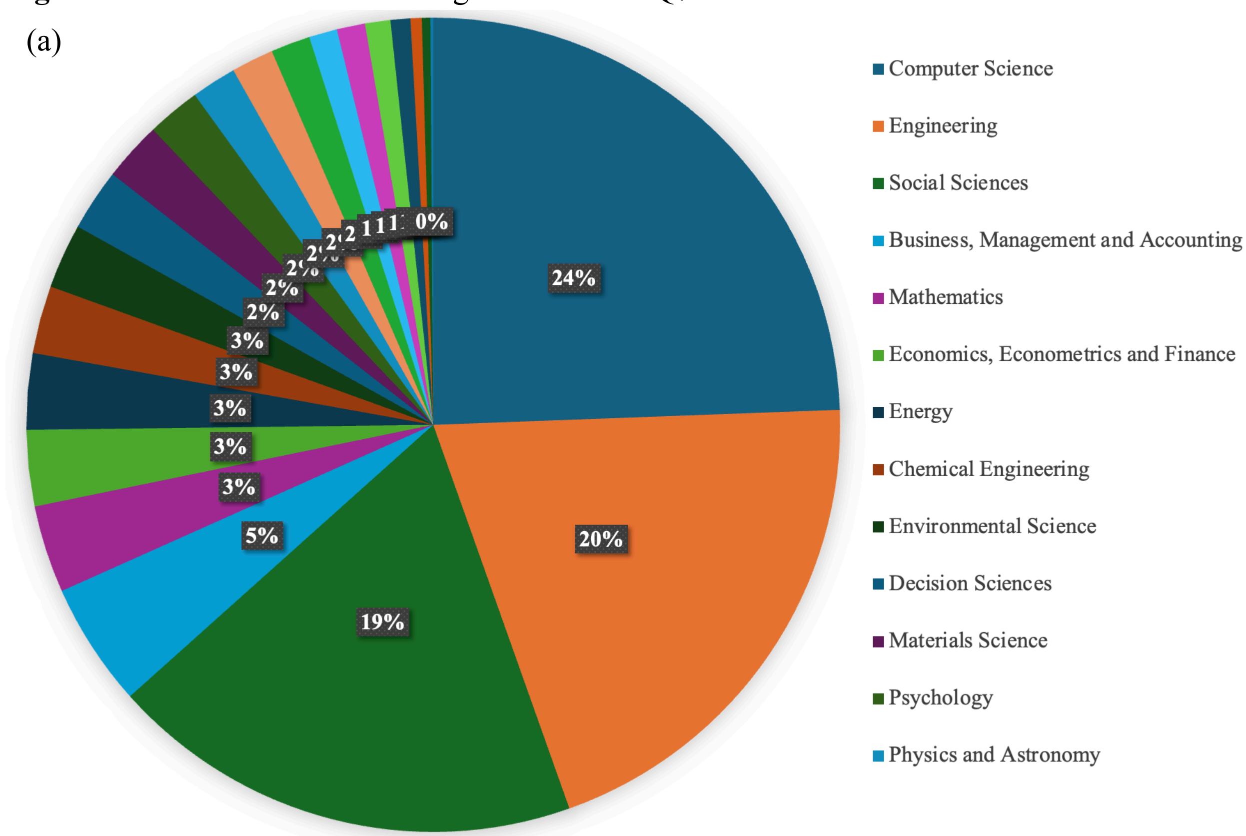
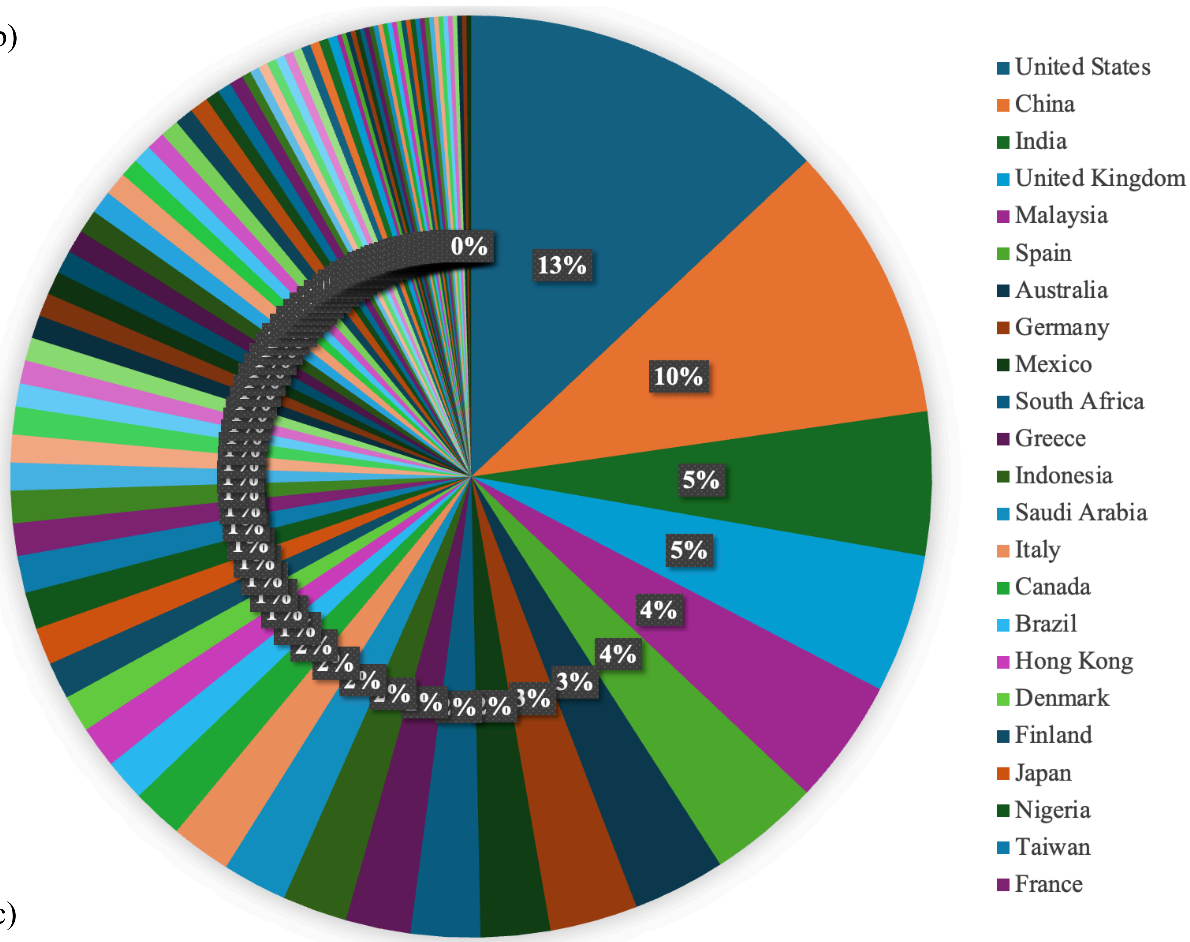


Figure 7: The co-citation network generated for RQ4.

(a)



(b)



(c)

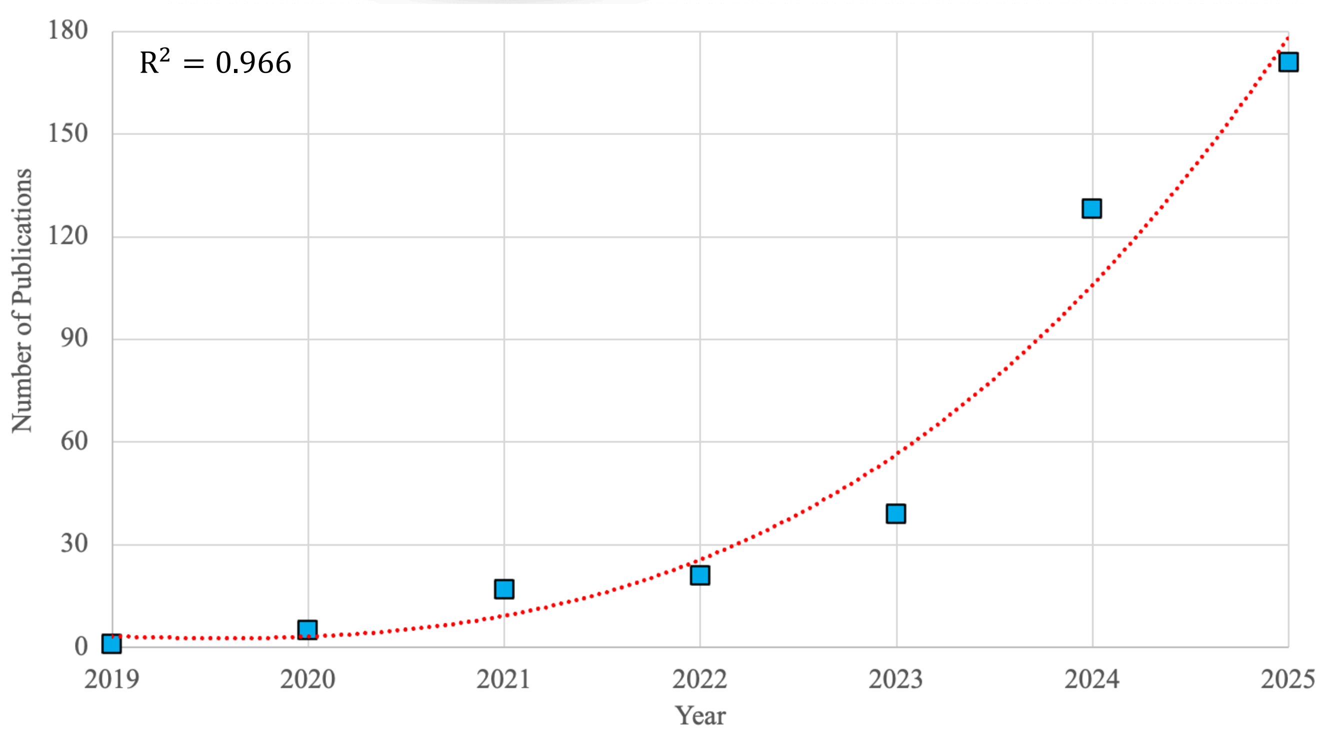


Figure 8: RQ_4 trends by (a) discipline, (b) countries, and (c) publication trends over the last decade.

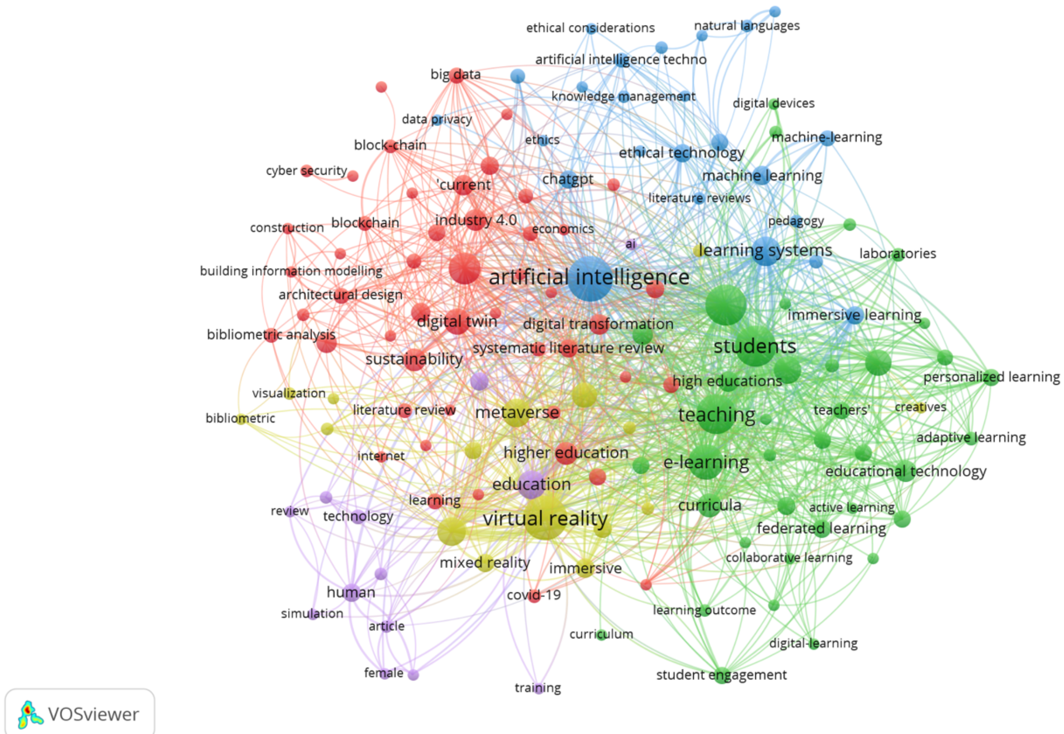
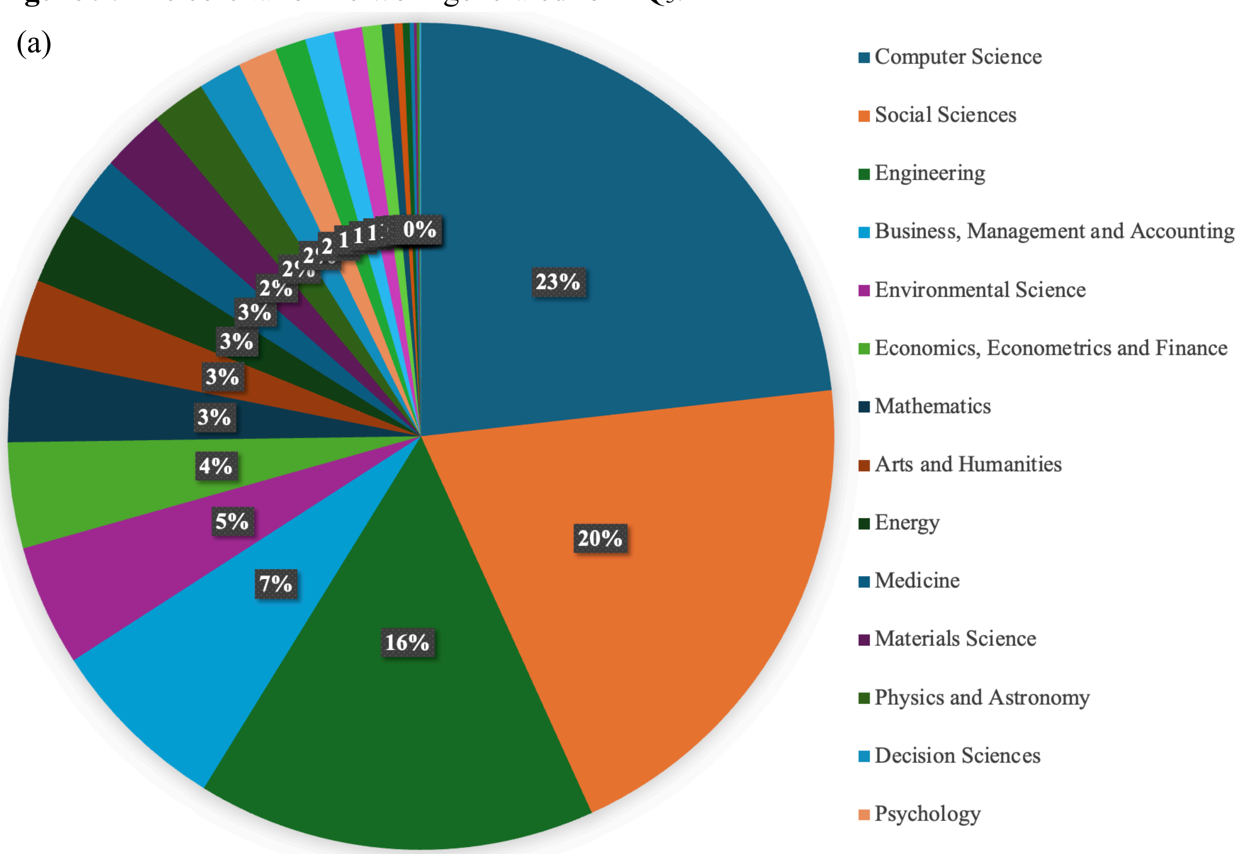


Figure 9: The co-citation network generated for RQ$_5$.

(a)



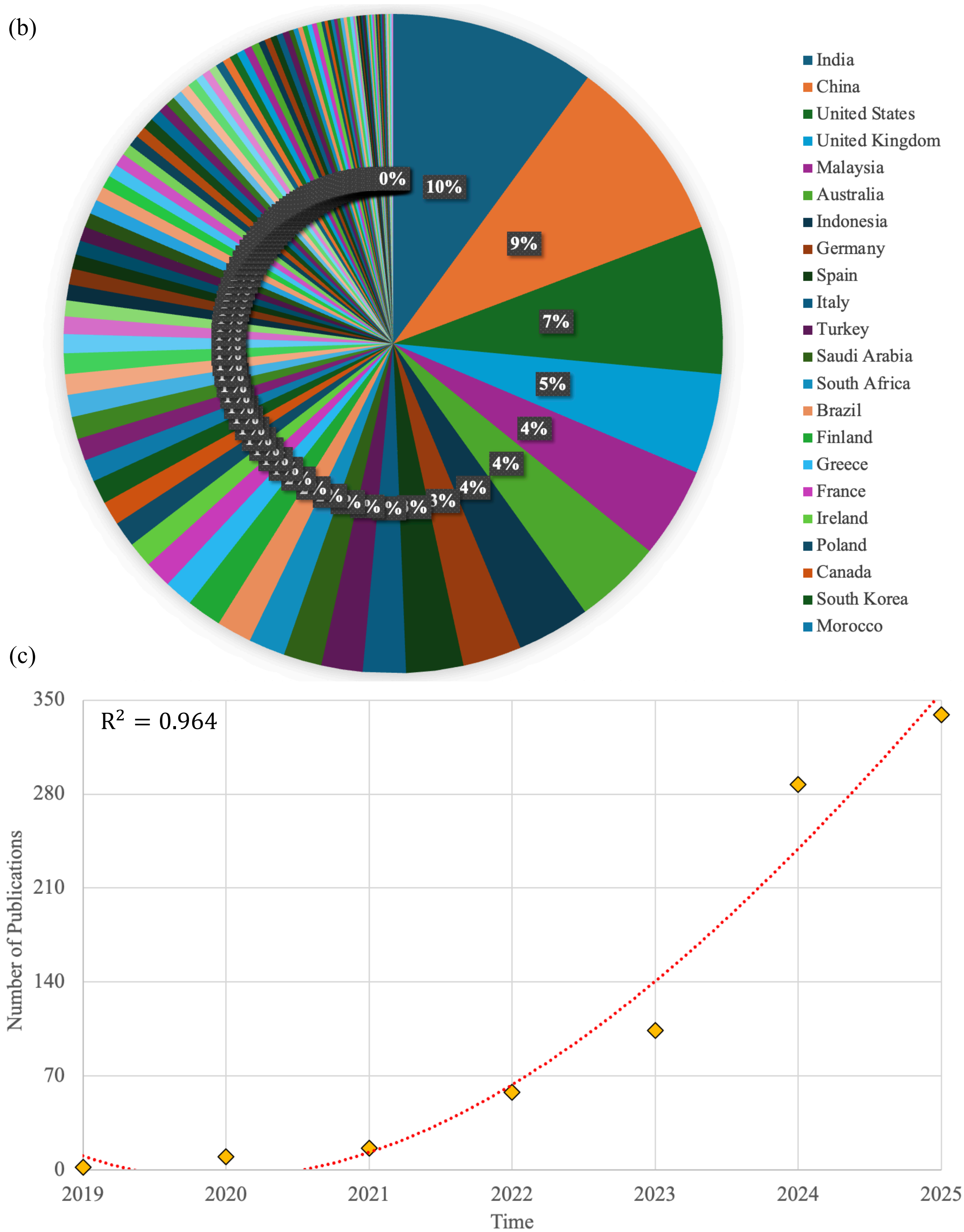


Figure 10: RQ_5 trends by (a) discipline, (b) countries, and (c) publication trends over the last decade.

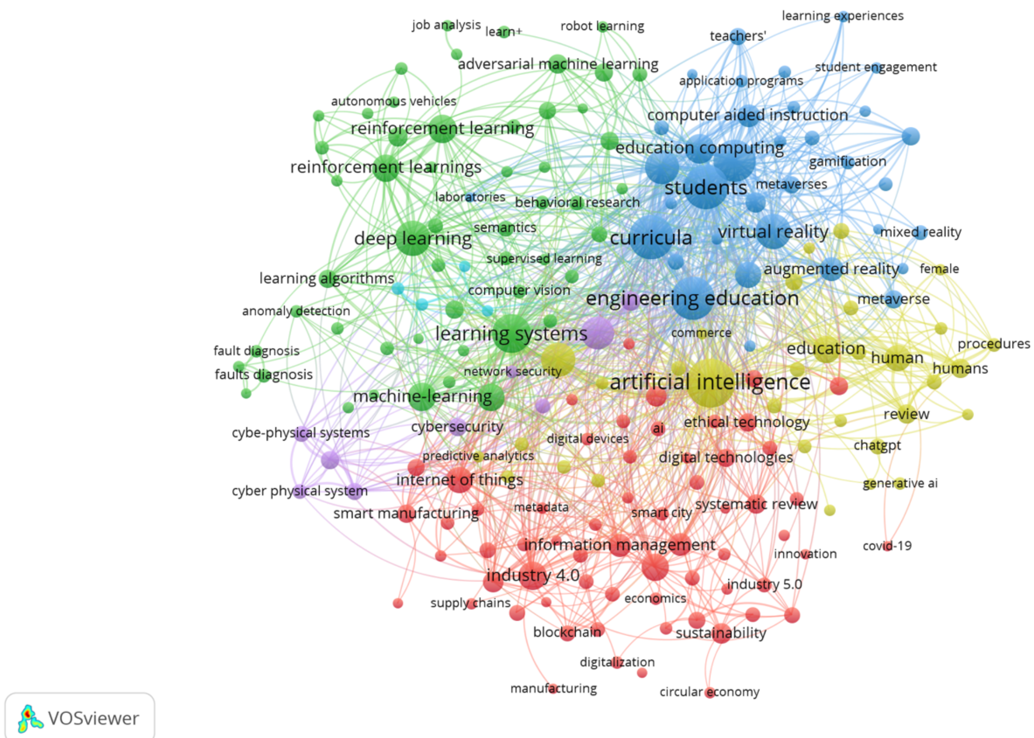
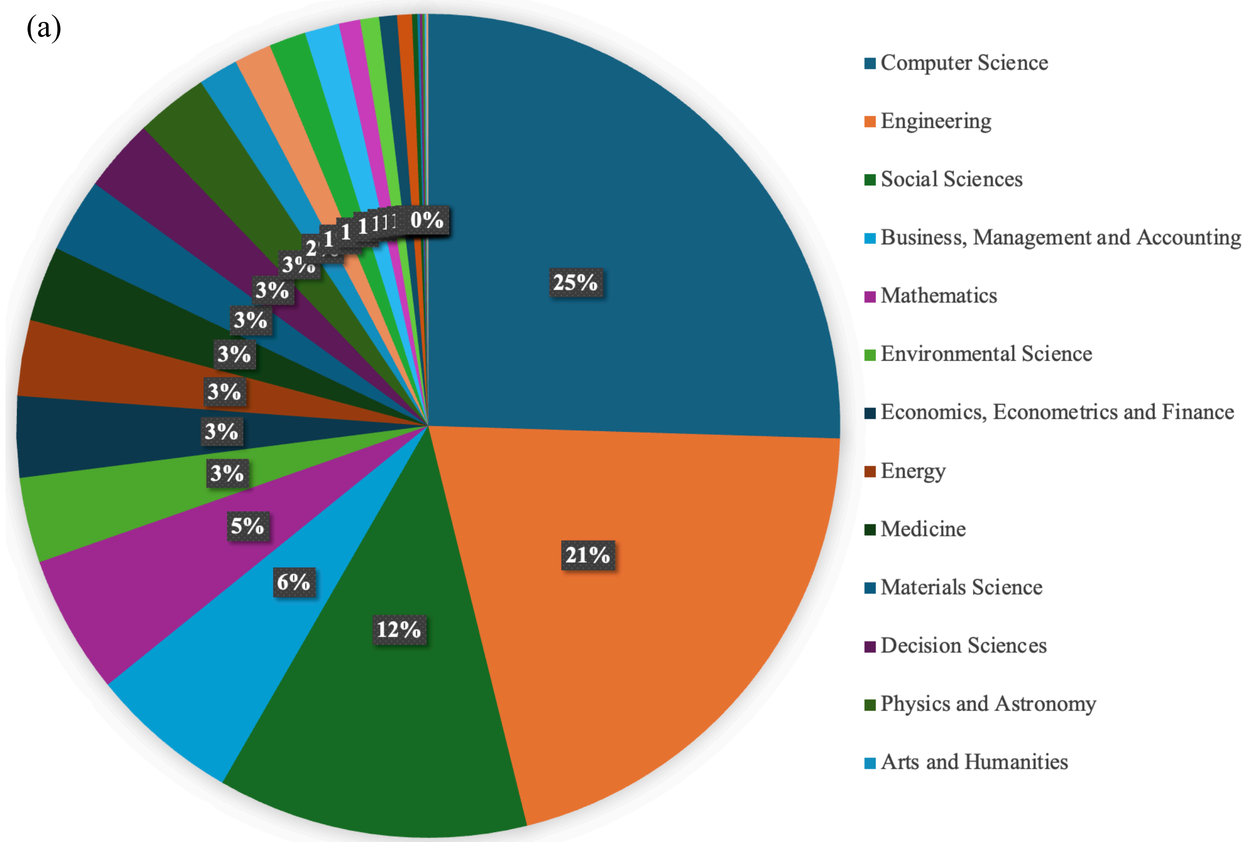
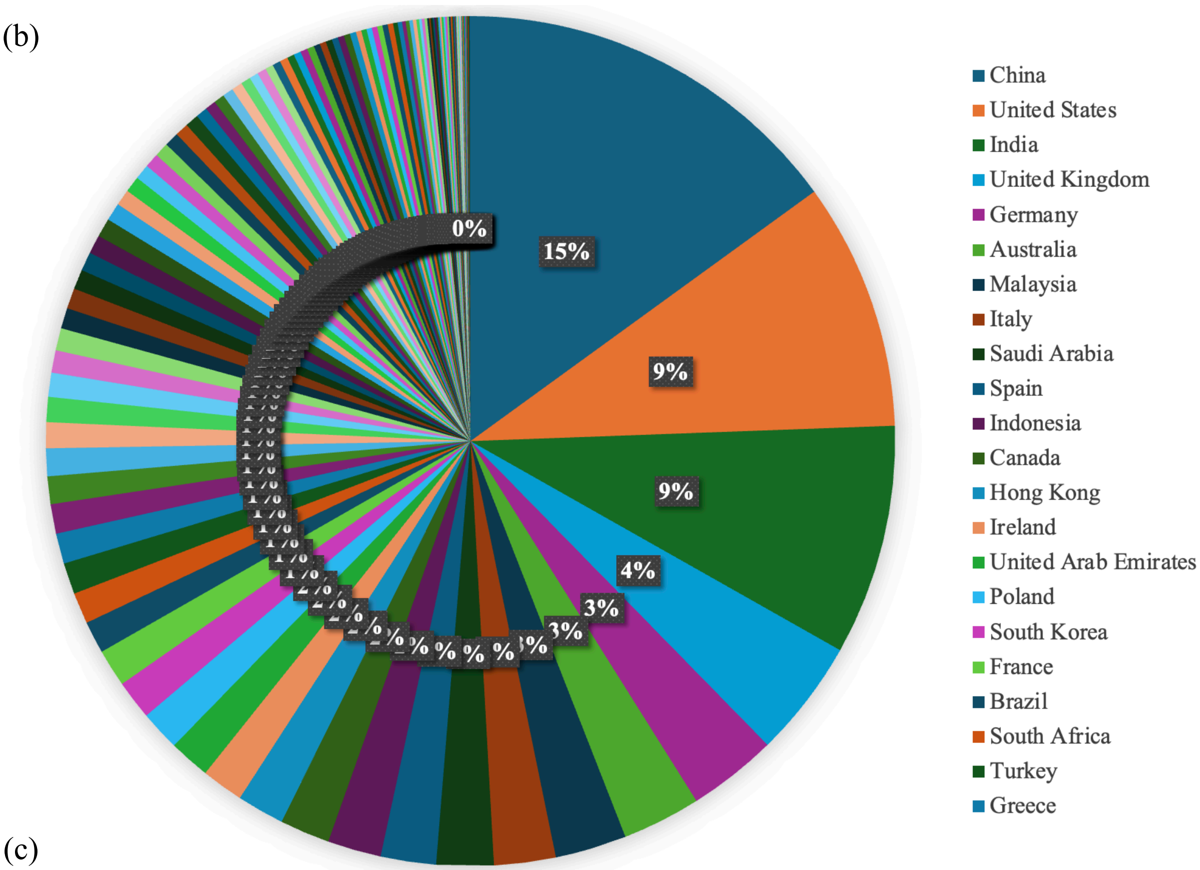


Figure 11: The co-citation network generated for RQ6.

(a)



(b)



(c)

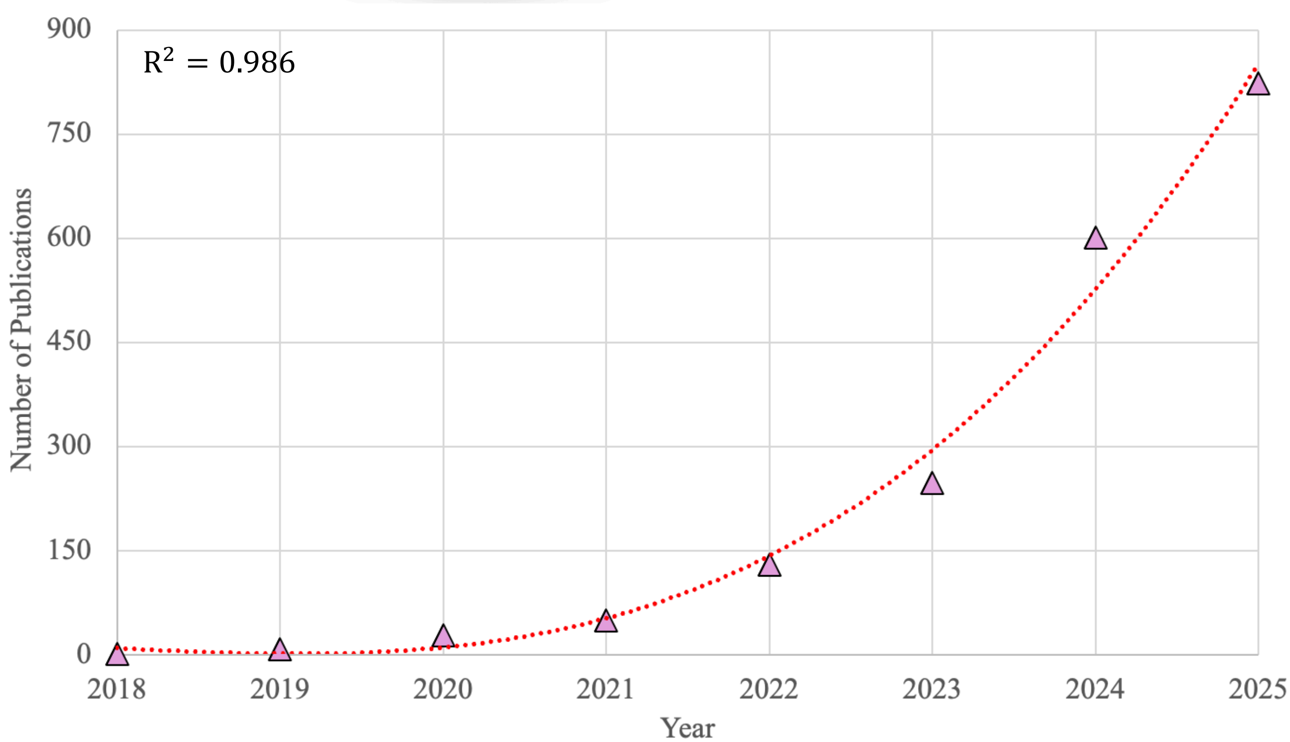


Figure 12: RQ_6 trends by (a) discipline, (b) countries, and (c) publication trends over the last decade.

Appendix B: Table of acronyms and symbols used in this work.

Acronym	Description	Acronym	Description
E.D. 5.0	Education 5.0	VR	Virtual Reality
I.D. 5.0	Industry 5.0	AR	Augmented Reality
HEI	Higher Education Institutes	RQ	Research Question
ML	Machine Learning	R^2	Regression Coefficient
IoT	Internet of Things	LLMs	Large Language Models