

Charting the Evolution of Generative Artificial Intelligence: Insights from A Systematic Literature Review

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ABSTRACT: In this systematic literature review, we aimed to identify and thoroughly analyze the existing scientific knowledge related to a notably emerging field of generative AI. In strict adherence to the SPAR-4-SLR protocol, we focus on 1,104 peer-reviewed articles from the Scopus database, published between 2015 and 2025. Using bibliometric and thematic mapping methods, we address two main research questions: the first concerns the major publication trends in GenAI research, and the second deals with the intellectual structures and thematic domains shaping the field.

Our results indicate an abrupt increase in scientific production since 2022, a consequence of the launch of models such as GPT, DALL-E, and Stable Diffusion, which are becoming increasingly powerful. We further identify five main research clusters: the technological foundations of generative AI, where researchers focus on building and utilizing LLMs and deep learning; professional and educational applications; ethical and governance issues; AI-assisted creativity; and user perceptions. Additionally, we find that higher education plays a significant role in the area, both in the application of ideas and the exploration of relevant questions. This review highlights the field's strong interdisciplinary character and, at the same time, reveals the current challenges that the sector faces. We outline a systematic research program to guide further studies of the implementation, impact, and problems of GenAI in enterprises and communities.

KEYWORDS: generative artificial intelligence, systematic review, SPAR-4-SLR, large language models, ChatGPT.

1. INTRODUCTION

In the era of rapid digital transformation, generative artificial intelligence (GenAI) has gained a prominent standing as a pioneering technology with a wide range of applications. GenAI utilizes the training data to generate original content, such as text, images, code, or music; hence, it is reconstructing the foundation of creativity, automation, and human resource performance in several sectors, including education, healthcare, industry, and media. The capacity of GenAI to drive productivity, foster innovation, and contribute to complex decision-making processes positions it as a strategic asset for enhancing the competitiveness of organizations. Notwithstanding this rapid growth and broad adoption, however, academic research on the subject remains scattered, and there are a lot of inconsistencies in findings about real-world applications of the technology, the risks involved, and the consequences of its adoption.

To fill this void, systematic research is conducted following the SPAR-4-SLR protocol, i.e., three consecutive steps: Design, Conduct, and Reporting. Through this formalized approach, the investigation of issues concerning generative AI is conducted in a comprehensive, transparent, and reproducible manner. The current inquiry examines the conceptual foundations, factual information, research strategies, and sectors where agreement among scholars is far from clear or still debatable.

Aligned with the principles of the SPAR-4-SLR framework, the study is guided by three core objectives:

- To detect and create a schematic representation of the principal research lines on generative AI over a decade (2015-2025), using bibliometric analysis and thematic classification as tools.
- To critically survey the most significant publications in the area of the use of generative AI in organizations, as well as the positive and negative aspects of it.
- To establish a consistent structure for the discipline by identifying current patterns, prominent theoretical positions, and emerging research topics.

2. OBJECTIVE OF THE SYSTEMATIC LITERATURE REVIEW USING THE SPAR-4-SLR PROTOCOL

The unprecedented speed of generative artificial intelligence (GenAI) adoption, fueled by the creation of advanced models such as GPT, DALL-E, and Stable Diffusion, has greatly exceeded the capability of academic research to track its development. The majority of investigations concentrate on the technological and ethical aspects of GenAI, but the lack of in-depth and interdisciplinary insights that would indicate the far-reaching effects of this technology in the domains of professional, educational, and economic sectors remain.

This systematic literature review, to this end, is set to delineate the gap in existing knowledge through the following objectives:

- To investigate the bibliometric characteristics of generative AI studies by looking into the authors who produced most of the work, the sources of publications, and the patterns of academic output.
- To discover the cognitive structure of the field, we must determine the major conceptual lenses being studied, the named academic disciplines contributing to the field, and the recurring topics, such as applications, governance, trust, algorithmic bias, productivity, and creativity, that are being discussed.
- To indicate the available restrictions in the literature, as well as the areas in talk and the open issues/questions that have not been clarified so far.

The review utilizes the Scopus database to identify peer-reviewed publications from 2020 to 2025, representing the recent emergence of generative AI as a field of study. The literature search employed a set of relevant keywords, including: "generative AI," "text-to-image generation," "LLM," "ChatGPT," "AI content generation," "foundation models," and "Generative Artificial Intelligence." Thus, the total number of peer-reviewed articles selected for the final analysis was 1,104.

The review attempts to answer two main research questions:

- **RQ1:** Which bibliometric trends are most prominent and are influencing the field of generative AI research?
- **RQ2:** What is the configuration of the intellectual structure of this field, and what are the main thematic areas that have appeared?

3. THEORETICAL BACKGROUND

Generative Artificial Intelligence (GenAI) is a revolutionary development in technology with the potential to create a wide range of content, including text, images, 3D models, animations, and more, autonomously. These types of technologies are becoming increasingly intelligent and are being integrated into everyday life in many places. They have a positive impact on various sectors of the economy, such as education, creative industries, services, and communication (Chiu, 2021; Kasneci et al., 2023; Rospigliosi, 2023).

In educational spaces, GenAI is reconfiguring learning situations through increased interactivity and facilitating personalized content delivery. It can provide customized help or create teaching materials, including videos and exercise sheets (Chiu, 2021; Rospigliosi, 2023). On a general level, the response of GenAI to the needs of individuals exhibits its capability to enhance accessibility, learning effectiveness, and user involvement in different fields (Chang & Kidman, 2023; Chiu, 2023).

However, the expansion of GenAI adoption also highlights critical issues. Relying too heavily on these systems could lead to less meaningful interactions with people, less personalized assistance, and a reduced development of complex cognitive skills, which are crucial for learning, decision-making, and collaborating with others (Farrokhnia et al., 2023; Rospigliosi, 2023). Additionally, the correctness and reliability of AI-generated data remain significant concerns.

In both scholarly and business settings, self-regulated learning (SRL) is recognized as a crucial factor in achieving success and adapting to change (Roth et al., 2016; Sitzmann & Ely, 2011). SRL is often based on three stages—planning, performance, and self-reflection—and implies that learners act on their initiative and solve various problems independently (Zimmerman, 2011; Peverly et al., 2003). As such, GenAI might be a help or a hindrance to the implementation of autonomous learning, depending on how it is utilized.

Going beyond the educational field, GenAI has successfully ventured into the healthcare domain as well. It is being utilized to empower medical diagnostics via imaging report generation, surgical procedure simulations, and personalized treatment plan creation. A case in point, Biswas (2023) demonstrates how ChatGPT can enable clinicians to compose clinical information or patient record summaries. Nevertheless, the issue of the reliability of these sources still lingers, especially in terms of patient safety and legal responsibility (Jeblick et al., 2022).

GenAI is becoming a pivotal force in the creative and media sectors, revolutionizing the creative process in these industries. To mention a few, DALL-E and Midjourney are tools that can generate visual content and artworks by using simple text as input. McCormack et al. (2019) illustrate the emergence of the human-machine "co-creation" paradigm, in which AI collaborates with human creators. This change in direction inevitably raises some questions related to intellectual property rights, the authenticity of creative works, and the artist's continually evolving role.

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In marketing and communication, GenAI is primarily used to perform the following tasks: automating the creation of promotional content, tailoring advertising messages, and enhancing customer experiences. Huang and Rust (2021) suggest that AI systems, by combining behavioral data with linguistic modeling, can tap into consumers' psyches in more profound and targeted ways, thereby establishing loyalty and brand engagement. However, this progress is faced with ethical problems, especially in the manipulation of information and the lack of transparency in the algorithm.

In the legal profession, the new generation of AI-powered tools, which are bright and innovative, can learn from the past by using examples from previous cases, summarize them, write contracts, and predict litigation outcomes, all while utilizing judicial data. Katz et al. (2017) suggest that such technologies cannot be fully used in realizing their potential without being governed by the strictest ethical standards to eliminate biases and maintain professional integrity.

In the broader context of the modern work environment, the ability of individuals to engage in self-regulated learning remains of paramount importance. Zimmerman (2011) and Roth et al. (2016) emphasize that the skills of goal setting, self-monitoring, and reflecting on one's learning are indispensable for both academic and career achievements. GenAI's mass adoption could either be a boon for the empowerment of this autonomy or a bane by sapping the user's energy, as they become overly dependent on the systems that are 'thinking' for them (Peverly et al., 2003; Sitzmann & Ely, 2011).

Generative Artificial Intelligence (GenAI), the platform through which computers can generate various types of texts, images, sounds or interactive materials, becomes more and more known as a revolutionary technology by people from different fields such as education, healthcare, marketing, media, law, and engineering (Kasneci et al., 2023; Rospigliosi, 2023). The latest academic literature explores multiple theoretical frameworks from the behavioral sciences and the information systems research community to trace the adoption, utilization, and understanding of the innovation's implications for people and organizations.

One of the most widely adopted models is the Technology Acceptance Model (TAM), introduced by Davis (1989). This model suggests that the decision to adopt a new technology is primarily influenced by two key perceptions: the technology's perceived usefulness and the perceived ease of use. Regarding GenAI, a vast array of studies emphasizes that users' perceptions of the two factors represent a necessary condition for forming the intention to accept tools like ChatGPT or DALL·E (Kasneci et al., 2023). For example, within an educational context, teachers tend to use GenAI more in their academic activities if they believe it is efficient for planning and easy to operate.

The Unified Theory of Acceptance and Use of Technology (UTAUT), developed by Venkatesh et al. (2003), is a model that extends the Technology Acceptance Model (TAM) by incorporating the factors of social influence and facilitating conditions. Dwivedi et al. (2023) conducted a study using the UTAUT framework to investigate the acceptance of generative artificial intelligence (GenAI) in digital marketing. Their results reveal that users of GenAI are not only attracted by its functionality, but the people around them also influence them, partly because they have the necessary technological infrastructure in their workplaces.

On the other hand, the Theory of Planned Behavior (TPB) by Ajzen (1991) illustrates the change in individuals' intention to adopt GenAI. It has been especially proven useful in situations such as education or the workplace. Chiu (2023) has demonstrated that attitudes, subjective norms, and perceived behavioral control are, to a great extent, determining factors in the adoption behavior of GenAI technologies among both educators and learners.

The Self-Determination Theory (SDT), developed by Deci and Ryan (1985), examines the intrinsic and extrinsic motivations that underlie human actions. The use of AI technologies opens the way for SDT to assess whether these tools are meeting users' needs for autonomy, competence, and relatedness. To illustrate this concept, Chiu (2021) provides an exploration of student involvement with AI-based learning platforms through this theory.

Rogers' (2003) Diffusion of Innovations theory offers a comprehensive framework for understanding the process by which a society adopts new technologies. This model has been utilized to track the implementation of GenAI across various sectors. Zawacki-Richter et al. (2019) employed this viewpoint to investigate how higher education institutions incorporate AI, addressing issues such as perceived relative advantage and compatibility with existing practices.

The analysis of GenAI's use within various theoretical frameworks offers a deeper understanding of its emerging impact, barriers, and facilitating factors. Those models, such as TAM, UTAUT, and TPB, focus on the factors that need to be changed to enable acceptance. In contrast, SDT and the Diffusion of Innovations model are more social, motivational, and organizational. The current challenge is to integrate these diverse aspects, thereby enabling the development of GenAI applications that are ethical, effective, and human-centered.

4. METHODOLOGY: THE SPAR-4-SLR PROTOCOL (SCIENTIFIC PROCEDURES AND RATIONALES FOR SYSTEMATIC LITERATURE REVIEWS)

To establish a transparent and systematic methodology for our literature review, we employed the SPAR-4-SLR protocol as outlined by (Attaoui & Gaber, 2024; ATTAOUI & GABER, 2025; Paul et al., 2021). This approach is a specifically designed framework for

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conducting structured and repeatable systematic literature reviews in the field of management sciences, facilitating detailed and consistent integration of research.

This research has aimed to explore the field of generative artificial intelligence (GenAI) using the SPAR-4-SLR protocol. The primary focus was on analyzing academic papers related to GenAI and its applications in various areas. The protocol is designed with three main phases—assembly, organization, and evaluation—each containing six sub-stages: identification, acquisition, organization, purification, evaluation, and reporting.

4.1 Assembling

Identification: To begin with, we formulated research questions and defined the scope of the study. This review focuses on scholarly articles that investigate generative AI from technological, ethical, economic, managerial, and societal perspectives. We considered English-language, peer-reviewed journal articles published between 2020 and 2025 in the fields of Computer Science, Business, Management & Accounting, Social Sciences, and Decision Sciences as our inclusion criteria.

Acquisition: The corpus of documents was collected from the Scopus database using search keywords such as “Generative AI,” “LLM,” “GPT,” “AI-generated content,” “ChatGPT,” and “Foundation models.” After screening, our sample consisted of 1,104 articles. We also considered the journal's rank, the number of citations, and the authors' affiliations when selecting documents from the corpus.

4.2 Organizing and Purifying

The collected dataset was refined using several criteria:

- Duplicate entries were removed.
- Excluding papers that were not related to the topic of interest or too technical (e.g., algorithmic research without implications for applications or impact on society), and
- Retaining papers that provided some conceptual insight or empirical evidence regarding GenAI.

All references were exported in BibTeX format and analyzed using visualization tools such as VOSviewer.

4.3 Evaluating and Analyzing

A dual analytical strategy was implemented:

Bibliometric Analysis enabled us to:

- Examine the evolution of the number of publications over time, by country, and by organization.
- Highlight the most productive authors and journals,
- Visualize the relationships between scientific collaborators.

Thematic Analysis was conducted using keyword co-occurrence, analysis of titles and abstracts, and bibliographic coupling to identify key thematic clusters:

- The first cluster centered on the Core Technologies of Generative AI
- The second cluster talked about Education, Learners, and Personalized Learning
- The third cluster explored Arts and Humanities, Curriculum Design, and Higher-level Cognition
- The fourth cluster discussed Advanced Data Analytics and Generative AI Tools
- The final cluster focused on Evaluation, User Interaction, and Qualitative Research

We found a high level of interdisciplinarity and significant growth of the field, almost explosive, over the last three years, particularly from 2022 to 2024. We have presented the results of our study through visual representations of the data, including graphs, tables, and networks.

5. ANALYSIS OF FINDINGS FROM THE SYSTEMATIC LITERATURE REVIEW

5.1. Bibliometric Analysis

The bibliometric analysis presented in this paper aims to provide a comprehensive understanding of the scientific evolution and publishing patterns in the context of generative artificial intelligence (GenAI). Utilizing visualization techniques including VOSviewer and Biblioshiny, we examined the relationships between authors, keywords, journals, and collaborations to reveal the underlying composition of the domain.

The analysis employed three primary methods:

- Co-citation analysis to identify the key researchers and seminal works defining the field;
- Keyword co-occurrence analysis to identify the most important topics covered in the articles;
- Performance analysis based on the number of publications, citations, and impact to identify the most influential articles, researchers, and journals.

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5.1.1. Dataset Performance

A total of 1,104 peer-reviewed journal and conference papers indexed in Scopus, published between 2022 and 2025, have been identified, illustrating the rapid development of generative AI as a distinct research domain. As demonstrated in Figure 1, the number of papers has grown at an exponential rate in the past three years:

- In 2023, research on GenAI was still in its infancy, since fewer than 100 papers on the topic were available.
- In 2024, the number of publications increased significantly, with over 450 papers published, indicating a growing academic interest in the subject.
- By 2025, this trend is expected to continue and accelerate. More than 600 papers were published this year alone, demonstrating an ever-growing and increasingly global interest in generative AI technologies among academics.

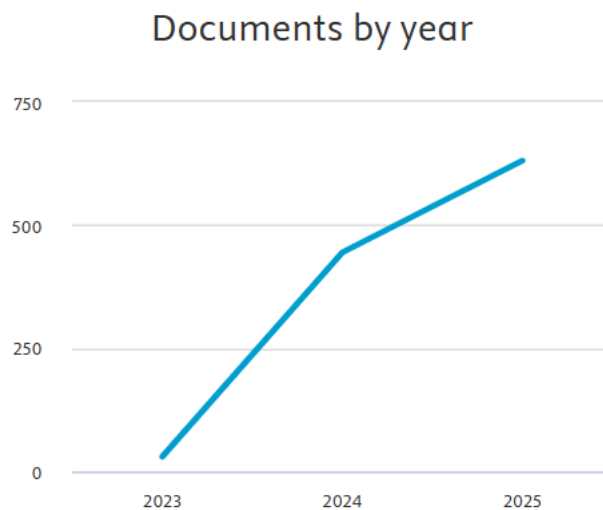


Figure 1. Number of Documents Published per Year on Generative Artificial Intelligence (2022–2025)

Source: Created by the author

Documents by subject area

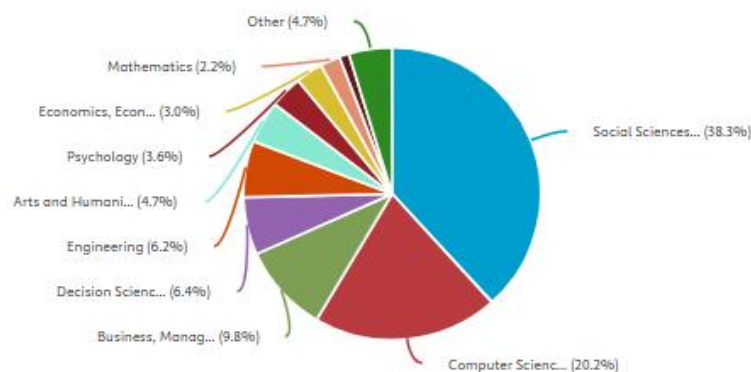


Figure 2 : Generative AI Documents by Field (before restricting the search to the three management specialties)

Source: Created by the author

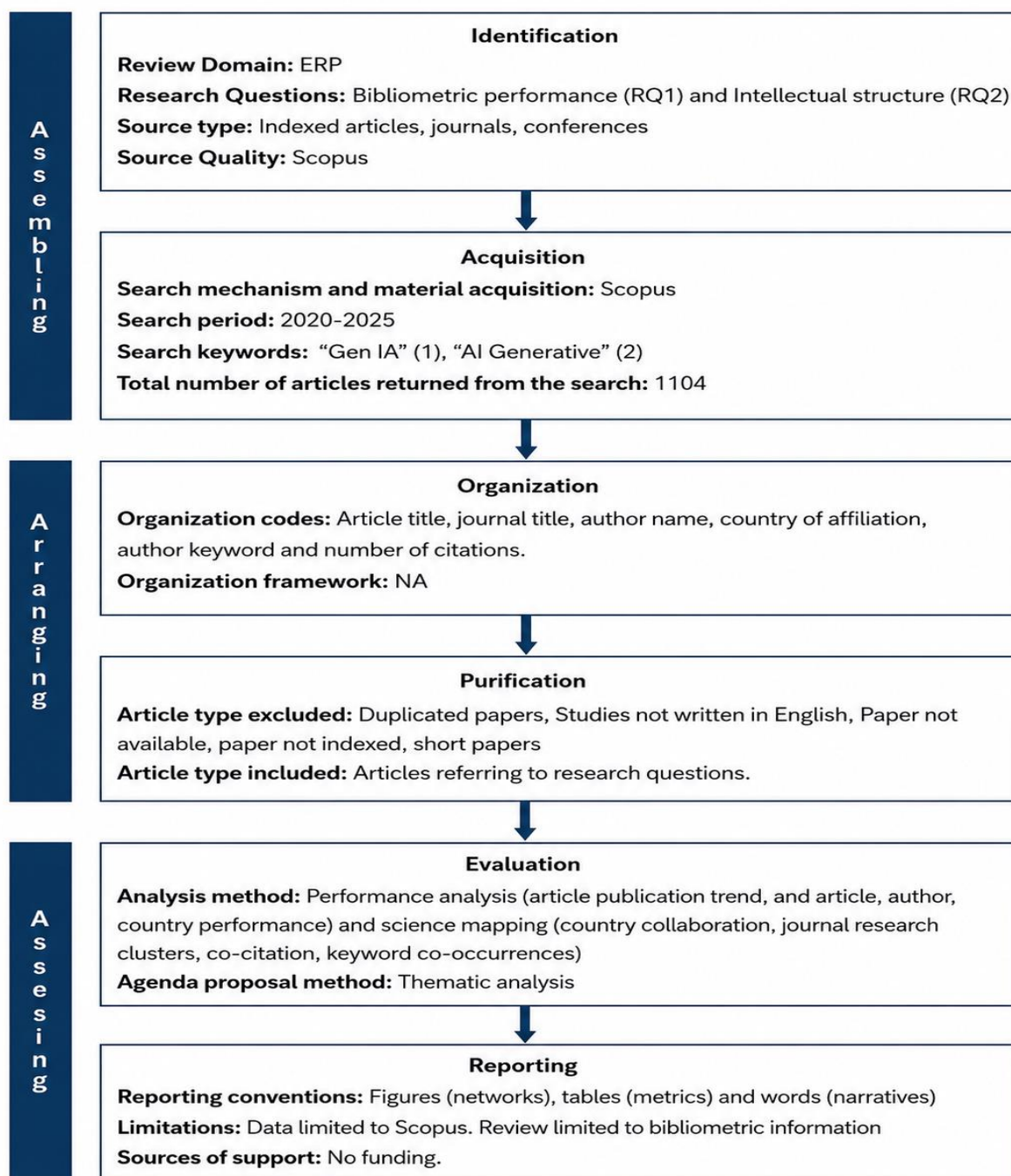


Figure 3: The SPAR-4-SLR Protocol Applied to Generative AI

Source: Created by the author

The rapid growth in research related to generative AI is a reflection of the popularity of generative AI models, such as GPT-4, DALL-E, Stable Diffusion, and Claude, which have inspired a wave of research into topics including their use cases, risks, capabilities, and socio-technical implications.

In addition, the surge in academic work is driven by strong interdisciplinary research efforts, involving researchers from computer science, management, law, psychology, design, education, and many other fields. This wide-ranging involvement not only expands the academic discourse but also complicates and enriches the network of topics within the research landscape.

5.1.2. Author Contributions in Generative AI Research

Through bibliometric analysis of the 1,104 articles in the dataset, the study identified the leading authors contributing to generative AI research. Figure 4 presents the top ten scholars with the greatest number of publications on this subject, based on Scopus data spanning 2023 to 2025.

Documents by author

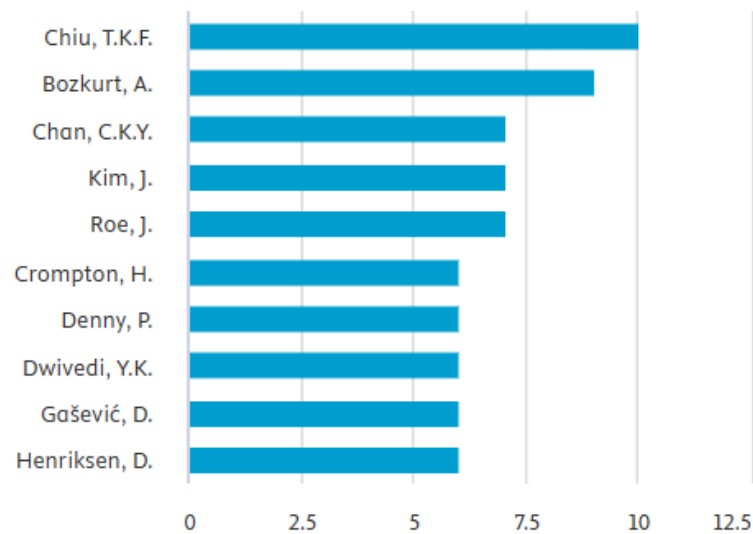


Figure 4. Number of Documents Published by Author in the Field of Generative AI (2022–2025)

Leading the list is Chiu, T.K.F., who has authored 10 papers, indicating a strong and sustained interest in generative AI research. His roles primarily include the use of generative tools in education, the changes to digital learning, and the responsible adoption of GenAI in teaching and learning.

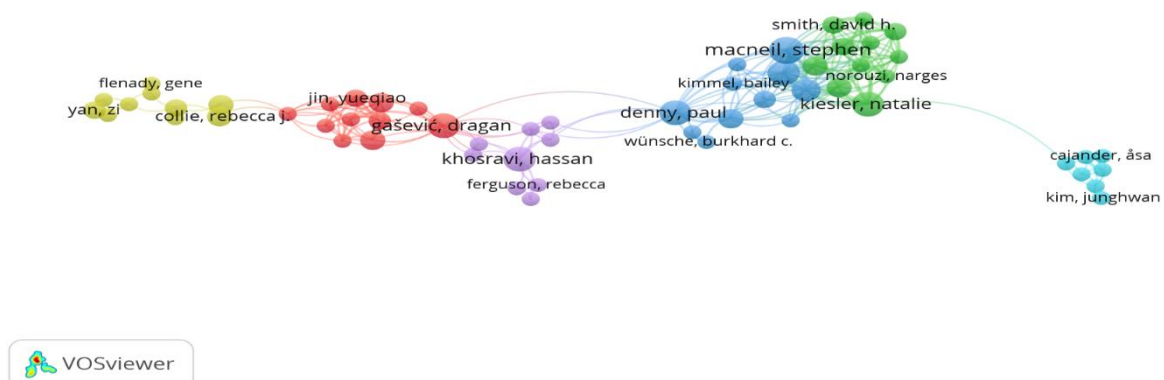
Close behind is Bozkurt, A., with nine publications. His interests include generative AI impact in open education, personalized learning, and ethical issues in generative content creation. Other leading authors such as Chan, C.K.Y., Kim, J., and Roe, J. have published at least seven papers and cover a wide area of topics such as AI-assisted creativity and trust of AI-generated content.

The rest of the list includes scholars such as Crompton, H., Denny, P., Dwivedi, Y.K., Gošević, D., and Henriksen, D., who have contributed to discussions on topics including algorithmic governance, regulatory approaches, and the measurement of organizational performance and the impacts of generative AI.

This showcases a vibrant and diverse research community, with top authors representing a wide range of disciplinary backgrounds, including educational technology, information systems management, and applied computer science.

This variety demonstrates not only the interdisciplinary nature of the field but also its youthfulness, as no author has yet established themselves as a leader in scientific literature, as is the case for other, more mature disciplines.

Figure 5: Most Prolific Authors in Generative AI Literature (2022–2025)



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The visualization of color grouping in the co-author network further shows the formation of collaborative networks within the field. The color-coded clusters primarily correspond to specific thematic focuses, including ethical issues, challenges, and opportunities in education, the psychological aspects of human-AI interaction, and transformations in organizations and leadership resulting from the adoption of generative AI.

Overall, the visualization marks a point of interest in the dynamic scientific activity surrounding generative artificial intelligence, highlighting the key players and main themes within the field for the years 2023–2025 immediately.

5.1.3. Citation-Based Evaluation of Publication Impact: Identifying Key Contributions

To examine the most significant contributions to the generative artificial intelligence (GenAI) literature, we have identified the highly cited papers within our Scopus sample, which covers the period from 2020 to 2025. To do so, we used local citations, that is, the number of times a paper was cited by other documents in the same sample—since it provides a more precise measure of impact within the field than global citations, which capture citations from all scientific fields.

Table 1 lists the top 20 most locally cited papers in the GenAI literature. These papers represent significant contributions that have significantly influenced the development of the GenAI field. They encompass a range of publications, including state-of-the-art reviews, conceptual papers, empirical studies on GenAI use cases, and critical perspectives on the impact of GenAI on society, education, and organizations.

Table 1: The 20 Most Cited Generative AI Articles from 2020 to 2025

Rank	Authors	Citation	Reference
1	Chan, C.K.Y., Hu, W.	683	(Chan & Hu, 2023)
2	<u>Chiu, T.K.F.</u>	261	(Chiu, 2024b)
3	Peres, R., Schreier, M., Schweidel, D., Sorescu, A.	261	(Peres et al., 2023)
4	Chan, C.K.Y., Lee, K.K.W.	206	(Chan & Lee, 2023)
5	Prather, J., Denny, P., Leinonen, J., ... Reeves, B.N., Savelka, J.	172	(Prather et al., 2023)
6	Chiu, T.K.F.	169	(Chiu, 2024a)
7	Mishra, P., Warr, M., Islam, R.	163	(Mishra et al., 2023)
8	Kanbach, D.K., Heiduk, L., Blueher, G., Schreiter, M., Lahmann, A.	160	(Kanbach et al., 2024)
9	Yusuf, A., Pervin, N., Román-González, M.	120	(Yusuf et al., 2024)
10	Mariani, M., Dwivedi, Y.K.	107	(Mariani & Dwivedi, 2024)
11	Ivanov, S., Soliman, M., Tuomi, A., Alkathiri, N.A., Al-Alawi, A.N.	106	(Ivanov et al., 2024)
12	<u>Law, L.</u>	99	(Law, 2024)
13	<u>Luo, J.</u>	89	(Luo, 2024)
14	Ferrara, E.	84	(Ferrara, 2024)
15	Ding, L., Li, T., Jiang, S., Gapud, A.	81	(Ding et al., 2023)
16	Huang, M.-H., Rust, R.T.	70	(Huang & Rust, 2024)
17	Crompton, H., Edmett, A., Ichaporia, N., Burke, D.	68	(Crompton et al., 2024)

18	Giannakos, M., Azevedo, R., Brusilovsky, P., ... Mavrikis, M., Rienties, B.	66	(Giannakos et al., 2024)
19	Chen, B., Zhu, X., Díaz del Castillo H., F.	58	(Chen et al., 2023)
20	Kim, J., Yu, S., Detrick, R., Li, N.	56	(Kim et al., 2025)

Source: Created by the author

In essence, these works have shaped the foundational theoretical and empirical cornerstones of the domain, serving as a springboard for further inquiries aimed at enhancing our understanding of the organizational, cognitive, and societal consequences of generative AI.

- For instance, Chan and Hu's (2023) study, which has garnered 683 citations, presents a comprehensive review of the cognitive and educational effects of generative technologies within digital learning environments.
- Chiu’s investigations (2024a, 2024b), which appear twice among the most cited articles, have notably influenced our understanding of teachers’ attitudes and the policies shaping the adoption of generative AI.
- Peres et al. (2023) have made significant contributions to marketing research by examining how consumers and generative AI collaborate to create value in online environments.

By mapping these prominent articles, we unveil seminal theoretical and empirical works for the community, thereby building a platform for future research to enrich our understanding of the organizational, cognitive, and societal implications of generative AI.

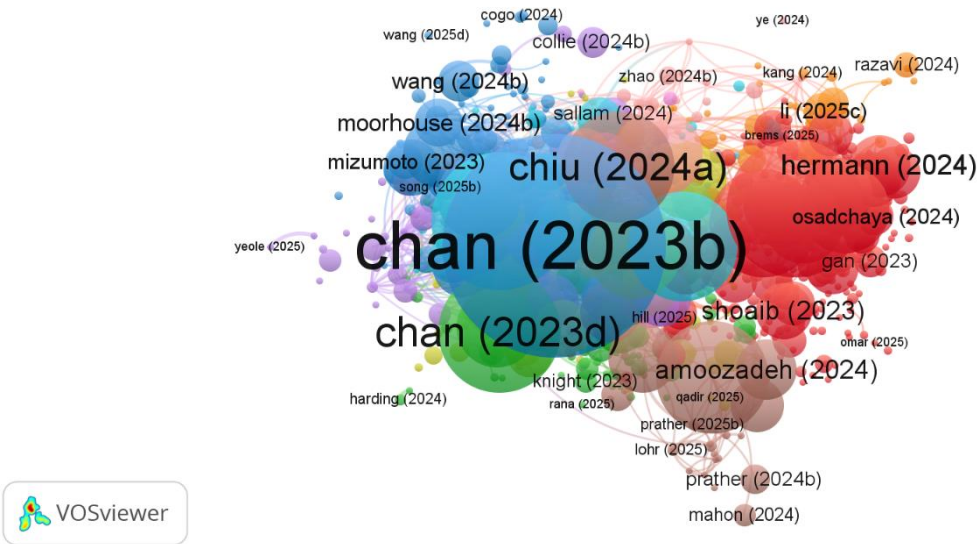


Figure 6: Article Performance

The top five most cited articles broadly focus on the use of generative artificial intelligence (GenAI) in education. A recent study by Chan and Hu (2023) examines how university students perceive generative AI (GenAI), such as ChatGPT, in the context of higher education. Drawing on an online survey of 399 students from different Hong Kong universities, the authors explore their experience with these technologies, their willingness to use and recommend them, as well as their perceived benefits and concerns. The results show a generally enthusiastic attitude. Many students regard GenAI as a potent learning assistant: it can provide tailored support, spur creative writing, offer feedback on essays, summarize text, and create images. GenAI can also serve as a valuable aide for menial or paperwork tasks. Yet, the students also have a multitude of worries. They identify various risks, including unreliable AI-generated answers, privacy concerns, plagiarism, and detrimental effects on analytical thinking, innovation, and individual growth. Some are even concerned that these technologies could undermine their long-term job prospects. Furthermore, the absence of clear institutional guidelines causes unease. Chan and Hu draw on John Biggs’ 3P model, which holds that students’ perceptions and attitudes shape their learning methods and outcomes. Hence, to fully reap the benefits of generative AI uptake, the authors call for improved AI literacy, bolstered learners’

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critical thinking capabilities, and personalized ethical and instructional policies. While students recognize GenAI's potential to revolutionize higher education, they stress the need for scrutiny to ensure its benefits are maximized and risks minimized.

The paper by Thomas K. F. Chiu (2024) analyzes the use and development of generative AI tools, such as ChatGPT and Midjourney, in school education. Unlike the current research direction, which focuses on higher education, this qualitative study involved 88 teachers and school leaders from 30 schools in Hong Kong to understand how these technologies affect management and educational research, and their role in this context. The thematic analysis revealed four distinct dimensions:

For students, teachers emphasize the importance of acquiring new skills, including AI literacy, AI education, critical thinking, digital literacy, and media and information literacy, as well as transversal skills such as creativity, communication, and learning to learn or autonomy. All are considered essential skills for effectively dealing with GenAI.

For teachers, the advent of these technologies requires a rethinking of their role and their level of AI literacy. The study emphasizes the development of new facilitation skills (e.g., helping students to ask the right questions of the AI) and the need to adopt interdisciplinary approaches, as the answers provided by GenAI often span multiple subject areas.

In terms of evaluation, ChatGPT raises questions about the usefulness of homework. Teachers call for a rethinking of evaluation with a stronger focus on formative assessment, oral assessment, and assessment of transversal skills, which are often overlooked or neglected.

At the management level, teachers see a powerful potential for GenAI to support them by automating repetitive and time-consuming tasks, producing reports, and even assisting with decision-making. However, the study notes that managerial staff remain poorly trained and insufficiently informed about these uses.

The authors of the paper offer several implications for practice, including the "learn-it-all" teacher mindset, integrating basic AI skills into curricula, and encouraging interdisciplinary approaches. For educational policy, there is a need for assessment reform, considering AI as a subject in itself, and developing new professional standards for all education actors (teachers, school leaders, managers). Finally, the study recommends future research on assessing generic skills, developing AI training for all school staff, and revitalizing initial teacher education programs.

The article by Peres, Schreier, Schweidel, and Sorescu (2023), "On ChatGPT and beyond: How generative artificial intelligence may affect research, teaching, and practice," published in the *International Journal of Research in Marketing*, discusses how generative AI, such as ChatGPT, may impact three areas: academic research, higher education, and marketing practice.

The authors see significant opportunities but also serious challenges. In research, they urge maintaining human accountability: ChatGPT should not be named as a co-author, and if researchers use its output, they must fully disclose this to avoid plagiarism. Moreover, human scrutiny is essential to counteract biases and the imperfections of language models, such as fabricated citations or false information. In education, generative AI disrupts conventional assessment methods. The authors recommend equipping students to use such systems judiciously by developing pedagogical approaches grounded on principles of honesty, disclosure, and new skill sets, such as prompt engineering. In marketing practice, the article demonstrates that GenAI can rapidly automate the creation of content (e.g., text, images, and videos), facilitate personalization, and lower costs. It also allows small firms and amateurs to innovate and create, thereby democratizing art and science. Yet, such democratization also creates thorny legal dilemmas relating to intellectual property and copyright of AI-generated content.

The article calls for a profound reflection on the ethical and responsible use of generative AI, while emphasizing the urgent need to adapt academic, pedagogical, and professional practices to this technological reality.

The final paper is by Cecilia Ka Yuk Chan and Katherine K. W. Lee of the University of Hong Kong, who studied generational attitudes in adopting generative artificial intelligence (GenAI) tools, such as ChatGPT, in higher education. The research primarily explored and contrasted how Generation Z (Gen Z) students and their Generation X (Gen X) and Generation Y (Millennial) teachers view, utilize, and respond to the adoption of GenAI in learning and teaching. The results showed that Gen Z students, who were born into a digitally immersive environment, have a generally positive perception of GenAI. They view it as a technology that can play a critical role in enhancing the efficiency of the education process, delivering more tailored experiences, and boosting their academic performance, particularly in writing-related, language, and information-related subjects. The students stated that they frequently utilized tools like ChatGPT, intending to employ them for idea generation, simplifying complex texts, and obtaining instant responses and feedback without fear of judgment.

In contrast, Gen X and Gen Y educators, while in favor of GenAI in education, were more cautious. Their worries included academic misconduct, misinformation, biases in AI-generated content, and students' excessive reliance on these tools. Many educators called for universities to swiftly develop policies and ethical standards to regulate the use of AI in education. While some teachers welcomed the use of AI in teaching and guiding students to develop AI critical literacy, others were skeptical about GenAI's current capabilities, claiming it is merely reshuffling existing knowledge. Despite these generational differences, both groups shared an understanding of GenAI's limitations and agreed on the necessity of combining technological tools with traditional pedagogical

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approaches. They emphasized the importance of developing students' critical thinking skills, information literacy, and ethical awareness when interacting with AI-powered applications.

To conclude, the study highlights a generational divide in the acceptance and use of GenAI, with Gen Z students more inclined to adopt such technologies compared to their more cautious teachers. Addressing this gap through comprehensive policy development, educator training, and open dialogue is crucial to maximize the benefits of GenAI while mitigating its risks, ultimately promoting its responsible and equitable integration into higher education.

5.1.4. Performance of Countries

Figures 7 and 8 illustrate the comparative performance of different countries based on the quantity of publications, citation counts, and overall link strength. These metrics provide valuable insights into the global research landscape concerning generative AI.

Documents by country/territory

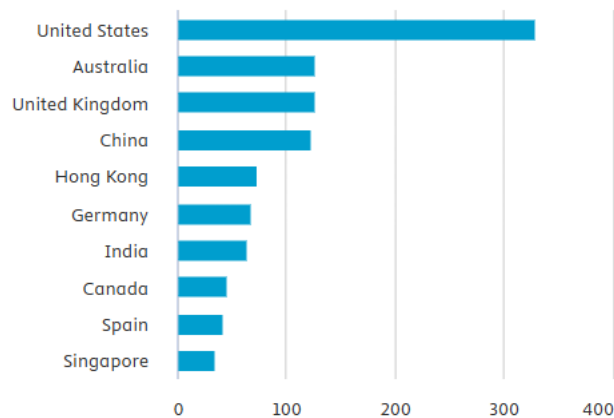


Figure 7: Distribution of documents by country

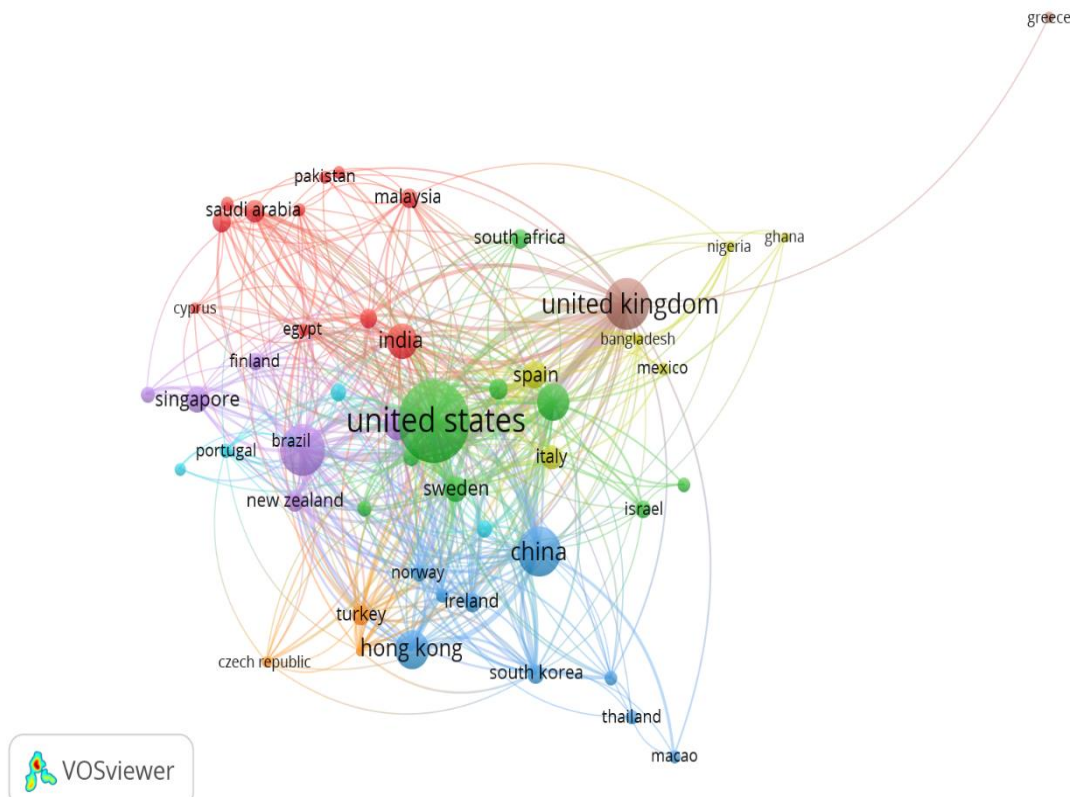


Figure 8: Country Performance

The figures provided above offer a broad overview of global research in the field of generative artificial intelligence, highlighting the geographic distribution of published works and the collaborative international networks. The first figure, in the form of a bar chart, shows the volume of scientific publications that each country or territory is responsible for. It vividly highlights the leading

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role of the United States, whose publication numbers far exceed those of other countries. Australia, the United Kingdom, and China, as the following top three countries, contribute significantly but still lag far behind the United States. Additionally, countries such as India, Canada, Germany, and Hong Kong are actively involved, which indicates a geographically diversified yet uneven participation in AI research.

The second figure, a collaboration network generated using VOSviewer, illustrates foreign co-authorship patterns. Such a figure shows an extensive network of ties, with the United States situated predominantly in the center of the global scientific cooperation network. The United Kingdom, China, India, Germany, and several other countries stand out as key hubs due to their significant roles not only as knowledge producers but also as partners in joint research projects. Furthermore, well-integrated clusters of the region, such as those in Europe, Asia, and the Middle East, are visible; however, some countries, like Greece, are less so.

These images collectively illustrate that the research on generative AI is a worldwide undertaking, primarily led by a few countries but still robust due to significant international cooperation. This situation is indicative of the increasing importance of generative AI in global research priorities.

The collaboration map created by VOSviewer reasserts this tendency. The network is highly concentrated in some areas, despite having numerous international connections. The centers of power are the United States, the United Kingdom, China, and India. The picture shows that some countries, such as Greece, are only on the periphery, with few connections. At the same time, large areas, such as sub-Saharan Africa, much of Central America, and parts of Central Asia, are almost absent from these academic networks.

The reasons for such differences may be explained by various factors, including the uneven distribution of research funding, limited access to digital technology and educational resources, as well as differing scientific agendas in different regions of the world. Underrepresented areas in the global scientific community are the first to struggle with the question of how fair the distribution of opportunities is and whether the development of AI technology will be inclusive.

In conclusion, the research on generative artificial intelligence is spreading exponentially across the globe; however, it remains highly concentrated in a few countries, leaving many regions on the margins. To develop AI that is genuinely inclusive and capable of addressing humanity's global issues, it is necessary to make significant efforts to ensure that the nations least represented in the scientific research community have access to it.

5.2 Thematic Content Analysis of Generative AI Literature (2020–2025)

The surge in generative artificial intelligence, propelled by advancements such as large language models (LLMs) like GPT, has significantly reshaped both scientific inquiry and educational methodologies. Correspondingly, an increasing body of literature has emerged, investigating the applications, effects, and broader implications of generative AI across diverse domains, especially within education.

Utilizing VOSviewer, a keyword co-occurrence map visualizes the predominant themes in recent scholarly work on generative AI. By clustering interrelated keywords, this approach identifies major research topics, emergent lines of inquiry, and interdisciplinary connections.

This thematic examination highlights several core research areas, ranging from the technical underpinnings of AI systems to their educational applications, alongside ethical, cognitive, and societal considerations associated with their integration into higher education. The findings reveal a rapidly growing field characterized by both the intricate technological nature of these systems and the human-centered challenges they provoke.

Complementing bibliometric methods, thematic analysis helps to uncover key concepts, thematic clusters, and intellectual trends shaping scientific discourse on generative AI. VOSviewer facilitates this by mapping keyword co-occurrences, where node size reflects term frequency and color denotes cluster membership.

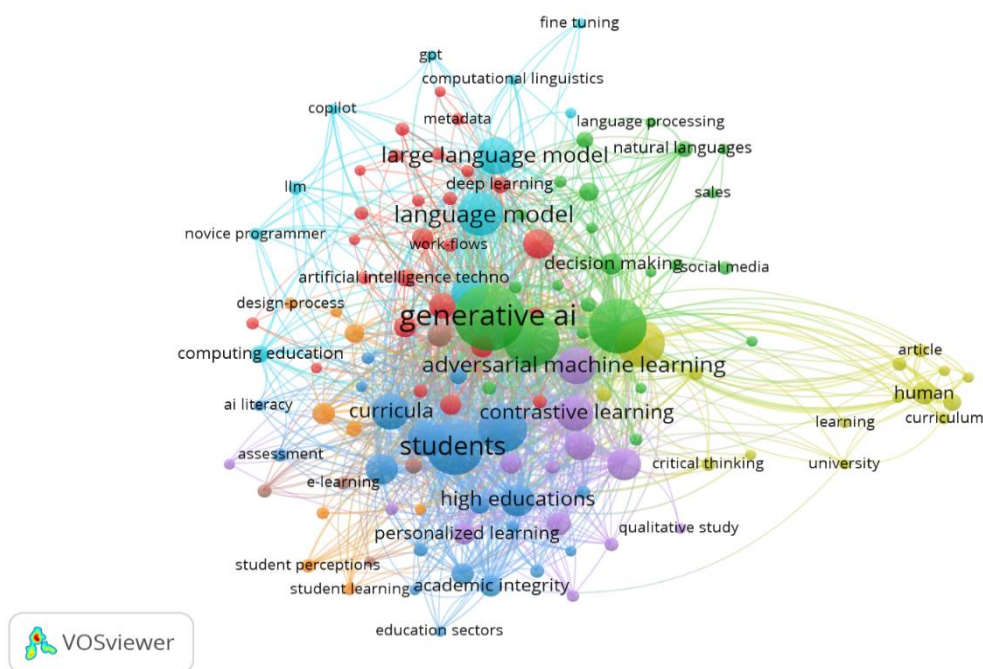


Figure 9 : The visualization map of keyword occurrences in the corpus of studied articles (1104 articles)

Core Technologies of Generative AI (Green Cluster): This cluster is located at the center of the thematic map and includes main topics such as “generative AI,” “language model,” “large language model (LLM),” “deep learning,” and “decision making.” It represents the major tech and theoretical issues in the field of generative AI. The research is primarily geared towards the development, training, and improvement of generative models, mainly employing transformer-based architectures, utilizing deep learning, and employing methods of unsupervised learning. The current research models, such as GPT, BERT, and T5, are leading the race not only for their language capabilities but also for their cognitive power - their ability to reason, converse, produce fluent and creative text, and solve complex problems. Nevertheless, concerns are growing as they are inherently non-deterministic, imbued with biases, and without transparency, and these issues may have adverse effects on automated decision-making in sensitive areas such as healthcare, legal systems, and finance. Hence, the cluster forms a foundation or core for understanding generative AI, while simultaneously raising some essential epistemological and ethical questions.

Education, Learners, and Customized Learning (Blue Cluster): This cluster revolves around concepts such as “students,” “higher education,” “academic integrity,” “personalized learning,” and “education sectors,” thus a large part of it is about the application of generative AI in the educational field. As a result, such technologies are hailed as enabling students to grasp course content better, assisting with the creation of educational materials, and serving as intelligent digital assistants. Besides the experts, some good features of the adaptive learning experience were mentioned, such as the customization of educational paths and learners being given the chance to practice creativity in tech-supported environments. On the other hand, significant problems were discussed, including breaches of academic honesty (such as the facilitation of plagiarism and the use of AI to generate texts), the loss of skills like writing and critical thinking, and inequality in access to technology. This cluster highlights the dual nature of generative AI: on the one hand, it serves as the driving force behind educational innovation, and on the other hand, it raises concerns about governance and ethical regulation.

Humanities, Curriculum Design, and Critical Thinking (Yellow Cluster): On the right-hand side of the map, this cluster signifies a group of words that includes “human,” “curriculum,” “critical thinking,” “university,” and “learning.” It characterizes a human-centered, reflective perspective on generative AI. The people who research this matter question the cognitive, cultural, and social effects of these technologies on human learning, and they are also considering the necessary educational reforms to incorporate AI tools in an ethical and responsible way.

The key idea here is the development of critical thinking skills, particularly in light of the rapid increase in automated knowledge generation. AI is considered a possible factor that could weaken autonomous cognitive engagement; therefore, students must receive instructions on how to analyze, interpret, and critically evaluate content generated by AI. This cluster is still discussing the conflicts between technology and human values, emphasizing the need to balance innovations with educational principles.

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Advanced Methodologies and Generative AI Tools (Red cluster). The cluster, which is technically inclined in nature, comprises words such as “fine tuning,” “metadata,” “computational linguistics,” “copilot,” “GPT,” and “LLM.” It discusses the tactics for the betterment and personalization of generative AI. For example, fine-tuning enables general models to be adapted for specific tasks or industries, such as healthcare, law, and education, thus allowing for targeted applications. The inclusion of the GitHub Copilot example is made, which is the source of LLMs that help software developers accomplish tasks. Computational linguistics is a key aspect that improves the models’ understanding and processing of natural language. This cluster will serve as proof that generative AI is undergoing technological changes, extending beyond research for new ideas to concrete and professional applications, such as coding assistance, automated writing support, and translation.

Evaluation, User Perceptions, and Qualitative Research (Purple cluster)

This cluster primarily focuses on the impact of generative AI on teaching and learning, as well as the students' acceptance and reception of the tools. AI use is presented as a potential problem from the students' perspective, which highlights concerns and ethical issues, as well as its positive impact in the form of better understanding, time efficiency, and motivation. The emphasis is primarily on qualitative methods, as they are well-suited to shedding light on the dynamics of AI implementation in various educational settings. This cluster underscores the profound and subtle local realities of AI technology use, as well as the role of research in focusing on human experience.

Comprehensive Overview

The thematic map from the paper illustrates that research on generative AI is organized into five main areas: foundational technologies, educational applications, humanistic and critical perspectives, specialized technical advancements, and empirical investigations into reception. Such an interdisciplinary arrangement highlights that generative AI is no longer only a computational issue, but it has also become an educational, cultural, social, and ethical matter.

The visibility of education-related clusters (blue, purple, and yellow) confirms that higher education is a crucial venue for introducing generative AI, not only for pedagogical innovation but also for reflective critique of its applications. In summary, these issues require the development of responsible, context-aware, and human-centered AI.

CONCLUSION

This literature review, grounded in keyword co-occurrence analysis, delineates structured implications for researchers and practitioners.

For researchers, this synthesis provides a robust platform to pinpoint core concepts, dominant themes, and emerging gaps, while facilitating the discovery of potential interdisciplinary collaborations among AI specialists, educators, sociologists, linguists, and computer scientists.

For practitioners in education and technology, it provides a clear overview of areas where generative AI is already exerting practical influence and where pedagogical or ethical adjustments are underway. It thus serves as a strategic guide for developing training programs, shaping educational policies, and implementing responsible, human-centered digital tools.

Significance of the Education Cluster: A Central and Cross-Cutting Theme

Among the identified clusters, the education-focused one occupies a pivotal and transversal role. It demonstrates how education, particularly at the tertiary level has become a prime domain for generative AI experimentation and transformation.

This cluster highlights both the widespread incorporation of tools such as ChatGPT, Copilot, and other LLMs into learning processes and the critical challenges they present ensuring fair evaluation, preserving student cognitive engagement amidst automation, and fostering critical thinking alongside tool integration.

Its significance also stems from education’s dual function as a transmitter of knowledge and a developer of future skills. Decisions made today concerning AI integration will profoundly influence how future generations understand, use, and challenge these technologies. Hence, research on generative AI in education occupies a vital place in scientific and societal dialogues.

Directions for Future Research

This review undoubtedly raises many additional topics for exploration. On the technology side, the issues, which include a lack of transparency in the models, bias removal, local adjustment, and achieving better results in the case of multilingual or domain-specific tasks, remain unsolved. From the educational and ethical perspectives, it would be beneficial to have more long-term, comparative, and qualitative studies to gain a deeper understanding of AI’s impact on teaching methods, learning outcomes, and social interactions. Accessibility, equity, and inclusion issues, as well as the changing role of the teacher in the context of automation, are some topics that need to be investigated in depth. The good news is that it is possible to implement measures

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such as creating regulatory frameworks that are not only flexible but also protective, involving end-users in the joint design of AI tools, as well as integrating AI into active and critical pedagogical strategies.

Generative AI has ceased to be just a technological matter; it has become a social force that transforms education, skill development, knowledge generation, and the cognitive engagement of humanity. This literature review provides a broad, interdisciplinary framework that is vital for steering this movement in an ethical, inclusive, and socially beneficial direction.

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