



AI-POWERED HUMAN-COMPUTER INTERACTION: A BIBLIOMETRIC STUDY

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Abstract: This study presents a thorough analysis of the Artificial Intelligence (AI) and Human-Computer Interaction (HCI) intersection, with the aim of identifying important trends, themes, and influential research in this rapidly changing field. The integration of AI into HCI has resulted in significant advancements across various domains, such as healthcare, education, and user experience design. Although there is a growing interest in this area, the number of studies is still limited, and the research is gradually increasing. This study aims to fill the gap by providing a comprehensive overview of the current literature, focusing on the gaps, emerging trends, and future directions in AI-driven HCI. The research methodology adheres to the PRISMA protocol, which guarantees a systematic and clear review process. A total of 84 peer-reviewed publications from the Scopus database, spanning a 30-year period from 1994 to 2025, were examined. The research corpus was subjected to bibliometric analysis, Social Network Analysis (SNA), and text mining techniques to map the landscape of AI and HCI research. The study also recognized key authors, influential countries, and significant academic sources contributing to this field. The results of the analysis identified five primary thematic groups: Explainable AI (XAI), Human-Computer Interaction (HCI) and AI in Education and Training, Human-Robot Interaction (HRI), and AI and User Experience (UX). These themes emphasize the wide-ranging applications of AI in HCI, such as enhancing diagnostic precision in healthcare, personalizing educational content, and enhancing user experience through adaptive and emotionally intelligent interfaces. However, the study also revealed significant gaps in the existing literature, particularly regarding ethical considerations, transparency, and user control. The analysis indicates that ethical issues are not adequately emphasized in current research, suggesting a crucial area for future investigation. The study suggests that while AI has considerable potential to transform HCI, its successful incorporation will depend on addressing these gaps and ensuring that AI-driven systems prioritize human-centered design principles. The results also highlight the prominent role of countries like the People's Republic of China (PRC) in advancing this field, and emphasize the need for broader international cooperation. This research provides a deeper understanding of the evolving landscape of AI and HCI and serves as a foundation for future studies.

Keywords: Artificial intelligence, Human-computer Interaction, Explainable artificial intelligence, Human-centered design, Human-robot interaction, Social network analysis

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1. Introduction

Human-computer interaction (HCI) research has been a remarkable success and has significantly transformed the field of computing. Human-computer interaction (HCI) has undergone significant evolution since its inception, moving from simple user interface design to the integration of complex systems (Myers, 1998). HCI has continually advanced to improve the interaction between humans and machines, and its scope has expanded to encompass a wide range of disciplines, including psychology, design, ergonomics, and cognitive science (Dix, 2017). This evolution reflects technological advancements, which have enabled the development of more sophisticated and effective HCI systems.

The advancement of Artificial Intelligence (AI) has significantly impacted the field of human-computer interaction (HCI), leading to a new era of innovation in the way we interact with technology (Alkathiri, 2022).

AI-driven systems have made it possible for user experiences to be more intuitive, adaptive, and personalized, thereby transforming the essence of human-computer interactions.

The convergence of Artificial Intelligence (AI) and Human-Computer Interaction (HCI) marks an important joint in the advancement of technology. The integration of AI's cognitive capabilities into HCI frameworks is transforming the manner individuals interaction with digital interfaces (Usmani et al., 2024). This convergence is driven by the need to develop more intuitive, adaptive, and personalized user experiences that provide the evolving needs of individuals in an increasingly digital world. The coordination of AI and HCI holds significant implications across various industries, including healthcare, education, entertainment, and manufacturing. AI's growing capacity to analyze vast amounts of data, identify patterns, and make informed decisions, HCI



systems can anticipate user requirements, deliver customized recommendations, and facilitate seamless interactions (Xu et al., 2023). This enhances efficiency, productivity, and user satisfaction, ultimately shaping the future of human-computer interactions.

This integration of AI and HCI has created new research opportunities, enabling investigations into the potential of intelligent systems to comprehend, anticipate, and respond to human requirements in increasingly complex and refined ways. This research aims to investigate the intersection between AI and HCI by a bibliometric overview, utilizing the PRISMA protocol to systematically identify and analyze key trends, thematic clusters, and influential studies in the past decade.

1.2. Literature Review

Integration and convergence of HCI and AI has been studied in different aspects by various scholars in different fields. Contemporary literature indicates that AI and HCI research encompass a diverse array of subjects, such as the ethical uses of AI-driven systems, the improvement of user experience through adaptive interfaces, the incorporation of AI into immersive environments like virtual reality, and the utilization of AI for personalized education and healthcare solutions. Nazar et al. (2021) examined the difficulties and possibilities of HCI and Explainable Artificial Intelligence (XAI) convergence in the healthcare industry. They emphasized the significance of explainability and user-centered design principles in AI applications. The main finding of the study is that explainability in AI is crucial for building trust and ensuring effective user interaction in healthcare applications. In another aspect Wang et al. (2023) studied the relationship between in education field. Their work examines the application of human-computer interaction (HCI) and deep learning to assess and enhance teaching efficiency in the fields of innovation and entrepreneurship. According to their research, incorporating human-computer interaction and deep learning algorithms greatly improves the evaluation of innovation and entrepreneurship education by addressing the deficiencies in conventional assessment techniques and delivering a more comprehensive examination of classroom performance and student conduct.

Further studies of AI and HCI also covered the realm of perception and psychological effects such as Kosch et al. (2023) in the field. Their research focuses on investigating the placebo effect of user expectations on the evaluation of adaptive AI systems in human-computer interaction, exploring how system descriptions can influence perceived performance and user satisfaction. This research indicates that user expectations play a significant role in the assessment of AI systems, emphasizing the importance of accounting for placebo effects in human-computer interaction studies. Similarly Nicolescu and Tudorache (2022) analyzed the perception of HCI and AI, focusing on the psychological effects. In their paper, they examined

customer experience with AI chatbots, identifying key factors that influence user satisfaction and future usage intentions. The research highlights that the combination of chatbot-related, customer-related, and context-related elements affects customer perceptions and emotions when interacting with AI chatbots, ultimately impacting their behaviors towards both the technology and the company. This underscores the intricate nature of customer experience in this particular domain.

In the current literature, it is acknowledged that the human element plays a crucial role in the field of HCI and AI applications. According to Xu (2019) some perspectives underscore the importance of adopting a comprehensive human-centered AI framework for creating AI solutions that are both ethical and explainable. By doing so, AI can enhance human capabilities and foster user trust and confidence.

Taking into account the aforementioned factors, it is clear that the literature examines the coordination of HCI and AI across a variety of domains, focusing on their psychological, technological, and educational aspects. While several systematic reviews have been conducted within this framework, it can be contended that a comprehensive study encompassing all of these discussions is still lacking. One noteworthy bibliometric analysis in this context is by Šumak et al. (2021). The study aims to systematically review and analyze existing research in the field of Human-Computer Intelligent Interaction (HCII) and Intelligent User Interfaces (IUI), identifying trends and conducting demographic analyses within this area. The study concludes that despite significant growth in research related to HCII and IUI, there remains considerable confusion in the classification of these concepts, a lack of qualitative user studies, and a pressing need for more philosophical inquiry into the ethical implications of intelligent solutions.

A recent bibliometric study conducted by Nicolescu and Tudorache (2022) examined factors that influence customer interactions with AI chatbots in the realm of customer service. Their paper, "Human-Computer Interaction in Customer Service: The Experience with AI Chatbots," analyzed 40 empirical studies to provide insights into how chatbot functionality, system design, and anthropomorphic features affect user perceptions and behaviors. By categorizing these factors into user-related, context-related, and technology-related aspects, the authors highlight the importance of a well-designed chatbot in enhancing customer satisfaction and engagement. Their research underscores the growing significance of AI chatbots in customer service and emphasizes the need for further investigation to optimize their performance.

Given the considerable influence of AI and human-computer interaction (HCI) across various industries, including healthcare, education, entertainment, and manufacturing, existing systematic reviews often fail to provide a comprehensive overview. Typically, these reviews concentrate on specific aspects of the field. To

bridge this gap, the current study employs a holistic approach by synthesizing the entire body of literature at the intersection of AI and HCI. This method seeks to provide a more comprehensive understanding of the field, enabling a clearer vision of the general trends and patterns prevalent in the literature. In this sense the study aims to investigate these research questions:

1. What is the general bibliometric outlook about HCI and AI relationship?
2. What are the patterns and research trends about HCI and AI?

2. Materials and Methods

This study aims to investigate the HCI and AI relationship in the current literature by conducting a bibliometric analysis (Donthu et al., 2021) to systematically review the current literature on HCI and AI. The methodology includes traditional bibliometric analysis, analytic approaches, and data mining. Network analysis and text mining is used to plot the current status with data visualization (Aggarwal, 2015). To conduct the research PRISMA protocol is used (Page et al., 2021).

The research corpus consists of peer reviewed publications written in English and indexed by Scopus. The search strategy utilizes a combination of Boolean operators 'OR' and 'AND' to capture relevant publications. The search queries included: ("human-computer interaction" OR "HCI") AND ("Artificial Intelligence" OR "AI").

Table 1. Information on the research corpus and search queries

Research Corpus	
Database	Scopus
Period	1994-2025
Search Query	("human-computer interaction" OR "HCI") AND ("Artificial Intelligence" OR "AI").

This research employs four steps of data analysis procedures to examine articles, assuming that the title, abstract, and keywords encapsulate the essence of academic publications. Initially, conventional bibliometric analysis techniques are applied to offer a general overview of the research corpus. PRISMA protocol is used to retrieve data from the research corpus.

Social network analysis (Serrat, 2017) is performed to visualize and identify collaborative networks among researchers, institutions, and research communities, shedding light on knowledge diffusion and patterns of collaboration.

R Studio is used to analyze the retrieved dataset of 84 publications, including articles and conference proceedings papers. Several R packages are specifically designed for bibliometric analysis, such as 'bibliometrix' or 'Rbibliometrics,' which are used for plotting the data.

3. Results and Discussion

3.1. General Bibliometric Outlook

In this study, a 30-year period has been considered to better analyze the intensity of different studies in the fields of HCI and AI, taking into account developments in computer science and HCI. Interestingly, as shown in the Figure 1, research on AI within the HCI field began to gain significant momentum in 2016 and saw a major surge during the COVID-19 pandemic, reaching its peak during that time.

Articles with the highest citation scores were primarily focused on human-computer interaction, artificial intelligence, deep learning, and the internet of things (IoT). As shown in Figure 2, these articles emphasized the main keywords related to their topics, citation paths, and interlinkages between authors and citations.

The most relevant academic sources for articles were Lecture Notes in Computer Science, Innovations in Artificial Intelligence and Human-Computer Interaction, and International Journal of Human-Computer Interaction as shown in the Figure 3.

Most influential researchers were Xu (2019) with his paper on promoting a human-centered approach to artificial intelligence (AI) and machine learning (ML) development titled "Toward human-centered AI: a perspective from human-computer interaction" with 212 citations on Scopus database, and Lisetti & Schiano (2000) with their work on developing an automatic facial expression interpreter with AI cited 155 times on Scopus as shown in Figure 4.

A total of 29 countries contributed research on HCI and AI, demonstrating the widespread nature of the field. The PRC led the way with 58 publications, followed closely by India with 36, the USA with 15, and Germany with 14. These four countries accounted for the majority of the publications in this domain, as shown in Figure 5.

The majority of the study's research papers (n=49) come from the HCI field, making it the most prominent area. The research on AI (n=31) represents the second-largest field, as shown through the analysis of the Scopus database. As anticipated, topics connected to machine learning, deep learning, and their applications occupy a substantial portion of the research corpus, as depicted in Figure 6. Furthermore, although it is present at a smaller scale, the theme of ethical technology within the field signals promising future directions and emerging trends.

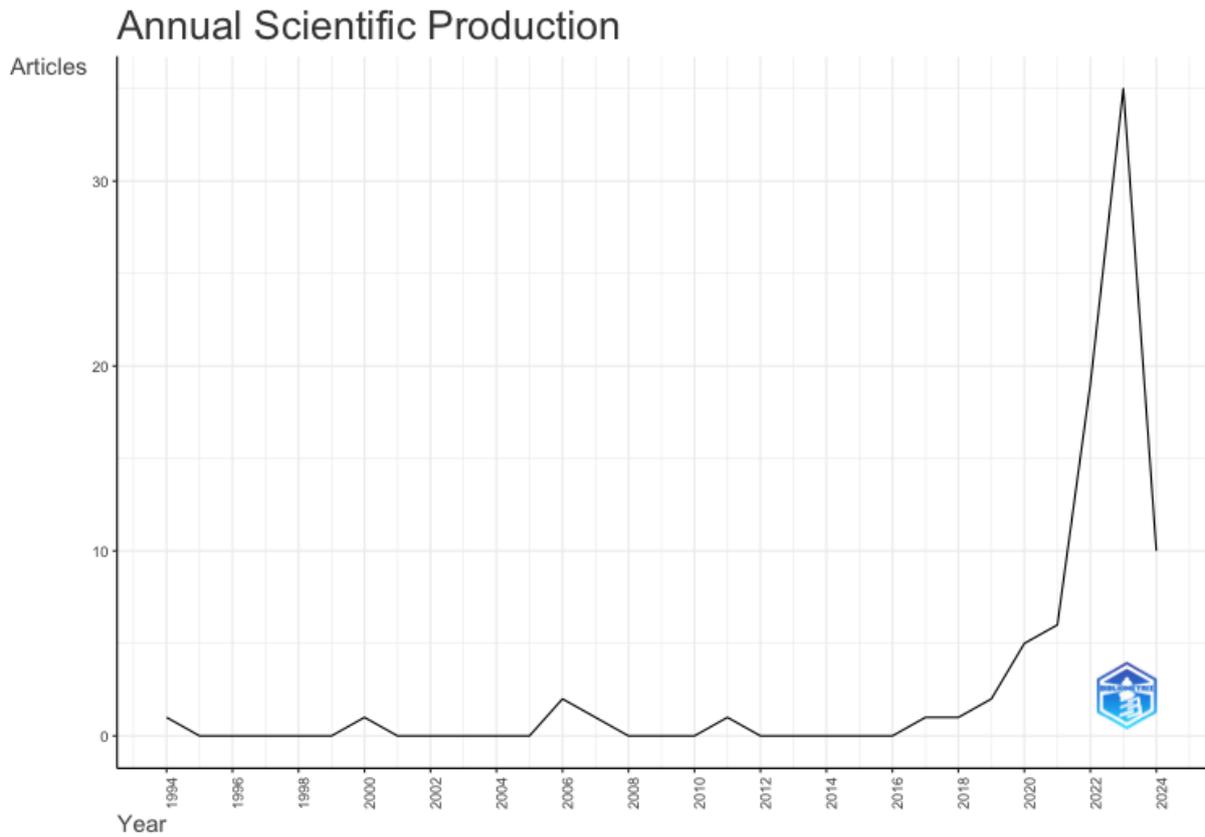


Figure 1. Timeline of publications on HCI and AI in the literature.

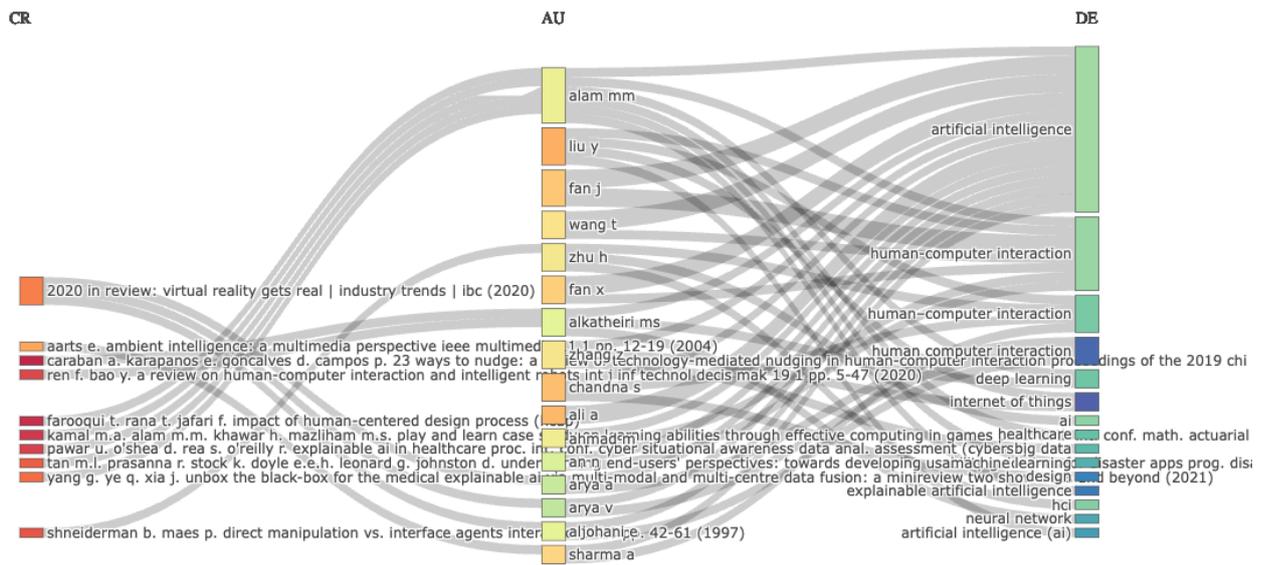


Figure 2. Citation paths and most cited keywords in the related works.



Figure 3. Most relevant sources of academic research on HCI and AI.

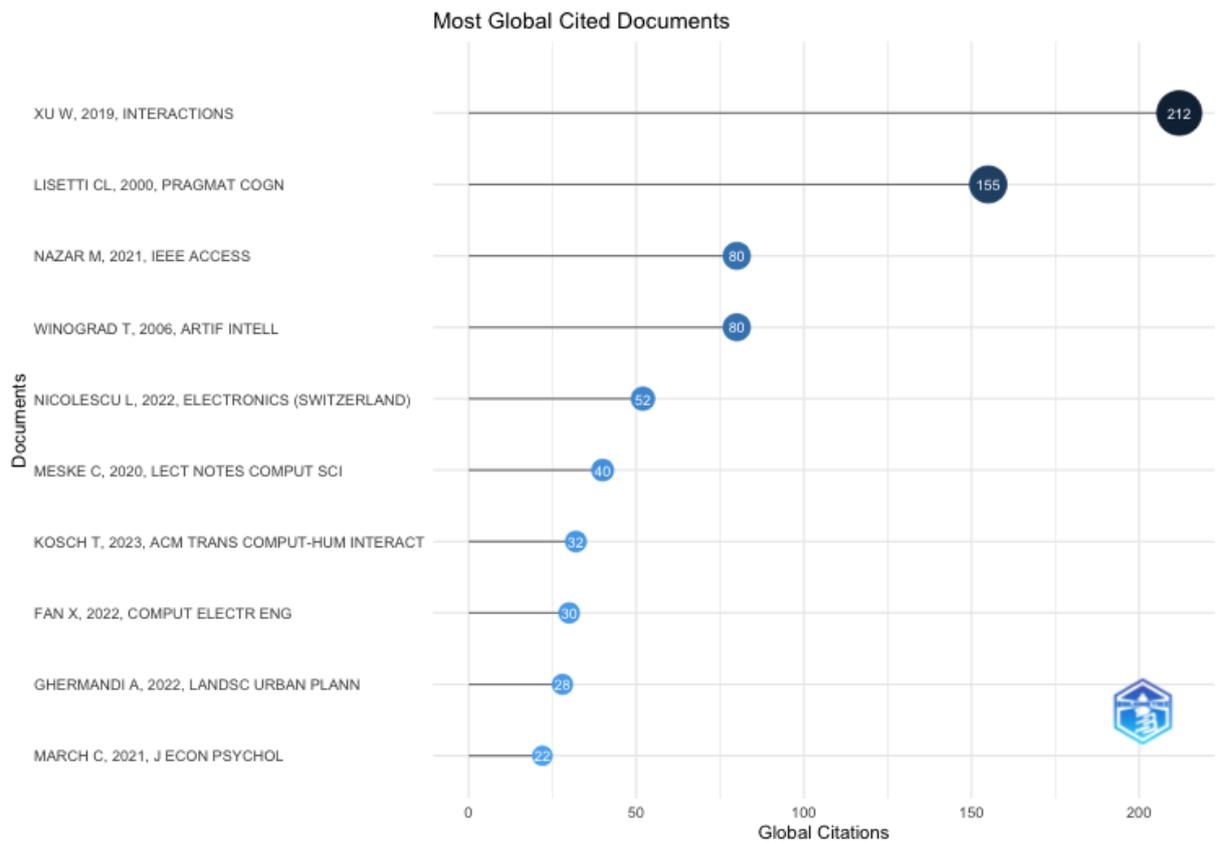


Figure 4. Most influential research on HCI and AI on Scopus database.

Country Scientific Production

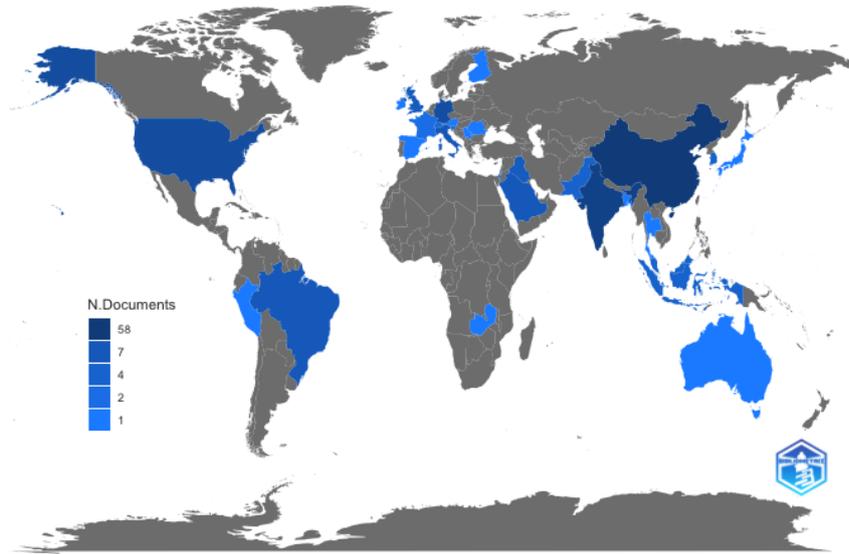


Figure 5. Contributions of the countries to the field.



Figure 6. Subject areas plot.

3.2. Social Network Analysis

Social network analysis (SNA) was implemented to examine the connection between the tags and keywords in the research papers. This method provides effective ways to summarize and understand network structures, identifying vital individuals or objects that occupy significant positions within a map matrix (Tabassum et al., 2018). Keywords act as granular representations, and analyzing the links in relation to these keywords is essential for comprehending the network's structure. The SNA of the keywords is illustrated in Figure 7.

Five themes emerged from the SNA analysis of abstracts, tags, and keywords of the research corpus obtained from Scopus database. (1) Explainable AI (XAI): The

importance of clarity and transparency in AI systems, especially in crucial sectors such as healthcare, has been a consistent topic. Researchers have explored various techniques for creating explanations, assessing their usefulness, and tackling the obstacles of trust and prejudice in decision-making that relies on AI. (2) HCI and AI in Education and Training: The use of AI to improve learning experiences, customize educational content, and support intelligent tutoring systems is another key area of focus. Research in this cluster examines the integration of AI across different educational contexts, such as language acquisition, skill development, and academic administration. (3) HCI and AI for Healthcare: The literature suggests that AI has the

experiences. Their article highlights that incorporating inquiry-based learning with the aid of artificial intelligence use in HCI in English language teaching considerably augments students' critical thinking competencies and cultivates enduring learning aptitudes. The main idea put forward is the combination of Artificial Intelligence (AI) and Human-Computer Interaction (HCI) to improve educational and training experiences in this theme.

3.2.3. HCI and AI for healthcare

Third theme emerged from SNA of the research corpus is titled as HCI and AI for Healthcare. This theme highlights the capacity of AI to transform healthcare by enhancing diagnostic accuracy, offering personalized treatment suggestions, and streamlining patient monitoring through Human-Computer Interaction (HCI). According to the paper "Human-Computer Interaction in Intelligent Medical System under the Background of Artificial Intelligence" written by Zhou (2022), the connection between artificial intelligence (AI) and human-computer interaction (HCI) has advanced to a higher level of intelligence. These systems are capable of understanding and responding to human behaviors and emotions, resulting in improved efficiency and quality of user interactions through innovative interface designs that incorporate cognitive, behavioral, and emotional aspects of the user experience. Similar to the first theme, Nazar et al. (2021) highlights the significance of incorporating user-centered design principles in the development of AI applications, underlining the necessity of comprehending the healthcare professionals and patients' needs and preferences to create effective and user-friendly AI tools for the medical field's human-computer interaction (HCI) design. The significant influence of artificial intelligence in healthcare, particularly in human-computer interaction, is highlighted by its emphasis on user-centered design to create sophisticated, responsive, and user-friendly medical systems that improve both diagnostic accuracy and patient care.

3.2.4. Human-robot interaction (HRI)

According to **Figure 7**, HRI appears as a separate cluster of publications that emerged from the network analysis of the specified research corpus. Research on human-robot interaction (HRI) aims to enhance trust, safety, and user experience. This area of study examines the obstacles in designing and evaluating interactive systems that facilitate effective collaboration and communication between humans and robots. As a result, it has become an increasingly popular field of research. For instance, Maruyama (2022) states that the crucial connection between Human-Computer Interaction (HCI) and Artificial Intelligence (AI) is essential for reenvisioning how humans and AI robot scientists can evolve together in scientific practices. This emphasizes the importance of efficient collaboration and interaction that can improve both human and machine intelligence while addressing ethical and sustainability concerns. Similarly, the study conducted by Govindaraju and Thangam (2024) also

highlights the importance of understanding emotions in human-machine interactions and how it can be applied to improve the design and evaluation of interactive systems for seamless collaboration and communication between humans and robots. The incorporation of emotional intelligence into robotics emphasizes the significance of designing human-robot interactions that are both intuitive and emotionally responsive.

3.2.5. AI and user experience (UX)

The last theme that emerged from the research corpus's Social Network Analysis (SNA) is the significant influence of AI on user experience, with a particular emphasis on personalization, adaptivity, and emotional intelligence. The research conducted by Stige et al. (2023) presents a comprehensive examination of the incorporation of artificial intelligence (AI) in the user experience (UX) design process. This study emphasizes the potential of AI to improve various stages, such as comprehending user context, recognizing requirements, assisting in designing solutions, and evaluating outcomes. The paper highlights particular AI tools and methods that can streamline various aspects of user experience (UX) design, thereby enhancing productivity and innovation. The study is structured around a user-centered design paradigm, spotlighting shortcomings in existing literature and proposing potential avenues for future research, particularly in the realm of alternative design methodologies and gathering initial data from professionals in the field. The results highlight the significant influence of AI on UX design and emphasize the need for more research into its successful integration and the consequences for designers. According to Virvou (2023), AI has the potential to dramatically improve User Experience (UX) by providing personalized and efficient experiences. However, it also presents challenges related to trust, explainability, and the need for user control. To address these issues, it is important to carefully balance the benefits and drawbacks of AI, taking into account the insights gained from historical human-computer interaction (HCI) research and ongoing exploration of the interrelationship between AI and HCI. The research on AI and UX examines the significant part AI plays in enhancing the UX design process, encompassing the comprehension of user requirements to the assessment of results, while simultaneously recognizing the obstacles that emerge, including problems connected to trust, clarity, and user authority.

The recent incorporation of Generative AI (GenAI) has sparked a significant transformation in personalization within UX design. Unlike conventional AI systems that depend on set parameters, GenAI allows for the real-time creation of customized content and interfaces, tailored to the specific intentions of users (Peláez et al., 2024). This transformation from 'static' personalization to 'generative' personalization allows HCI systems to provide more intuitive and context-aware experiences (Huang, 2023). As noted in recent literature, the ability of Large Language Models (LLMs) to understand and

generate natural language has lowered the barrier for complex human-machine interactions, effectively turning the user interface into a fluid, conversational dialogue rather than a set of rigid menus(Okpala, 2024).

4. Conclusion

This research intended to provide a comprehensive bibliometric overview of the intersection between Artificial Intelligence (AI) and Human-Computer Interaction (HCI) by analyzing 84 peer-reviewed publications, sourced from the Scopus database, spanning a period of 30 years (1994-2024). The study employed the PRISMA protocol to systematically identify and synthesize key trends, thematic clusters, and influential research within this domain.

The Social Network Analysis (SNA) performed on the research dataset uncovered five key themes: Explainable AI (XAI), Human-Computer Interaction (HCI) and AI in Education and Training, HCI and AI for Healthcare, Human-Robot Interaction (HRI), and AI and User Experience (UX). These themes demonstrate the broad range of AI applications in HCI, encompassing advancements in educational technologies, healthcare diagnostics, and user experience through personalization and emotional intelligence. The study's results reveal the significant potential of AI to transform HCI by facilitating more responsive, intuitive, and adaptive systems. However, despite these promising advancements, the research also uncovered several important gaps in the existing literature. Firstly, there is an urgent need for further research into the ethical implications of AI in HCI, with a particular focus on issues such as transparency, trust, and user autonomy. Although Explainable AI (XAI) has emerged as a critical area of study, current research efforts are insufficient in addressing the intricacies of building AI systems that are both explainable and trustworthy. The current literature does not emphasize ethical considerations enough, highlighting a significant gap that needs to be addressed. Secondly, while there has been a growth in studies on AI and HCI, the field remains relatively under-explored. This limited body of work suggests that there is ample scope for future research, particularly in investigating new applications and refining existing methodologies.

The ongoing expansion of research in this area is attributed to the growing incorporation of artificial intelligence into a multitude of human-computer interaction aspects. Regionally, a limited number of countries have demonstrated significant influence, with the People's Republic of China (PRC) spearheading the efforts. The PRC has generated the highest volume of publications, trailed by India, the United States, and Germany. Collectively, these nations account for the bulk of the research output, which underscores their innovative contributions to both AI and HCI. However, the worldwide distribution of research is still unbalanced, emphasizing the importance of fostering broader international collaboration and participation.

In conclusion, the potential for innovation at the intersection of AI and HCI is extending across numerous domains such as healthcare and education. Nevertheless, to fully realize this potential, it is crucial to bridge existing gaps in the literature, particularly those concerning ethics, trust, and user experience. As AI technology continues to advance, future research must concentrate on developing frameworks that guarantee AI systems are not only efficient but also aligned with the values and requirements of the individuals they serve. Ultimately, the successful incorporation of AI into HCI will hinge on balancing technological breakthroughs with ethical considerations, ensuring that AI-driven systems augment human capabilities while preserving user trust and autonomy.

Finally, the rapid emergence of GenAI marks a transformative era for the AI-HCI intersection. This transition moves beyond simple task automation toward a collaborative partnership between humans and machines. While GenAI offers unprecedented opportunities for creativity and accessibility, it also necessitates a critical focus on human-centered design to mitigate risks such as algorithmic bias and the loss of user agency. Future research should prioritize maintaining human control within these increasingly autonomous and generative digital ecosystems.

Author Contributions

The percentages of the author' contributions are presented below. The author reviewed and approved the final version of the manuscript.

	M.E.D.
C	100
D	100
S	100
DCP	100
DAI	100
L	100
W	100
CR	100
SR	100
PM	100
FA	100

C= concept, D= design, S= supervision, DCP= data collection and/or processing, DAI= data analysis and/or interpretation, L= literature search, W= writing, CR= critical review, SR= submission and revision, PM= project management, FA= funding acquisition.

Conflict of Interest

The author declared that there is no conflict of interest.

Ethical Consideration

Ethics committee approval was not required for this study because there was no study on animals or humans.

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