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Balancing Intelligence and Emotion: Mapping Global Research on Artificial Intelligence and Student Anxiety in Higher Education (2020-2024)

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Abstract. Generative AI technologies have changed how higher education works in terms of teaching and learning. Such changes opened up new dimensions, creating opportunities for students to personalize their learning effectively. Even with these improvements in AI technologies, there are many concerns about how higher education students would cope with the uncertainties that come with learning with AI. This bibliometric study aims to examine the research patterns on how AI affects students' anxiety in higher education worldwide. The study utilized VOSviewer to analyze data extracted from the Scopus database for the years 2020-2024, determining the performance, co-citation, and co-occurrence of studies. The results show a sharp increase in interest in the topic since 2020, with China, the US, and the UK charting the most contributions. Four main themes were identified: changing how teachers teach with AI, ensuring everyone feels included, addressing mental health, and utilizing smart technology ethically. The combination of education, psychology, and technology indicates how the research focus has changed over time. The results indicate that AI not only helps people generate new ideas but also causes mental stress for its users.

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The findings indicate that while AI supports idea generation and personalized learning, it also contributes to heightened psychological strain among students. By integrating educational, psychological, and technological perspectives, this study advances a theory-informed understanding of AI-related student anxiety and supports Sustainable Development Goal 4 (Quality Education) by advocating responsible, emotionally aware, and ethically grounded AI use in higher education.

Keywords: Artificial Intelligence (AI); higher education; student anxiety; generative AI; emotional well-being

1. Introduction

The rapid growth of generative artificial intelligence (genAI) systems like ChatGPT, Gemini, and Claude has completely changed higher education. These tools have changed the way students learn, write, and think by giving them rapid access to personalized explanations, essay drafts, and academic help. Tasks that used to take a lot of time and effort, such as writing reports, generating ideas, or editing academic work, can now be completed in a matter of minutes (Tzirides et al., 2023). This has led to a new wave of educational innovation, with genAI increasingly used in teaching and learning (Cacho, 2024).

Even though genAI has brought many positive effects to education, technological changes have had negative effects on people's mental health and moral stability. Students are becoming increasingly anxious about academic honesty. The reliance on AI-generated outputs has become questionable as they are becoming more efficient and easier to obtain (Sallam et al., 2024). Hence, teachers face challenges in balancing AI's potential for deep learning with its risks of harming pupils' cognitive and creative abilities (Li & Balinas, 2025).

In the last few years, empirical investigations have helped us understand this changing phenomenon. Researchers such as Kasneci et al. (2023) and Dwivedi et al. (2023) have discussed how genAI could support personalized feedback, better academic writing, and self-directed learning. These findings are supported by recent systematic reviews that show how AI can help students learn independently and think critically (Sardi et al., 2025). Likewise, research by Rudolph et al. (2023) and Cotton et al. (2024) shows that students have positive feelings about AI tools that help with language accuracy, organizing ideas, and motivating learning. This is supported by evidence that AI improves students' creative thinking and lowers their academic anxiety by making them feel more capable (Hwang & Wu, 2025).

However, such hope is tempered by signs of rising fear and moral conflict. Students are confused about what "acceptable AI use" means, which makes them feel guilty, anxious, and unsure of themselves (Wu & Dang, 2025). Other students worried that AI would take away human creativity and academic integrity (Chanpradit, 2025). These results align with studies worldwide that

show university students in healthcare and technological disciplines have significant concerns and suspicion regarding genAI (Sallam et al., 2025). Even with these concerns, universities worldwide are still split. Some include AI literacy in their courses, while others limit or even forbid the usage of generative AI (Chan & Colloton, 2024). This broken institutional approach is similar to the broader ambiguity in academic discourse, where the pros and cons of genAI in education remain hotly contested (Suprobo & Basuki, 2025).

Despite the rapid growth of empirical studies examining generative AI adoption in higher education, existing research remains fragmented across technological, pedagogical, and psychological domains. Many studies focus on academic performance, integrity, or usability, while the emotional and anxiety-related consequences of AI-mediated learning are often treated as secondary concerns (Bo et al., 2025). Moreover, prior reviews and bibliometric studies on AI in education tend to emphasize instructional innovation rather than student well-being. As a result, there is limited global-level synthesis that systematically maps how student anxiety emerges, evolves, and is theorized within AI-enhanced higher education contexts (Tiannan et al., 2025).

This bibliometric analysis provides a comprehensive, evidence-based overview of how students in higher education use generative AI. Instead of relying on small studies or single points of view, the analysis combines global data to help teachers and policymakers gain a clear understanding of how genAI affects students' learning and emotional well-being. These kinds of observations can help shape school regulations, AI-integrated curricula, and mental health support systems that encourage kids to use AI responsibly and in balance.

To reach this goal, the study is based on three main research topics:

1. What are the main performance trends in the literature on generative AI in higher education, particularly regarding students' use, perceptions, and anxiety?
2. What intellectual structures and foundational works underpin the field as revealed through co-citation analysis?
3. What are the dominant and emerging themes related to generative AI, student learning, and emotional responses in higher education as revealed through co-occurrence analysis?

2. Method

This bibliometric study uses a quantitative research approach to comprehensively map and analyze the scholarly landscape of the use of artificial intelligence (AI) in higher education, with a focus on its impact on students' well-being. Similar methods have been used successfully to examine how AI can help college students with their mental health and anxiety, showing that this field of research is growing rapidly and that researchers are working together across disciplines (Chen et al., 2024). On November 5, 2025, data will be taken from the Scopus database. This database was chosen for its extensive collection of peer-reviewed papers and its high-quality indexing criteria. The search technique utilizes relevant keywords like "artificial intelligence," "anxiety," and "higher education." The methods used

are based on recent bibliometric studies integrating PRISMA procedures with keyword co-occurrence mapping (Wider et al., 2024).

The retrieved dataset was exported in CSV format and refined using Microsoft Excel. Keywords were harmonized to ensure consistency by merging synonymous or redundant terms (e.g., "AI" and "artificial intelligence (AI)") to show consistency with recent large-scale educational AI analyses (Šijan et al., 2025). After data cleaning, the data were imported into VOSviewer (Version 1.6.20) for bibliometric mapping and visualization. This follows best practices from earlier reviews that used comparable tools for network and co-citation visualization (Kavitha et al., 2024).

Scopus was selected as the primary database due to its comprehensive coverage of peer-reviewed journals, strong international representation, and structured metadata suitable for bibliometric mapping (Bo et al., 2025). Compared to other databases, Scopus offers greater consistency in citation indexing, which is essential for co-citation and co-occurrence analyses. The bibliometric approach was adopted to ensure methodological rigor, transparency, and replicability by systematically identifying publication trends, intellectual structures, and thematic patterns across a large corpus of studies (Mee et al., 2025). This design enhances the reliability of findings by minimizing selection bias and enabling objective network-based analysis rather than subjective narrative interpretation.

3. Search Strategy

The bibliometric analysis used a structured search strategy in the Scopus database to ensure that all peer-reviewed literature on the relationship between artificial intelligence (AI), anxiety, and higher education was included. The search was conducted using the Boolean string TITLE-ABS-KEY ("artificial intelligence" OR "AI") AND ("anxiety") AND ("higher education") and limited to the years 2020-2024 to locate the most current changes in how generative AI is being used and how it affects students' mental well-being.

To ensure the data were interpreted correctly, only journal articles written in English were extracted. Besides, all open access content was chosen so that the articles may be easily shared and copied. The first search returned 4,020 documents, which were then narrowed to 1,006 eligible records by filtering for year of publication, document type, and language. From the number 641 studies were used for bibliometric analysis after reviewing and excluding articles that were not research or open access. VOSviewer and Excel were utilized to harmonize the data for consistency.

Table 1: Inclusion Criteria for Bibliometric Analysis

Scopus Database	ALL
Time period	2020 to 2024
Search field	TITLE-ABS-KEY
Search keywords	“Artificial intelligence” OR “AI” AND “anxiety” AND “higher education”
Document Types	Article
Language	English
Open Access	All Open Access

The keyword strategy was informed by prior bibliometric and systematic reviews on artificial intelligence in education and student mental health. Core terms such as “artificial intelligence,” “anxiety,” and “higher education” were selected to balance conceptual breadth with analytical precision. Exclusion of non-English publications, conference papers, and non-open-access documents was applied to ensure data quality, replicability, and accessibility. These criteria align with established bibliometric best practices and support consistent cross-study comparison.

Figure 1 presents the PRISMA flowchart, outlining the step-by-step procedure for identifying, filtering, and selecting papers relevant to the bibliometric analysis of AI-induced anxiety in higher education. The identification phase yielded 4,020 records from the Scopus database using predetermined keywords. During the screening phase, 2,241 records published outside the chosen time window (2020-2024) were excluded. This left 1,779 papers to be looked at more closely. The next step in the eligibility process was to use filters to retain only peer-reviewed English-language journal articles.

This stage removed 773 publications that were either not research-based or written in a language other than English. This left 1,006 full-text articles for eligibility screening. 365 papers were left out since they weren't open access, leaving 641 studies that satisfied all of the criteria for inclusion. These studies were considered appropriate for quantitative bibliometric mapping and Visualization. The PRISMA framework ensured that the methods were clear, cut down on selection bias, and kept a clear record of data refinement that was necessary for the analysis to be credible and reliable.

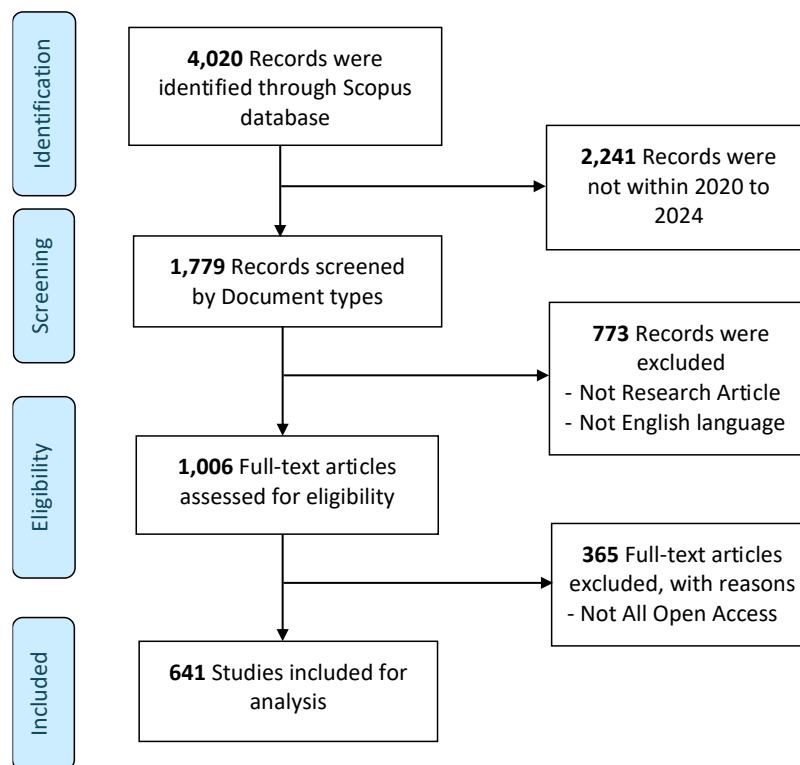


Figure 1: PRISMA Flowchart

4. Results

4.1 Performance Analysis

The performance analysis provides an overview of research worldwide on how artificial intelligence (AI) affects students' anxiety in higher education. The temporal distribution shows that publications grew quickly between 2020 and 2024. This is because generative AI tools are becoming more common, and researchers are becoming more interested in how they affect students' mental health. Sources show that the field is interdisciplinary, connecting educational technology, psychology, and sustainability studies.

4.1.1 Document by Years

From 2020 to 2024, the number of scientific articles on the issue of artificial intelligence (AI) and student concern in higher education grew quickly and steadily. In 2020, the first year, only 11 papers were published, which was the first time the research emphasis came to light. In 2021, this figure more than quadrupled (36), and in 2022, it doubled again (72). This shows that more people are aware of AI's effects on education and mental health. In 2023, there were 125 publications, far more than in 2020.

In 2024, there were 397 publications, which was a 36-fold increase from 2020. This rapid increase shows how quickly generative AI technologies like ChatGPT, Gemini, and Copilot are being used in schools, prompting new concerns about student fear, academic honesty, and reliance on technology. The growing trend shows that there is still significant interest in AI research worldwide, and that fear about AI has shifted from a minor issue to a major topic in educational psychology.

4.1.2 Documents by Sources

The distribution of publications among academic sources highlights the interdisciplinary character of AI-related anxiety research in higher education. *Computers and Education: Artificial Intelligence* has 30 articles, making it the best place to conduct research on AI in the classroom. *Sustainability (Switzerland)* comes next with 24, showing how the connection between technology ethics and sustainable learning ecosystems is expanding. *Frontiers in Psychology* (22) and *IEEE Access* (16) illustrate the dual emphasis on cognitive-emotional effects and technology design frameworks.

Journals such as *Heliyon* (13), *Frontiers in Education* (10), and *Education Sciences* (9) demonstrate how educational innovation and affective research can work together. The existence of *Language Testing in Asia* and the *International Review of Research in Open and Distributed Learning* signifies that regional and online learning environments are becoming increasingly crucial to conversation. In general, these sources show that research on AI and student anxiety spans a wide range of fields, including educational technology, psychology, and applied sciences that cross disciplinary boundaries.

4.1.3 Documents by Authors

The author's distribution shows that a group of experts is leading the way in research throughout the world studying the emotional and educational effects of AI integration. Chai, C.S., has eight publications, which show that they have consistently worked to improve AI literacy and teacher preparedness in higher education. Chadaga, K., Prabhu, S., Sampathila, N., and Sanusi, I. T. are among the new authors examining how AI affects students' mental and social health.

Each of them has published six to seven articles. Chiu, T. K. F., and Adelana, O. P. add to the conversation from the point of view, and Adelana, O. P., contributes to the conversation from the perspectives of digital pedagogy and educational design. Sallam, M., and Alam, S. add to the conversation from the point of view, and Alam, S., adds to the conversation from the perspectives of psychological and cross-cultural studies. The way the authorship is set up shows both worldwide collaboration and regional specialisation. This suggests that the area benefits from a mix of technological and human-centered knowledge. This variety of writers demonstrates the importance of AI-related anxiety research across different fields.

4.1.4 Documents by Organisations

Institutional affiliations indicate that Asian and Middle Eastern universities are well represented, suggesting that AI research in education is spreading worldwide. The Chinese University of Hong Kong has the most publications, with 15. The University of Johannesburg (13) and Manipal Academy of Higher Education (11) are close behind. Beijing Normal University and Prince Sattam Bin Abdulaziz University (both 11) have also made important contributions. This shows how important China and Saudi Arabia are to AI adoption and pedagogical studies. The Education University of Hong Kong and Nanyang Technological University are examples of institutions that are heavily involved in technology-driven education centers. At the same time, Princess Nourah Bint Abdulrahman University and Applied Science Private University demonstrate

that more women are becoming academic leaders and that researchers from different countries are working together. These affiliations show that AI-in-education research is moving to Asia and the Middle East, where the digital revolution and mental health awareness are advancing.

4.1.5 Documents by Countries

An examination of performance by country shows that China leads the world in AI-related higher education research, with 126 publications. This makes China the world leader in looking into educational technologies and student well-being. The United States (68) and the United Kingdom (54) come next, adding theoretical and moral frameworks based on higher education in the West. The fact that Saudi Arabia (51) and India (49) are at the top of the list shows how quickly AI is being adopted in emerging economies.

Australia (34) and Spain (32) are two examples of how research is becoming more popular in the Asia-Pacific and European regions. At the same time, Indonesia (29), Malaysia (27), and South Africa (26) show that developing countries are increasingly engaging with digital learning anxiety and AI literacy. This distribution shows a balanced worldwide research effort, with both developed and developing countries recognizing the psychological effects of AI-enhanced learning environments and contributing to policy-relevant knowledge for a fair and sustainable future in higher education.

Overall, the rapid growth and global distribution of publications reflect increasing scholarly concern over the psychological implications of AI integration in higher education. Such growth echoes prior findings that link accelerated technological adoption with heightened student anxiety, uncertainty, and ethical apprehension.

4.2 Co-Citation Analysis

The co-citation analysis identifies 10 foundational publications that jointly delineate the intellectual framework for research on artificial intelligence (AI) and student fear in higher education. Braun and Clarke's (2006) key work on thematic analysis, which has the most citations and links, anchors the area methodologically. This shows how important it is to examine students' emotional and psychological experiences with AI qualitatively. Ajzen's (1991) Theory of Planned Behavior serves as the theoretical foundation for comprehending user attitudes, perceived control, and behavioral intentions regarding AI adoption in educational settings. Zawacki-Richter et al. (2019) and Chen et al. (2020) provide thorough evaluations that outline the current state of AI applications in higher education, highlighting areas where educators are not involved and ethical concerns.

Table 2: Co-citations (Top 10 Articles)

Rank	Authors	Title	Citations	Total Link Strength
1	Braun & Clarke (2006)	Using thematic analysis in psychology	7	5
2	Ajzen (1991)	The theory of planned behavior	6	6
3	Zawacki-Richter et al. (2019)	Systematic review of research on artificial intelligence applications in higher education – where are the educators?	5	2
4	Chen et al. (2020)	Artificial intelligence in education: a review	4	5
5	Chiu & Chai (2020)	Sustainable curriculum planning for artificial intelligence education: a self-determination theory perspective	4	9
6	Al-Fraihat et al. (2020)	Evaluating e-learning systems success: an empirical study	3	1
7	Aldosari (2020)	The future of higher education in the light of artificial intelligence transformations	3	3
8	Alharbi (2023)	AI in the foreign language classroom: a pedagogical overview of automated writing assistance tools	3	6
9	Araujo et al. (2020)	In ai we trust? perceptions about automated decision-making by artificial intelligence	3	1
10	Ayedoun et al. (2019)	Adding communicative and affective strategies to an embodied conversational agent to enhance second language learners' willingness to communicate	3	5

Chiu and Chai (2020) use self-determination theory to suggest long-lasting AI-integrated curricula that promote independence and competence, which are important for lowering academic anxiety. Al-Fraihat et al. (2020) propose empirical methods for measuring the success of e-learning systems that link usability and satisfaction to student confidence. Aldosari's (2020) and Alharbi's (2023) works place AI changes and new teaching approaches in context, especially in language acquisition using automated writing tools. Araujo et al. (2020) discuss how people trust AI and see it as moral, a concern similar to those about fairness and openness. Lastly, Ayedoun et al. (2019) include communicative and affective methods into AI-driven learning environments, directly addressing emotional well-being and engagement. This research collectively establishes a cohesive theoretical and empirical framework for investigating the influence of AI on learning behavior, trust, and anxiety in higher education.

4.2.1 Co-Citation Analysis by Clusters

The co-citation analysis identifies four principal intellectual clusters that collectively influence the study domain concerning artificial intelligence (AI) and student anxiety in higher education. These groups show that research connecting technology, psychology, and education is constantly evolving across fields.

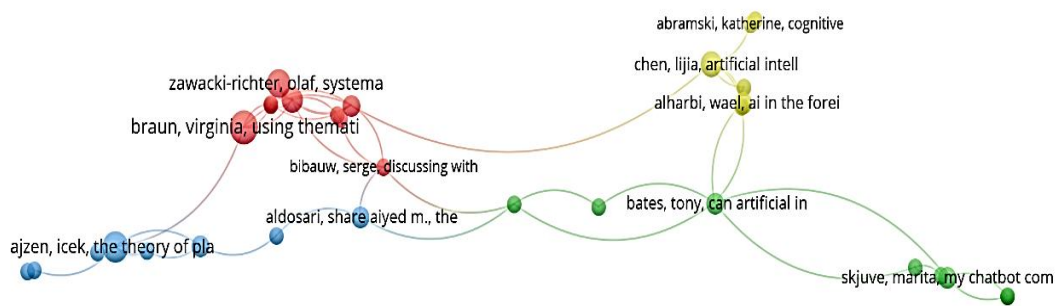


Figure 2: Co-citations Analysis (VOSviewer Visualization)

Cluster 1 examines pedagogical frameworks and students' emotional responses in AI-enhanced education. Chiu and Chai (2020) and Chai et al. (2021) are two important publications that focus on the self-determination and motivation components of AI curriculum planning. They stress the importance of student autonomy and participation. Zawacki-Richter et al. (2019) examine how AI is being used in higher education in a structured manner and find that teachers are not yet ready for it.

Braun and Clarke (2006) provide a methodological basis for examining the qualitative aspects of student experience, particularly anxiety and acceptance. Research such as Abbad et al. (2009) and Balakrishnan et al. (2022) investigates behavioral intention models in e-learning, correlating user pleasure and perceived competence with AI integration. This group of studies shows how AI use can affect teaching and learning, as well as emotional health, and how teacher preparedness, learning design, and emotional health all play a role in creating long-lasting AI-driven education practices.

Cluster 2 encompasses the technological and psychological factors influencing AI adoption, particularly through chatbots and intelligent agents. Ashfaq et al. (2020) and Suhaili et al. (2021) investigate the factors influencing user happiness and ongoing engagement with AI-powered chatbots, whilst Skjuve et al. (2021) explore human-chatbot interactions and emotional attachment. Avella et al. (2016) contextualizes this within the realm of learning analytics, highlighting the role of AI in augmenting personalization and monitoring student performance.

Theoretical foundations from Bandura (1989) and Bates et al. (2020) underscore self-efficacy and the possibility for transformative learning in AI-mediated contexts. Pillai and Sivathanu (2020) broaden this to practical settings, encompassing hospitality and STEM education. This cluster connects human-

technology interaction, cognitive psychology, and new ideas in education. It shows how emotional trust and perceived utility affect how people utilize AI in higher education.

Cluster 3 focuses on theoretical frameworks elucidating behavioural intention, technology acceptance, and perceived control in the context of AI adoption. Based on Ajzen's (1991, 2002) Theory of Planned Behavior and Bandura's (1977) self-efficacy theory, it combines motivational psychology with theories of technology acceptance. Venkatesh et al. (2012) expand upon this with the Unified Theory of Acceptance and Use of Technology (UTAUT2), offering strong indicators of AI adoption in educational settings. Bagozzi and Yi (1988) enhance methodological rigor in the assessment of structural equation models, which are frequently employed in such research. Aldosari (2020) situates these frameworks within the digital transformation of higher education, whereas Cetinic and She (2022) associate innovative uses of AI with user cognition and aesthetic perception. This cluster represents the intellectual basis for comprehending how psychological constructs regulate AI engagement, especially in alleviating fear and boosting confidence among students.

Cluster 4 encompasses the latest discussions regarding cognitive, ethical, and pedagogical challenges arising from AI in educational settings. Abramski et al. (2023) and Altmäe et al. (2023) examine the cognitive biases and moral problems that arise with AI models like GPT-3 and GPT-4. They show how algorithmic bias is similar to student worry. Burkhard (2022) and Alharbi (2023) examine AI writing assistance and students' perceptions of automated feedback. This is because people are worried about relying too much on technology and not thinking enough. Chen et al. (2020) establish the cluster by conducting an exhaustive analysis of AI applications in education, delineating both potential benefits and hazards. These studies collectively indicate a transition from AI adoption to a critical examination of its cognitive and emotional ramifications, compelling educators to reconcile innovation with ethical considerations and student welfare in higher education settings.

This intellectual structure is consistent with earlier research on students' engagement with AI in higher education. Students' responses are shaped not only by technological affordances but also by behavioral intention, self-efficacy, and perceived control. These psychological factors are closely associated with anxiety in academic decision-making.

Table 3: Co-citation Analysis by Clusters

Cluster No and Colour	Cluster Labels	No. of Articles	Representative Publications
Cluster 1 (Red)	Pedagogical Integration and Emotional Dimensions of AI Learning	9	Abbad et al. (2009); Balakrishnan et al. (2022); Braun & Clarke (2006); Chai et al. (2021); Chiu & Chai (2020); Zawacki-Richter et al. (2019)
Cluster 2 (Green)	Technological Adoption and Human-AI Interaction	8	Ashfaq et al. (2020); Avella et al. (2016); Bandura (1989); Bates et al. (2020); Suhaili et al. (2021); Pillai & Sivathanu (2020); Skjuve et al. (2021)
Cluster 3 (Blue)	Behavioral Intentions and Acceptance Models in AI Use	8	Ajzen (2002); Ajzen (1991); Aldosari (2020); Bagozzi & Yi (1988); Bandura (1977); Cetinic & She (2022); Venkatesh et al. (2012)
Cluster 4 (Yellow)	Cognitive and Ethical Challenges in AI-Supported Learning	6	Abramski et al. (2023); Alharbi (2023); Altmäe et al. (2023); Burkhard (2022); Chen et al. (2020)

4.3 Co-Occurrence Analysis

The co-occurrence analysis shows the main ideas and new themes that have emerged in research on AI and students' concerns in higher education. The most important keyword, "artificial intelligence" (139 times; 480 total link strength), holds the network together and underscores its importance in defining modern educational research. The words "human" (35) and "student" (29) show how much attention is paid to how people and AI interact and how students feel in tech-mediated settings. The fact that mental health (17) and anxiety (connected through related terms) come up so often shows that people are becoming more worried about the emotional effects of AI-driven learning.

Table 4: The 15 Most Frequent Keywords in the Co-Occurrence Analysis

Rank	Keyword	Occurrences	Total Link Strength
1	artificial intelligence	139	480
2	human	35	280
3	student	29	207
4	article	27	248
5	covid-19	19	124
6	machine learning	19	113
7	chatbot	19	69
8	mental health	17	145
9	education	17	87
10	chatgpt	15	32
11	teaching	14	92
12	e-learning	14	81
13	adult	13	138
14	female	11	105
15	higher education	11	22

At the same time, machine learning (19) and chatbots (19) are technology tools that are improving education, especially through automated feedback and tutoring systems. The fact that ChatGPT (15) is included shows that interest in generative AI tools has grown a lot since 2023. Keywords such as e-learning, teaching, and education (14-17) show how AI is being used in the classroom, while demographic-related keywords such as adult, female, and higher education refer to analyses that are both gendered and inclusive. The whole network has 1,782 nodes, 670 links, and a total link strength of 1,723. It shows how technology, education, and psychology are converging in the evolving conversation around AI and student well-being.

The prominence of mental health, anxiety, and ethical technology-related keywords indicates that emotional well-being has become a central concern in AI-related educational research. This concern appears alongside ongoing pedagogical innovation in higher education. Such patterns reinforce prior studies that caution against treating generative AI adoption as a purely technical or instructional matter.

4.3.1 Co-Occurrence Analysis by Clusters

The co-occurrence analysis identifies four principal thematic clusters that delineate the conceptual framework of research concerning artificial intelligence (AI) and student fear in higher education. Cluster 1 (Pedagogical Transformation in AI-Enhanced Learning) shows how AI, e-learning, and virtual reality are transforming how universities teach and learn, with a focus on interactive, personalized learning experiences. Cluster 2 (Human-Centered and Demographic Dimensions) concentrates on the human and social aspects of AI integration, tackling inclusion, gender disparities, and the emotional variability of learners in digital contexts. Cluster 3 (Psychological Well-being and Emotional Responses) centers on the affective outcomes of AI adoption, particularly anxiety, emotion regulation, and mental health challenges intensified during the COVID-19 pandemic.

Lastly, Cluster 4 (Technological Ethics and Intelligent Educational Systems) emphasises the importance of ensuring that AI applications such as chatbots and ChatGPT are ethical, open, and accountable to support educational ecosystems that are safe for the mind and the environment.

Cluster 1 focuses on the changes in teaching and learning that are happening in higher education as AI and immersive technologies change the way people learn. The words "student," "e-learning," "teaching," "higher education," and "virtual reality" show how digital platforms are becoming a part of everyday education. This group of articles shows how AI-powered tools and virtual environments make teaching more interactive, accessible, and personalized. The link between learning systems and virtual reality shows that immersive learning experiences are becoming increasingly popular, as they are lower cognitive barriers and encourage participation.

Much of the research in this group examines how teachers and schools adapt to AI-enabled teaching methods and how these changes affect students' motivation, performance, and anxiety. Overall, this group shows a time of change in higher education, when teaching methods change to find a balance between new technologies and human-centered learning in AI-mediated classrooms.

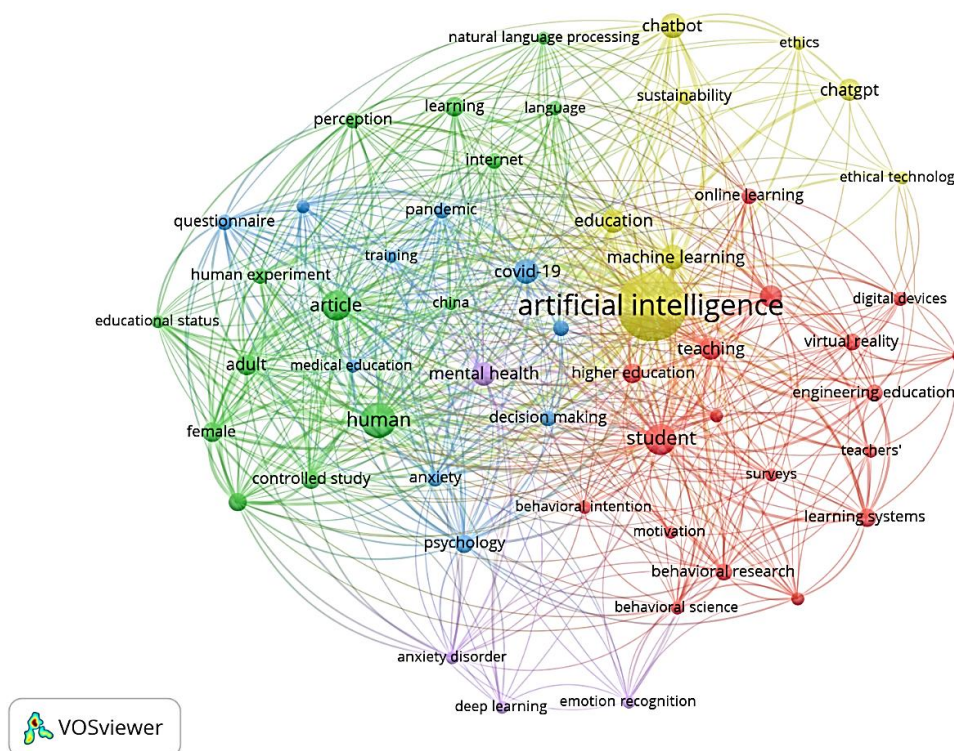


Figure 4: Co-Occurrence Analysis (VOSviewer Visualization)

Cluster 2 examines the human and demographic dimensions of AI-related educational research. The main words that stand out are "human," "adult," "female," "male," and "learning." These words show that the focus is on including

everyone, recognizing gender differences, and recognizing the psychological diversity of learners in AI-supported environments. The existence of a controlled study and publication indicates the empirical rigor and methodological sophistication in the analysis of human–AI interactions. This group shows that AI's effect on education goes beyond only cognitive achievement; it also affects social, emotional, and identity-related areas. Studies in this area generally look at how adults, especially women, deal with anxiety when studying online, which shows how important it is to have personalized support systems. This group ultimately places AI adoption within a larger humanistic framework, acknowledging that technology's role in education must be guided by diversity, empathy, and ethical considerations.

Cluster 3 focuses on the emotional and psychological aspects of using AI in education. Words like worry, emotion, psychology, decision-making, and pandemic show that people are very interested in how AI technologies affect people during the COVID-19 epidemic. This group shows how the pandemic sped up the use of AI-based e-learning technologies, which made students' mental health problems worse. The relationship between COVID-19 and decision-making shows how stressful and unclear it is to switch to learning through technology. Research within this cluster often examines the impact of AI-driven educational environments on students' cognitive load, emotional regulation, and perceived control – elements intricately associated with anxiety and motivation. In general, this theme stresses that psychological adaptability is just as important as technological preparation in higher education's AI revolution. It calls for digital pedagogies that are attentive to mental health.

Cluster 4 discusses the moral and technological bases of AI's role in education. Artificial intelligence, machine learning, chatbots, ChatGPT, and ethical technology are among the main buzzwords indicating that more and more researchers are interested in how intelligent systems can be developed, used, and have moral consequences in learning. This group shows how generative AI and conversational agents are becoming important parts of modern teaching, prompting discussions about authorship, bias, and responsible use.

The connection between education and ethical technology shows that the current conversation goes beyond just how things work. It also involves how schools can help students and teachers learn about AI and ethics. A lot of research here looks at how tools like ChatGPT affect the authenticity of learning, critical thinking, and academic honesty. This group of articles shows that there are two problems with using AI for innovation: ensuring its use aligns with educational values and upholding ethical accountability. Collectively, these thematic clusters indicate that student anxiety in AI-mediated higher education is not an isolated emotional response. Instead, it is a multidimensional outcome shaped by pedagogical practices, psychological pressures, and ethical uncertainties.

Table 5: Co-Occurrence Analysis of Keywords

Cluster No and Colour	Cluster Label	Number of Keywords	Representative Keywords
Cluster 1 (Red)	Pedagogical Transformation in AI-Enhanced Learning	18	'student', 'e-learning', 'teaching', 'higher education', 'learning systems', 'virtual reality'
Cluster 2 (Green)	Human-Centered and Demographic Dimensions of AI Research	14	'human', 'article', 'adult', 'female', 'male', 'learning', 'controlled study'
Cluster 3 (Blue)	Psychological Well-being and Emotional Responses to AI	10	'Covid-19', 'psychology', 'anxiety', 'emotion', 'pandemic', 'decision making'
Cluster 4 (Yellow)	Technological Ethics and Intelligent Educational Systems	8	'Artificial intelligence', 'chatbot', 'ChatGPT', 'education', 'machine learning', 'ethical technology'

5. Discussion

This study advances theoretical understanding by positioning student anxiety as a central construct within AI-mediated higher education research. The co-citation analysis reveals that foundational theories such as the Theory of Planned Behaviour and Social Cognitive Theory remain influential, while newer pedagogical frameworks, including Self-Determination Theory, increasingly integrate emotional regulation and motivation. By synthesising these perspectives through bibliometric mapping, the study extends existing technology acceptance models to explicitly incorporate psychological well-being, thereby addressing a critical gap in AI-in-education research.

The findings of this bibliometric analysis indicate that both co-citation and co-occurrence analyses show a rising academic concern about generative artificial intelligence (genAI) and students' anxiety in higher education. The performance analysis showed an increase in publications from 2020 to 2024. The data indicates a rapid integration of generative AI tools such as ChatGPT and its implications for students' psychological and educational well-being. The results from co-citation analysis show the integration of behavioral intention models (Ajzen, 1991; Bandura, 1977) into pedagogical frameworks, highlighting students' stress motivation, emotional control, and self-determination in learning with AI.

The clustering of keywords strengthened the links between the four broad areas of educational change, human-centered inclusion, psychological well-being, and ethical AI practices. These clusters demonstrate how genAI makes learning accessible to suit students in higher education. In contrast, the study highlights the concerns about anxiety, trust, and digital ethics among students in using AI. The current research dimension calls for a more balanced approach to combining new technologies with emotional support systems and ethical literacy in

education. This will ensure that AI-driven education will not only help students to excel but also strengthen their mental well-being.

5.1 Implications

The study enhances understanding of artificial intelligence (AI) and its contributions to psychological and educational theories, highlighting students' experiences in higher education. The co-citation analysis suggested that the fundamental frameworks, including the Theory of Planned Behavior (Ajzen, 1991) and Social Cognitive Theory (Bandura, 1977, 1989), support the study on the impact of perceived control, self-efficacy, and attitudes on technology acceptance and anxiety.

Thus, to highlight motivation and emotional control in AI-mediated learning, the models were incorporated into contemporary frameworks, like Self-Determination Theory (Chiu & Chai, 2020). By connecting technology acceptance to emotional aspects, this synthesis advances the field of educational psychology, an area that has yet to be extensively explored in AI research. The results of this study were consistent with recent studies (Zawacki-Richter et al., 2019; Chen et al., 2020) that emphasize how theory-driven frameworks link cognitive engagement with emotional well-being in digital learning environments.

In addition, the practical implications indicate the usefulness of information on how AI could be used responsibly in higher education. The performance and co-occurrence analyses revealed that a high number of researchers are becoming increasingly interested in research on anxiety, ethics, and trust. Such an increase indicates the importance of comprehensive AI literacy programs that not only teach technical skills but also emotional and ethical skills. This not only helps students feel less confused and anxious but also enables teachers to give out clear rules and systematic advice on the use of AI tools like ChatGPT (Alharbi, 2023; Burkhard, 2022).

Additionally, institutions can tailor their teaching methods to mitigate mental health issues by personalizing AI-enabled programs with psychological support services. Such programs encourage students to be more confident and resilient online. These implications suggest that the future of AI in higher education depends on striking a balance between technological progress and emotional intelligence. However, such progress should consider human values and ethical stewardship in order to create a safe and fair learning environment.

At the institutional level, higher education providers should move beyond restrictive or permissive AI policies toward structured governance frameworks that integrate AI literacy, ethical guidance, and mental health support. Professional development programs can equip educators to scaffold responsible AI use while mitigating student anxiety. At the policy level, these findings support the development of internationally aligned guidelines for ethical AI adoption in higher education, ensuring that technological innovation advances alongside student well-being and inclusiveness in line with Sustainable Development Goal 4.

6. Conclusion

This bibliometric analysis provides a comprehensive examination of the global research landscape on artificial intelligence (AI) and student anxiety in higher education. The findings indicate an increase in scholarly focus from 2020 to 2024. The results from the extracted data show that AI technologies, especially generative tools like ChatGPT, have the capability to change personalized learning in matching students' needs. In contrast, such advancements also raise new psychological, ethical, and pedagogical problems for students in higher education. Co-citation and co-occurrence analyses revealed four predominant themes, namely instructional innovation, human-centered inclusion, psychological well-being, and ethical AI integration.

The study aligns with the global views surrounding Sustainable Development Goal (SDG) 4 on Quality Education. The results highlight the dual role of AI in education, functioning as a catalyst for learning as well as a cause of cognitive and emotional stress among students in higher education. Therefore, future research should focus on the creation of emotionally intelligent AI systems. Institutes of higher education should develop institutional frameworks that foster technological proficiency and student well-being, where AI could be used in a fair and inclusive way. The outcomes of digital change in education could then remain humane, ethical, and sustainable.

7. References

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