



BRAIN. Broad Research in Artificial Intelligence and Neuroscience

e-ISSN: 2067-3957 | p-ISSN: 2068-0473

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2026, Volume 17, Issue 3, pages: 112-139

Submitted: May 24th, 2026 | Accepted for publication: August 23rd, 2026

Ethical Considerations in the Application of Artificial Intelligence in Education: A Bibliometric and Thematic Inquiry

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Abstract: The integration of artificial intelligence (AI) in education and training presents not only significant opportunities but also critical ethical challenges that warrant careful consideration. This study investigates the current state of knowledge on AI ethics in education by analysing annual publication trends, key scholarly sources, prominent conceptual themes (keywords), and the interrelationships among these concepts. Additionally, it explores prospective teachers' perspectives on ethical issues associated with AI in educational settings and their proposed solutions. The research is structured in two parts. Part A employs a bibliometric analysis of publications indexed in the Web of Science and Scopus databases to examine trends in scholarly output, identify influential sources, and map the conceptual structure of the field. Part B utilises thematic content analysis to interpret teacher candidates' views on ethical challenges in the educational application of AI and their suggestions for addressing these concerns. Findings reveal that the annual distribution of publications on AI ethics in education has followed a gradual growth pattern, with minimal output from 1985 until a notable increase post-2021, reflecting the emerging nature of this field. Thematic analysis of teacher candidates' responses indicated that ethical AI is both a technical and a human problem: teacher education must combine technical literacy (what models do and can do), ethical reflection (values, privacy, fairness), and practical pedagogy (classroom policies, assessment design, and student support). The predominant themes in teacher candidates' likely solutions to the ethical problems in the application of AI in education underscore the importance of policy fluency, participatory design, ethical pedagogy, and continuous professional development ecosystems. The study concludes by proposing a future research agenda to advance the field and discusses implications for policy and educational practice.

Keywords: artificial intelligence; ethics; teacher candidates; teacher education; ethical application; AI in education.

How to cite: Adedoyin, O. B., Altinay, Z., & Karasel, N. (2026). Ethical considerations in the application of artificial intelligence in education: A bibliometric and thematic inquiry. *BRAIN. Broad Research in Artificial Intelligence and Neuroscience*, 112-139. <https://doi.org/10.70594/brain/17.3/7>



1. Introduction

Artificial intelligence (AI) is used in almost every area of our lives today, such as communication, performing work and transactions in a digital environment, finding a location, quickly accessing information, entertainment, storage, banking, finance, social media, health, and ensuring institutional and national security (Komalavalli et al., 2020). This situation also brings with it some concerns and some of these concerns are: the fate of the data that AI will collect as it takes its place in every area of life, who will have access to this data, what kind of operations will be performed on the collected data, and the sale of the data (Au-Yong-Oliveira et al., 2020; Makridakis, 2017). Especially considering that individuals use technology more and spend more time in the digital environment, the amount of data obtained can be estimated, and this concern may be justified. According to Fast and Horvitz (2017), other concerns about AI are: AI getting out of control, increasing human losses in wars, and people becoming unemployed. Among these concerns, the possibility of AI replacing humans in all professions is one of the most debated issues today (Reiss, 2021).

The ethical issues encountered in using AI in education and training include significant risks that need to be considered as much as the opportunities provided by the technology. These issues are often based on fundamental ethical principles, such as student privacy, fairness, transparency, human autonomy, and equality (Gartner & Krasna, 2023). AI systems often use large data sets containing sensitive information about students' personal information, learning styles, and performance. This can threaten students' privacy and increase the risk of misuse of personal data. Lack of transparency about collecting, storing, and using students' data can lead to privacy violations. Algorithmic bias stands out as another important ethical issue. AI systems may reflect biases found in past data in situations where fair and equal evaluation is required in education. This can unfairly impact certain students, especially minority groups, and make it harder to provide equal opportunities in education. Transparency and understandability presents a challenge due to the complexity of AI applications. Teachers and students may have difficulty understanding how AI systems work and make decisions. This can lead to a lack of trust in the systems' decisions and accountability issues. Students' over-reliance on AI systems can also compromise human autonomy. AI's ability to automate and personalise learning can limit students' ability to explore their learning paths and think independently. This can negatively impact students' critical thinking and problem-solving skills. Inequality of access is also a major ethical issue. Access to AI technologies can vary across schools and districts. This can result in some students benefiting from advanced AI tools while others are denied access, widening the digital divide in education (Bogina, et al., 2022; Dabis & Csaki, 2024). These make changes in educational objectives:

- The use of AI can change the purpose and methods of education. This carries the risk of technology-centred approaches replacing human-centred approaches in education.
- It is important not to ignore basic educational objectives such as human development and critical thinking during the integration of AI into educational systems.
- Although the use of AI in education has the potential to increase student success and enrich learning experiences, caution should be exercised regarding the ethical use of these technologies. Conscious and responsible action by stakeholders in education can help minimise these ethical issues.

One of the main purposes of education is to prepare learners for the future by addressing social problems and teaching them to cope with the rapid development of technologies. Today, as technology advances, the use of AI applications in education has attracted attention. AI, which is based on the introduction of the term computer science into our lives, first took its place in the world of technology as systems that encode human reasoning principles to simulate human intelligence through databases and then imitate decision-making processes with this reasoning power (Schiff, 2022; Shih et al., 2021).

It has been observed that teachers who used AI applications in their classes during the compulsory distance education period continued to use the applications after the period by benefiting from this experience, and in addition to experience, it is seen that the existence of new and functional applications that have been opened to the use of the education community in recent years has a positive contribution, especially in terms of usage. Although the compulsory distance education period has many disadvantages in terms of the world of education, it is seen that it has made a positive contribution to the knowledge and competence of teachers in using technology and the number of studies added to the literature (Mouta et al., 2024; Al-Zahrani & Alasmari, 2024). In line with the supply-demand balance, applications that meet more needs in pedagogical terms have been developed, and the compulsory distance education period has been a period in which the competence in terms of teachers, students, and teaching materials has increased in terms of technology. The need for technology use that emerged during the compulsory distance education period has enabled many teachers who previously had prejudices about using technology in their classes to meet the applications. It is thought that giving technology integration courses that can contribute to the professional competence of teacher candidates who have not started their profession and whose teaching methods and styles have not become a habit, and compulsory courses on AI ethics can increase teachers' recognition and use of AI/technological applications and the integration of technology into the lesson, and for those who are currently teaching, supporting the process with in-service training will contribute (Airaj, 2024). Song and Ko (2024) noted that their study provided a preliminary understanding of the likely connections between teacher candidates' perception of AI ethics education and their demographic features; however, it remains open for further exploration to unearth a more conclusive comprehension of any existing connections. Regarding the sensitivity of ethics in AI, Poli et al. (2025) emphasised the importance of continuing intellectual discussions about the ethical implications of AI and ensuring that these systems are developed and deployed in a responsible, transparent, and equitable manner.

This research aims to evaluate teacher candidates' awareness of ethics in AI in teacher education, determine the ethical problems that may occur in AI pedagogy, present suggestions based on the existing body of knowledge, and examine the implications for policy and practice.

Research Questions (RQ)

1. What is the distribution of existing studies on AI in education and ethics based on annual publications, most relevant sources, and leading concepts (i.e., keywords) explored?
2. What is the relationship between the leading concepts explored in existing studies on AI in education and ethics?
3. What are the teacher candidates' views on the ethical problems in the application of AI in education, and the proposed solutions to these ethical problems?

2. Theoretical Framework

This research sits at the nexus of teacher professional development, educational innovation, and technology ethics, based on sociotechnical systems theory, critical digital pedagogy, and responsible research and innovation (RRI), and offers a prism through which to examine both the micro-level viewpoints of teacher candidates and the macro-level trends in scholarship. RRI emphasises anticipation, inclusivity, responsiveness, and reflexivity in the development and use of emerging technologies (Owen et al., 2013). RRI provides a basis for comprehending bibliometric trends in this study: the expanding corpus of research on AI ethics in education shows efforts by the academic community to foresee ethical risks, engage stakeholders, and suggest responsible solutions. In addition, RRI interprets teacher candidates' reflections as manifestations of responsiveness and inclusivity in the ethical development of AI systems.

When applied to the digital sphere, critical pedagogy sees AI as a sociopolitical force that has the power to either promote emancipation or perpetuate injustices (Selwyn, 2024). This viewpoint places the privacy, bias, and inclusivity worries of teacher candidates within larger

debates over the role and regulation of AI in education. The study emphasises how prevailing research narratives may elevate some voices while marginalising others by integrating bibliometric trends within this framework, thereby reaffirming the need for more critical and inclusive discourses in teacher education. According to sociotechnical systems theory, institutional, organisational, and human dimensions are intricately entwined with technological systems (Xu & Gao, 2024). This theory, when applied in this study, supports the study's dual focus: teacher candidates' perspectives show the human-educational system where ethical issues appear in practice, while bibliometric mapping shows how the knowledge infrastructure of AI ethics in education develops. When taken as a whole, these levels highlight how social systems in which AI tools function are inextricably linked to AI ethics.

By integrating these theoretical stances, the framework positions bibliometric trends as evidence of the evolving intellectual structure of AI ethics in education, and a thematic analysis of teacher candidates' opinions reveals how these theoretical debates translate into real-world ethical problems and suggested solutions. To ensure that the study not only maps "what is known" about AI ethics but also critically engages with "what should be done" to prepare future educators for ethical AI use, RRI, critical pedagogy, and sociotechnical thinking are integrated. This framework thus supports the study's two objectives: (i) to identify and summarise the global research landscape on AI ethics in education, and (ii) to highlight the perspectives of teacher candidates in forming responsible, inclusive, and ethical AI integration in educational practice.

3. Methods

3.1. Research Design

This study was divided into two parts, namely Part A and Part B. Part A focused on addressing RQ1 and RQ2 through a bibliometric analysis to determine the distribution of the existing body of knowledge on AI in education and ethics. Part B adopted a qualitative research approach to address RQ3. Qualitative research can be defined as research that utilises qualitative data collection methods, such as observation, interviews, and document analysis, and employs a qualitative process to present perceptions and events realistically and holistically within a natural environment (Yıldırım & Şimşek, 2018). According to Kuş (2003), the basic feature of qualitative research is to reveal the participants' perspectives and to see the world through the eyes of the participants.

3.2. Study Group

For Part A, the Web of Science (WOS) and Scopus databases served as the sources of data using PRISMA guidelines, and study participants for Part B of the study were selected using purposive random sampling from the students who registered for the course "Ethics in Education" from various fields of teacher education programmes in the Faculty of Education of Near East University. Purposive random sampling is the classification of systematically and randomly selected case examples in line with the purpose of the study (Marshall & Rossman, 2014).

3.3. Data Collection

Data collection for the bibliometric analysis (i.e., Part A) was conducted in July 2025 using the following search strings on the WOS and Scopus databases:

Table 1. Search String & Database

Search String	Database
TS=(((“artificial intelligence” OR “machine learning” OR “deep learning” OR AI OR AIED) AND (pedagog* OR teaching OR educat*) AND (ethic*)))	WOS
TITLE-ABS-KEY((“artificial intelligence” OR “machine learning” OR “deep learning” OR AI OR AIED) AND (pedagog* OR teaching OR educat*) AND ethic*)	Scopus
<i>Source: Authors</i>	

Based on the above search string, 3,914 documents were returned on July 21st 2025, on WOS and 7,789 on Scopus databases. To obtain more accurate results, the search was filtered to exclude reviews, conference papers and reviews, book, note, letter, erratum, retracted, short survey, data paper, editorials, retracted publication, meeting, meeting abstract, editorials, book review, and book chapters, and limited to studies published in English. Figure 1 below shows the document selection process according to the updated PRISMA guidelines (Page et al., 2021).

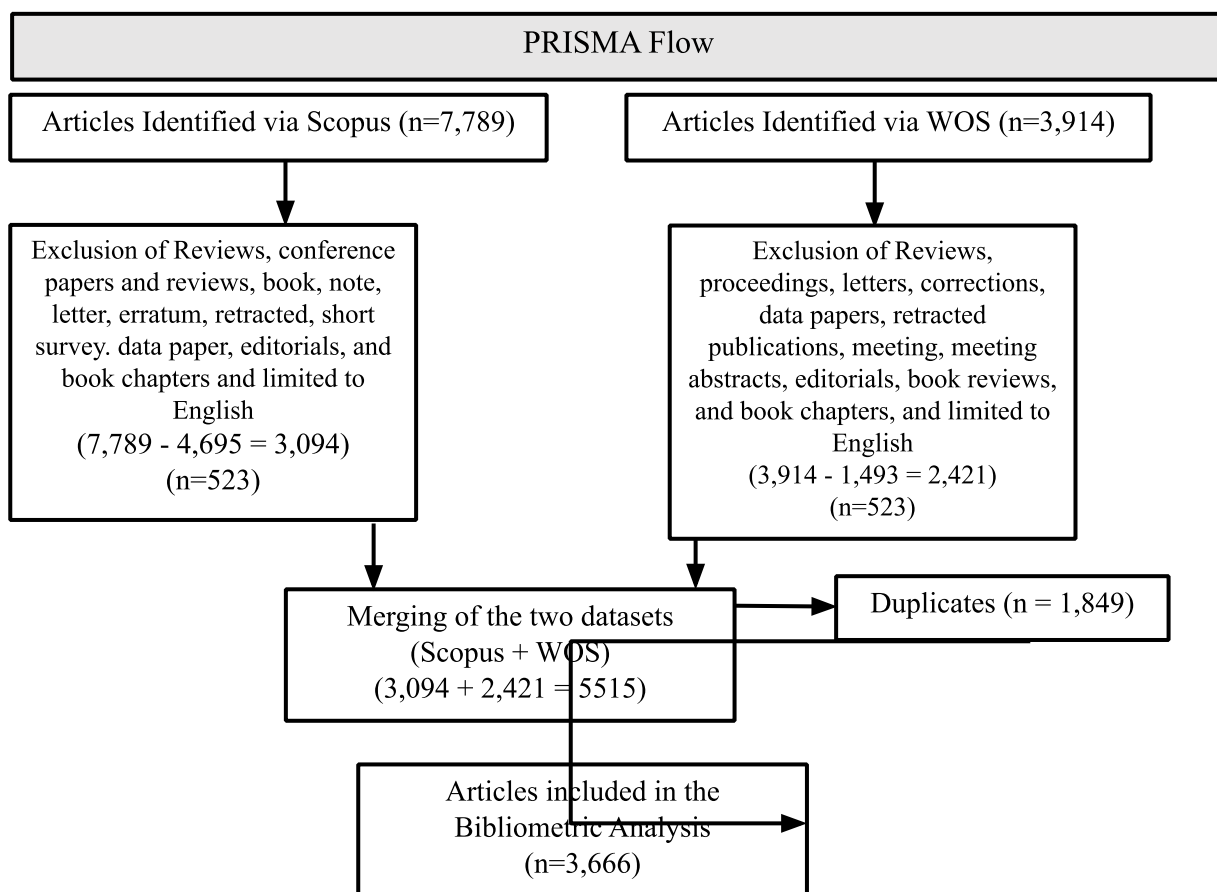


Figure 1. PRISMA Model adapted for the document selection process

For Part B, 40 participants reported their views on the learning management system (i.e., Moodle) as self-reflection tasks. They also shared their experiences in the discussion, like a focus group. Data were gathered using self-reflection tasks created within the scope of this study that included two open-ended semi-structured interview questions (Legard et al., 2003). To ascertain the internal validity of the self-reflection open-ended semi-structured interview questions, it was presented for review by faculty members from the Department of Educational Sciences, Faculty of Education, Near East University to obtain expert opinions. The form was rearranged in line with

their recommendations. On the online platform, participants were invited to a focus group discussion, and they reflected on their views based on their answers to self-reflection tasks.

3.4. Data Analysis

In Part A (i.e., RQ1 & RQ2), bibliometric analysis was conducted on the 3666 documents using Biblioshiny software to ascertain the distribution of existing studies on AI in education and ethics based on the number of articles published annually, most relevant sources, and leading concepts (i.e., keywords) explored, and the relationship between these leading concepts.

Thematic content analysis (Anderson, 2007) was adopted for Part B (i.e., RQ3), responses were coded properly, frequent codes were clustered by creating sub-themes, and interrelated sub-themes were unified to establish themes. To support each theme, excerpts from participants' responses were presented.

4. Research Findings

Part A: Existing Body of Knowledge from Bibliometric Analysis

4.1. Annual Distribution of Studies on AI Ethics in Education

This study conducted a bibliometric analysis to determine the annual distribution of studies on AI ethics in education, and the results are presented in Fig. 2 below.

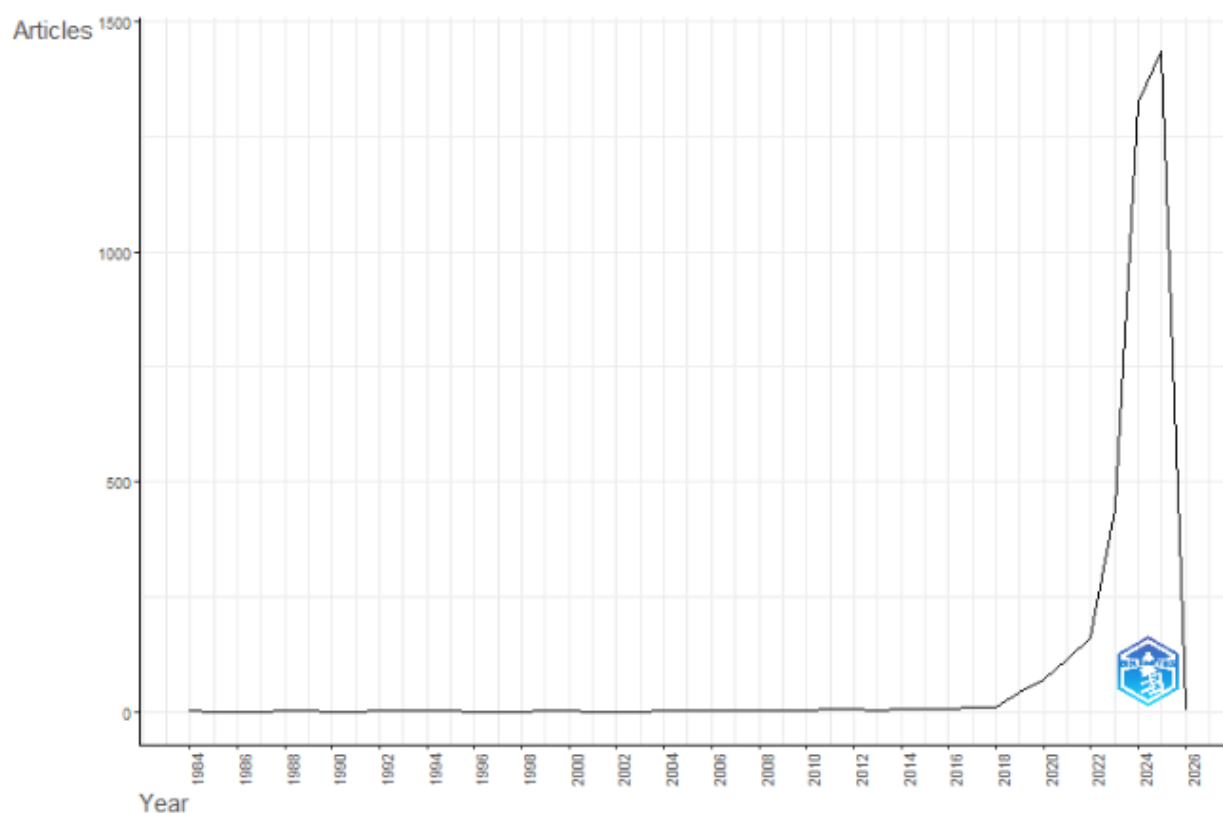


Figure 2. Annual Distribution of Studies on AI Ethics in Education

Fig. 2 above illustrates the number of articles published annually from 1984 to 2025 on AI ethics in education, reflecting the trends in interest and research output over time. In the early years (1980s-2018), there was minimal research interest; the graph displays extremely low and almost flat publication levels from 1984 to about 2018. This implies that there was little emphasis on the relationship between AI, ethics, and education at this time. There was probably research on AI in

education, but it was either divided into other, more general domains or paid little attention to ethics. There is a discernible upward trend between 2018 and 2021 that may have been brought on by developments in AI technologies such as deep learning and intelligent tutoring systems, increased public discussion of AI ethics, bias, and fairness, and the use of AI tools such as adaptive learning platforms in the classroom. This phase can be regarded as the initial growth that succeeded the long period of minimal activity (1980s–2018).

Between 2022 and 2024, publications increased dramatically and exponentially, reaching a peak of almost 1,500 articles in 2024. This explosion coincides with the introduction and globalisation of ChatGPT and other generative AI (GenAI) tools in late 2022, pressing ethical discussions in education regarding bias, plagiarism, misinformation, data privacy, and AI policy, and the broad use of AI in K–12, higher education, and healthcare training settings, all of which increase demand for research. The notable decline in 2025 is probably the result of insufficient data for the year at the time of analysis. This decline should be interpreted with caution because many academic databases only update full-year publication counts retroactively.

4.2. Most Relevant Sources

This study conducted a bibliometric analysis to identify the most relevant academic sources (i.e., journals) based on the number of documents published on AI ethics in education, and the results are presented in Fig. 3 below.

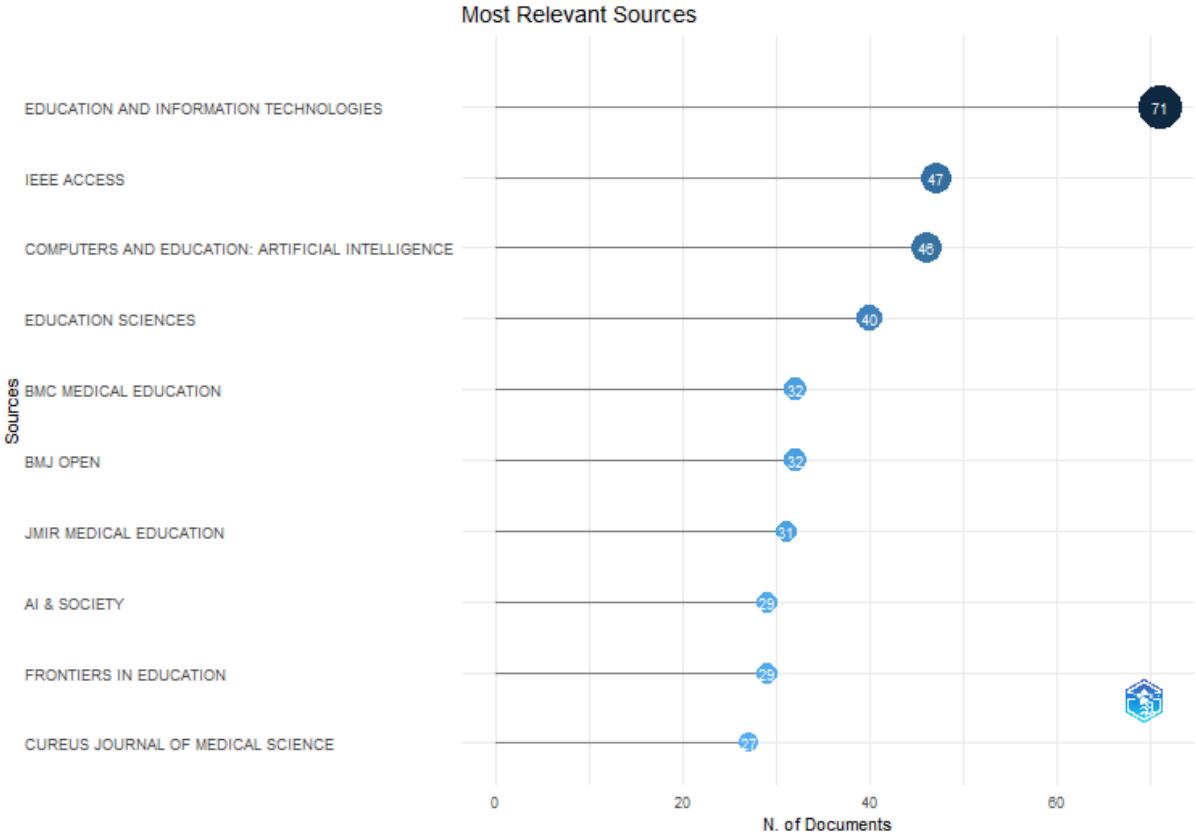


Figure 3. Most Relevant Sources of Studies on AI Ethics in Education

Figure 3 above shows the top ten relevant sources based on the number of articles published on AI ethics in education, and these academic journals can be categorised into 4 categories, namely: core education and AI journals, technical and interdisciplinary journals, medical and health education journals, and emerging or supportive platforms. The journals under core education and AI are “Education and Information Technologies”, followed by “Computers and Education: Artificial Intelligence”, and “Education Sciences”. These journals are leading in relevance and volume because “Education and Information Technologies” with 71 articles dominates the research domain,

an overarching research focus on AI as a whole rather than its narrower domains, as one might expect in a more established discipline. Keywords such as “artificial intelligence” with 28.2%, “generative artificial intelligence” with 7.2%, and “machine learning” with 3.6% comprise roughly 43% of all occurrences. This distribution reveals that most studies may be using AI as a wider framing device rather than engaging with certain technical subtypes.

“ChatGPT” as the second-most frequent term, covered 8.9%, well ahead of “large language model” with 2.6% or “chatbot” with 1.9%. Ethics and integrity concepts form a coherent, sizable cluster with roughly 12 to 13%, covering keywords such as “ethics”, “artificial intelligence ethics”, “academic integrity”, “ethical considerations”, “plagiarism”, “privacy”, “data privacy”, “bias”, and “ethical artificial intelligence”. Education-level keywords cluster around institutional context rather than pedagogy. “Education”, “higher education”, “medical education”, “educational technology”, “nursing education”, and “medical students” are the keywords under the education-level concepts. The combination of actual pedagogical mechanisms such as “personalised learning”, “pedagogy”, “critical thinking”, “assessment”, “digital literacy”, and “learning analytics” sits under 3%. Method-and-field self-reference concepts such as “systematic review”, “bibliometric analysis”, “survey”, and “research” are a small but telling minority because they appear near the bottom of the TreeMap.

4.4. The Relationship Between the Leading Concepts

Using a thematic map, this study determined the relationship between the leading concepts explored, and the results are presented in Fig. 5 below. In bibliometric or thematic analysis, a thematic map is a strategic diagram that illustrates the relationships between various topics in terms of development (density) and relevance (centrality) (Tennekes, 2018).

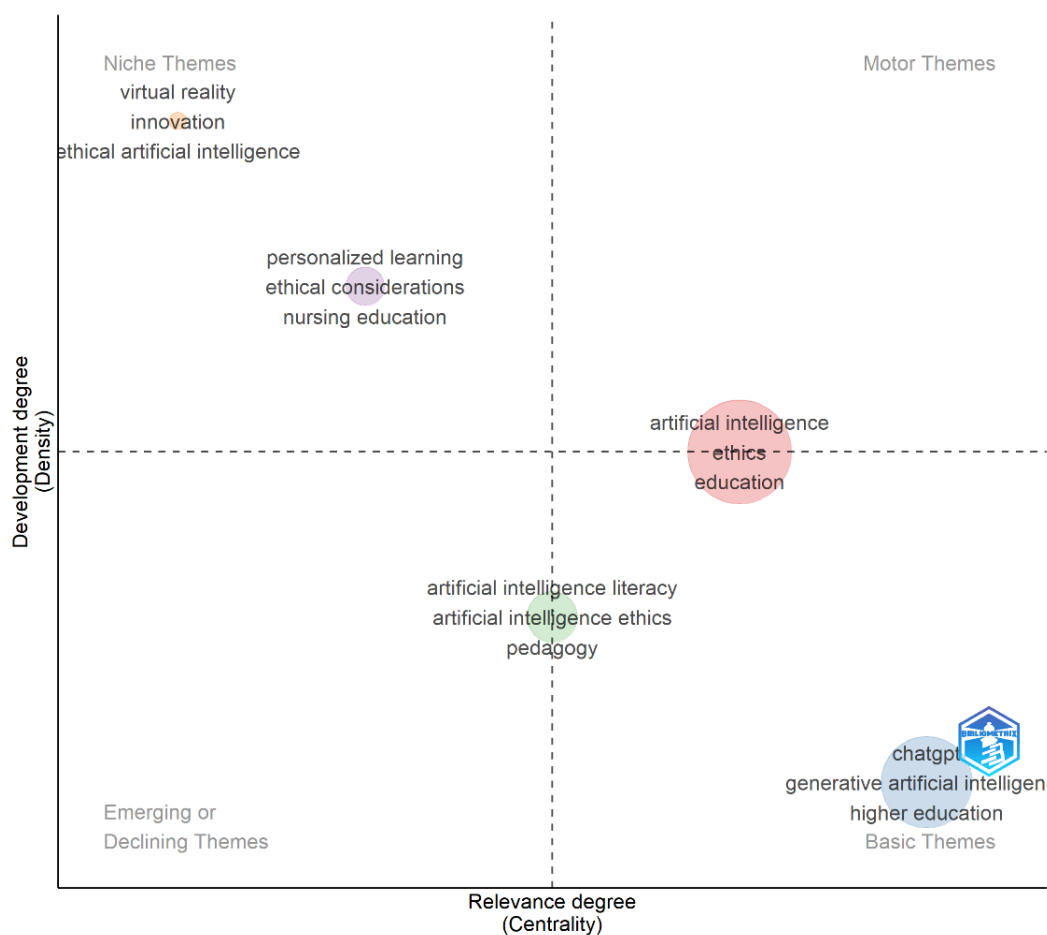


Figure 5. The Relationship Between the Leading Concepts

While the Y-axis displays the development degree (Density) of keywords, which indicates how well-developed or mature a theme is (its internal strength), the X-axis shows the relevance degree (Centrality) of keywords, which measures how significant or connected a theme is to other themes (its influence). “Artificial intelligence”, “ethics”, and “education” are well-developed and essential keywords in AI ethics in education, and they are included in the motor theme with high centrality and high density in the upper right. These keywords are core and mature topics that are driving the discussion of AI ethics in education. They are also central to the literature and highly interconnected, suggesting that they are either the leading current debates in the field or serving as a foundation.

The keywords “virtual reality”, “innovation”, “ethical artificial intelligence” and “personalised learning”, “ethical considerations”, “nursing education” are part of the niche theme with low centrality and high density in the upper left. Despite being well-developed and specialised, these keywords have few connections to other themes. Although they are well-researched and sophisticated subfields, they are not yet at the forefront of the larger discussion on the ethics of AI in education. In the lower right, the basic theme with high centrality and low density includes “ChatGPT”, “generative artificial intelligence”, “higher education”, and “artificial intelligence literacy”, “artificial intelligence ethics”, “pedagogy” as keywords. These keywords are important and widely discussed, but underdeveloped. They are essential to the discussion and appear in many works, but their conceptual or methodological treatment is still evolving, and this suggests a need for deeper exploration of ChatGPT and general tech tools in education ethics. No keyword appears on the emerging or declining theme with low centrality and low density in the lower left.

Part B: Teacher Candidates’ Perceptions

As teacher candidates are an integral part of the future of education, transferring values plays a great role. In this respect, it is crucial to assess their understanding of AI ethics in education. In addition, equipping them with the skills to apply AI in education based on ethical standards remains a key mission for effective pedagogies in teacher education programs.

4.5. Teacher Candidates’ Views on the Ethical Problems in the Application of AI in Education

To reveal teacher candidates’ views on the ethical issues in the use of AI in education, participants were asked to share their views on the ethical problems in the application of AI in education, and their responses were coded to create sub-themes and themes. The distributions regarding these themes are presented in Table 2 below.

Table 2: Teacher Candidates’ Views on the Ethical Problems in the Application of AI in Education

Codes	Sub-themes	Themes
Stress and anxiety, dependency, misuse in assessments, unfair advantage	Psychological impacts; Over-reliance; Academic integrity	Student Well-being and Learning Integrity
Bias & discrimination, digital divide	Algorithmic bias; Equity in access	Fairness, Bias, and Inclusion
Privacy & storage issues, opaque sourcing	Transparency in storage & destruction; Data governance	Data Ethics and Privacy
Unresolved labour practices in training data	Hidden labour; Fair compensation	Labour and Exploitation in AI Development
IP infringement, misuse for fake & misleading images	Copyright ethics; Harmful content creation	Intellectual Property and Misuse

Excerpts from teacher candidates’ responses that supported the above themes are presented below:

“I think that the stress and anxiety that students face in AI-supported learning environments today is increasing with the widespread use of these technologies in education”. (TC02)

“In my opinion, AI systems learn based on educational data mostly provided by humans, and sometimes they internalise the prejudices in this data and lead to biases based on ethnicity, gender or other personal characteristics”. (TC04)

“Although some big companies developing AI systems have claimed not to store users’ data, privacy is still a big issue in AI because no one knows where data supplied to AI systems is stored, and the process of retrieval and destruction of stored data is problematic”. (TC03)

“Educators must not shy away from equality problems such as the digital divide and disparity in access to technological devices and infrastructures when discussing the integration of AI applications into education as an ethical issue to enhance equal access”. (TC06)

“In academics, unethical use of AI can have negative impacts on academic integrity, where students only use AI systems for answering assessment questions rather than using these systems for personalised learning or as a guide”. (TC12).

“Instead of reading or consulting books for class work or academic tasks, some students use an AI system to solve questions. Instructors might see this set of students as brilliant students, while those who read several materials to construct their knowledge will be perceived as average students”. (TC32)

“I’m sure that it won’t be out of place if I should say that some of my colleagues cannot do anything on their own without AI, and they over-rely on AI now”. (TC33)

“I attended a workshop on the utilisation of AI systems to enhance academic writing, and one of the issues raised was who and how AI system developers generate data to train their machines. These questions remain unresolved to date, and this leads to the issue of hidden labour and questions about how those generating data were recruited and their remuneration scales”. (TC08)

“AI platforms have been used unethically to create unreal and foul images that can mislead unsuspecting audiences on social media platforms”. (TC19)

“AI developers have been accused of using third-party images in training their machines without getting necessary copyright approval”. (TC27)

Based on the participants’ responses on the ethical problems in the application of AI in education, privacy and storage issues and opaque sourcing were listed under the data ethics and privacy theme, followed by the student well-being and learning integrity theme that captured psychological concerns such as stress, anxiety, and dependency, and academic integrity issues such as misuse in assessments and unfair advantage in AI-supported learning environments. The ethical issues under the fairness, bias, and inclusion theme consist of algorithmic bias and equity in access. Other ethical problems highlighted by participants include hidden labour and fair compensation under the labour and exploitation in AI development theme, and the intellectual property and misuse theme that addressed copyright ethics and harmful content creation.

4.6. Solutions to Ethical Problems in AI

To reveal teacher candidates’ views on the solutions to the ethical issues in the use of AI in education, participants were asked to share their views on how the identified ethical problems in the application of AI in education can be resolved, and their responses were coded to create themes. The distributions regarding these themes are presented in Table 3 below.

Table 3. Solutions to the Identified Ethical Problems

Codes	Sub-themes	Themes
Development of national/institutional policies	Policy frameworks; Regulation and enforcement; Oversight and monitoring	Governance and Policy Frameworks

Establishment of international/national regulatory frameworks AI policy addressing data privacy, security, and justice Oversight functions by government/stakeholders		
Involving multiple stakeholders in AI design, testing, evaluation Transparency in AI development and data sourcing	Stakeholder participation; Transparency and accountability	Inclusive and Participatory Development
AI should accommodate diverse learning methods (personalised, differentiated, collaborative, creative, self-regulated learning, etc.)	Adaptability in pedagogy; Inclusive learning environments	Pedagogical Responsiveness and Inclusive Learning
Organising workshops, seminars, conferences for educators	Professional development; Continuous learning	Capacity Building and Continuous Professional Development

Excerpts from teacher candidates' responses that supported the above themes are presented below:

"I don't think there is a specific solution that fits all, but involving all stakeholders such as policymakers, educators, AI developers, students, etc. in the requirement gathering, testing, and evaluation process will go a long way". (TC20)

"Development of national or institutional policy frameworks that can address ethical problems can be a take-off point to tackle ethical problems in the application of AI in education". (TC26)

"I suggest that AI should be developed to accommodate diverse learning methods such as personalised and differentiated learning, language learning, critical thinking skills, active learning, adaptable learning, creating collaborative learning environments, creative learning, problem-based learning, project-based learning, self-directed learning, self-paced learning, self-regulated learning, and simulation-based learning environments". (TC40)

"My most important suggestion on the solutions is the establishment of regulatory frameworks and standards at international and national levels to ensure the ethical use of AI". (TC37)

"AI policy frameworks should cover the issues of data privacy, security, and algorithmic justice, and again, I suggest that society should educate people about the potential of AI technologies and their adverse effects of unethical use of AI". (TC29)

"There must be transparency on the part of those developing AI applications, who are those gathering data for training their systems? How much are they paying them? They owe the public the truth about these questions through transparency". (TC35)

"Government agencies and other stakeholders can engage in nonstop oversight functions to ensure ethical application of AI in education". (TC15)

"New AI systems are developed daily because AI is a topical issue, and for educators to keep up with the latest trends in the industry, workshops, seminars, and conferences should be organised for them to use AI in education ethically". (TC30)

Based on the participants' responses to the solutions for addressing ethical issues in the use of AI in education, policy frameworks, regulation, and enforcement, as well as oversight and monitoring, were proposed by respondents under the theme of AI governance and policy. The inclusive and participatory development theme includes stakeholder participation, transparency, and accountability, while the pedagogical responsiveness and inclusive learning theme includes adaptability in pedagogy and inclusive learning environments. The capacity building and continuous professional development theme addressed teachers' professional development and

continuous learning as part of the solutions to the identified ethical issues in the AI application in education.

5. Discussion

5.1. Annual Distribution of Studies on AI Ethics in Education

Annual publications in the early years (1980s-2018) of research exploration on AI ethics in education indicated minimal research interest, and a closer look at the study published in 1984 shows that AI was not used as an abbreviation or initialism for Artificial Intelligence, but for Amnesty International in the study (see Thomsen et al. 1984). Following McCarthy et al. (2006)'s coining of the term artificial intelligence in their 1955 research proposal, AI became the standard abbreviation or initialism for the term in technical writing and academic literature, while AI was chosen as Amnesty International's organisational acronym upon its founding in 1961, and by 1984 and before, Amnesty International was frequently mentioned in legal and academic writings using AI. Thus, context matters in the usage of AI as an abbreviation or initialism; AI always refers to artificial intelligence when used in a computer science or technology context, particularly in documents or conferences from the late 1950s onward. However, in legal, human rights, or non-governmental organisation contexts, particularly documents that mention Amnesty International, such as Thomsen et al. (1984) study, AI was used for Amnesty International. Research attention on AI and education probably has existed before and during the early periods, but little has focused on the nexus between AI, ethics, and education.

The discernible upward trend between 2018 and 2021 in this study gives credence to similar bibliometric findings of Luckyardi et al. (2025) and Rahmiyanti (2024). This upward trend between 2018 and 2021 represents the initial growth phase that succeeded the long period of minimal activity on AI ethics in education between the 1980s and 2018. Several factors, such as increased public discourse on AI ethics, bias, and fairness; the use of adaptive learning platforms in the classroom; and advancements in AI technologies through machine learning, deep learning, and intelligent tutoring systems, followed some AI winters. The exponential increase in research output on AI ethics in education between 2022 and 2024 can be linked to the introduction and globalisation of ChatGPT and other GenAI tools in late 2022, necessitating ethical discourse in education regarding plagiarism (King & ChatGPT, 2023; Sysoyev, 2024), algorithm (Slimi & Carballido, 2023), racial (Shanklin et al., 2022; Balakrishnan et al., 2025; Kapur et al., 2025), gender (Luckin et al., 2024; Mattiazzi, 2025), and other biases, data privacy issues, misinformation, and AI policy, the broad integration of AI in K-12, higher education, and healthcare training settings, equality issues in the integration of AI applications into education, unethical use of AI, security vulnerabilities, copyright concerns, over-reliance on AI, and hidden labour, all of which increase demand for research on AI ethics in education.

A cautious interpretation of the notable decline in 2025 can be linked to insufficient data for the year at the time of study, because many academic databases only update full-year publication counts retroactively, or the likelihood of another AI winter. The term "AI winter" refers to periods in the history of AI research that follow periods of great optimism and investment, characterised by declines in funding, public interest, and overall activity (Harguess & Ward, 2022). In the development of AI, these cycles of excitement and disappointment are common. The first, which lasted from 1974 to 1980, and the second, which lasted from the late 1980s to the mid-1990s, are the two most notable AI winters (Toosi et al., 2021).

5.2. Most Relevant Sources

The categorisation of the most relevant sources of studies on AI ethics in education into core education and AI, technical, medical, and emerging platforms aligns with the evolving ecosystem of AI ethics in education research. For instance, journals under the core education and AI category remain primary outlets for exploring AI ethics in pedagogical settings. Recently, studies such as

Wiese et al. (2025) in “Computers and Education: Artificial Intelligence” provide a cutting-edge analysis of pedagogical strategies, highlighting the challenges in content, assessment, and ethics pedagogy, noting that effective teaching draws on holistic case-based pedagogies and group work to develop ethical reasoning in applied contexts, and Mumtaz et al. (2025) in “Education and Information Technologies” investigates cultural variations among graduate business students in the U.S. and UAE. The study shows how cultural frameworks (e.g., Hofstede’s dimensions) shape ethical perceptions of AI use in learning, which are essential for designing equitable policies in multicultural classrooms. Thus, these two studies underscore the need for curriculum design that accounts for cultural context, assessment strategy, and pedagogical alignment with ethical outcomes. “AI & Society” as a journal under the technical and interdisciplinary category continues to emphasise philosophical and social dimensions, with discourses of fairness, transparency, academic integrity, and algorithmic accountability remaining central. Fyfe’s (2023) study addressed academic cheating with the aid of a GenAI system, and Ball and Koliouris (2023) discussed the role of philosopher engineers in deployment management, objective setting, and training of AI systems. Studies published under this category of journals show how ethics can be deeply integrated into system design rather than treated as a supplementary, and require interdisciplinary collaboration between engineers and educators.

The medical and health education journals category addressed the intersection of AI and professional training, highlighting unique ethical stakes. Ethical frameworks in health education signal the importance of domain-specific case studies and governance models that can be transferred to broader educational contexts. Yousef et al. (2025) recognised the significant potential of AI in enhancing medical education in limited resource environments by improving research efficiency and academic outcomes. Studies published on “BMC Medical Education”, “JMIR Medical Education”, and other related journals similarly address ethics in AI-supported simulations (Karabacak et al., 2023), assessments, and patient data use (Starr et al., 2023), emphasising the criticality of informed consent, accuracy, and human oversight. In addition, Marín et al. (2025) draw on health and medical contexts to flag concerns such as algorithmic bias, academic integrity, and data privacy in clinical and simulated learning tools, advocating for widespread institutional adoption of algorithm audits, data governance protocols, and policy clarity. Al-Ani et al. (2024) placed the responsibility of ethical application of AI in health and medical contexts on institutions, researchers, and governmental agencies.

Lastly, the emerging or supportive platforms category focused on student experiences and support structures, pointing to educational innovation via tutor training, institutional policy design, and awareness campaigns as key levers of ethical integration of AI into education. Alnsour et al. (2025) highlight the difficulties faced by peer tutors when students use GenAI like ChatGPT without disclosing their usage. Tutors encourage openness, motivational analysis, and group revision, which supports academic integrity and ethical discourse. To achieve ethical AI application in education, Amini et al. (2026) proposed four pillars of a novel student-centered framework as validation and source verification, transparency and acknowledgment, context-dependent similarity index, and direct source linking.

5.3. Leading Concepts (i.e., Keywords Explored)

“Artificial intelligence”, “generative artificial intelligence”, and “machine learning” constituting close to 40% of all keyword occurrences is a concentration that is not unique to this study. Recent bibliometric studies by Mittal et al. (2026), Durak et al. (2024), and López-Chila et al. (2024) reported that keyword usage remained anchored to broad, umbrella-level terms rather than differentiating into specific AI subtypes. This convergence of independently gathered data sets from diverse databases, timeframes, and academic fields suggests that the field has not yet differentiated into distinct sub-literatures around particular AI techniques or applications, but remains what Kuhn (1970) might term pre-paradigmatic, defining its bounds rather than testing mechanisms within a shared conceptual framework.

The result of “ChatGPT” having more occurrences than “large language model” and “chatbot” aligned with Farhat et al. (2023) findings that revealed an intense concentration of research activity around one specific product, with an unprecedented number of publications appearing in a short period after the November 2022 launch of ChatGPT. Similarly, Pradana et al. (2023) found that ChatGPT-specific literature formed a heavily inter-cited cluster by 2023, despite ChatGPT’s recent emergence. A systematic review by Ogunleye et al. (2024) noted that the majority of research on generative AI focuses on one commercial product, not the broader category of large language models. This is an important observation from the current study because an excessive focus on one commercial product can make the field’s findings potentially questionable. Conclusions of studies on ChatGPT and academic writing, ChatGPT and assessment design, or ChatGPT and misconduct might not be applicable to other LLMs with customised data, training, and safety measures. However, they are often presented as generalisable findings about the LLM category as a whole or used as a theoretical basis for recommendations concerning generative AI in general, which could be misleading.

Combining keywords like “ethics”, “artificial intelligence ethics”, “academic integrity”, “ethical considerations”, “plagiarism”, “privacy”, “data privacy”, and “bias” produces a combined share approaching that of ChatGPT alone, and this is not an isolated finding. Yu and Yu (2023) identified academic integrity, transparency, and accountability as the dominant thematic clusters in that space well before the ChatGPT wave, indicating that the ethics concern predates ChatGPT and has only been amplified by it. Qadhi et al. (2024) likewise found that issues of research ethics and integrity concerns are among the two or three thematic pillars in generative-AI-and-higher-education scholarship, besides pedagogical application and institutional policy. Ekundayo et al. (2024) reported similar and increasing emphasis on data privacy and bias as sub-themes in the ethics cluster. Thus, these findings support treating ethics as one of the field’s central pillars, if not on a par with the technology-adoption literature.

“Education”, “higher education”, and “medical education” captured under the Education-level terms cluster around institutional context rather than pedagogical mechanisms which cannot be isolated from other terms describing how learning actually changes. These terms are “personalised learning”, “pedagogy”, “critical thinking”, and “digital literacy”. This gap was explicitly noted by Ogunleye et al. (2024) that the larger part of extant studies focuses on detection of AI-generated text and institutional policy positioning, with comparatively little investigating how GenAI can be integrated into curriculum design, assessment redesign, or teaching delivery in a theorised way. Durak et al. (2024) also noted a similar imbalance, reporting that AIED research to date has been dominated by adoption and perception studies, rather than those that test specific instructional mechanisms. This suggests that the field might have been quicker to ask whether institutions should allow or restrict AI than to ask how learning itself is being reshaped by it.

5.4. The Relationship Between the Leading Concepts

The thematic landscape of AI ethics in education aims to establish the relationship between core concepts explored by authors by identifying which topics are well-established, which are emerging, and which need more traction. The key relational finding is that “ethics” does not stand distinctly apart from “AI” and “education” as an external addition. It holds the same motor-theme cluster position with both terms, at high centrality and high density. This signifies that it is simultaneously well-developed and highly interconnected with the field’s most connective concepts. This finding is replicated in Pinho et al. (2025), which revealed that ethics-adjacent terms were distributed across multiple structural positions, not limited to one peripheral location, and the GenAI and ethics pairing occupied the frontier of the basic and motor quadrant. Yu and Yu (2023) also found that ethics-related terms clustered with academic integrity and transparency as densely interconnected nodes rather than stand-alone foci, supporting the idea that the relationship between AI, education, and ethics is one of structural co-occurrence rather than ethics trailing behind as an afterthought.

The “ChatGPT”, “generative artificial intelligence”, and “higher education” cluster, along with the “artificial intelligence literacy”, “artificial intelligence ethics”, and “pedagogy” cluster, both occupy high centrality but relatively low density. In terms of structure, this indicates that both terms are constantly mentioned in the field's many sub-literatures, but have not yet consolidated themselves into a single coherent research program of their own. Pinho et al. (2025) found the same pattern for their AI and chatbot cluster (classified as basic and transversal) and their GenAI cluster (classified on the basic and motor frontier), concluding that these are shared infrastructural vocabulary running through the whole field rather than bounded sub-fields. Mittal et al. (2026) and Durak et al. (2024) both find converging evidence at a larger scale, both finding that generic AI and GenAI terminology recur across nearly every subject category in their datasets (education, health, business). This is exactly the profile of a high-centrality, still-developing basic theme. The relationship that this indicates is that GenAI technology functions less as its own specific research topic and more as a connective tissue linking otherwise separate conversations, medical education, pedagogy, integrity, and policy, without a fully mature theoretical core of its own.

Both niche clusters (“virtual reality”, “innovation”, “ethical artificial intelligence”, and “personalised learning”, “ethical considerations”, “nursing education”) appeared to be characterised by a high density but low centrality. This suggests that they are well-developed areas that have limited connections with other fields. Consequently, there is a third distinct location for ethics-adjacent vocabulary on the map (following the motor-theme “ethics” and the basic-theme “artificial intelligence ethics”). These terms are “ethical artificial intelligence” and “ethical considerations”. Pinho et al. (2025) found a similar pattern within their niche quadrant, as medical education, research ethics, and skills also formed a cluster of high-density and low-centrality terms. This suggests that the field has its own internal structure and has not yet integrated into the broader thematic area. Qadhi et al. (2024) also discovered that ethics discourse tied to specific professional or disciplinary contexts (health sciences in particular) tends to develop its own internally referential body of work that engages less with the broader AI-education ethics conversation than one might expect given the shared vocabulary. Summarily, this suggests that ethics-related fields have a unique pattern in the map, as they tend to appear as separate “islands” of research, which indicates that they develop their own internal theoretical frameworks rather than building upon a shared set of concepts.

No cluster in the present dataset belongs exclusively to the emerging or declining quadrant (i.e., of low centrality and density). In the same vein as Pinho et al. (2025), where an emerging quadrant was found in their own study, one of which comprised AI ethics and education, one can conclude that such a finding would be informative, not contradictory. Given the thematic map's sensitivity to the specific database, time window, and keyword field used to build it, identical underlying concepts (ethics, education) might show up as an emerging, still-forming theme in one study, but as a mature motor theme in another. Ogunleye et al. (2024) offered a methodological caveat along these lines that conceptual structure as determined by keywords is necessarily a snapshot bounded by the search string and time period used to define it, rather than an inherent property of the field itself. The relationship between concepts may not be fixed; it is actively being reorganised through increases in the volume of literature. The structural role of a concept (motor, basic, niche, or emergent) should always be interpreted as a statement about a particular corpus at a particular moment, rather than a permanent map of the field.

5.5. Teacher Candidates' Views on the Ethical Problems in the Application of AI in Education

Teacher candidates' views on the ethical problems in the use of AI in education when asked to share their views include racial, gender, and other biases, privacy problems, increasing levels of stress and anxiety in AI-supported learning environments, equality issues in the integration of AI applications into education, unethical use of AI, academic integrity issues, data breaches and security vulnerabilities, copyright concerns, over-reliance on AI, and hidden labour, captured under

five distinct themes, namely; student well-being and learning integrity, fairness, bias, and inclusion, data ethics and privacy, labour and exploitation in AI development, and intellectual property and misuse.

The psychological and pedagogical effects of AI in learning environments are encapsulated in the theme of student well-being and learning integrity. These include increased stress and anxiety, fewer opportunities for in-depth learning, and threats to academic integrity when students use AI outputs in place of independent study. AI tools, such as chatbots for mental health, can both promote well-being and increase anxiety in students who feel pressured to keep up with rapidly evolving technology or unclear institutional expectations. While Klimova and Pikhart (2025) documented the effects of AI and generative tools on student mental health and social functioning, Jukiewicz's (2025) results show how GenAI reshapes teaching and student wellbeing and call for pedagogies that deliberately attend to psychological impacts. In addition, an early trial of AI mental-wellness chatbots for college students by Reyes-Portillo et al. (2025) indicated their potential but also highlighted ethical trade-offs around privacy, efficacy, and dependency. Welding (2023)'s survey results show that more than 50% of college students agreed that the application of AI systems to complete academic tasks such as examinations and assignments is cheating and plagiarism, which are core components of academic integrity issues. Academic integrity concerns listed by participants buttress the positions of Kumar et al. (2024), Currie (2023), Mijwil et al. (2023), etc., on the risks AI systems pose to professionalism, ethics, and integrity. Teacher-education programs need to prepare aspiring educators to identify and reduce the negative effects of AI on students' well-being (such as stress and dependency) while also using tools sensibly (such as mental health resources). Therefore, methods for incorporating AI into pedagogical training can be used to enhance learning resilience and critical thinking rather than to replace them.

The fairness, bias, and inclusion theme concerns algorithmic bias, discriminatory outcomes, and unequal access. For instance, AI systems trained on historical or skewed educational datasets can perpetuate or amplify inequities (race, gender, socio-economic status). At the same time, differential access to devices and connectivity (i.e., the digital divide) makes AI's benefits unevenly distributed. Empirical findings of Boateng and Boateng (2025) and Gandara et al. (2024) indicate that predictive algorithms in higher education can produce racially disparate outcomes, emphasising the need for fairness audits. Iqbal et al. (2025) also proposed classroom interventions that teach students about bias and filtering in pedagogical modules, an essential part of responsible AI literacy. Teacher educators must prepare teachers to identify algorithmic bias, interpret model outputs critically, and design classroom practices that counteract biased recommendations (e.g., unfair placement, misclassification). Programs should include instruction on dataset representativeness, fairness metrics, and inclusive pedagogical practices.

The data ethics and privacy governance theme addresses how student and staff data are collected, stored, shared, and deleted by AI systems. Core concerns include non-transparent data retention practices, insufficient consent, lack of student control over personal data, and institutional governance gaps around third-party AI vendors. In support of this, the findings of Xue et al. (2025) comparative study also noted the critical concerns of AI-driven supervision, institutional governance, and student data security in both English and Chinese media. Imohimi (2025) added that the extensive use of AI models in digital education calls for data protection measures that shield students, most especially those who are younger, from surveillance programs that might violate their right to privacy. Teacher-education programs must prioritise teaching future educators about data stewardship, informed consent, and basic privacy protections so they can advocate for students and implement classroom safeguards. Higher education institutions should also include educators in procurement and governance decisions for AI tools.

The labour ethics and hidden “data work” theme highlights the invisible human labour that underpins AI development. Crowdworkers, annotators, and content curators whose work produces the training data might be experiencing ethical problems that include exploitative working conditions, lack of recognition, and opaque recruitment or compensation practices. Teacher educators should situate AI tools within their supply chains and model ethical procurement and critique, understanding that seemingly neutral educational tools are built on human labour whose welfare raises moral responsibilities. Morreale et al. (2024) case studies and Graham et al. (2025) reflective analysis also acknowledged hidden and precarious labour practices in AI training and called for transparency, fair pay, and ethical design practices. Zhang et al. (2025) buttressed the daily work conditions of AI trainers and the ethical consequences of “performative accuracy”. This indicates that education about AI should therefore include the socio-economic and labour dimensions of AI production. The intellectual property, misuse, and misinformation theme covers copyright infringement in training corpora, misuse of AI to generate deceptive content (deepfakes, fabricated images), and ethical questions about ownership and attribution of AI outputs. These abuses can harm reputations, spread misinformation, and create legal-ethical dilemmas.

Copyright concern is a major issue in image generation, especially in this era of Deep Generative Models (DGM), which is a significant development in image generation. To create high-quality images, large quantities of data that might often include copyright-protected data are required for training GenAI systems information (Lucchi, 2024). Ren et al. (2024) addressed copyright issues in DGM under data copyright protection and model copyright protection to capture the various parties (i.e. source data owners, DGM users, and providers) involved in the generation process. DGM cannot be exempted from the issue of unethical use of GenAI systems where they are deployed to generate abusive and unreal images and videos (i.e., deepfakes). For instance, numerous abusive and unreal images and videos exist in cyberspace that are capable of negatively affecting the human psyche, especially children who might think such images and videos exist, but in an actual sense, they are AI-generated. Okolie (2023) noted that the utilisation of GenAI for deepfakes is possibly a highly debatable topic due to ethical concerns. Thus, teacher candidates’ ethical concerns about DGM through deepfakes are not out of place because deepfakes are capable of igniting political, racial, gender, and religious problems. Teacher-education curricula should include critical media literacy, legal, and ethical literacy about IP and attribution. Teachers must be prepared to detect and respond to AI-generated misinformation and to teach students about ethical content creation and citation when using generative tools.

5.6. Solutions to Ethical Problems in AI

Teacher candidates’ views on solutions to the ethical issues of using AI in education incorporate governance and policy frameworks, inclusive and participatory development, pedagogical responsiveness and inclusive learning, as well as capacity building and continuous professional development, as suggested by participants. Participants stated that effective implementation of AI in education requires collaboration among diverse stakeholders, including educators, policymakers, and developers, unambiguous policies, and ethical standards at national and international levels are critical for ensuring the responsible use of AI in education, and transparency in AI development processes, including data sources and compensation, is necessary to build public trust and uphold ethical standards. The governance and policy framework’s theme reflects the role of structured guidelines, national and institutional frameworks, and international regulations in guiding the ethical adoption of AI in education. Governance through robust policies and regulatory structures ensures that ethical risks, such as privacy, justice, and accountability, can be systematically addressed, thereby reducing the arbitrary or exploitative use of AI in education. This theme argues that ethical AI in education needs clear and enforceable rules, starting from institutional guidelines to national and international regulations. Strong governance aligns technical practice (e.g., risk controls, assessment integrity) with legal and ethical duties (privacy, equity, accountability). Since strong policies and regulatory oversight are essential for ensuring

accountability and standardisation, teacher-education programs should prepare future teachers to work within and help shape policy for understanding risk-based classifications of AI (e.g., high-risk uses), data-governance requirements, assessment integrity rules, and procurement safeguards for third-party tools. It is also important to note that coursework can aid the translation of policy into classroom practices (e.g., disclosure norms, assessment design, reporting pathways). According to McMurtrie (2023), numerous higher education institutions have yet to develop their institutional policies on AI, leaving its adoption by educators and application by students at the discretion of educators. On a global scale, there are 195 countries recognised by the United Nations, and the OECD.AI (2024) database indicated that there are over 1000 AI policy initiatives from 69 countries, territories, and the EU. This implies that despite the global adoption and integration of AI systems, 126 countries are yet to set up national policies for AI, and this can create gaps to be unethically exploited in AI adoption and implementation, not only in education but in all spheres of life. Participants noted the relevance of oversight mechanisms required to address ethical challenges in deploying AI in education, and these oversight mechanisms can be explicitly highlighted in national, regional, and institutional policies on AI.

The inclusive and participatory development theme emphasises collaboration among all stakeholders (i.e., educators, developers, policymakers, and learners) to ensure AI systems are ethically designed, tested, and applied in education. This theme argues that ethical AI improves when stakeholders co-design it by collaborating on requirements, testing, evaluation, and transparency around data practices, including labelling and remuneration of data workers. Teacher-education programs can model participatory design (PD) in methods courses by having candidates co-create prompts, policies, and classroom AI workflows with students, and require transparency exercises (e.g., data-provenance audits) to build algorithmic accountability literacy. Mavri et al. (2025) and Eliassen and Lykke (2024) PD studies in education and adjacent domains show toolkits and co-design models that elevate end-user voice, improve fit-for-purpose EdTech and AI, and surface ethical concerns early.

The pedagogical responsiveness and inclusive learning theme views AI not as a one-size-fits-all tool, but as a pedagogical partner that supports differentiated, accessible, and ethically aware learning (e.g., explicit scaffolds for critical thinking, collaboration, reflective writing, and assessment authenticity). Iqbal et al. (2025) reinforced the link between pedagogy and responsible deployment through their work on educators' AI literacy, showing factors that shape ethical classroom use. García-López and Trujillo-Liñán (2025) argued that GenAI's potential requires instructional strategies to protect equity, privacy, and integrity. Awadallah Alkouk and Khlaif (2024) also recommended AI-resistant assessment practices that strike a balance between benefits and authenticity. Teacher-education curricula can integrate AI-aligned pedagogy (e.g., explainable feedback, transparency/disclosure routines, equity checks) and assess when to withhold automation to preserve productive struggle and academic integrity. Teacher candidates should learn to design assignments and policies where AI augments (not replaces) learning.

The capacity-building and continuous professional development theme focuses on equipping educators with the knowledge and skills necessary to use AI ethically in teaching and assessment. Training, workshops, and seminars are seen as critical for responsible adoption. Sustainable and ethical AI use depends on ongoing professional learning through workshops, peer mentoring, reflective practice, and communities of inquiry that evolve with the technology and policy landscape. This supports the position of Mah et al. (2025) for strong faculty demand for mandatory PD on AI ethics and institutional support, which can serve as an actionable signal for teacher-education design. Teacher-education programs should embed AI literacy (technical & ethical) across coursework and practical, build continuous professional development pipelines with schools and districts, and mentor novices in how to evaluate tools, interpret model outputs, and implement privacy and fairness safeguards.

6. Further Research Agenda

Researchers can explore cross-disciplinary evaluation of ethics pedagogy efficacy (quantitative learning outcomes, student moral reasoning), and co-design with students and tutors to build ethics guidelines that reflect lived educational experiences. Research attention should be diverted toward longitudinal studies on how policies (e.g., disclosure or domain-specific AI limits) impact academic integrity, equity, and student learning over time. Researchers can expand frameworks to include Global South contexts, student diversity, and non-Western educational values.

The necessity to bridge specialised AI disciplines, such as adversarial machine learning and contrastive learning, covered under niche themes with ethical and pedagogical narratives, has created research gaps that should be explored by researchers because these methods are powerful but underutilised within educational ethics. For instance, researchers can investigate how adversarial techniques might safeguard educational AI from manipulation (e.g., detecting plagiarism or misuse), and explore contrastive learning's role in delivering fairer educational recommendations. There are indications that AI tools are here to stay, and this presents the need for richer, theory-grounded frameworks for their ethical integration in learning environments.

The keyword “impact” under the emerging or declining themes with low centrality and low density can signal concept-level interest without empirical clarity. Researchers can replace these broad keywords with sharper, context-rich keywords such as “algorithmic transparency”, “student-AI agency”, or “assessment integrity”, etc., by filling the specificity gap with focused studies, not catch-all mentions. Future studies should examine both the supportive and detrimental effects of AI on student well-being, including stress, anxiety, and technology dependency. Longitudinal designs can explore how AI adoption shapes student resilience, coping mechanisms, and academic motivation over time. There is also a need for comparative research on AI-driven mental health tools (e.g., chatbots) to evaluate their efficacy, ethical trade-offs, and potential risks to student autonomy and data privacy. Researchers can investigate how AI influences academic honesty and the evolving definitions of plagiarism in AI-mediated environments. Beyond surveys, mixed-method studies could assess student and faculty perceptions of integrity in the age of GenAI, focusing on boundaries between acceptable support and unethical substitution. Interventions that cultivate ethical awareness and digital literacy in higher education require systematic evaluation. Future work should explore frameworks for integrating AI ethics and well-being into teacher preparation. Studies might test how pedagogical training can empower future educators to critically evaluate AI outputs, foster independent thinking, and safeguard student mental health. Comparative research across teacher-education programs globally could highlight best practices for embedding AI literacy and ethical reflexivity.

Future research should investigate how different models of professional development (e.g., workshops, peer mentoring, online training modules, micro-credentials) impact educators' AI literacy, ethical awareness, and classroom practice. Longitudinal and experimental studies can measure changes in teacher confidence, ethical decision-making, and student outcomes following training. Studies should examine strategies for embedding AI ethics into continuous professional development frameworks. This includes exploring reflective practice, case-based learning, and scenario-based training that allows educators to anticipate and manage ethical dilemmas in AI-supported teaching and assessment. There is a need for research on the sustainability and scalability of capacity-building programs, particularly in resource-constrained contexts. Comparative studies across regions and institutions could identify models of professional learning that remain effective as AI technologies and policies evolve.

7. Conclusion

The annual publications between 1983-2017 represent a niche or non-existent focus on ethics in AI and education, and the gradual increase between 2018-2021 indicated early engagement with ethical AI in digital learning. Exponential growth between 2022-2024 might have been

triggered by GenAI tools, which demanded urgent academic responses, and the apparent decline in 2025 is likely due to data lag, not an actual research drop. AI ethics in education as a research domain is experiencing rapid expansion, especially since ChatGPT was made available to the general public. There is a wealth of opportunity for original research, particularly in understudied areas like AI fairness in curriculum, student agency, and governance in educational settings. Researchers, policymakers, and educators are now urgently addressing AI ethics in formal learning systems.

The most relevant sources of studies on AI ethics in education indicated that the field is multidisciplinary, spanning education, technology, health, and societal impact. “Education and Information Technologies” is the most influential and prolific source, making it ideal for researchers aiming to publish or follow current thought leadership. While education-centered journals dominate in quantity, technical and medical sources show growing involvement, highlighting the cross-sector implications of ethical AI.

The conceptual map articulates that ethics is not a monolithic or uniformly positioned concept in this literature. It occupies at least three distinct structural roles simultaneously: a central, driving role alongside artificial intelligence and education, a transversal, infrastructural role tied to literacy and pedagogy, and a specialised, self-contained role within sector-specific applications such as nursing education.

Across all the themes, the study findings indicated that ethical AI is both a technical and a human problem: teacher education must combine technical literacy (what models do and can do), ethical reflection (values, privacy, fairness), and practical pedagogy (classroom policies, assessment design, and student support).-The overarching themes in teacher candidates’ likely solutions to the ethical problems in the application of AI in education underscore the importance of policy fluency, participatory design, ethical pedagogy, and continuous professional development ecosystems. These themes align with the broader vision of responsibly leveraging AI to enhance learning experiences while safeguarding societal values and individual rights. The findings of this study indicated that teacher candidates are conscious of the ethical issues surrounding the application of AI in education.

8. Implications for Policy and Practice

Since ethics is inherently intertwined with core AI-education discourse, policies that make AI adoption and AI ethics sequential concerns (adopt first, regulate ethics later) fail to grasp the field’s conceptual structure. Ethics needs to be embedded into AI-in-education policy at the point of adoption, because the research base does not separate these as sequential considerations. The low density of the ChatGPT and GenAI cluster relative to its high centrality implies that policy narrowly built around named tools risks relying on the least theoretically mature part of the evidence base. Policymakers should weigh guidance more heavily towards the motor-theme literature (AI, ethics, and education jointly), which is more conceptually settled, and treat tool-specific guidance as provisional and subject to revision. Policy should also be framed around functional capabilities of generative systems (text generation, code generation, personalisation, assessment simulation) rather than named vendors.

The structural isolation of clusters of sector-specific ethics (nursing education, health-related applications) suggests that policies addressing ethics may not be transferable between sectors. For instance, guidance developed within medical education on issues of ethics may not necessarily apply to K-12 or postsecondary education more generally, given the extent of differences evident in this domain. The field would benefit from a more focused set of sector-specific working groups that can feed into a shared central framework, rather than the reverse. The scale of the ethics and integrity cluster in comparison with the pedagogy cluster suggests that policymakers have, appropriately, prioritised integrity as an urgent first-order concern, but the evidence base of what actually works in redesigning the assessment, rather than just detecting or prohibiting the use of AI, is still limited. Funding bodies and accreditation agencies should consider designating specific

support for intervention studies (assessment models redesigned, AI-literacy curricula), rather than continuing to fund mainly descriptive or perception-based studies, which the current concept distribution suggests already dominate the field.

For practitioners and instructional designers, the very fact that ethics-related terminology occurs three times across clusters that have little conceptual overlap is a caution against thinking about “AI ethics training” as a monolithic whole. What the literature on AI ethics in the broad category of core-motors addresses (values-laden questions about AI and education itself) is not the same as what the literature on pedagogy adjacent to AI addresses (instructional literacy), which in turn differs from ethics-related questions raised in non-education domains like nursing education. In other words, when designing faculty development and student AI-literacy tracks, institutions should recognise the possibility that different modules address different types of ethics.

To advance this field, interdisciplinary research that ties technical capabilities to ethical frameworks, empirical studies spotlighting student voices, faculty practices, and policy landscapes, and curriculum development that treats ethics as the heartbeat, not an afterthought of AI integration, should be given attention. Policymakers should incentivise the advancement of AI systems that prioritise ethical considerations such as equity, privacy, and inclusivity, and educational institutions should incentivise open discourse among AI developers, educators, and teacher candidates to align AI technologies with instructional goals. Regular review and adaptation of AI policies in education should be undertaken to mitigate scepticism and fears about AI, ensuring its ethical application aligns with evolving societal and educational needs. Governments, institutions, and international bodies should collaborate to develop shared ethical standards for AI use in education, addressing global challenges like deepfakes, biases, and copyright infringements.

9. Recommendations

This study applied bibliometric analysis to evaluate the distribution of existing studies on AI in education and ethics using two databases (i.e., WOS and Scopus databases). Further studies can combine additional databases for the bibliometric analysis. It is also essential to note that the participants of this study were drawn from the students who registered for the course “Ethics in Education” from various fields of teacher education programmes in the Faculty of Education of Near East University, and the knowledge gained from the course might have influenced their responses. Further study can explore the possibility of developing research instruments that can be applied to a quantitative or mixed-method approach using a larger number of participants.

Ethical Approval: This study was approved by the Scientific Research Ethics Committee of Near East University.

Informed Consent Statement: Participants were informed of the study's objectives and their right to withdraw their consent at any time and for any reason, as required by research ethics. Written informed consent has been obtained from the participants to publish this paper.

Data Availability Statement: The data presented in this study are available on request from the corresponding author. The data are not publicly available due to the privacy of the participants.

Competing Interests: No potential conflict of interest was reported by the authors.

Funding Statement

No funding was received for conducting this study.

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