2026 ASEE ANNUAL CONFERENCE June 21–24, 2026 | Charlotte Convention Center, NC

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ASEE AMERICAN SOCIETY FOR ENGINEERING EDUCATION

Paper ID #50454

Data Science & Artificial Intelligence 5.0 (DSAI 5.0) at Higher Education Institutes (HEIs): Bibliometric Analysis Captures a Shift Towards Society 5.0.

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Data Science & Artificial Intelligence 5.0 (DSAI 5.0) at Higher Education Institutes (HEIs): Bibliometric Analysis Captures a Shift Towards Society 5.0.

Abstract: The world today relies heavily on Artificial Intelligence (AI), a natural consequence of the Fifth Industrial Revolution. A rapidly emerging field in recent years is Data Science & Artificial Intelligence (DSAI), which has necessitated universities and Higher Education Institutes (HEIs) to shift their research/teaching focus to encompass these aspects. DSAI-centered initiatives involve interdisciplinary data collaboration with subject-matter experts/students, often at the intersection of AI, Machine Learning (ML), Virtual Reality (VR), and Augmented Reality (AR). Such paradigm shifts are becoming a part of globally led initiatives that aim to incorporate Education 5.0 (E.D. 5.0) competencies and Industry 5.0 (I.D. 5.0) skillsets, to meet the Society 5.0 global vision. Thus, it becomes crucial to detect the spatiotemporal evolution, as well as future growth trends of DSAI in the Fifth Industrial Revolution. A set of strategically posed Research Questions (RQs) deriving from a comprehensive literature review is identified, and a bibliometric analysis is performed on the Scopus scientific database from 2016 (the start of I.D. 5.0) to 2025 (present day), with appropriate Inclusion & Exclusion criteria to eliminate duplicate entries, to analyze and understand these patterns. From initially generic results capturing global trends, our search became further refined, targeting STEM-based (Science, Technology, Engineering, and Mathematics) fields that incorporate engineering education elements. The obtained co-citation networks identify key factors propelling DSAI growth and innovation, namely, AI, ML, data science, data mining, deep learning, and big data. Publication trends reveal a non-linear (quadratic and cubic) temporal increase in DSAI-based research, confirming its ever-evolving relevance towards shaping research and teaching at HEIs. Computer science, engineering, medicine, and mathematics emerge as top disciplines leading this change. The United States and the United Kingdom emerge as contributors from the Global North; India and China lead these transformative initiatives from the Global South. Our work captures direct evidence of how E.D. 5.0 and I.D. 5.0 leads to the creation of DSAI 5.0, aimed at using DSAI-based methods and techniques to push mankind towards Society 5.0. With the rapid assimilation of pedagogy-based learning methods (active, experiential, inquiry-driven, project-based) involving learning via digital-twin interaction(s), instructors/educators must also understand this shift to design HEI education curricula. Students can be trained in I.D. 5.0 skillsets and E.D. 5.0 competencies, ensuring that they are perceived as valuable in the job market, post-graduation. Long-term, we envision capturing the myriad aspects of DSAI 5.0 for both global and sector-specific contexts, inspiring future work evoking thoughtful, conscientious curricula design. We aim to empower HEIs to create future generations of well-trained, ethically aware, morally responsible graduates who can act as future leaders/innovators, shaping humanity's collective migration towards Society 5.0.

Keywords: Data Science and Artificial Intelligence (DSAI), Education 5.0 (E.D. 5.0), Industry 5.0 (I.D. 5.0), Higher Education Institutes (HEIs), Society 5.0.

Introduction: The Fifth Industrial Revolution is identified by the unique developments of Data Science (DS) and Artificial Intelligence (AI)[*], often characterized as the novel, emergent research branch of DSAI. This is a direct consequence of bridging the Education 5.0 (E.D. 5.0) and Industry 5.0 (I.D. 5.0) gap [5,6], characteristic hallmarks of the Fifth Industrial Revolution. An indirect consequence of the COVID-19 pandemic was a rapid migration towards (and adoption of) online teaching/assessments at universities, leading to a complete revamp of the pedagogical landscape [4,20]. Today, the world lies at an interesting juxtaposition, where AI assimilation has led to Higher Education Institutes (HEIs) pushing for relevant curriculum revamps, while adhering to all major requirements of accreditation bodies (such as ABET in the US and the CEAB in Canada). The intention remains to catalyze (primarily) undergraduate learning, to train them in accordance with E.D. 5.0 requirements. This ensures that upon graduation, they hold the requisite I.D. skillsets and competencies to be perceived as valuable (i.e., employable) by industry. This change manifests already across multiple fields, such as identifying transformative pathways to morph a traditional subject like Fluid Mechanics to Fluid Mechanics 5.0 [1], revamping rigorous Chemical Process Design courses to meet I.D. competencies [12], and identifying relevant causal factors to shift from the E.D. 4.0 to E.D. 5.0 landscape [5]. Analogously, emergent research also identifies how AI and DSAI-led initiatives [6,12] are impacting and transforming the fields of AI, engineering education, and sustainability. While performing curricular revamps, research has also captured an existing AI implementation gap [8] between the Global North and the Global South, which further exacerbates if the two major Global South economic driver nations (India and China) are excluded from this comparison. Paralleling these innovations, AI has also exponentially catalyzed the fields of data science, big data, and ML [4]. With the launch of ChatGPT in 2022, followed by the rapid release of Large Language Models (LLMs)-based search engines such as Copilot, Gemini, DeepSeek, etc., DSAI has become progressively accessible to the lay (non-academic) audience [13,14]. This trend rapidly continues in the Global South – for instance, at the 2026 India AI Impact Summit, multiple newer, robust LLMs have been released, such as Sarvam AI (Sarvam-30B and Sarvam-105B), BharatGen (Param2 17B), Vachana (which etymologically originates from the Sanskrit root word vachana, meaning, to speak), Tech Mahindra (Project Indus 8B), etc. These initiatives have led to the emergence of the novel field of Effective Prompt Engineering (EPE) [11]. Strategic utilization of such LLMs can perform detailed statistical data analysis [19], solve complex engineering problems, and facilitate human-AI collaboration via chatbots [14,15,22]. DSAI has exponentially grown in recent years and today, encompasses diverse aspects of global engineering, technology, society, and economics. As today's universities and HEIs become formative grounds to train the minds of younger generations to attain E.D. 5.0 competencies and I.D. 5.0 skillsets, it becomes imperative to track how DSAI is contributing towards shifting global/societal mindsets towards Society 5.0. Society 5.0, a concept initially proposed by the Government of Japan during its Fifth Science and Technology Basic Plan in January 2026, envisions a super-smart, cognizant society that elegantly balances economic growth and prosperity, sustainable development, and cyberspace integration, while successfully solving key global and social issues [7,13]. This work aims to track

[*] **Appendix B** lists a table of symbols and abbreviations that are used throughout this work.

the impacts of DSAI, first globally, and then, within the academic landscape (with emphasis on the United States academia), towards realizing this vision. Our analysis captures this shift (via bibliometric analysis) via the creation of six research questions that examine the currently underway and emergent areas of research, development, and innovation that future researchers can aim to focus efforts on, to swiftly realize Society 5.0.

Methods: Post a comprehensive analysis of the engineering education/pedagogical literature, a set of Research Questions (hereafter referred to as RQs) was formulated, as summarized in **Table 1**. The RQs were subjected to rigorous Inclusion and Exclusion criteria: the search was intentionally limited to the last decade (from 2016 to 2025) and was also restricted to the fields of Engineering, Computer Science, Mathematics, Decision Sciences, and Chemical Engineering. Document types were limited to articles, conference proceedings, books, book chapters, and reviews, and only fully published articles were considered (no articles in press). The search was conducted on the Scopus scientific database, and repeated multiple times to ensure full data reproducibility. We checked the data file for each search to eliminate any duplicate entries (none found). For each RQ, bibliometric analysis led to the generation of co-citation network maps on VOS viewer, with key attributes and keywords linked to each other. The larger the bubble and the stronger the link in a co-citation network map, the stronger the interrelation between the analyzed attributes. Temporal publication trends, as well as country and discipline-specific data, were analyzed using MS-Excel; these data are presented in **Appendix A**. In total, six RQs were analyzed, each building on the previous one (by combining AND/OR Boolean operators), with the search becoming successively restrictive. This was a planned strategic move, with the intention of placing maximum constraint on the search (thus, making it extremely rigorous). Thus, the results obtained are non-trivial and are the result of having subjected each RQ to the strongest search scrutiny. In the next section, we present our results and discuss the consequential impacts and predictions of DSAI incorporation across HEIs.

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

RQ	**Scopus Search Prompt**
RQ_1	Data Science AND Artificial Intelligence OR AI
RQ_2	Data Science AND Artificial Intelligence OR AI AND university OR Higher Education Institute
RQ_3	Data Science AND Artificial Intelligence OR AI AND university OR Higher Education Institute AND undergraduate
RQ_4	Data Science AND Artificial Intelligence OR AI AND university OR Higher Education Institute AND undergraduate AND United States or USA

RQ_5	Data Science AND Artificial Intelligence OR AI AND university OR Higher Education Institute AND pedagogy OR pedagogical innovation
RQ_6	Data Science AND Artificial Intelligence OR AI AND university OR Higher Education Institute AND pedagogy OR pedagogical innovation AND United States OR USA

Results & Discussion: We now present the results and findings of each of our RQs and analyze the broader context of our results. The data captures and quantifies an observable shift towards Society 5.0, as AI/ML-assisted DSAI-led innovations pave the way towards bridging the existing AI-implementation gap, uniting the E.D. 5.0-I.D. 5.0 framework.

RQ_1: The search focused broadly on Data Science and AI (hereafter, DSAI) specifically in the last decade. The emergence of DSAI-related articles has exploded, from a mere 1788 articles in 2016 to 43,829 in 2025 alone! Temporal trends reveal a quadratic increase in publications in this research domain, supplemented with a strong regression coefficient ($R^2 = 0.991$). As shown in **Figure 1**, the relative link strengths between these clusters are most centered around AI, ML, human/humans, deep learning, Internet of Things (IoT), adversarial machine learning, forecasting, optimizations, neural networks/convolutional neural networks, blockchain, and sustainable development. These capture the direct fields/attributes that have been and continue to be impacted by DSAI-driven innovation. Fields leading this DSAI changes (see **Figure 2**) are Computer Science (38%, 163771 articles), Engineering (18%, 79919 articles), Mathematics (12%, 51853 articles), Decision Sciences (7%, 31859 articles), and then the Social Sciences (4%, 16538 articles). Countries leading these publication initiatives are China (16%, 44444 articles), India (14%, 37769 articles), the United States (12%, 32903 articles), the United Kingdom (4%, 10921 articles), and Germany (4%, 10361 articles). The Global South dominates on a global lens, primarily driven by China and India. Among the Global North economies, the United States of America continues to outperform other member countries in this country bloc. Top funding agencies for this research are the National Natural Science Foundation of China, the National Science Foundation, the National Key Research & Development Program, the Horizon 2020 Framework Program, and the European Commission. Our data shows an exponential rise in DSAI-related research in the past decade, which coincides with the rapid emergence of AI-based research, catalyzing the Fifth Industrial Education (E.D. 5.0) and Industrial (I.D. 5.0) Revolution. This unification is the predicted causal vehicle towards shifting global populations towards the Society 5.0 vision, characterized by a thoughtful union of technology and humanity.

RQ_2: The search was narrowed to capture the impacts of DSAI across Higher Education Institutes (HEIs) over the last decade. Major keywords are clustered on AI, ML, deep learning, etc. (in essence, the same keywords as those for the previous search). This is not erroneous and indicates that the very impacts of DSAI are also on track towards being implemented at HEIs, as presented

in **Figure 3**. This is direct evidence that AI/ML-driven changes in the I.D. 5.0 landscape is being directly reflected in the E.D. 5.0 landscape. However, the removal of the sustainable development keyword means that E.D. 5.0 still needs to be aligned with Society 5.0 targets. As summarized in **Figure 4**, we observe that research in this specific subfield has also exploded, from 1457 articles in 2016 to 36,243 articles in 2025. This is almost a 25-time increase in peer-reviewed publications over the last decade! Temporal trends show a quadratic best fit to this data, additionally confirmed by a strong value of $R^2 = 0.991$. Top fields in this domain are Computer Science (38%, 134625 articles), Engineering (18%, 64844 articles), Mathematics (12%, 41919 articles), Decision Sciences (7%, 25388 articles), and Social Sciences (4%, 14059 articles). This order is identical to that reported for the previous RQ, suggesting that it is highly likely that this mirroring is suggestive that most published DSAI articles in the last decade have likely risen from HEIs. This highlights the crucial role of universities and academic institutions as training grounds to create future generations of DSAI-aware/DSAI-trained graduates. Again, top funding agencies for HEI-led DSAI initiatives are the National Natural Science Foundation of China, the National Science Foundation, the National Key Research and Development Program of China, the Horizon 2020 Framework Program, and the Fundamental Research Fund for the Central Universities.

RQ_3: Within the context of HEIs, recent pedagogical and engineering education-based research has captured such initial shifts (but with growing momentum) executed via strategic curriculum revamps at the undergraduate level. Thus, our next search is a further refinement on RQ_2, with an additional filter of the search being restricted to only the undergraduate level. A summary of these results is presented in **Figure 5**, which shows that the major keywords are centered around AI, ML, students, teaching, engineering education, deep learning, educational data mining, e-learning, contrastive learning, learning analytics, computer-aided instruction, curriculum, language models, and ethics. These keywords independently prove that the implementation vehicle for these changes is engineering education. This is a striking realization, since it confirms that within the HEI context at the undergraduate level, curriculum revamps implemented through pedagogical and engineering education frameworks are more likely to bear fruit and bridge the E.D. 5.0 – I.D. 5.0 gap. Our search reveals a rapid increase in DSAI-themed publications, from only 15 in 2016 to 762 in 2025. Compared objectively, this is over a 50-fold increase in publications, suggesting that it is primarily at the undergraduate level at HEIs that paradigm shifts are being reported (**Figure 6**). A second-order polynomial best fits the data, and this is further reinforced by a stronger regression coefficient ($R^2 = 0.995$). The top fields continue to be the same as reported above, except that there is a shift in the order, namely, Computer Science (36%, 2316 articles), Engineering (15%, 945 articles), Social Sciences (14%, 933 articles), Mathematics (8%, 519 articles) and Decision Sciences (6%, 377 articles). For this specific RQ, the top nations are the United States (18%, 710 articles), India (8%, 311 articles), China (7%, 273 articles), the United Kingdom (4%, 159 articles), and Indonesia (4%, 145 articles). The United States is the clear leader of initiatives in this aspect for the Global North and overall, while India and China continue to dominate contributions of the Global South, with Indonesia emerging as a key player as well. Top funding agencies are the National Science

Foundation, the National Natural Science Foundation of China, the European Commission, the Japan Society for the Promotion of Science, and the Horizon 2020 Framework Program. Data shows that top US and Global North universities leading this change are Purdue University, Carnegie Mellon University, Stanford University, Nanyang Technological University, and the University of Toronto.

RQ_4: We now decided to further refine this search, restricting our results specifically to the United States. This is because it appears that while the Global South appears to lead overall, leading steps and initiatives of the Global North (which is led by the USA) must also be analyzed, to capture the most significant DSAI-led transformational changes within the Global North bloc. From **Figure 7**, we observe that the keywords that are most clustered are AI, ML, engineering education, curricula, teaching, students, data mining, deep learning, human and education. This essentially implies that DSAI-led initiatives in the Global North are primarily being targeted through the lens of curriculum revamp and the use of LLMs consciously to shape student ethics and knowledge retention. In fact, the latter is another exciting, emergent field within engineering education known as Effective Prompt Engineering (EPE) [11,17]. Starting from a mere 5 articles published in 2016, 280 articles were published in 2025 for this RQ, showing a 56-fold increase in publications. While we urge the reader not to literally take the 56-fold increase value, but rather, to perceive this as a metric of the rapid increase in research interest (and correspondingly, publications) in this field. As shown in **Figure 8**, a quadratic polynomial best fits the data, supported by a strong regression coefficient ($R^2 = 0.985$)**.** The top performing fields for this RQ are Computer Science (34%, 854 articles), Social Sciences (16%, 404 articles), Engineering (13%, 338 articles), Mathematics (7%, 187 articles), and Decision Sciences (5%, 120 articles). The United States (expectedly) leads publications for this RQ (43%, 710 articles), with key other nations following, namely, India (5%, 80 articles), China (4%, 74 articles), the United Kingdom (4%, 63 articles), and Canada (3%, 48 articles). Despite the search being specifically restricted to the United States, the other countries reported are therefore indicators of academic collaborations between the USA and these nations, leading to publications. Therefore, it is not surprising to see the top five countries predominantly being Global North economies (*i.e.*, the ivory tower effect of academia – the Global North universities typically tend to collaborate with countries within their own country bloc, as against the aspirational Global South, that is often observed to collaborate with the Global North, with intentions to gain publication legitimacy, viewership, and impact). The top funding agencies for this RQ are, expectedly, mostly American bodies – the National Science Foundation, the National Natural Science Foundation of China, the National Institutes of Health, the European Commission, the Alfred P. Sloan Foundation, and the U.S. Department of Energy.

RQ_5: The search was now transformed to capture the exact impacts of curriculum revamps across HEIs. Typically, such revamps are built on the direct implementation of pedagogical learning models and frameworks such as Bloom's taxonomy and Fink's taxonomy of significant learning. As summarized in **Figure 9**, the clusters are somewhat limited, and primarily center around AI,

ML, teaching, students, engineering education/education, students and ethical technology. There is a direct one-to-one mapping captured between the implementation of pedagogical frameworks in the curriculum and student learning. This result is most encouraging for faculty/educators who seek to revamp their courses, as our evidence points to there being long-term benefits towards the implementation of such thoughtful initiatives into the undergraduate educational landscape. The results of our Scopus search (refer to **Figure 10**) reveal that this is an emergent area of research, with only 2 articles reported in 2017, as against 167 articles published in 2025 (more than an 80-fold increase over the last decade). A cubic polynomial best fits the data, suggesting that research interest and publication have increased even more strongly than those of our previous RQs. Our observation is further reinforced by a regression coefficient of $R^2 = 0.996$, the strongest value obtained till now! This change is predominantly driven by the disciplines of Computer Science (33%, 391 articles), Social Sciences (24%, 278 articles), Engineering (12%, 146 articles), Mathematics (5%, 53 articles), and the Decision Sciences (4%, 46 articles). Interestingly, the United States far outperforms its competitor nations in this RQ, with 19% or 130 articles. It is then followed by India (5%, 36 articles), China (5%, 35 articles), the United Kingdom (4%, 30 articles), and Indonesia (3%, 22 articles). Recent research on pedagogical innovation and curricular revamps in the Fifth Industrial Revolution shows that, other than India and China, Brazil, Malaysia, and Indonesia (not necessarily in any order) are emergent Global South power economies. Therefore, the island nation of Indonesia cracking the top five countries for this RQ is not counterintuitive, but rather, is expected. The top funding agencies that have driven such research over the last decade are the National Science Foundation, the European Commission, the National Natural Science Foundation of China, the Ministry of Science and Technology, Taiwan, and the National Science and Technology Council. Some top universities that we observe matching our search results are Purdue University, Itä-Suomen yliopisto (in Finland), the University of Hong Kong, Purdue Polytechnique Institute, the Chinese University of Hong Kong, and the Delft University of Technology (TU Delft). Within North America, the top universities are Purdue University, the University of North Texas, Stanford University, George Mason University, the University of California, Berkeley (UC Berkeley), the University of Pennsylvania (UPenn), the University of Washington, and the University of Toronto (UofT). We can clearly observe that even within academic institutes, the top universities are all members of the Global North, further cementing the ivory-tower effect of academic publications and collaborations that was mentioned previously.

RQ_6: Our last search targeted a further refinement of the previous RQ, but specifically within the United States context. From this lens, the keywords in the co-citation network (refer to **Figure 11**) are most centered around AI, ML, engineering education, students, teaching, ethical technology, and computer-aided instruction. Note that the keywords of AI and ethics always arise concurrently, suggesting the need for imparting to students the ethical use of AI. Analyzing **Figure 12**, from a mere 1 article published in 2017, the bibliometric data shows that 78 articles were published in 2025, i.e., a 78-fold increase! While we recognize that the data is a rather small set to claim a 78-fold increase, we are merely stating this to emphasize the rapid growth in research in this area. Our

claim is also substantiated by a strong regression coefficient ($R^2 = 0.983$), and a cubic polynomial best fits our data. Top disciplines matching our search are Computer Science (34%, 188 articles), Social Sciences (25%, 141 articles), Engineering (9%, 51 articles), Business, Management, and Accounting (4%, 23 articles), and Decision Sciences and Mathematics (also at 4%, 22 articles in each). In terms of countries matching our search, the United States continues to be the top performer (37%, 130 articles), followed by India (6%, 21 articles), China (4%, 14 articles), Finland (4%, 14 articles), and the United Kingdom (4%, 13 articles). As expected, most of the top performers are members of the Global North country bloc, except for India and China, the major superpowers and change/innovation drivers from the Global South. The top funding agencies matching our search are the National Science Foundation, the European Commission, the National Natural Science Foundation of China, the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (in Brazil), and the Alfred P. Sloan Foundation. Top US universities matching our search are Purdue University, Purdue Polytechnic Institute, University of North Texas, Stanford University, George Mason University, and the University of California, Berkeley. In summary, our six RQs have comprehensively captured the full impacts of DSAI and DSAI-led research across universities and HEIs, both globally and, specifically, within the United States and North America.

Conclusions: Data Science and Artificial Intelligence (DSAI) led initiatives are transforming the global education (E.D. 5.0) and industry (I.D. 5.0) landscape, and in turn, moving the world rapidly towards attaining the Society 5.0 global vision. Our bibliometric analysis has conclusively proved that within the context of academia, this change appears to be primarily observed at universities and Higher Education Institutes (HEIs). The choice of our analysis method (bibliometric analysis) is not arbitrary, but a cautious, premeditative decision. The analysis method is global, does not rely on the researcher making any a priori assumptions, and comprehensively scans the entire Scopus database (or similar scientific databases) without any bias. Consequently, the results are globally applicable and capture trends and forecast demand patterns that mirror current global geopolitical and socio-economic landscapes. As traditional STEM fields (Science, Technology, Engineering, and Mathematics) are transforming to STEAM fields (Science, Technology, Engineering, Arts, and Mathematics), DSAI-led initiatives at HEIs provide an appropriate framework to train younger generations on the multifaceted aspects of AI and ethics – which is critical for creating ethical and philosophical guardrails for constructive AI usage, to realize Society 5.0. Our results conclusively demonstrate that DSAI is paving the way (via strategic pedagogical/curricular revamps, especially targeted at the undergraduate level) to realize E.D. 5.0. This is poised to (and is already) shaping more AI-ready and AI-competent graduates who will have appropriate skillsets to be perceived as valuable and employable by I.D. 5.0. This will, in turn, shape the framework for attaining the Society 5.0 vision, which is characterized by the merging of cyberspace using technologies like AI, ML, IoT, CPS, and big data to strategically and innovatively address pressing social issues (ageing, labor shortage, sustainable development [16], etc.) to create a human-centric and inclusive future that balances cutting edge technology with societal well-being. Therefore, as a last thought, the role of academic universities and HEIs cannot be overstated and serves as a nascent training

ground to equip future generations with the appropriate wisdom, AI-awareness, technological readiness, and ethical framework to become competent global citizens that catalyze Society 5.0. In the spirit of The Wheel of Sharp Weapons [9,21], we encourage the researcher to manifest as Yamantaka†, to forcefully dismantle the traditional silos of academic ignorance. By apprehending DSAI in its total scope, we can strategically bridge the currently existent structural chasm between E.D.5.0 and I.D. 5.0, thus transforming data into a unified engine propelling global self-reliance. A final comment must be made on how these trends transcend beyond the mathematical and the philosophical, to practical, implementable, and scalable trends that inform instructional design, faculty development, curricular coherence, and assessment practices within engineering and data science education. The identification of DSAI implementation and realization strategies in this work paves the way for educators to design curricula in accordance with six increasingly complex cognitive levels of Bloom's taxonomy [2,10,15,18]: remember, understand, apply, analyze, evaluate, and create. This shifts the impetus among students, from perfunctory rote memorization and replication in assessments, to long-term conceptual retention and implementation of these concepts across less defined, more abstract environments (which is representative of the reality of I.D. 5.0). For educators, instructors, and faculty, this work conveys an evidence-based message of designing content and assessments more thoughtfully, yet rigorously, that creates the required environment to realize these learning goals, empowering Fink's significant learning [3], while also meeting (and over long-term, exceeding) accreditation frameworks like the ABET and CEAB. Building on our work, future research is proposed to robustly analyze our findings and trends via both qualitative and quantitative frameworks.

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† The Wheel of Sharp Weapons is a traditional Vajrayana text in Tibetan Buddhism. Within that context, Yamantaka is the most wrathful emanation of Manjushri, the Bodhisattva of Wisdom. While Manjushri embodies the clear-light awareness of pure knowledge, Yamantaka represents the active transmutation of that knowledge to quell the Yama (Sanskrit: death, symbolic) of systemic ignorance. In the context of DSAI, this metaphor encourages the researcher to adopt a multi-pronged, nuanced, synergistic approach to overcome traditionally existent (and deep rooted) academic silos that currently hinder E.D. 5.0 – I.D. 5.0 synchronization. The 13-deity practice of Yamantaka remains a cornerstone practice of the Gelug and the Sakya schools even today, as a swift means to transcend dualistic ignorance.

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

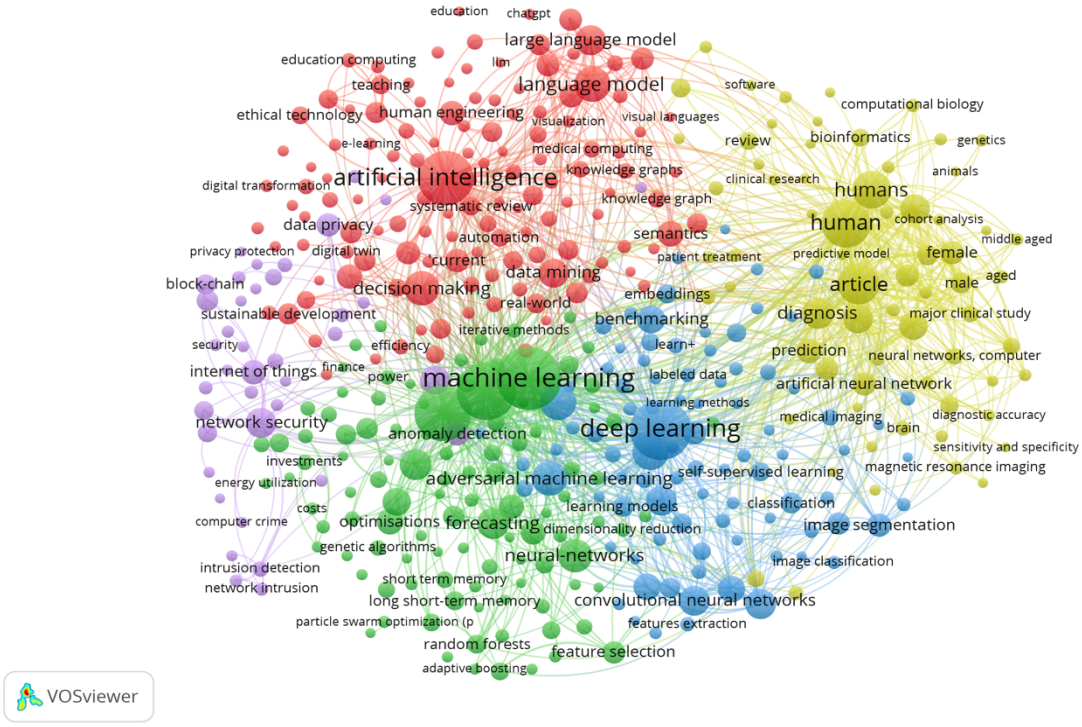
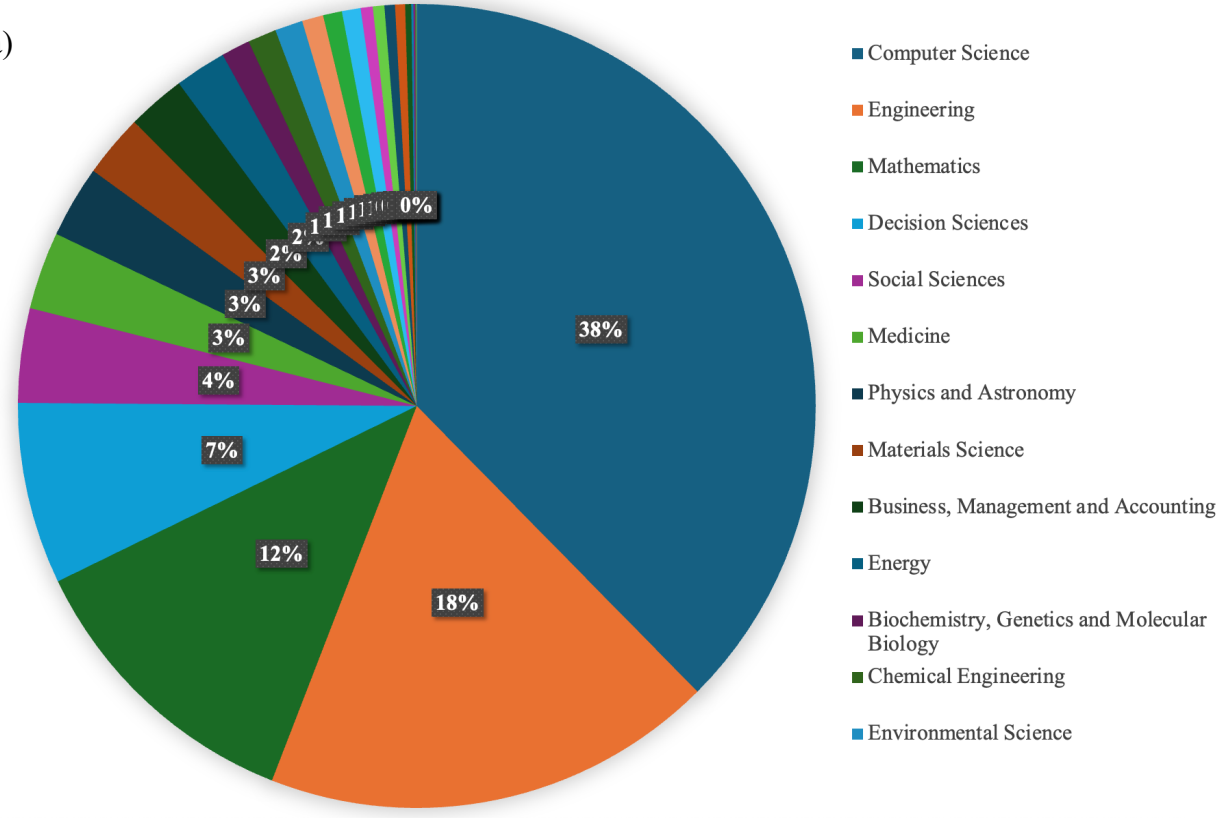


Figure 1: The co-citation network generated for RQ_1.

(a)



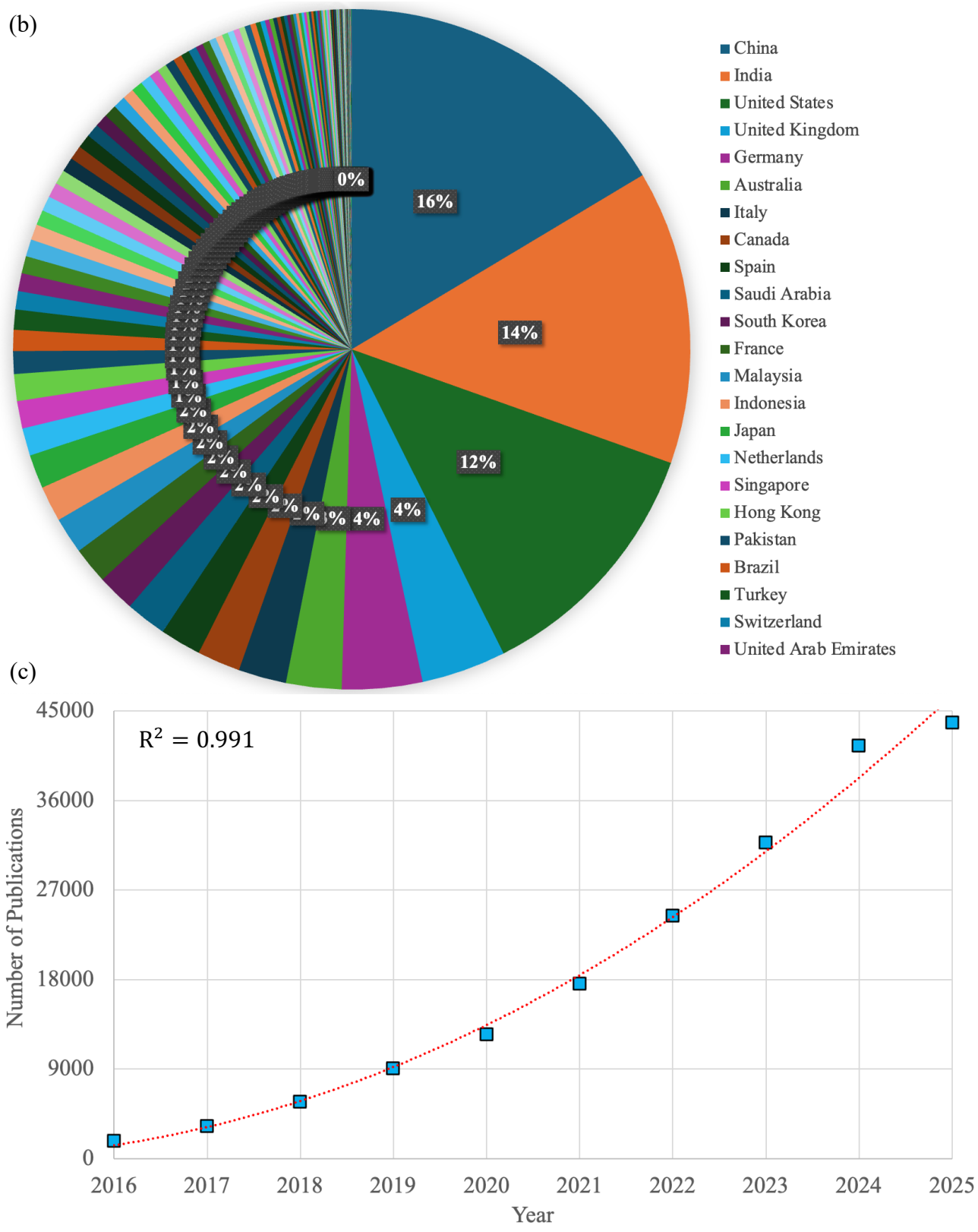


Figure 2: RQ_1 trends by (a) discipline, (b) countries, and (c) publication trends over the last decade.

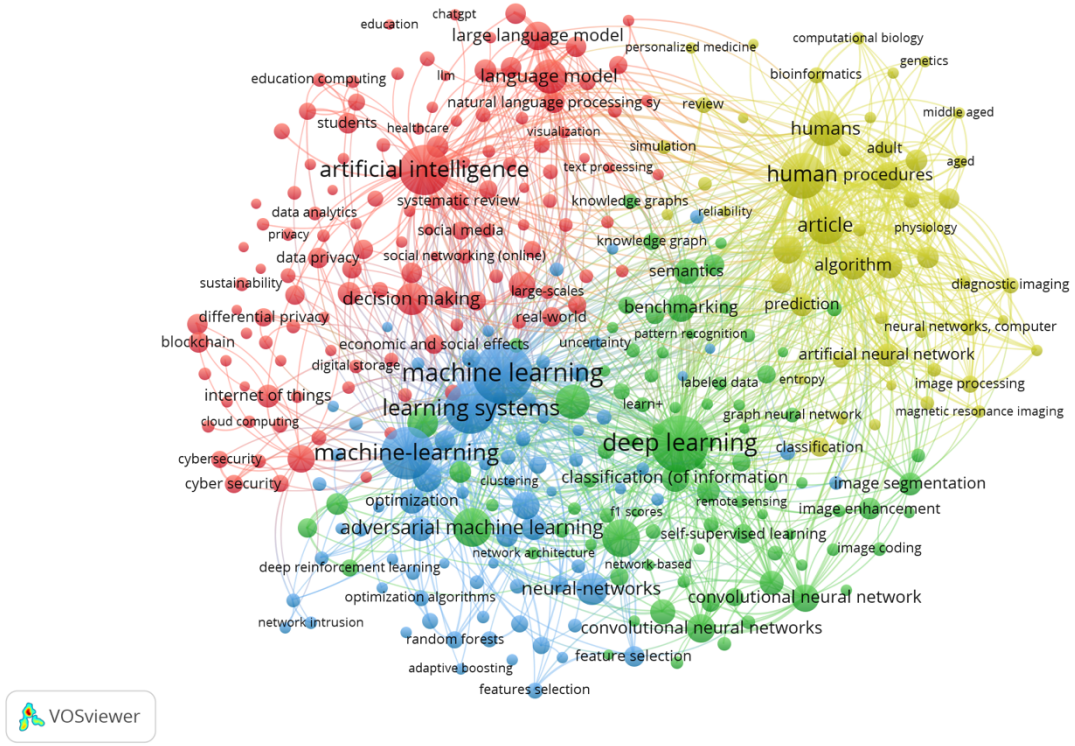
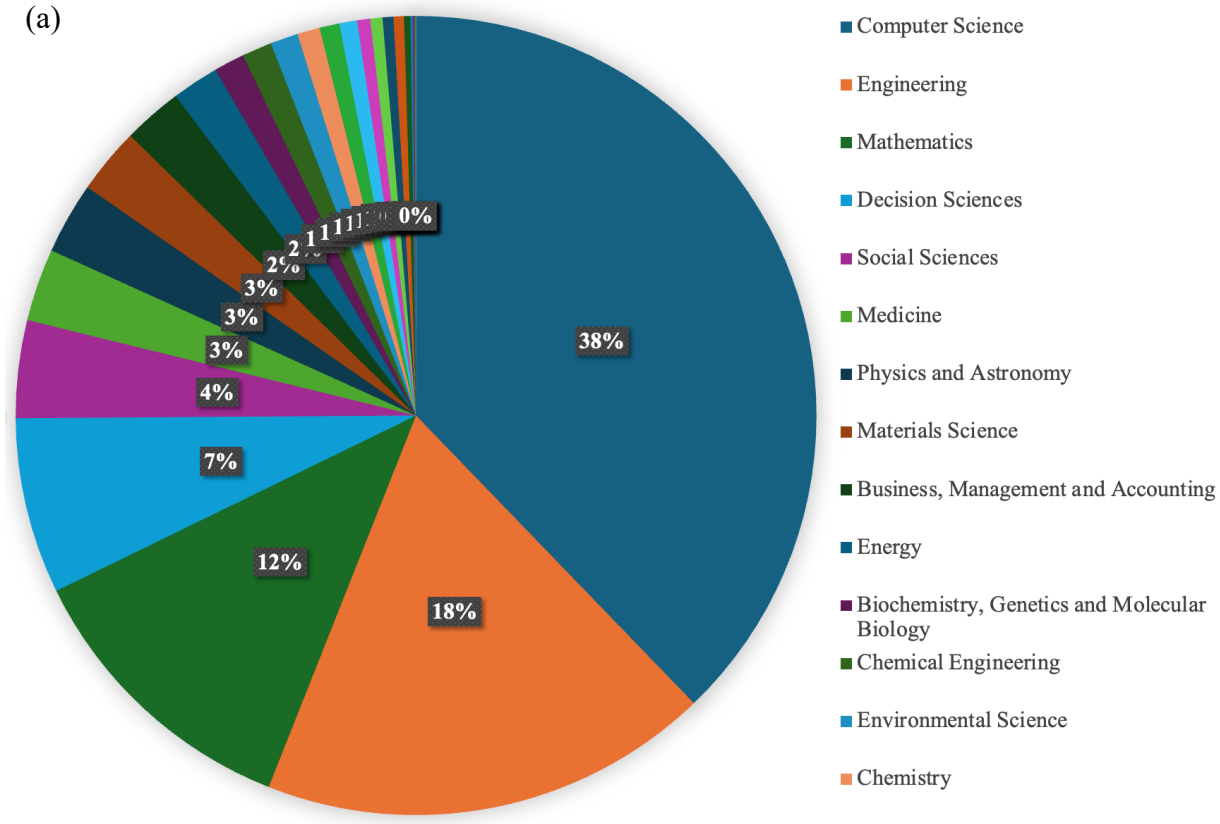


Figure 3: The co-citation network generated for RQ_2.



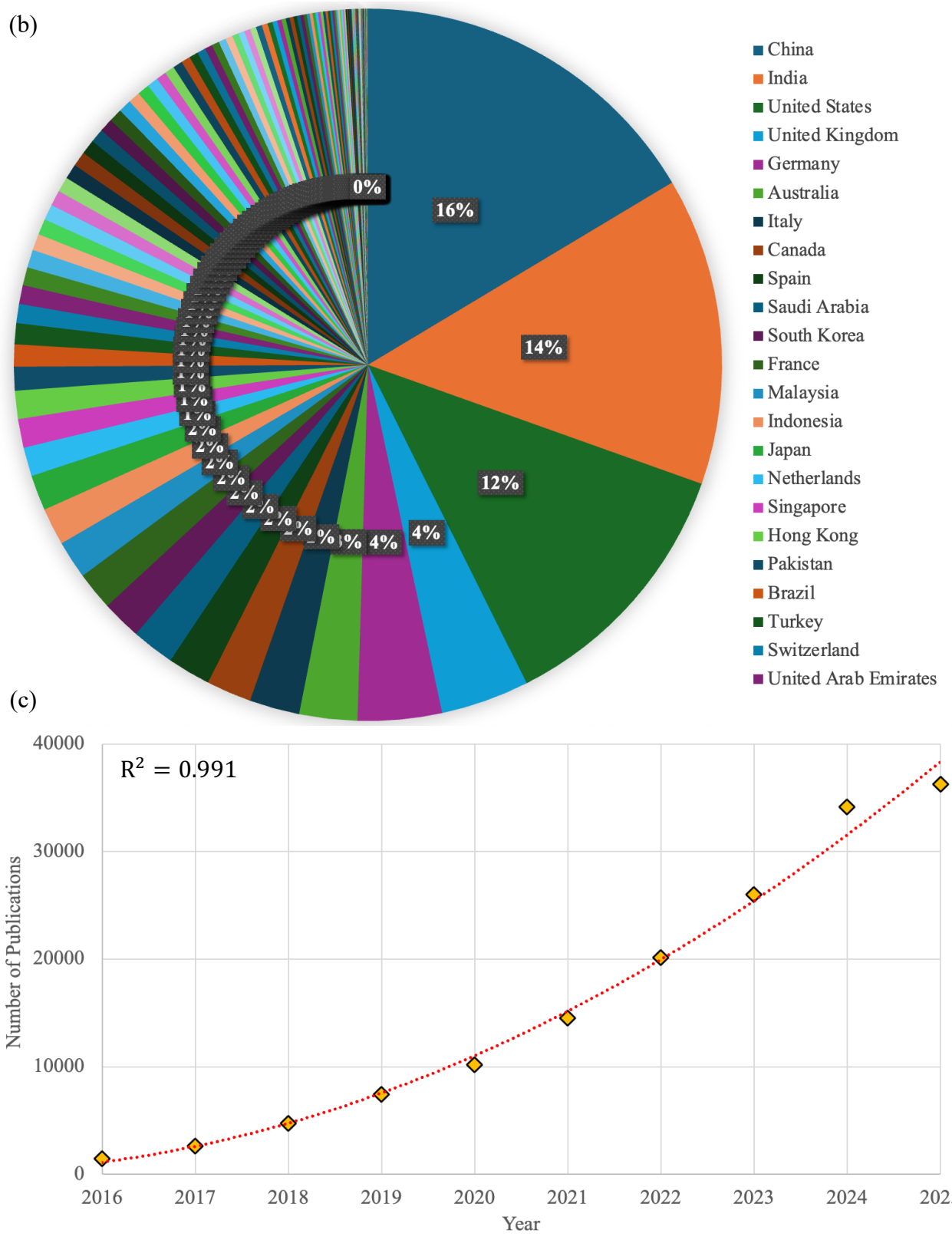


Figure 4: RQ_2 trends by (a) discipline, (b) countries, and (c) publication trends over the last decade.

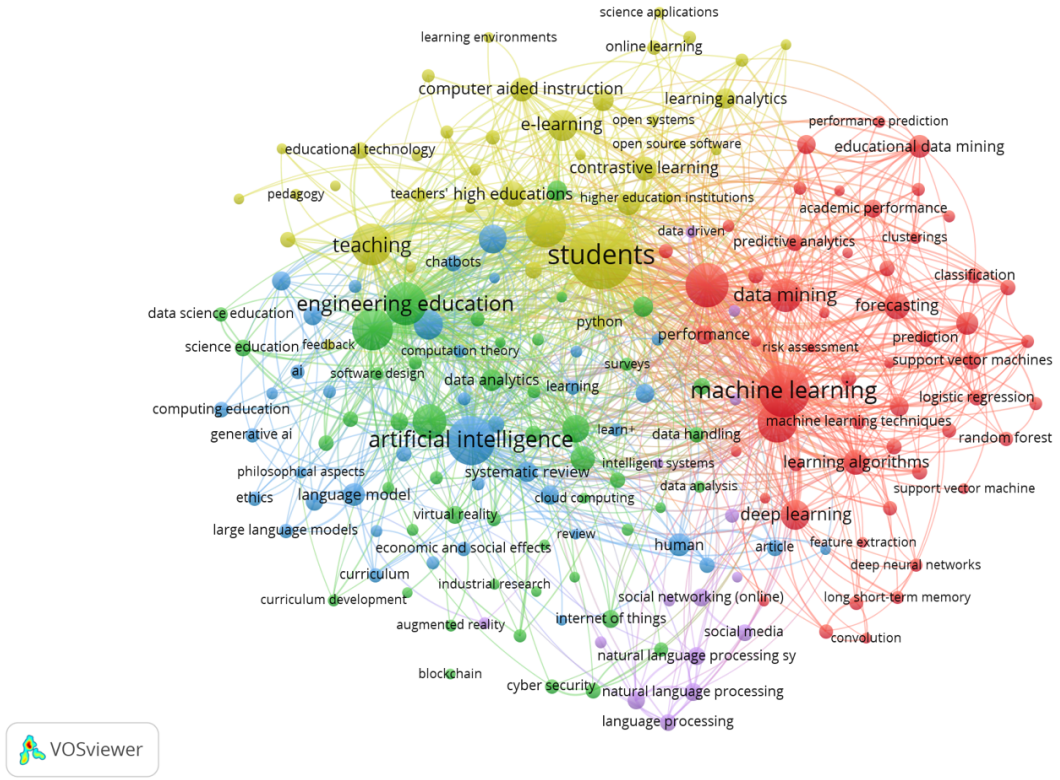
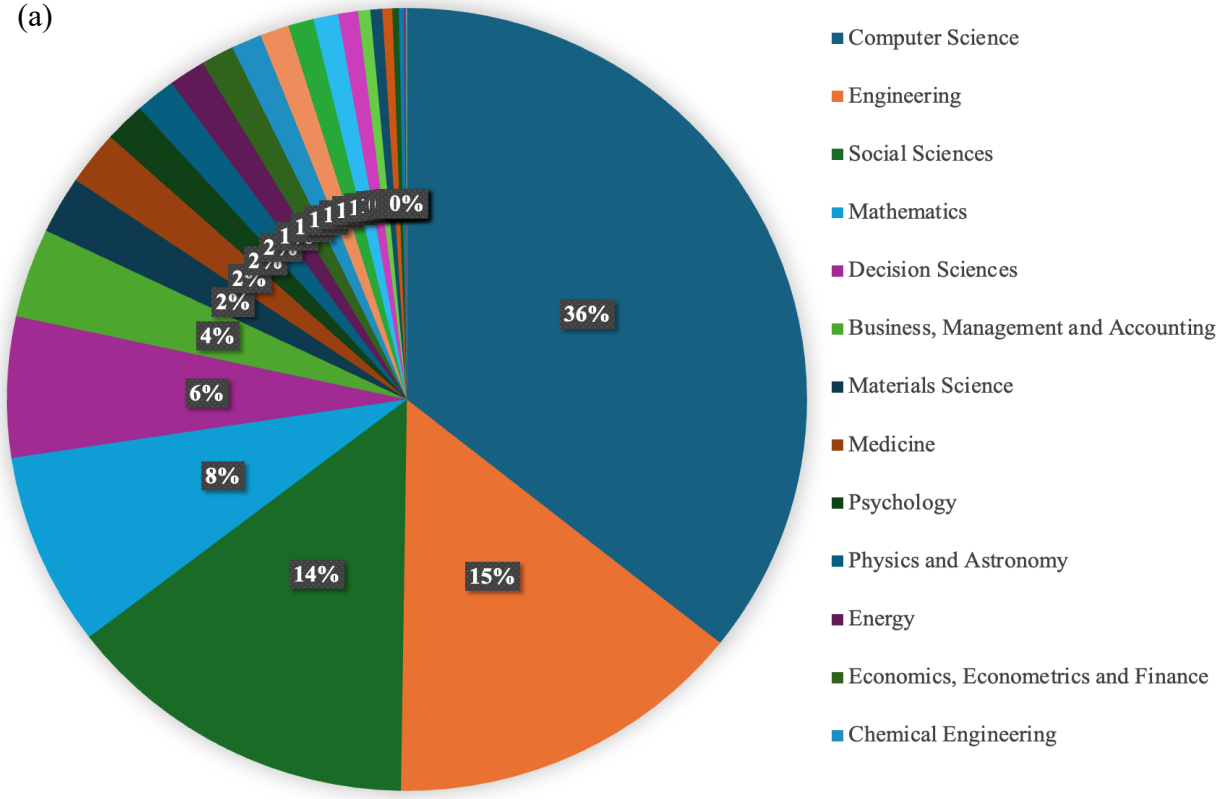


Figure 5: The co-citation network generated for RQ_3.

(a)



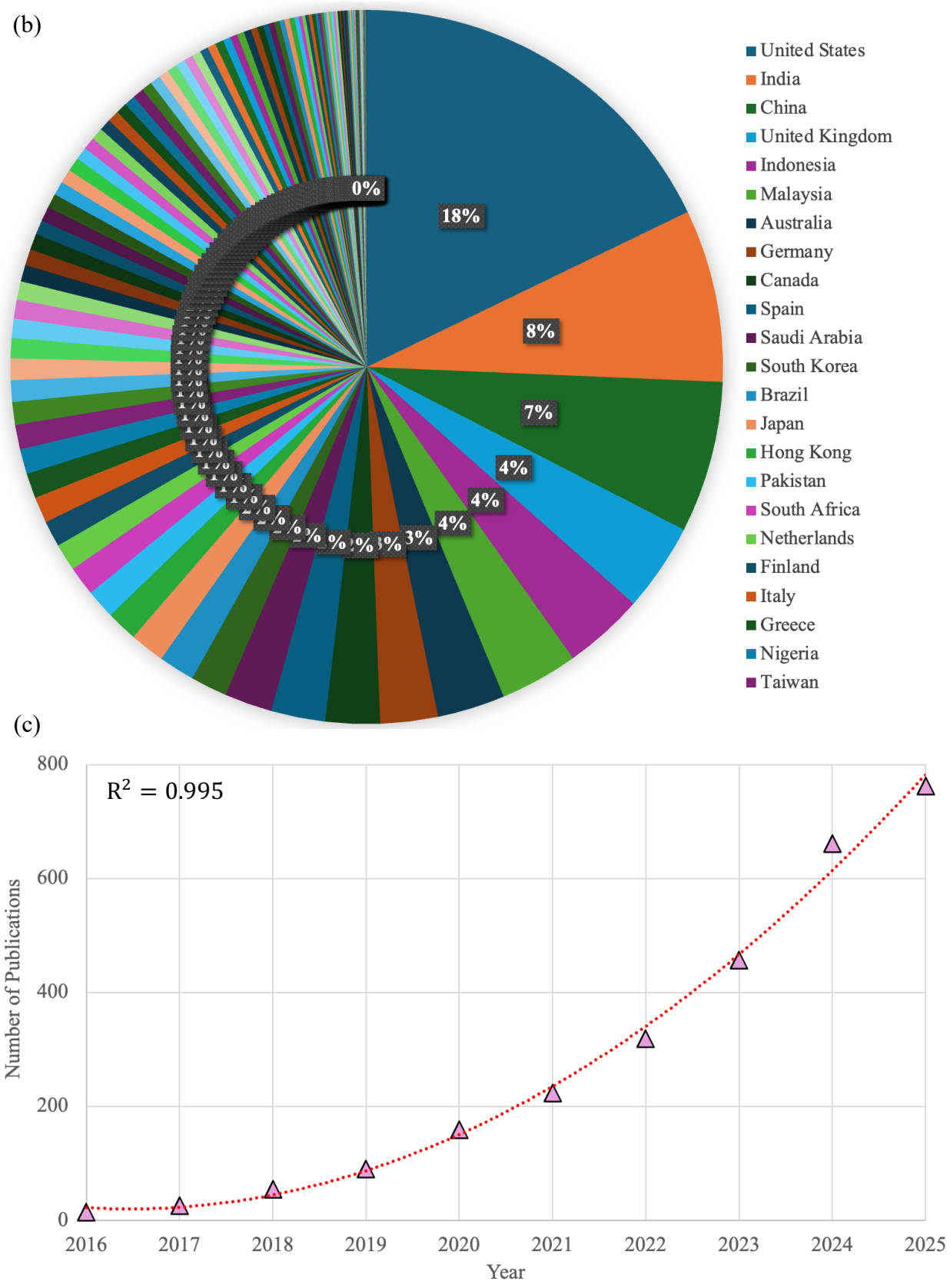


Figure 6: RQ_3 trends by (a) discipline, (b) countries, and (c) publication trends over the last decade.

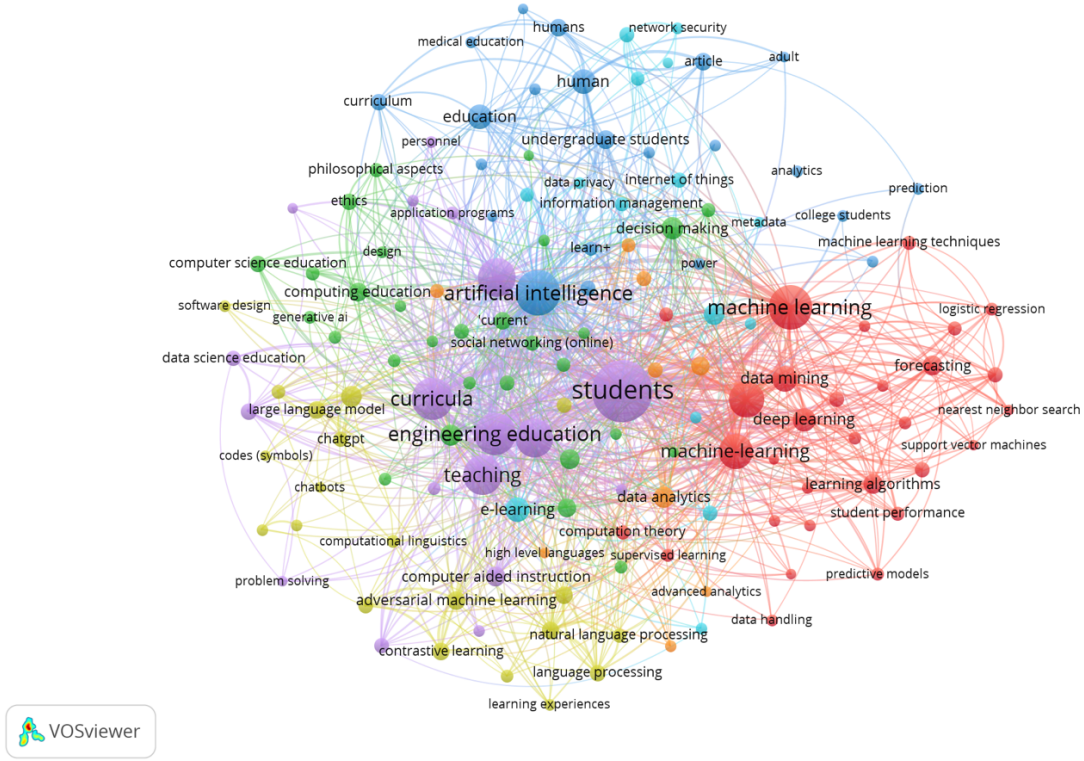
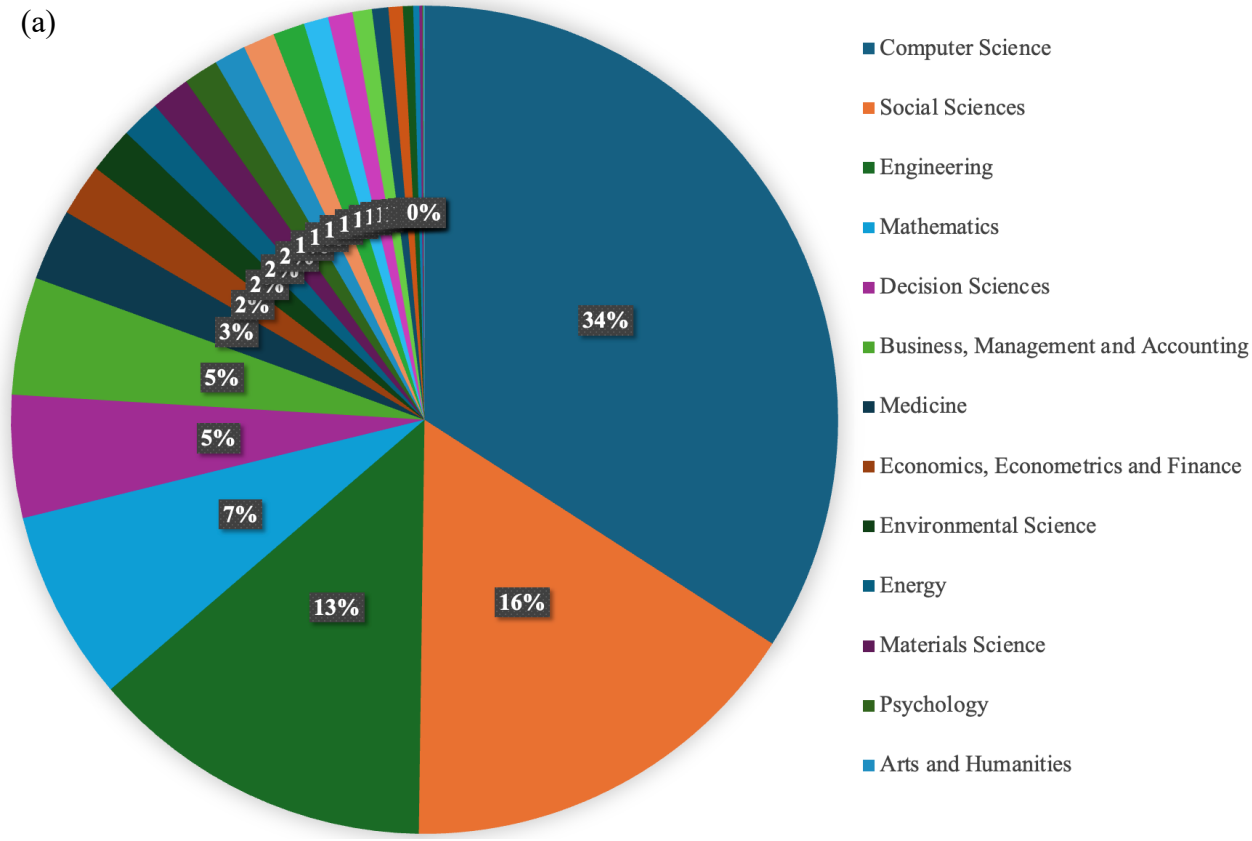


Figure 7: The co-citation network generated for RQ4.

(a)



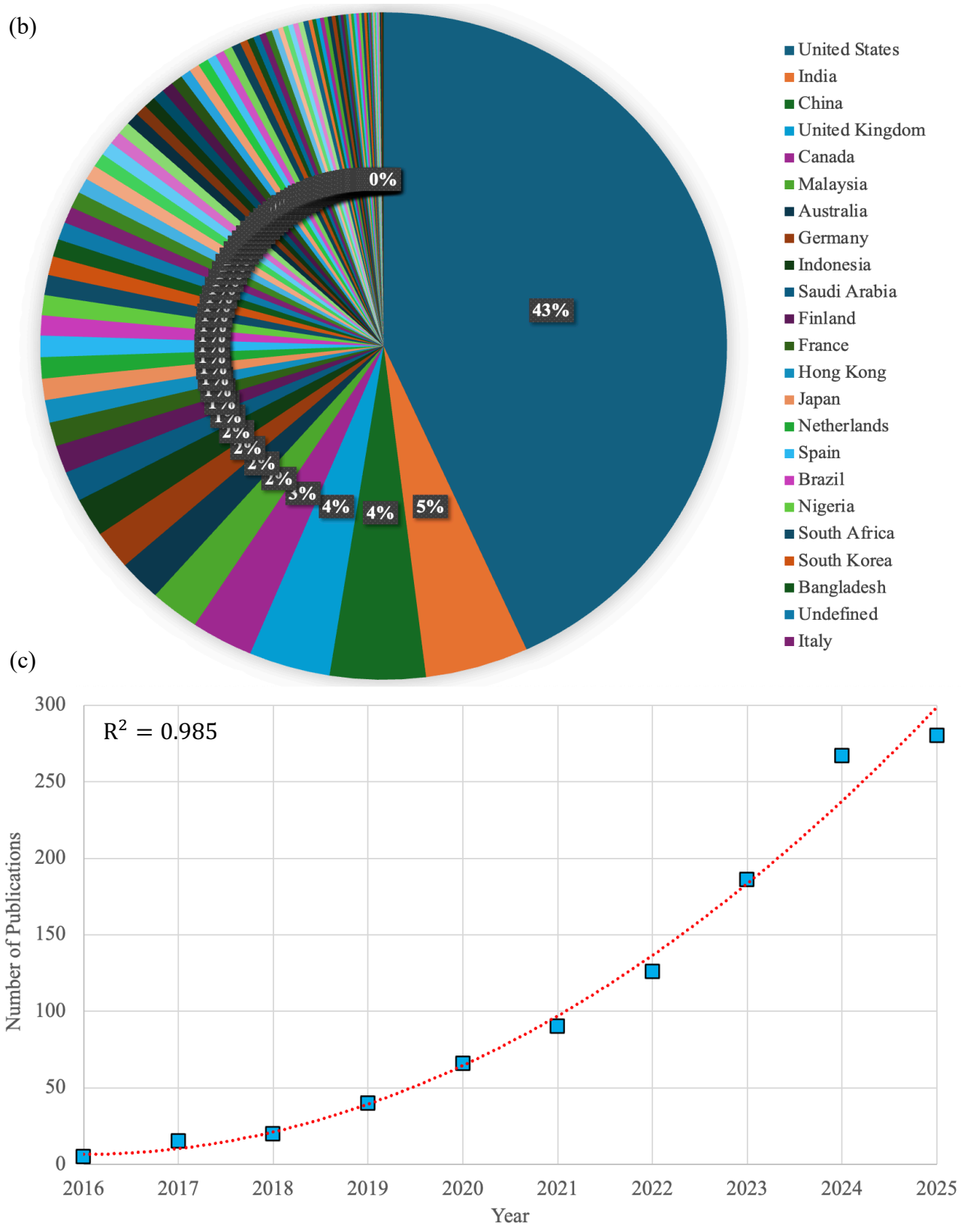


Figure 8: RQ_4 trends by (a) discipline, (b) countries, and (c) publication trends over the last decade.

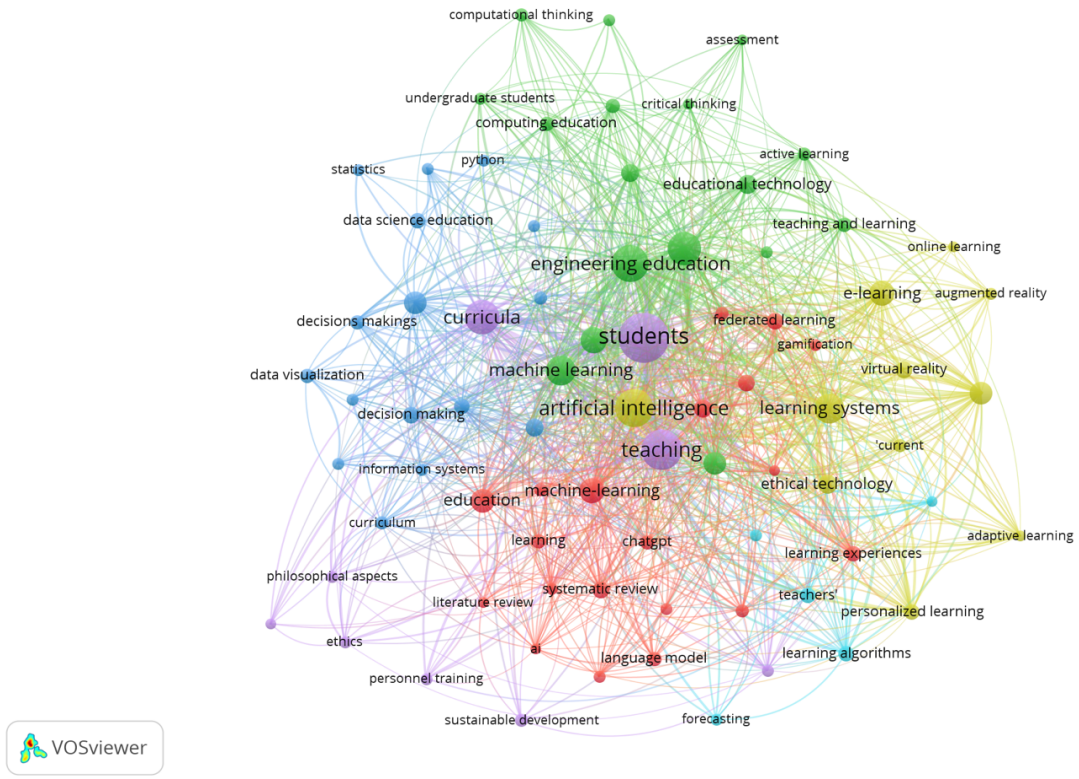
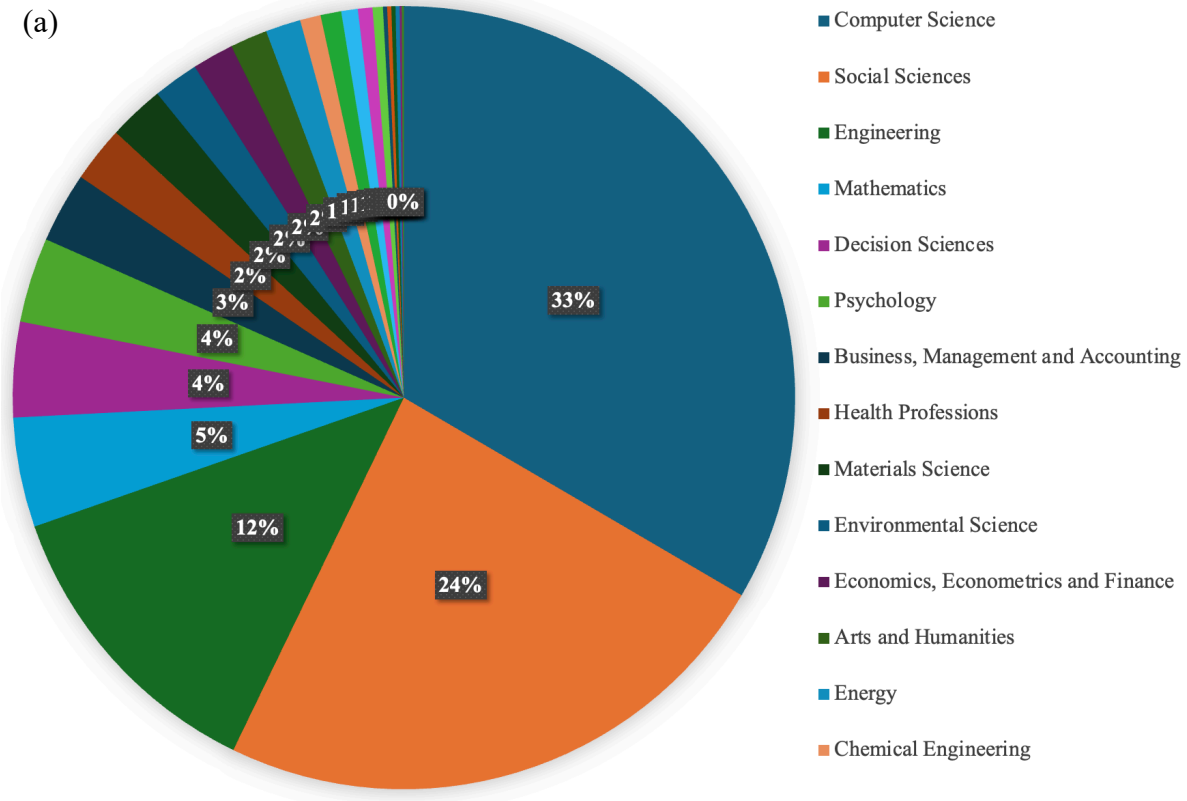


Figure 9: The co-citation network generated for RQ_5.



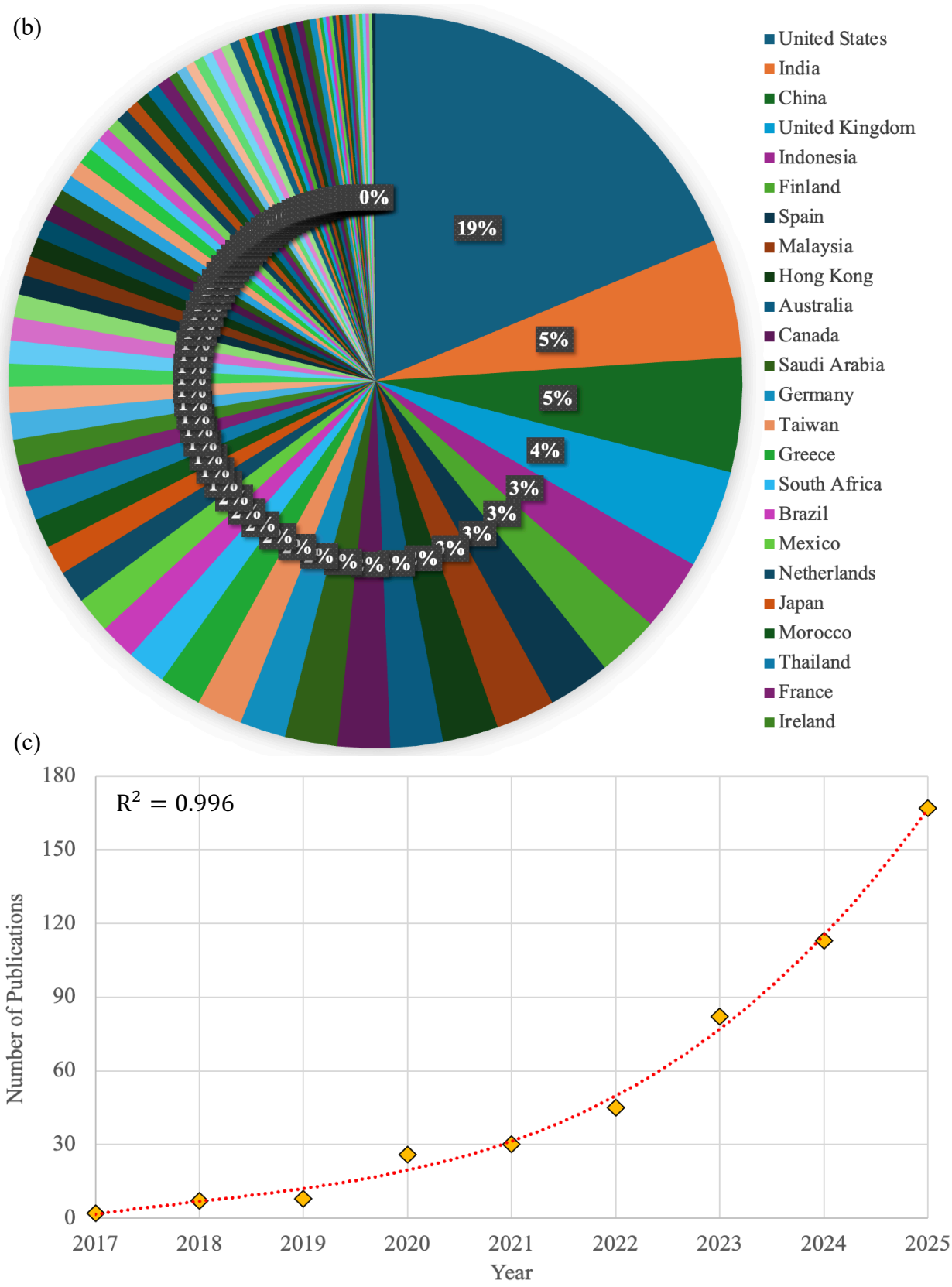


Figure 10: RQ_5 trends by (a) discipline, (b) countries, and (c) publication trends over the last decade.

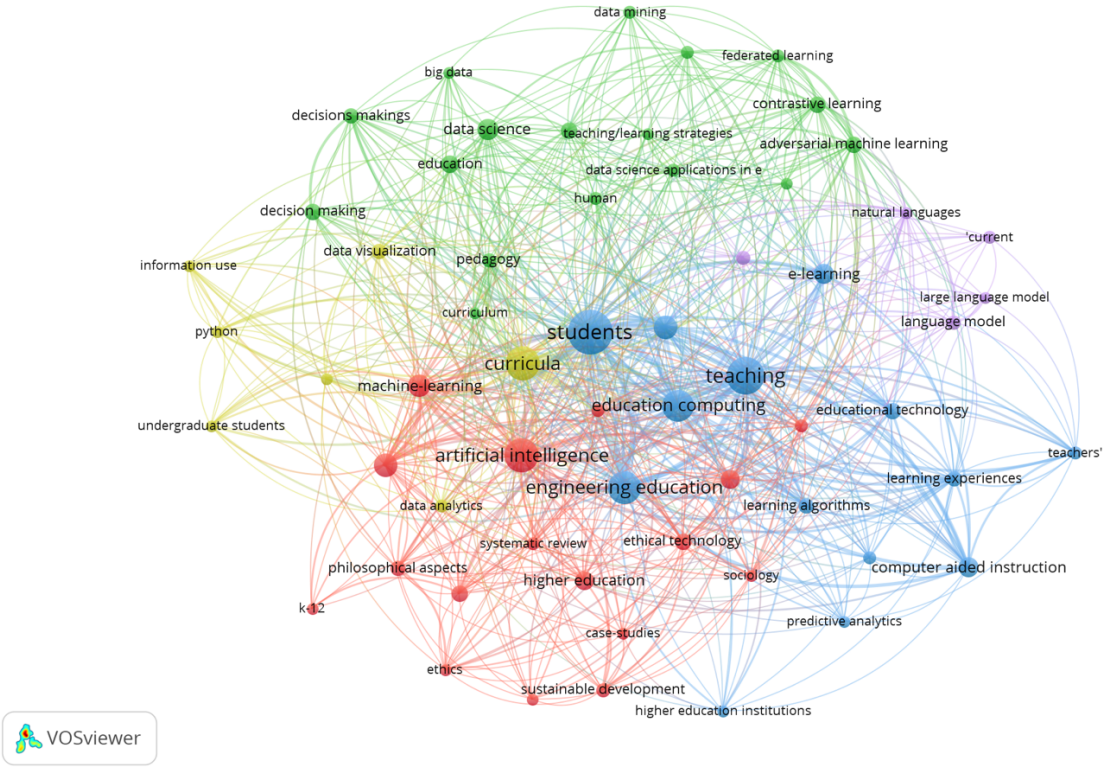
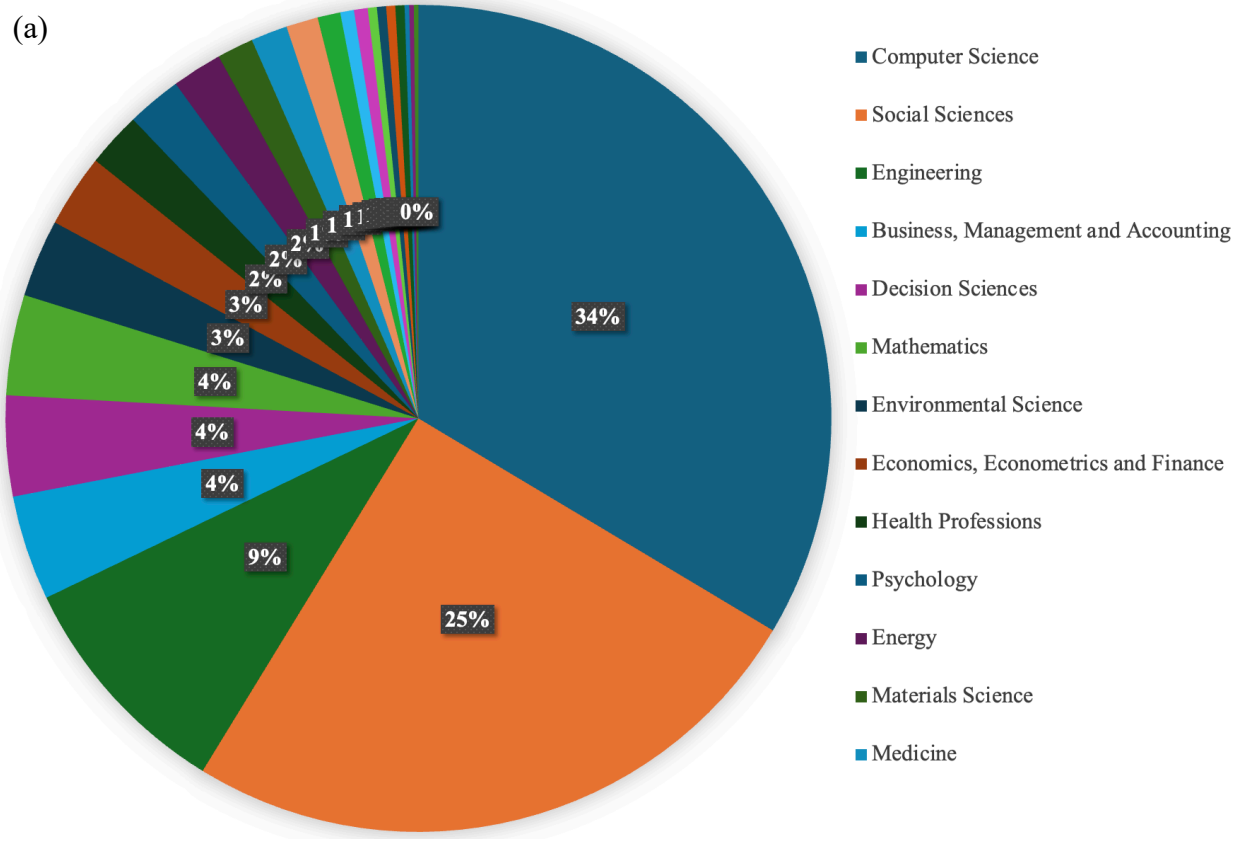


Figure 11: The co-citation network generated for RQ_6.



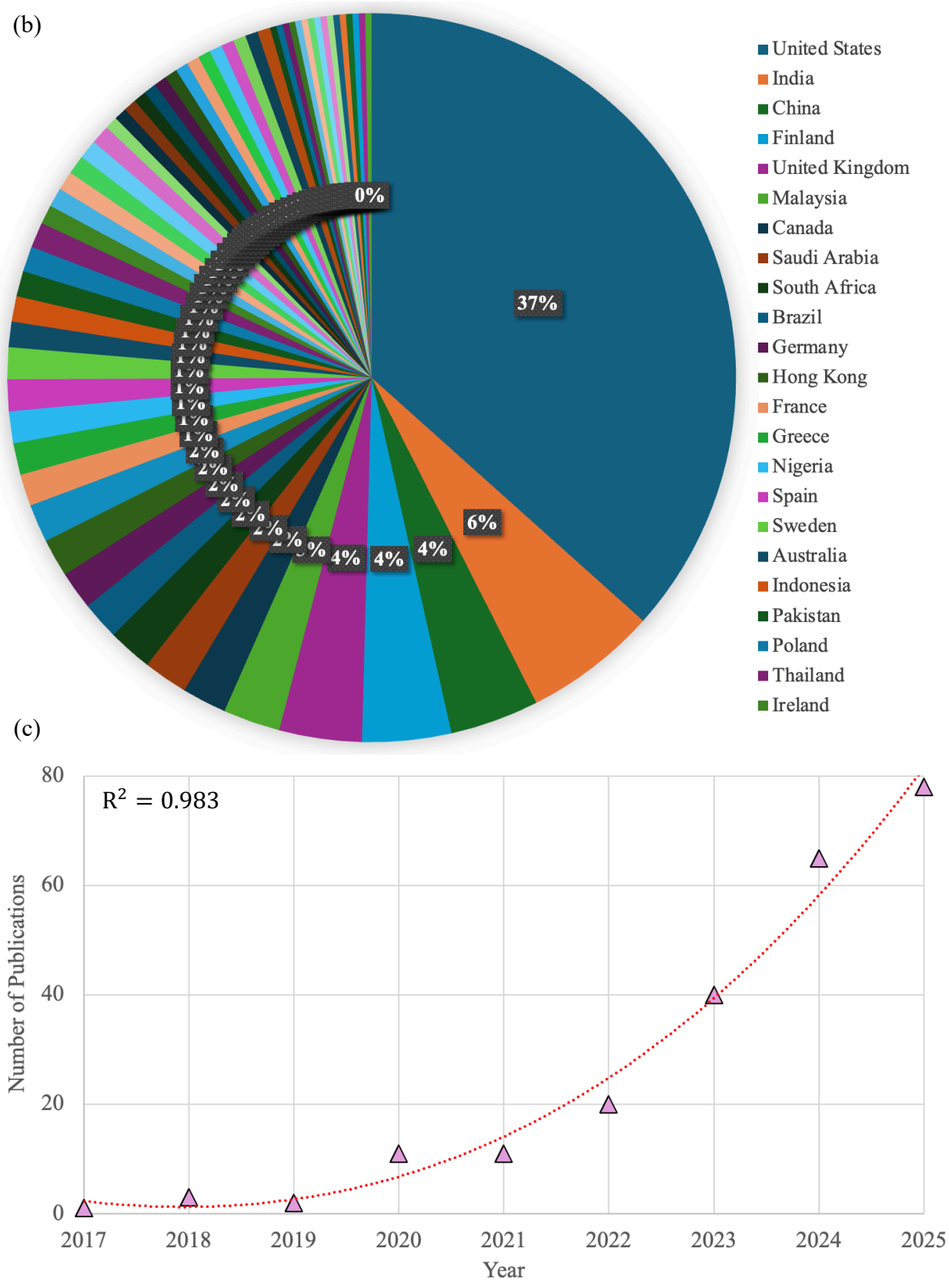


Figure 12: RQ_6 trends by (a) discipline, (b) countries, and (c) publication trends over the last decade.

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
DSAI	Data Science & Artificial Intelligence	DSAI 5.0	Data Science & Artificial Intelligence 5.0
STEM	Science, Technology, Engineering and Mathematics	STEAM	Science, Technology, Engineering, Arts and Mathematics
ML	Machine Learning	R^2	Regression Coefficient
IoT	Internet of Things	CPS	Cyber-Physical Systems
LLMs	Large Language Models	EPE	Effective Prompt Engineering
ABET	Accreditation Board for Engineering & Technology	CEAB	Canadian Engineering Accreditation Board