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Exploring the Scholarly Landscape: AI Teaching and Learning in Adult Education

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Abstract

Examining the scope of research on AI teaching and learning in adult education is important for keeping up with current trends. It also helps find gaps that need more research in this area. This study conducts a comprehensive analysis of citation metrics in AI teaching and adult learning up to August 20, 2023, utilizing a Bibliometric analysis approach. This paper examines 435 selected papers that assess key citation metrics (total citations, citations per year, per paper, and per author) to gauge research impact. The main result shows that a significant increase in research output since 2009, with 2022 being the year of highest publication volume. The findings reveal robust scholarly engagement, articles and conference papers dominate this field, comprising 89.66% of the corpus, with peer-reviewed articles and conference papers taking precedence. English is the predominant language of publication (98.39%), while other languages, such as Chinese, Spanish, and Portuguese, are used to a lesser extent. Social sciences (51.03%) are the primary focus of this research, followed by computer science (45.75%), engineering (26.44%), and business-related fields (9.89%). This study's implications are twofold. Theoretically, it underscores the ongoing significance of AI-enhanced adult education, encouraging exploration of evolving theoretical frameworks. Managerially, it advises practitioners and policymakers to draw insights from highly cited articles when making decisions about program development and implementation. Future research could be updated with more recent data to incorporate changing citation trends investigating highly cited articles' content and impact may reveal their influence. In summary, this analysis provides valuable insights into the scholarly influence of AI in adult education, offering a solid foundation for further exploration of theoretical and practical aspects within this dynamic field.

Keywords: AI Teaching and Learning, Adult Education, Educational Technologies, Adult Learning Environment, Bibliometric Analysis.

Introduction

The integration of Artificial Intelligence (AI) into the field of education has emerged as a transformative catalyst, reshaping pedagogical approaches, and fostering heightened academic success across diverse domains. As stated by Lin at al (2018), AI possesses the potential to bridge the gap between online and in-person learning, offering a hybridized methodology. The adult learning environments have experienced the impact of AI-driven educational technology in this era characterized by swift technological breakthroughs. According to Dilmurod and Fazliddin (2021), the integration of AI in the realm of higher education has the potential to facilitate the identification of personalized learning strategies for students, which can be adapted to their individual capabilities and aligned with the demands of the labour market. The convergence of AI and adult education is a dynamic and continuously expanding field, which facilitates the development of novel frameworks for teaching and learning.

Prior scholarly investigations have acknowledged the significant influence of AI inside educational settings, as evidenced by a plethora of academic literature that explores its various applications and implications (Wang et al., 2023; Kizilcec, 2023; Seo et al., 2021; Tuomi, 2019). This research have provided insights into the potential of AI to improve personalized learning, increase student engagement, and optimize educational outcomes. However, despite the widespread fascination with AI's overall influence in education, a rapidly expanding niche within this realm revolves around AI-driven educational systems tailored explicitly for adult learners. Looking ahead, AI holds the potential to usher in profound transformations in the field of education, with a particular emphasis on enriching the learning journeys of individuals with distinct educational needs (Reiss, 2021).

The expanding impact and development of AI in the field of education necessitates a heightened emphasis on effectively navigating the vast array of scholarly literature in order to discern significant contributions and emerging patterns. This assessment provides valuable direction for academics and educators who are navigating the complex landscape of AI in adult learning. Additionally, it establishes a solid groundwork for future research and policy deliberations. Despite the increasing acknowledgement of the revolutionary potential of AI-powered educational technology in the field of education, there exists a unique and relatively untapped area pertaining to the application of AI in adult learning. Prior studies have extensively investigated the influence of AI on pedagogical approaches and educational achievements inside conventional educational environments (Tuomi, 2019; Kizilcec, 2023; Wang et al., 2023; Martínez et al., 2023; Guan et al., 2020; Zhang & Aslan, 2021). Nevertheless, a distinct gap emerges in the form of limited comprehensive bibliometric assessments that focus on AI-driven educational technologies tailored for adult learners. Furthermore, the extent to which AI affects the achievements and engagement of adult learners remains unclear.

Motivated by the imperative to enhance adult education, a fundamental facet of lifelong learning, this study aims to leverage AI-driven educational technology to elevate the quality and accessibility of learning opportunities for adults. Recent research by Kuleto et al (2021) has underscored the paramount significance of AI and machine learning in optimizing learning outcomes, fostering skill development in students, facilitating collaborative learning within higher education institutions (HEIs), and establishing inclusive research environments.

These groundbreaking innovations hold immense promise for enriching the educational experiences of adult learners, facilitating their efficient acquisition of new skills and knowledge. This research study makes substantial contributions to the intersection of AI and adult education. It offers profound bibliometric insights through a thorough examination of research pertaining to AI-driven educational systems in adult learning contexts. Furthermore, this study provides a comprehensive view of the scholarly landscape by employing rigorous quantitative assessments, including trend analysis, identification of pivotal research themes, recognition of influential authors, and examination of highly cited publications. These findings represent a valuable asset for scholars, educators, and decision-makers, equipping them with valuable guidance to navigate the dynamic terrain of this rapidly evolving discipline.

Therefore, main objective of this study is to address a significant research gap by the implementation of a comprehensive bibliometric analysis. This analysis will provide useful insights into the present status of research, emerging patterns, and notable publications within this area of expertise. Utilizing a comprehensive bibliometric framework, this study employs a systematic and quantitative approach to analyze the current corpus of literature. This analysis aims to provide insights into crucial elements, including publishing trends, prominent research topics, influential authors, and noteworthy contributions. The objective of this undertaking is to comprehensively document the extensive knowledge and valuable insights that have influenced scholarly discourse on the integration of adult education and AI.

The subsequent sections of this manuscript are organized into five distinct parts. Section 2 presents a succinct overview of relevant academic material pertaining to AI-Driven Educational Technologies within the context of adult learning environments. The next part provides a thorough elucidation of the research technique utilized in this study. Sections 4 and 5 of the study are devoted to providing a comprehensive examination of the gathered data and its resulting findings. The sections ultimately lead to a comprehensive analysis encompassing the findings, conclusions, and recommendations of the study.

Literature Review

Themes in AI-Driven Educational Technologies:

Previous research has consistently shown that individualized learning experiences assisted by AI-driven educational systems are successful. An investigation conducted by El-Sabagh (2021) revealed that the utilization of adaptive learning platforms yielded notable enhancements in the engagement levels and information retention of adult learners when compared to conventional instructional approaches. In a similar vein, the study conducted by Chen et al (2020) highlights the utilization of machine learning and adaptability in educational systems. This approach has resulted in the customization and personalization of curriculum and content to align with the specific needs of students. Consequently, this has facilitated increased adoption and retention rates, leading to enhanced learner experiences and overall improvements in the quality of education.

The topic of adaptive learning systems has garnered significant attention in academic study (Lim et al., 2023; Desyatov, 2016). Lim et al (2023) conducted a study to investigate the effects of AI-driven adaptive learning on adult learners within a workplace environment. The findings of the study revealed that the implementation of adaptive learning systems not only enhanced the efficiency of learning but also had a positive impact on learners' self-confidence

and motivation. The findings of this study are consistent with the notion that tailored learning experiences have the potential to empower adult learners by fostering a sense of control over their educational journey. The implementation of personalized learning concepts in online courses has the ability to facilitate the fulfilment of students' psychological needs, such as autonomy and competence, as well as enhance their intrinsic motivation (Alamri et al., 2020). Adaptive learning is an educational approach that centres on individual learners' strengths and maintains their continuous engagement, resulting in enhanced learning results and a decrease in course dropouts. The implementation of adaptive learning in educational settings enables the customization of course material to suit the individual student, hence facilitating a distinctive and personalized learning experience that is not typically attainable in conventional classroom environments. The adaptive learning management system is designed to generate an individualized curriculum for each student, considering their existing knowledge level, preferred learning style, and ongoing learning pace. This system incorporates a dynamically updated knowledge base and prioritizes learning materials based on their relevance and importance (Sridharan et al., 2021; Wu et al., 2017).

According to Vesin et al (2018), adaptive learning systems that utilize technology or e-learning platforms have the potential to offer students prompt support, tailored resources that cater to their individual learning requirements, and pertinent feedback. The findings of this study offer valuable insights into strategies that higher education institutions and students can employ to improve the efficacy of e-learning systems, hence facilitating the integration of online technologies into the teaching and learning process (Wang et al., 2021). The integration of adaptive models, including technological programs and intelligent systems, holds potential for application inside the conventional classroom setting. Furthermore, it is anticipated that the utilization of such programs will experience significant growth in the foreseeable future. The utilization of AI-powered assessment systems has garnered significant attention within the realm of academic research (Seo et al., 2021). The literature has provided evidence that the utilization of AI-driven evaluation systems has the potential to effectively evaluate assignments and deliver timely feedback, hence alleviating the administrative workload for educators and enhancing the overall adult learning process (Biggan, 2010; Ala-Mutka, 2005).

AI possesses the ability to automate the process of assessment, enabling the evaluation of individual learners' work and progress, while also offering tailored feedback. The current trajectory of AI in the field of education is focused on enhancing learner agency and personalization. This involves enabling learners to engage in reflective practices and providing feedback to AI systems, which then adjust their approaches accordingly. Consequently, this iterative process contributes to the advancement of learner-centred, data-driven, and personalized learning methodologies (Ouyang & Jiao, 2021). The study conducted by Grenander et al (2021) examines the outcomes of experiments involving students, focusing on the impact of automated, data-driven, individualized feedback. The findings reveal a noteworthy enhancement of 22.95% in overall student performance outcomes, along with large increases in the subjective appraisal of the feedback. According to Clark (2012), providing comprehensive feedback aids in the student's comprehension of their strengths, areas for improvement, and strategies for advancement. The integration of AI in the process of assessment and feedback has the potential to boost formative assessment, thereby empowering adult learners to effectively monitor their progress and make well-informed

decisions on their learning strategies. This assertion is supported by the research conducted by (Bhagat et al., 2018; Baleni, 2015).

The existing body of literature suggests that the utilization of AI-driven educational technologies is having a transformative effect on the landscape of adult learning environments. However, there remains a need for additional research to investigate the enduring consequences and optimal strategies for the successful integration of AI into adult education (Kuleto et al., 2021; Dilmurod & Fazliddin, 2021; Reiss, 2021).

Benefits and Impact

Multiple research investigations have provided evidence supporting the favourable results linked to adult learning through the utilization of AI-based educational technology (Salas-Pilco et al., 2022). A thorough meta-analysis was conducted to examine the effects of AI-powered educational tools on adult learners. The results indicated a consistent enhancement in learning outcomes across several topic areas, as reported in previous studies by (Ma et al., 2014; Grgurovic et al., 2013). The findings emphasize the potential of AI in addressing educational gaps and enhancing the effectiveness of adult education initiatives. Researchers have examined the inclusivity of AI-driven technology (Salas-Pilco et al., 2022). The research conducted by Sanchez-Gordon et al (2018) centred on the examination of the accessibility elements that are incorporated into AI-driven educational platforms. The study demonstrated how these features specifically addressed the requirements of adult learners who have disabilities. According to Salas-Pilco et al (2022), the utilization of AI technology has the potential to enhance educational inclusivity by accommodating diverse adult learners through content adaptation and the provision of alternate formats. According to Salas-Pilco et al (2022), the existing body of literature suggests that the utilization of AI-driven educational technology is altering the landscape of adult learning environments. However, greater investigation is required to comprehensively examine the enduring effects and optimal strategies for seamlessly incorporating AI into adult education.

Challenges and Limitations

Recent scholarly research has brought attention to the ethical considerations associated with safeguarding data privacy in educational systems powered by AI (Simbeck, 2023; Hunkenschroer & Luetge, 2022). Simbeck (2023) conducted a study that examined the ethical considerations associated with data collecting and analysis in personalized learning systems. The study emphasized the importance of implementing robust data protection mechanisms and adopting transparent procedures for managing data. This study makes a valuable contribution to the expanding academic conversation surrounding the ethical considerations pertaining to data usage within the field of AI applied in educational settings. Scholars have extensively investigated the digital gap, a reoccurring phenomenon documented in the existing literature. The research conducted by the authors investigated the inequities in the availability of AI-driven instructional materials for adult learners residing in rural regions. The results emphasize the importance of resolving issues related to infrastructure and connectivity to guarantee universal access to AI-enhanced education, regardless of geographical constraints (Graves et al., 2021). The existing body of research suggests that it is imperative to confront ethical and access-related concerns in light of the ongoing development of AI within the realm of adult education (Simbeck, 2023; Hunkenschroer & Luetge, 2022; Akgun & Greenhow, 2021).

Emerging Trends and Future Directions

In recent years, there has been a growing number of research that has begun to investigate the possible applications of AI in the realms of lifelong learning and professional development. According to Zhang et. al (2022), a longitudinal study was conducted to monitor the professional progress of adult learners who participated in AI-driven upskilling programs. The findings of the study revealed that these programs made a substantial impact on the learners' employability and career development. Consequently, this research suggests a positive outlook for the future of AI-driven lifelong learning initiatives. The literature study has synthesized prior studies and research findings to offer a more comprehensive comprehension of the role of AI-driven educational technology in adult learning contexts. The studies collectively highlight the significant impact that AI can have on adult education. They emphasize the advantages of personalized learning, adaptability, and inclusive design, while also acknowledging the obstacles associated with data privacy and the digital divide (Tahiru, 2021; Reiss, 2021; Chen et al., 2020; Kuleto et al., 2021; Chiu, 2021).

Methods

The objective of this study is to evaluate the current patterns in the growth of scholarly literature pertaining to the AI teaching and learning for adult learners, utilizing the bibliometric analysis approach. This research utilizes network visualization and bibliometric indicators to show the findings. Bibliometric analysis is a widely employed and well-established methodology for assessing the output of scientific research within a particular subject (Zyoud et al., 2017). Bibliometric studies rely on statistical analysis facilitated by the examination of databases that prioritize indicators found in publications, including authors, sources, geographical distributions, and other diverse indicators (Dabirian et al., 2016). According to Pendlebury (2010), bibliometrics, also known as scientometrics, is a prominent method of conducting quantitative analysis in the field of science. In addition, Pendlebury (2010) asserts that bibliometrics is employed by various entities, including universities, government laboratories, policy makers, librarians, researchers, administrators, research directors, and information specialists, for the purpose of conducting research performance evaluation. In a study conducted by Ahmi and Mohamad (2019), it was emphasized that bibliometric analysis is increasingly being recognized as a valuable approach for uncovering research trends within specific domains. The bibliometric analysis provides valuable insights into specific research areas by presenting comprehensive data on publications obtained from specific databases. This includes information such as publication type, publication location, h-index, author details, frequency of keywords, and citation counts (Ahmi & Mohd Nasir, 2019).

In this study, a bibliometric analysis was performed utilizing VOSviewer, a freely accessible application utilized for the construction and visualization of network relationships (vosviewer.com). The software has the capability to construct a mapping of citation data obtained from well-known databases such as PubMed, Scopus, Dimensions, and Web of Science. Additionally, it encompasses two defined metrics, namely the quantity and cumulative strength of the connections, in order to visually represent the network of nodes. The relative importance and intensity of the connections between nodes are represented by the size of the nodes and the interconnecting lines (Donthu et al., 2020). VOSviewer is capable of generating a visual representation of network co-occurrence, which is derived from the terms extracted from the literature review (vosviewer.com). The software requires a

threshold that represents the minimum number of keywords that must be presented collectively in a document (Ciano et al., 2019). Harzing's Publish or Perish tool was employed for the purpose of this study. Publish or Perish is a well-established software program designed for the purpose of gathering and analyzing scholarly citations. The purpose of this tool is to assist individual academics in effectively presenting their research impact, even in cases where there is a scarcity of citations. Additionally, it has the potential to be utilized in bibliometric research, as exemplified by Harzing.com. This study furthermore examines the influence of publications through the utilization of VOSviewer and Publish or Perish, focusing on citation numbers, impact per publications, and citation per publication.

Source and Data Collection

The present study employed a bibliometric analysis, utilizing the Scopus database to collect the necessary data for the investigation. One of the key features of Scopus is its capacity to provide bibliometric indicators in a direct and user-friendly manner (Sweileh et al., 2018). Due to its renowned status as an academic database, with around 448 titles, this study utilizes the Scopus database as the major source for data collecting. The focus of this review was limited to the subject of technology teaching and learning for adults. The authors adhered to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines for conducting the document search, as depicted in Figure 1 (Moher et al., 2009). A series of searches was run, employing various combinations of the following keyword string: TITLE-ABS-KEY ("teaching" AND "learning" AND "technology" AND "higher learning") . This study explores the interplay between teaching, learning, technology, and higher education. By examining the relationship between these key elements, the research aims to shed light on the impact of technology on the teaching and learning processes within the context of higher education. Through a comprehensive analysis of existing literature, this study seeks to provide insights into the potential benefits and challenges associated with the integration of technology in higher learning environments.

A total of 448 papers were generated from the Scopus searches done on August 20, 2023 (see Figure 1). Subsequently, the process of filtration was conducted on a compilation of 448 documents, with certain exclusions made. Firstly, any papers that did not align with the core concept of technology teaching and learning for adult individuals were eliminated. Secondly, duplications between conference papers, articles, and books were identified and removed. Lastly, documents of unqualified types, such as notes, editorials, letters, retracted papers, and short surveys, were also excluded from the analysis. In conclusion, a detailed analysis was conducted on a total of 435 documents, with 13 papers being excluded from the analysis. Consequently, additional analysis was conducted using several tools including Harzing Publish or Perish, Microsoft Excel, and VOSviewer.

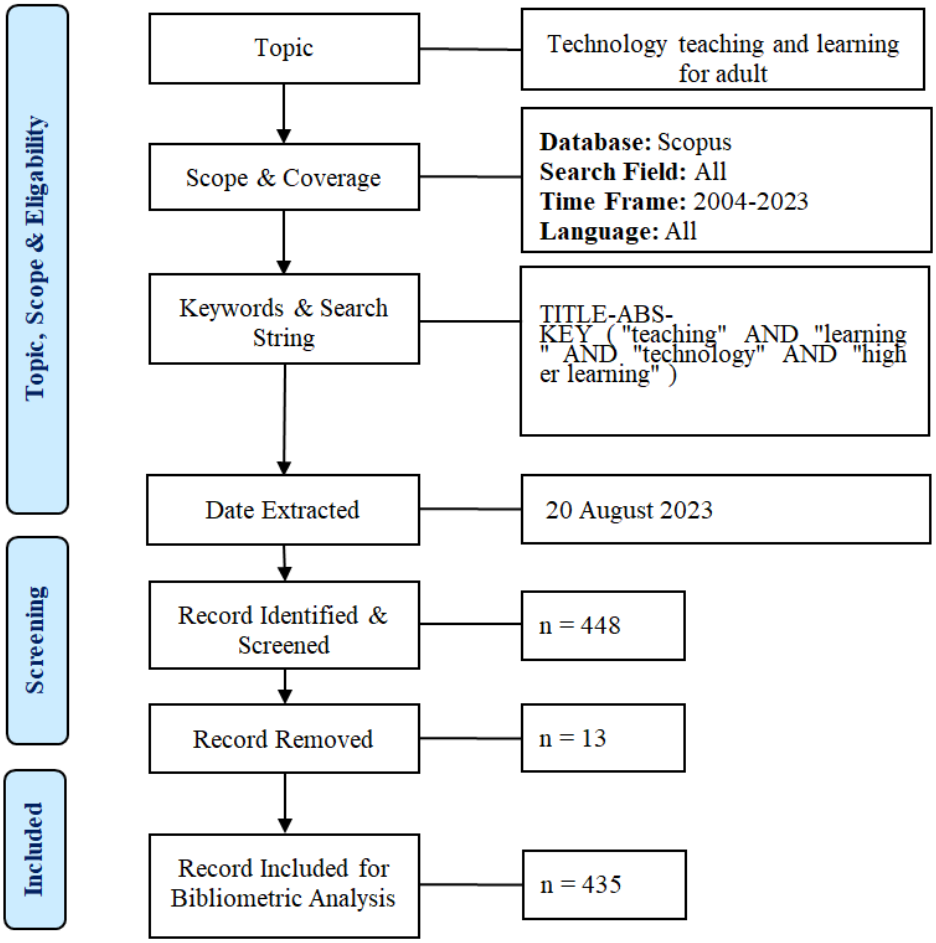

Fig. 1 PRISMA Flow Diagram

Source: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(7): e1000097. doi:10.1371/journal.pmed1000097

Results and Discussion

The evaluation of the academic work obtained during the search process was conducted using several criteria. These criteria included research productivity, the type of documents and sources, the language of the documents, the subject area, the most active source title, the distribution of publications by countries, the most active institutions, authorship analysis, keyword analysis, title and abstract analysis, and citation analysis. The findings also included annual growth data up until 2023, along with their corresponding frequency and percentage.

Document and Source Types

Further analysis was undertaken to ascertain the specific categories of documents and sources in which the research on teaching and learning AI for adult learners was found. According to the data presented in Table 1, it can be observed that articles and conference papers account for 89.66% of the corpus, indicating that these genres hold a dominant position within the dataset. The prominence of peer-reviewed articles and conference papers is underscored in the scholarly discussion surrounding AI education for adult learners. Notable

examples include the scoping literature review conducted by Laupichler et al. (2022) on AI literacy in higher and adult education, the comprehensive AI policy education framework developed by Chan (2023) for university teaching and learning, and the systematic review conducted by Kizilcec (2023) on research pertaining to AI applications in higher education. Furthermore, the table serves to emphasize the incorporation of various types of scholarly communication, including reviews, books, and editorials, thereby underscoring the multidimensional character of scholarly discourse within this field (Hussain & Ahmad, 2023; Soliman et al., 2023; Bawack et al., 2022; Liu et al., 2022; McGillivray et al., 2022).

Table 1
Document Type

Document Type	Total Publications (TP)	Percentage (%)
Article	201	46.21%
Conference Paper	189	43.45%
Book Chapter	25	5.75%
Review	10	2.30%
Conference Review	5	1.15%
Book	3	0.69%
Editorial	1	0.23%
Retracted	1	0.23%
Total	**435**	**100.00**

This research also found the dataset analysis of 435 articles pertaining to the teaching and learning of AI for adult learners, offers a thorough examination of the dispersion of these publications throughout several source categories (refer to Table 2). It provides information on the overall number of publications and their relative representation. The analysis reveals that journals are the primary source type, taking up 48.05% of the dataset, with conference proceedings following closely at 37.93%. The dataset presented in this study encompasses many scholarly channels, including traditional journals and conferences, book series, and books. This comprehensive representation highlights the diverse nature of scholarly discourse within this topic (McGillivray et al., 2022; Szomszor et al., 2020; Koesten et al., 2020; Means et al., 1995).

Table 2
Source Type

Source Type	Total Publications (TP)	Percentage (%)
Journal	209	48.05%
Conference Proceeding	165	37.93%
Book Series	33	7.59%
Book	27	6.21%
Trade Journal	1	0.23%
Total	**435**	**100.00**

Years of Publications/Evolution of Published Studies

This study examines research productivity by analyzing the annual output of scholarly documents. The analysis of publication years in the documents allows researchers to have a comprehensive understanding of the temporal trends related to the selected topic (Ahmi &

Mohamad, 2019). The initial publication on the topic of AI teaching and learning for adult education came out in 1987. Following the year 1987, there is a noticeable lack of consistency in the overall number of publications pertaining to this subject until the year 2009. From 2009 onwards, there has been a notable increase in scholarly publications pertaining to the integration of AI in adult education, a trend that has continued through 2023. In the field under consideration, the year 2022 witnessed the highest volume of publications, with a total of 49 articles published, accounting for 11.26% of the overall corpus. Subsequently, the year 2021 exhibited a growth rate of 10.11%, while the year 2020 demonstrated a growth rate of 8.05%, and the year 2019 displayed a growth rate of 7.36%. In the year 2018, a mere 3.91% of the total articles were dedicated to the specific topic or theme, as indicated in Table 3. Figure 2 illustrates the progression of publication activity within this field from 2004 to 2023, as depicted in graphical format. Scholars at that time exhibited significant interest in the field of AI teaching and learning for adult education, as evidenced by their attention to the observed trend and growth in this area. The emergence of this outcome is noteworthy, given the increasing significance of technological progress and educational matters as prominent worldwide issues since the 1980s.

Table 3
Year of Publications

Year	Total Publications	Percentage (%)
2023	25	5.75%
2022	49	11.26%
2021	44	10.11%
2020	35	8.05%
2019	32	7.36%
2018	17	3.91%
2017	30	6.90%
2016	16	3.68%
2015	16	3.68%
2014	22	5.06%
2013	22	5.06%
2012	18	4.14%
2011	23	5.29%
2010	30	6.90%
2009	19	4.37%
2008	7	1.61%
2007	12	2.76%
2006	5	1.15%
2005	8	1.84%
2004	5	1.15%
Total	**435**	**100.00**

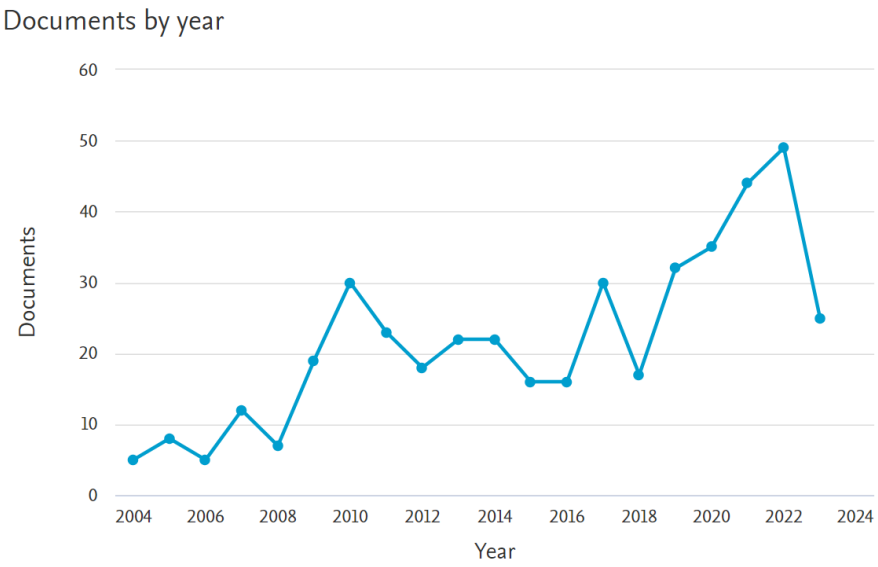

Fig. 2: Document by Year

Languages of Documents

The collected datasets went through analysis in order to identify the language features employed in the published documents. According to the data provided in Table 4, the predominant language utilized for publications pertaining to AI teaching and learning in the context of adult education is English, accounting for a significant majority (98.39%). It is worth noting that certain publications were produced in languages other than English, such as Chinese, Spanish, and Portuguese. However, Portuguese ranked as least used language for academic articles, accounting for a mere 0.23% of the total.

Table 4
Languages Used for Publications

Language	Total Publications*	Percentage (%)
English	429	98.39%
Spanish	4	0.92%
Chinese	2	0.46%
Portuguese	1	0.23%

Subject Area

Table 5 presents a comprehensive overview of the publications categorized according to their respective subject areas. The data reveals that the category of "social sciences" had the highest number of publications, with 222 publications, which accounts for 51.03% of the total. Subsequently, the field of study with the highest percentage is "computer science" at 45.75%, followed by "engineering" at 26.44%, and "business, management and accounting" at 9.89%. The remaining subject groups, namely economics, econometrics and finance, energy, physics and astronomy, environmental science, materials science, medicine, and biochemistry, genetics, and molecular biology, collectively accounted for less than 13% of the overall articles. The predominant emphasis on social sciences stems from the recognition that education and learning are fundamentally social in nature. Several co-authored studies examined in this study, such as the work of Kim et al (2021), propose that the social presence of an AI instructor serves as a mediator, elucidating the reasons behind the more positive

perceptions of AI instructor-based instruction when a relational AI instructor is present. The presence of a human teacher that is seen positively has a discernible impact on the formation of positive expectations for an AI teaching assistance. The influence of social presence on learners' perceptions of AI instructors has been identified as a significant factor in academic research (Kim et al., 2022; Tuomi, 2019).

Table 5
Subject Area

Subject Area	Total Publications	Percentage (%)
Social Sciences	222	51.03%
Computer Science	199	45.75%
Engineering	115	26.44%
Business, Management and Accounting	43	9.89%
Decision Sciences	27	6.21%
Arts and Humanities	25	5.75%
Mathematics	22	5.06%
Psychology	19	4.37%
Economics, Econometrics and Finance	12	2.76%
Energy	12	2.76%
Physics and Astronomy	12	2.76%
Environmental Science	11	2.53%
Materials Science	11	2.53%
Medicine	11	2.53%
Biochemistry, Genetics and Molecular Biology	8	1.84%

Most Active Source Titles

Table 6 focused on the topic of AI teaching and learning for adults is a concise representation of the key source titles that have made major contributions to the academic discussion in this area. Prominent publications encompass the "ASEE Annual Conference and Exposition Conference Proceedings," "Education and Information Technologies," and the "Proceedings of The International Conference on E Learning Icel," each boasting 16, 7, and 7 publications, correspondingly. The aforementioned scholarly references collectively provide a comprehensive understanding of the various aspects of academic involvement in AI-driven adult pedagogy. This involvement is demonstrated through participation in conferences, publication of research findings, and utilization of diverse platforms (Hussain & Ahmad, 2023; Holmes et al., 2022; Seo et al., 2021; Ahmad et al., 2020; Soliman et al., 2023; Guo et al., 2020).

The present research focuses on the prominent sources that have made substantial contributions to the academic discussion around teaching and learning of AI knowledge among adult learners. The incorporation of source titles, such as conference proceedings and specialized journals, serves to illustrate the wide range of channels through which research in this particular topic is disseminated. The aforementioned sources hold significant importance in influencing the scholarly discourse and offering valuable perspectives on the implementation of AI in the realm of adult education.

Table 6
Most Active Source Title

Source Title	Total Publications	Percentage (%)
ASEE Annual Conference And Exposition Conference Proceedings	16	3.68%
Education And Information Technologies	7	1.61%
Proceedings Of The International Conference On E Learning Icel	7	1.61%
Advances In Intelligent Systems And Computing	6	1.38%
Computers And Education	6	1.38%
Journal Of Physics Conference Series	6	1.38%
ACM International Conference Proceeding Series	5	1.15%
Advanced Materials Research	5	1.15%
Lecture Notes In Electrical Engineering	5	1.15%
Communications In Computer And Information Science	4	0.92%

Keywords Analysis

Table 7 presents the primary terms that emerge from the bibliometric search. This study examines the primary keywords that have been identified for the purpose of classifying specific areas. Keywords such as teaching, students, engineering education, and e-learning were found to be frequently utilized in relevant scholarly articles. This study subsequently examines the author's chosen keywords by generating a word cloud using the utilization of WordSift (WordSwift.org, 2021). The word cloud output, obtained with √n scale setting and limited to a maximum of 100 words, is depicted in Figure 3. The presented figure displays the 100 most frequently used words, including keywords, extracted from the published article on the topic of AI teaching and learning for adults. The magnitude of each term denotes the cumulative frequency of the keywords. In addition to the primary keyword used to search the document's title, the word cloud also encompasses other noteworthy keywords such as environments, communication, and collaborative. Furthermore, the utilization of diminutive vocabulary has played a substantial role in expediting the discourse around the subject of AI teaching and learning for adults in grownup scholarly investigations. It is crucial to acknowledge that all the words presented in Figure 3 are indicative of current trends or popular terms associated with the field of AI in adult education research. Therefore, it is anticipated that future study efforts can be focused on these identified terms.

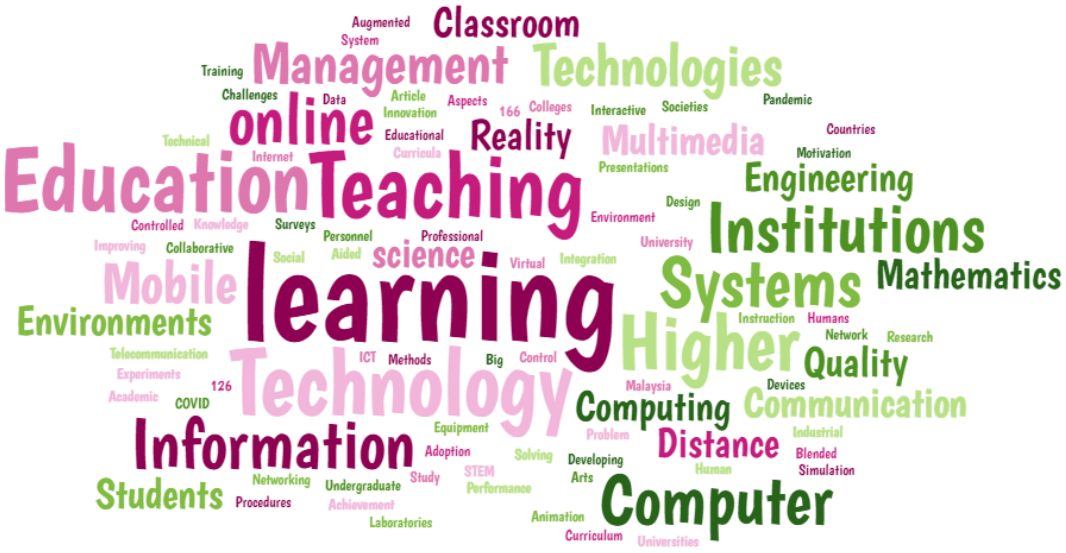

Fig. 3: Word cloud of the author keywords

Table 7
Top Keywords

Author Keywords	Total Publications	Percentage (%)
Teaching	166	38.16%
Students	126	28.97%
Engineering Education	92	21.15%
E-learning	88	20.23%
Higher Learning	87	20.00%
Education	61	14.02%
Curricula	48	11.03%
Teaching And Learning	46	10.57%
Learning Systems	45	10.34%
Higher Education	40	9.20%
Higher Learning Institutions	34	7.82%
Computer Aided Instruction	32	7.36%
Information Technology	32	7.36%
Societies And Institutions	29	6.67%
Learning	27	6.21%
Education Computing	25	5.75%
Technology	24	5.52%
Surveys	20	4.60%
Educational Technology	19	4.37%
Blended Learning	17	3.91%

Geographical Distribution of Publications - Most Influential Countries

This study further details the countries that have exhibited the highest levels of activity in terms of publishing documents about AI teaching and learning for adults. According

to Table 8, the countries that made significant contributions to the publications were Malaysia, China, the United States, and South Africa, each with a publication count exceeding 30.

Table 8
Top 20 Countries contributed to the publications

Country	Total Publications	Percentage (%)
Malaysia	101	23.22%
China	71	16.32%
United States	64	14.71%
South Africa	39	8.97%
United Kingdom	17	3.91%
Taiwan	15	3.45%
Singapore	14	3.22%
India	11	2.53%
Thailand	10	2.30%
Australia	8	1.84%
Tanzania	7	1.61%
Germany	6	1.38%
Kenya	6	1.38%
Nigeria	6	1.38%
Mexico	5	1.15%
Saudi Arabia	5	1.15%
Spain	5	1.15%
Belgium	4	0.92%
Canada	4	0.92%
Indonesia	4	0.92%
Portugal	4	0.92%
Botswana	3	0.69%

Authorship

Menkhoff, T. and Tan, C.K. emerge as the most productive contributors, having authored four papers apiece, which accounts for 0.92% of the overall corpus. Furthermore, a number of other prominent scholars, such Divaharan, S., Iyamu, T., Juhary, J., Nkonki, V., Yunus, M.M., and several others, have each contributed three scholarly documents, demonstrating their significant involvement in this particular academic area. The group of authors has made contributions of two papers for each individual, collectively representing a subset of the broader body of literature. The allocation of authorship underscores a heterogeneous and dispersed scholarly milieu, wherein numerous researchers are actively engaged in contributing to dialogues pertaining to AI-driven education within the realm of adult learning. It is imperative to underscore that the primary focus of this table is on the quantity of authorship, rather than on evaluating the specific impact, influence, or quality of content inside these papers. A comprehensive examination is required to assess the importance and academic value of the contributions made by each author to the field of study.

Table 9
Most Productive Authors

Author's Name	No. of Documents	Percentage (%)
Menkhoff, T.	4	0.92%
Tan, C.K.	4	0.92%
Divaharan, S.	3	0.69%
Iyamu, T.	3	0.69%
Juhary, J.	3	0.69%
Nkonki, V.	3	0.69%
Yunus, M.M.	3	0.69%
Abdullah, R.	2	0.46%
Abidin, N.Z.	2	0.46%
Ahmad, A.G.	2	0.46%
Ahmad, R.R.	2	0.46%
Ali, Z.M.	2	0.46%
Azlan, M.I.	2	0.46%
Chen, W.	2	0.46%
Darus, M.	2	0.46%
Harji, M.B.	2	0.46%
Hasan, K.K.	2	0.46%
Hashim, H.	2	0.46%
Hashim, I.	2	0.46%
Hsbollah, H.M.	2	0.46%

Text Analysis

The analysis of the title and abstract of the collected documents was conducted utilizing the full counting approach through the utilization of VOSviewer software. The binary counting approach refers to a technique in which the frequency of a noun appearing in an article is determined by a predetermined number of occurrences (Van Eck & Waltman, 2013). Figure 4 presents the visual representation of noun occurrences derived from the title and abstract. The magnitude of the events is denoted by the dimensions of the nodes, while the intensity of the connection is depicted by the width of the lines connecting the nodes. The terms that are related are organized together in order to demonstrate their interconnectedness. The findings of the analysis indicate a strong association and frequent co-occurrence between university, lecturer, e-learning, instruction, effectiveness, and science. Four distinct colors were derived from the investigation, each representing one of the four essential groupings identified in the analysis.

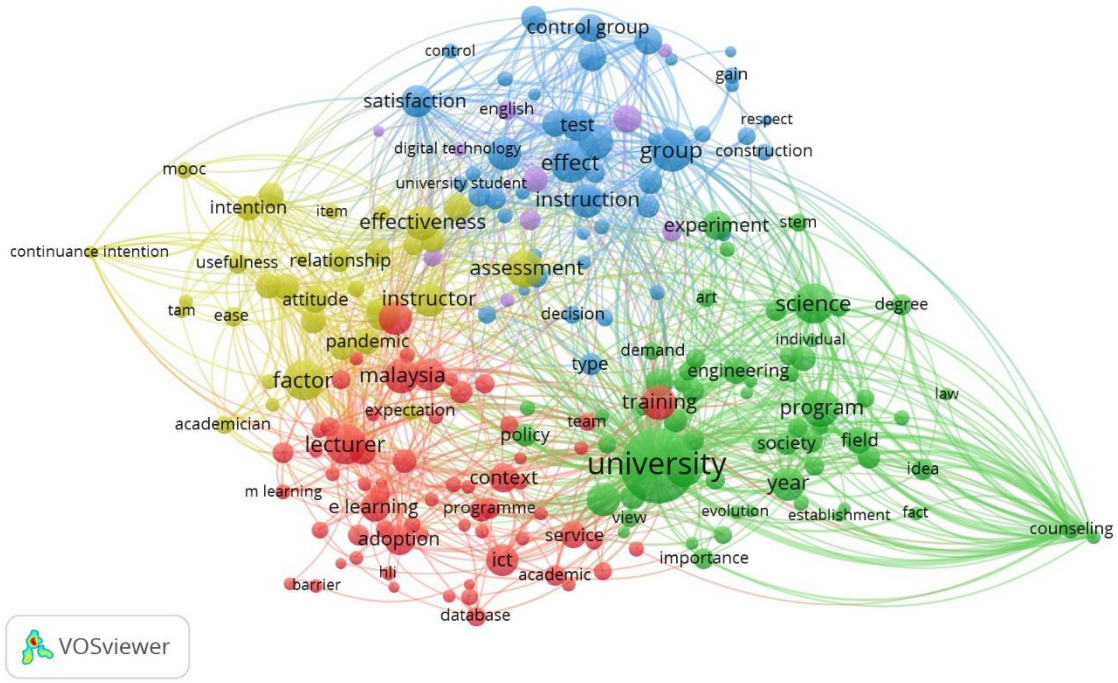

Fig. 4: VOSviewer visualization of a term co-occurrence network based on title and abstract fields (Full Counting)

Most Influential Institutions

Table 10 displays the institutions that hold the highest influence in the field of AI teaching and learning for adult publications. The two most influential institutions from Malaysia, namely Universiti Teknologi MARA and Universiti Kebangsaan Malaysia, have contributed significantly to academic publications, with 16 and 11 articles respectively. The institutions that have published more than 5 publications each include Universiti Malaya, Universiti Sains Malaysia, University of South Africa, Universiti Utara Malaysia, Universiti Teknologi Malaysia, Universiti Teknikal Malaysia Melaka, and Universiti Pendidikan Sultan Idris.

Table 10
Most influential institutions with minimum of five publications

Institution	Total Publications	Percentage (%)
Universiti Teknologi MARA	16	3.68%
Universiti Kebangsaan Malaysia	11	2.53%
Universiti Malaya	9	2.07%
Universiti Sains Malaysia	8	1.84%
University of South Africa	7	1.61%
Universiti Utara Malaysia	7	1.61%
Universiti Teknologi Malaysia	7	1.61%
Universiti Teknikal Malaysia Melaka	7	1.61%
Universiti Pendidikan Sultan Idris	6	1.38%
Cape Peninsula University of Technology	5	1.15%
Multimedia University	5	1.15%
Singapore Management University	5	1.15%
Universiti Putra Malaysia	5	1.15%

Citation Analysis

The citation metrics for the retrieved documents were displayed in Table 11 as of August 20, 2023. The citation measure for the retrieved data from the Scopus database was determined using Harzing's Publish or Perish software. The concise summary includes the citation count together with the corresponding metrics of citations per year, citations per paper, and citations per author. A comprehensive analysis reveals that a total of 435 scholarly papers were identified, encompassing 2234 citations. These papers mostly focused on the area of AI teaching and learning for adult publishing, exhibiting an average citation rate of 19 per year. The average number of citations per the paper was 5.14, while the combined h-index and g-index for all publications amounted to 21 and 36, respectively. Table 12 below presents the 20 most cited articles in the field of AI teaching and learning for adult. The paper titled “The Impending Revolution in Undergraduate Science Education” authored by R.L. Dehaan has garnered the highest number of citations to date, totalling 150. B. Gan, T. Menkhoff, and R. Smith authored an“article titled "Enhancing students' learning process through” interactive digital media: New opportunities for collaborative learning,” which has received 93 citations. Additionally, E. Lwoga published a paper titled “Making learning and Web 2.0 technologies work for higher learning institutions in Africa,” which has garnered 77 citations.

Table 11
Citations Metrics

Metrics	Data
Publication years	2004-2023
Citation years	19 (2004-2023)
Papers	435
Citations	2234
Citations/year	117.58
Citations/paper	5.14
Citations/author	1152.02
Papers/author	223.74
h-index	21
g-index	36

Table 12
Highly cited articles

No.	Authors	Title	Year	Cites	Cites per Year
1	R.L. Dehaan	The impending revolution in undergraduate science education	2005	150	8.33
2	B. Gan, T. Menkhoff, R. Smith	Enhancing students' learning process through interactive digital media: New opportunities for collaborative learning	2015	93	11.63
3	E. Lwoga	Making learning and Web 2.0 technologies work for higher learning institutions in Africa	2012	77	7

4	J.S. Mtebe, R. Raisamo	Challenges and instructors' intention to adopt and use open educational resources in higher education in tanzania	2014	76	8.44
5	H.M. Hsbollah, K.Md. Idris	E-learning adoption: The role of relative advantages, trialability and academic specialisation	2009	76	5.43
6	P. Pruet, C.S. Ang, D. Farzin	Understanding tablet computer usage among primary school students in underdeveloped areas: Students' technology experience, learning styles and attitudes	2016	73	10.43
7	M. Huda, M. Anshari, M.N. Almunawar, M. Shahrill, A. Tan, J.H. Jaidin, S. Daud, M. Masri	Innovative teaching in higher education: The big data approach	2016	65	9.29
8	D. Pundak, S. Rozner	Empowering engineering college staff to adopt active learning methods	2008	54	3.6
9	Y.-S. Chang, K.-J. Hu, C.-W. Chiang, A. Lugmayr	Applying mobile augmented reality (AR) to teach interior design students in layout plans: Evaluation of learning effectiveness based on the ARCS model of learning motivation theory	2020	46	15.33
10	F.-J. Scharfenberg, F.X. Bogner, S. Klautke	Learning in a gene technology laboratory with educational focus: Results of a teaching unit with authentic experiments	2007	42	2.63

Conclusion

The analysis of citation metrics, as of August 20, 2023, provides a comprehensive overview of scholarly engagement in AI teaching and learning for adult education. A total of 435 scholarly papers have been identified, amassing 2,234 citations. Notably, these publications exhibit an average citation rate of 19 per year, emphasizing the enduring relevance and impact of research in this field. The top-cited articles reveal pivotal contributions, with R.L. Dehaan's "The Impending Revolution in Undergraduate Science Education" standing out with 150 citations. Additionally, B. Gan, T. Menkhoff, and R. Smith's article on "Enhancing students' learning process through interactive digital media" and E. Lwoga's work on "Making learning and Web 2.0 technologies work for higher learning institutions in Africa" have garnered 93 and 77 citations, respectively.

Limitation of the study

While this study offers valuable insights, it is essential to acknowledge certain limitations. The analysis is contingent upon data available as of August 20, 2023, and may not

reflect more recent developments. Furthermore, the study primarily relies on citation metrics from the Scopus database, which may not encompass all relevant publications. Additionally, citation metrics alone may not fully capture the impact and quality of research.

Implication of the Study

Theoretical Implications: This study underscores the enduring significance of research in AI teaching and learning for adults, reflected in the sustained citation rates and highly cited articles. Researchers can draw upon these findings to identify seminal works and explore the evolving theoretical frameworks in this domain.

Managerial Implications: Practitioners and educational policymakers can glean insights from the most cited articles and their implications for AI-driven adult education. High-impact articles offer guidance for informed decision-making in program development and implementation.

Future Study

Future research can extend this analysis by incorporating more recent data to track evolving citation trends. Additionally, examining the content and impact of highly cited articles can provide a deeper understanding of their influence within the academic community. Furthermore, research can delve into the practical implications of these findings for instructional design and policy development in the context of adult education enhanced by AI. Finally, exploring the reasons behind the enduring relevance of certain articles could shed light on the factors contributing to their impact and inform future research strategies.

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