frontiers | Frontiers in Education

TYPE Systematic Review
PUBLISHED 16 October 2024
DOI 10.3389/feduc.2024.1470853

OPEN ACCESS

EDITED BY
Leman Figen Gul,
Istanbul Technical University, Türkiye

REVIEWED BY
Şermin Metin,
Hasan Kalyoncu University, Türkiye
Hiroyuki Obari,
Aoyama Gakuin, Japan

*CORRESPONDENCE
Yousef Aljemely
✉ y.aljemely@mu.edu.sa

RECEIVED 26 July 2024
ACCEPTED 03 October 2024
PUBLISHED 16 October 2024

CITATION
Aljemely Y (2024) Challenges and best practices in training teachers to utilize artificial intelligence: a systematic review. *Front. Educ.* 9:1470853. doi: 10.3389/feduc.2024.1470853

Challenges and best practices in training teachers to utilize artificial intelligence: a systematic review

Yousef Aljemely*

College of Education, Majmaah University, Al Majma'ah, Saudi Arabia

Introduction: The utilization of artificial intelligence is becoming a hot debate among researchers, academicians, and practitioners. Educational institutions are also training teachers to utilize AI in teaching. However, there is a dearth of investigation on the training of teachers to utilize AI. Therefore, this systematic review aims to highlight the challenges and best practices in training teachers to utilize AI. Strict inclusion and exclusion criteria were set to shortlist the relevant studies for review.

Methods: The review synthesized 10 studies focusing on the importance of AI, AI usage by teachers, challenges faced by teachers and trainers, and best practices that could be adopted by trainers.

Results: The results highlighted teachers lack the motivation for AI utilization and it is the biggest challenge faced by the trainers. Therefore, the training programs should be motivating, customized, and highlight the importance of AI. Moreover, the training sessions should also provide a trial of the latest AI technologies to the teachers so that they can get hands-on experience.

Discussion: This review can help AI trainers design customized training programs for teachers by keeping in mind the challenges faced by them. An effective training program can be designed if a trainer is aware of potential challenges faced by trainees. Thus, this research has not only discussed the challenges but also provided guidelines for AI trainers training teachers.

KEYWORDS

artificial intelligence, teaching, challenges, AI training, AI utilization, AI adoption

1 Introduction

Rapid digitalization has changed the world, and digital technologies have modernized every sector. Similarly, they have transformed the educational sector (Mohd Nizar et al., 2018). Digital technologies, tools, and applications such as artificial intelligence (AI) and artificial intelligence-based Chatbots have not only transformed the educational landscape (Nguyen et al., 2023) but have changed the entire approach to education (Romero Rodríguez et al., 2023). Akgun and Greenhow (2021) explained that artificial intelligence comprises advanced technologies, including natural language processing (NLP), machine learning, and algorithms. Fitria (2021) defined it more comprehensively as a "process of modeling human thinking and designing a machine so that it can behave like humans or other terms called cognitive tasks, namely how machines can learn automatically from programmed data and information" (p. 135). Previously artificial intelligence was studied in the scientific domain, but now it has become an important area of research in the field of education (Wang et al., 2021) as artificial intelligence-based technologies have changed the job functions and whole dynamics of the

education sector (Fitria, 2021) by facilitating students and teachers. Moreover, these technologies have created ease for learners; they can learn, collect material, and practice at any time they want (Wang et al., 2021; Fitria, 2021). Besides facilitating the students, these technologies have changed the role of teachers. Now, they can use any adequate artificial intelligence tool for teaching and evaluating the student's learning process (Edwards et al., 2018). Artificial intelligence is growing rapidly in every field, and 1 day it will be available in all areas (Furman and Seamans, 2019; Aggarwal et al., 2022; Joshi, 2024), and children brought up in that era will be known as AI natives (Williams et al., 2019). In the 21st century, one must be a technology user and gain knowledge about artificial intelligence to produce the technology in the future. Therefore, teachers must be aware of AI and use its applications because it will not merely create ease for them but also enable them to teach the AI tools. Teachers using AI can guide the students with the benefits of AI and its tools or applications.

The technological revolution has transformed the educational sector (Mohd Nizar et al., 2018), particularly artificial intelligence is changing educational practices (Romero Rodríguez et al., 2023). Thus, higher educational institutions are focusing on the adoption of AI (Bates et al., 2020; Knox, 2020) because, besides enhancing the efficiency of universities (Chen et al., 2020; Kuleto et al., 2021), it will create ease for teachers (Huang et al., 2021). Artificial intelligence (AI) has different applications for teachers. They can use facial expression recognition systems to develop insights about the learner's behaviors. Moreover, they can use automated assessment systems to evaluate students' performance (Akgun and Greenhow, 2021). In manufacturing organizations, artificial intelligence facilitates production and ensures the quality of production or production systems (Dhamija and Bag, 2020), but in the service sector, it enhances the service flexibility by improving the performance of employees (Wamba-Taguimdje et al., 2020). Similarly, AI can help teachers reduce their burden in the educational sector (Jawabri, 2017). However, teachers are facing different challenges in adopting artificial intelligence. Some teachers are unaware of using AI, but others feel it is inconvenient or perceive that AI and such technologies will replace their jobs 1 day (Tao et al., 2019). Currently, different artificial intelligence-based innovations, tools, and technologies are being utilized to facilitate the learning process and make it more practical. However, their application in the education sector is raising concerns among teachers. It may be challenging for them to adopt AI, but ultimately, it is a need of the hour and essential for the existence and continuity of education. It is a perception that AI will never replace teachers if collaboration can be developed between AI technologies and teachers. Teachers must collaborate with artificial intelligence in the implementation of learning. Furthermore, they must possess skills to utilize science and technology to gain benefits from artificial intelligence technologies (Fitria, 2021). However, the education of AI is a new concept that has not been discussed previously because there is a lack of trained teachers who can teach AI. Moreover, it is unclear how much AI will be advanced in 20 years. Therefore, many countries are focusing on education related to coding and computational thinking because learning codes can help teachers or learners creatively use AI and understand its concepts and mechanisms (De La Higuera, 2019).

Every individual, particularly teachers, need to understand AI and its utilization, but unlike other people, they require thorough training to prepare themselves for the adoption of digital skills (Vlasova et al., 2019; Nazaretsky et al., 2022). However, the training of the teachers can be challenging because most of them are unaware of AI and its key ideas. Therefore, they must be trained in AI utilization and adoption because it will be a valuable addition to their teaching and enhance their teaching skills (De La Higuera, 2019). The main reason for training teachers to use and understand artificial intelligence is to equip them with digital skills (Vlasova et al., 2019; Paiva and Bittencourt, 2020; Lee and Perret, 2022) and eliminate the challenges they face while using AI applications or tools. If any teacher cannot use digital tools today, he or she will not survive in this competitive environment tomorrow (De La Higuera, 2019). Therefore, training and educating teachers to utilize artificial intelligence is essential. Nowadays, AI is playing an important role in education (Zhai et al., 2021; Tahiru, 2021; Miao et al., 2021), and even many studies have emphasized highlighting the role of AI in education (e.g., Conati et al., 2018; Guilherme, 2019; Zhang and Aslan, 2021; Schiff, 2022; Holmes et al., 2022; Gillani et al., 2023) but there is paucity of research on training and education for AI (De La Higuera, 2019).

Trainers face different challenges while training teachers for AI adoption and utilization. Many teachers are unable to understand artificial intelligence and its usage because they lack the technical knowledge. Moreover, the institutions provide them limited access to software, hardware, and the Internet. Therefore, teachers are unable to use and integrate it into their existing curriculum. Furthermore, teachers perceive that the use of AI will breach their privacy and raise ethical issues. Thus, there is a need for comprehensive training to train teachers and overcome the challenges faced by them while understanding or using AI applications. However, it is still unclear how the training programs can be designed to facilitate the teachers to adopt and utilize AI in teaching. First, of all, they need to be motivated to learn about it and its usage in the classroom. Secondly, they should gain digital competence so that they can efficiently use AI and its applications (Polak et al., 2022). Both factors are equally important to sorting the large amount of data available on AI-enabled chatbots such as ChatGPT. This data can help the teachers and reduce their efforts in designing the curriculum and preparing the lectures (Romero Rodríguez et al., 2023).

The adoption of AI in education by teachers is a hot debate among researchers, teachers, and even policymakers are paying significant consideration to identifying the factors leading to the adoption and effective utilization of AI in education. Moreover, it is still an open debate about how teachers can be trained for it. Furthermore, many studies have focused on training students for AI usage, but there is a dearth of literature highlighting the teachers (Ayanwale et al., 2022). Lee and Perret (2022) reported that many teachers are unaware of artificial intelligence and this lack of awareness is acting as a barrier to the implementation of AI in education. Therefore, professional development programs should be conducted first to increase awareness of AI and its implementation. In addition, Russel and Norvig, 2010 mentioned that "all AI researchers should be concerned with the ethical implications of their work" (p. 1020). Thus, it is critical to explore the challenges and best practices in training teachers to utilize artificial intelligence. Hence, this systematic review has filled the gap by reviewing the studies that emphasized training and teachers for AI adoption and utilization. The review will help educational institutions aiming to implement AI and improve the performance of teachers. Moreover, it will help the trainers to develop an adequate training program for teachers by keeping in mind the challenges faced by them. In this digital era, every sector is adopting AI or using its different applications. Therefore, the educational sector must encourage teachers to use AI because they are the ones who can bring change.

The systematic literature review is based on five sections. The first section of the introduction explains the need for research. The second

section comprehensively discussed the steps followed for review and explained the whole process from data collection to evaluation. The third section presents the findings and explains the results. The fourth section has summarized the results and provided the implications. The fifth section has discussed the limitations and future recommendations.

2 Methodology

Qualitative studies generally focus on the assessment of qualitative data and the scope, context, and purpose of each research is different (Duffy and Chenail, 2009) which represents the approach to be used for investigation. This research aims to explore the prior studies focusing on challenges and best practices in training teachers to utilize artificial intelligence. Therefore, it has adopted the systematic literature approach and followed the subjectivist/interpretivist paradigm to critically evaluate the literature. This paradigm is most suitable for studies focusing on systematic literature review (Campbell, 2014). Generally systematic review is considered a type of qualitative research, but it significantly differs from traditional qualitative investigations because it does not include the thematic analysis, proposition development, or ethnographic analysis, rather it emphasizes the prior valid studies focusing on a similar theme. Vuori and Väisänen (2009) defined systematic literature review as "it is the valuable strategy, when the aim is to identify, evaluate, and synthesize all of the important research on a certain topic to acquire a complete picture of the studies and their findings" (p. 3). Many studies have highlighted systematic literature as the most adequate approach to explore, assess, and synthesize the literature on a specific area and gain valuable insights from the findings reported by prior studies (e.g., Cook et al., 1997) because it eliminates the bias caused by human error (Petticrew and Roberts, 2008) and critically expand the knowledge on a specific area that is under consideration. Furthermore, systematic review studies provide valuable insights by summarizing the findings of prior studies and strengthening the knowledge of novel topics (Palmatier et al., 2018).

This systematic review has focused on two key areas, first, it aims to identify the challenges faced by trainers while training teachers to use artificial intelligence. Secondly, it aims to investigate the best practices that could be used by trainers to enable and ensure the usage the AI by teachers. In the first of establishing the review, we developed different research protocols that could provide proper directions. First, we have not limited the scope to a specific category of teachers, as the aim was to target the studies on teachers (i.e., university and college). Secondly, it was observed that many studies have focused on AI usage intention among teachers and the challenges faced by them, thus, we could get a high volume that may become difficult to comprehend. Therefore, we developed the protocol based on the publication date and time horizon (i.e., from 2018 to 2024). Thirdly, we predefined the exclusion and inclusion criteria to ensure the consideration of the most relevant literature. Lastly, we chose an adequate strategy and method to conduct the review and comprehend the selected literature to generate valuable insights.

2.1 Inclusion/exclusion criteria

In quantitative or traditional qualitative studies, the scope is defined, but these studies consider all the available literature instead of setting specific inclusion or exclusion criteria. However, the systematic reviews require the inclusion and exclusion criteria to retain consistency and relevancy instead of generalizability. Therefore, in this review, we developed a perfect search strategy with the help of experts. We consulted two expert librarians and three university professors to set an appropriate search strategy. Based on their views, we developed a perfect plan to set inclusion and exclusion criteria so that only relevant research evidence could be considered. The plans aimed to consider the literature from reliable sources. Moreover, it was ensured that only high-quality qualitative, quantitative, and mixed method articles published within the last 7 years (i.e., from 2017 to 2024) will be shortlisted. Furthermore, the criteria of selection were limited to the consideration of articles published in the English language. Therefore, the articles published before 2017 or in any other language were considered inappropriate to be shortlisted. In addition, the review articles, conference proceedings, systematic review, meta-analysis, special issue proposals, opinion pieces, editorials, and non-research-based articles were not included.

The main goal was to target and include studies focusing on training programs for teachers to use AI in education, teachers' usage intention of AI in teaching, challenges and barriers faced by teachers in the AI adoption, strategies to enhance AI usage by teachers in teaching, and practices to training teachers to use AI for teaching purposes. The studies focusing on AI adoption by students or emphasizing any specific AI tool were excluded. These studies could be worthy or might have expanded the literature, but they are irrelevant to be considered as they do not fit within the scope of challenges faced by teachers in AI adoption.

The relevant databases were searched to follow the inclusion and exclusion criteria. First, the criteria of "publication year" was selected while searching. Secondly, all the articles shortlisted at the first stage were manually checked to identify their relevance and language. Thirdly, the nature or type of each article was manually ensured.

2.2 Search strategy

Searching the relevant literature for the systematic analysis is the most critical. Therefore, we developed a comprehensive search strategy to explore and identify the most relevant literature. First, we developed a list of renowned research databases to systematically search the peer-reviewed studies published from 2017 to 2024. The focus was mainly on searching the data from the following databases and publishers (See Table 1).

The search process from these publishers and databases took 7 days, it started on 1st July 2024 to 7th July 2024. Moreover, this process was completed on our own without any external assistance. To search and scrutinize the relevant literature search strings were developed. These strings include, "artificial adoption by teachers," "challenges faced by teachers in AI adoption," "AI in teaching," "training teachers to use AI," "challenges faced in training teachers to use A," "AI training programs for teachers," and "behavioral intention of teachers toward using AI in teaching." The search process was done manually instead of using any AI tool or research-assisting such as "Research Rabbit." The search strategy followed the protocols settled while explaining inclusion and exclusion criteria.

TABLE 1 List of databases and publishers.

Sr	List of databases	Sr	List of publishers
1	Google Scholar	1	Elsevier
2	EBSCO	2	Taylor and Francis
3	Scopus (SJR)	3	Emerald
4	Web of Science (Master Journal List)	4	Wiley
5	HJRS	5	Springer
6	PubMed	6	Sage
7	ERIC (Education Resources Information Center)	7	Hindawi
		8	MDPI
		9	IGI Global

2.3 Data management

The data collected after search and scrutiny were managed properly. In the first step, the data were organized, and the results derived from the search were shifted into the Endnote. In the second step, the data of grey literature or reports were manually added to the list. In the third step, the file of complete data was developed in MS Excel, and all the duplicate articles were excluded. Moreover, a list of finalized articles was developed in MS Word that comprised the details including, author(s) and publication year, study design and methodology, target population (teachers' demographics), and findings.

2.4 Study selection

The selection of relevant literature is the most important task after the management of the data. In this review, the first step of the selection process involved the screening of literature to eliminate duplicate studies, and remove the out-of-scope studies, particularly the studies that did not follow the inclusion and exclusion criteria were removed from the final list. While screening it was ensured that the titles and themes of the studies are relevant. Therefore, the abstracts, and titles of the studies were evaluated before the final selection. The total record of the initial investigation identified 816 studies (i.e., 689 from database searching and 127 from other sources), and 522 records were removed before screening as most of them were duplicates. A total of 126 records were removed from the remaining 294 records. The remaining 168 records were evaluated in terms of eligibility, but 87 of them were removed as their full texts were not available. Further, 81 articles were assessed and among them, 70 were removed due to irrelevancy with the theme. Thus, 11 studies were finally considered for the systematic review.

2.5 Process/method

Systematic review systematically analyses the literature and requires a systematic process for evaluation. Prior studies have recommended two approaches to including "Preferred Reporting Items for Systematic Reviews and Meta-Analyses" (PRISMA) and "Systematic Quantitative Assessment Technique (SQAT)" to conduct systematic reviews efficiently (e.g., Al Shebli and Alhosani, 2022; Almelhes, 2024). Zhu et al. (2018) highlighted that the Systematic Quantitative Assessment Technique is appropriate for evaluating the type of study, data collection approaches used by studies, and geographical area focused by studies. Moreover, it provided thorough guidelines for conducting a review. Whereas the guidelines or checklist of PRISMA are more comprehensive to systematically review the literature. The PRISMA technique is more adequate than MOOSE, Cochrane's Methodology, and the Campbell Collaboration's guidelines because they are either complex or provide guidelines for reporting meta-analyses of observational studies. Cochrane's review mainly focuses on studies related to medicine or healthcare, and its application in social sciences could be difficult. Whereas the PRISMA technique is flexible and adequate for systematic reviews in the domain of education or social sciences. Therefore, this systematic review has adopted the PRISMA approach and followed the PRISMA checklist. The flow diagram of PRISMA is shown in Figure 1.

2.6 Data extraction and analysis

The process of data extraction was done manually without the aid of any software and before systematic evaluation, the data were classified. A list was developed that mentioned the title, method, sample, area, and findings of each study that was shortlisted for final evaluation. In addition, the qualitative studies were assessed via the Critical Appraisal Skills Programme (2018), and the quantitative studies were evaluated on the parameters of the Effective Public Health Practice Project (2009) (EPHPP).

3 Results

The systematic review has mainly emphasized the 10 studies, three of them focused on highlighting the importance of AI in teaching and the adoption of AI by teachers. Three focused on the training of teachers for AI utilization, five focused on the challenges faced by teachers in AI utilization, and highlighted the best practices that could be ensured by trainers to train teachers for AI adoption. The prior studies have either focused on determining the factors leading to AI adoption by teachers or

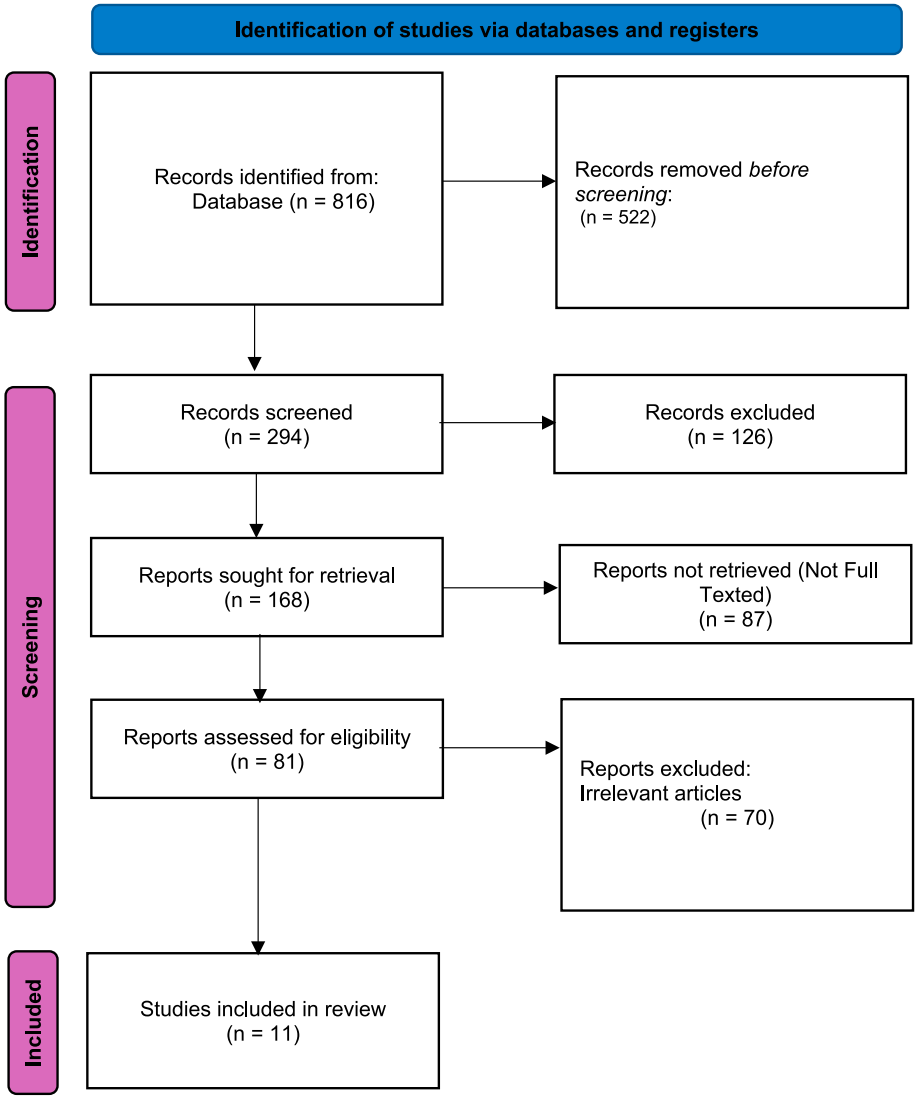

FIGURE 1
PRISMA flow diagram.

emphasized the need for AI adoption by teachers in teachers. However, there is a dearth of research focusing on all the themes, including the importance of AI adoption by teachers, challenges faced by teachers, challenges faced by trainers, and best practices that can be considered for training teachers to adopt AI. Therefore, this review has considered only the relevant studies that emphasized all these themes. The details of the studies are given in Table 2 below.

3.1 Study characteristics

The review has focused on the 10 latest studies and highlighted their characteristics including year of publication, country of investigation, target group, aim of the study, design of the study, sample size, data collection approach, and outcomes. The detail of the characteristics is given in the following subsections, and the summary is provided in (See Appendix I).

3.1.1 Year published and country of origin

While highlighting the characteristics of the studies undertaken for the review, first, their year of publication was mentioned. Among the 10 studies shortlisted for the review, three published in 2019 (3/10), one in 2020 (1/10), one in 2021 (1/10), two in 2022 (2/10), one in 2023 (1/10), and two in 2024 (2/10). Secondly, the country of origin was examined to highlight the country focused by each article. Among 10 studies, three (3/10) were general and they did not focus on any specific country. Six articles (6/10) focused on different countries including China, the Republic of Sakha, Germany, Turkey, Spain, and Oman. Whereas one article (1/100) focused on three different countries including Bulgaria, Italy, and Greece.

3.1.2 Focus or target

The review has focused on highlighting the challenges and best practices in training teachers to utilize artificial intelligence. Therefore, all the studies shortlisted for this review focused on this theme, but

TABLE 2 Studies considered for review.

S. no.	1st Author	Year	Study design
1	Guilherme, A	2019	Qualitative (Thought experiments)
2	De La Higuera	2019	Qualitative (Literature Analysis)
3	Vlasova, E.	2019	Quantitative (Experimental)
4	Lindner, A	2020	Qualitative
5	Fitria, T. N.	2021	Qualitative (Library Research)
6	Lin, H	2022	Quantitative
7	Polak, S	2022	Qualitative
8	Celik, I.	2023	Quantitative
9	Galindo-Domínguez, H	2024	Quantitative
10	Al-Mughairi, H.	2024	Qualitative

the target groups of the studies were different. Among 10 studies, three (3/10) were general and they did not focus on teachers or students. One study (1/10) focused on students and took their views about the training of teachers for AI adoption. Five articles (1/5) focused on teachers. Whereas one article (1/100) focused on both students and teachers.

3.1.3 Design, sample, and data collection

Among the 10 studies under consideration, six (6/10) were qualitative. Three of these studies were purely qualitative as they focused on interviews (i.e., Lindner and Berges, 2020; Polak et al., 2022; Al-Mughairi and Bhaskar, 2024). Whereas, the remaining three qualitative studies focused on thought experiments (Guilherme, 2019), literature analysis (De La Higuera, 2019), and library research (Fitria, 2021) by investigating the secondary data (i.e., literature). The remaining 4 studies considered for the review were quantitative, three (3/10) of them gathered data via surveys (i.e., Lin, 2022; Celik, 2023; Galindo-Domínguez et al., 2024), and one (1/10) focused on experimentation (i.e., Vlasova et al., 2019).

The three literature-based studies (i.e., Guilherme, 2019; De La Higuera, 2019; Fitria, 2021) focused on the prior studies and there was no proper information about the exact number of studies they focused. The three purely qualitative studies considered different sample sizes from 14 to 34. For quantitative studies, the sample size ranged from 290 to 5,558.

3.1.4 Aim of the studies

The ten studies considered for the review had different aims. However, all of them aimed to determine either the importance of AI in teaching, the adoption of AI by teachers, challenges faced by teachers in AI utilization, or highlight best practices that could be ensured by trainers to train teachers for AI adoption. The studies under consideration aimed to evaluate the technologization of education and its pros and cons in the context of teaching (Guilherme, 2019), to understand why teachers require AI adoption and which challenges are faced by trainers (De La Higuera, 2019), to implement a continuous training system for future teachers and realize the challenges faced in AI training (Vlasova et al., 2019), to explore the ideas and pre-concepts teachers have about AI and how professional development programs can be designed to handle their perceived challenges (Lindner and Berges, 2020), to investigate AI in education and its role in teaching and learning process (Fitria, 2021), and to determine AIED's influence on teaching effectiveness and explore the need of training teachers (Lin, 2022). Furthermore, they aimed to identify how teachers can be supported in AI implementation (Polak et al., 2022), highlight the importance of teachers' training for AI and the usage of AI in the classroom (Galindo-Domínguez et al., 2024), and explore the teachers' perspective on adoption of ChatGPT and identify the factors that can motivate the teachers to adopt it (Al-Mughairi and Bhaskar, 2024).

3.1.5 Outcomes

The outcomes of the studies under consideration have focused on challenges and best practices that could be considered by trainers to train teachers.

3.1.5.1 Challenges

Teachers not only develop innovative educational paths, but they also bring innovation to the classrooms. Therefore, besides highlighting their perceptions and attitudes about AI utilization, it is important to explore the challenges faced by them. The main factor behind AI utilization among teachers is motivation. If they are motivated, they will be able to gather information regarding AI adoption or utilization. The second factor is the skill factor which can lead to AI utilization. Teachers possess basic knowledge of digital skills, but they lack knowledge related to AI (Polak et al., 2022). Trainers can work on the skill factor, and they can enhance the knowledge of teachers about the use of AI, but they cannot effectively motivate teachers as it is an intrinsic human factor. However, the training content may be included with some motivational appeals that can motivate the teachers toward AI utilization.

3.1.5.2 Best practices

The outcomes of the studies under consideration highlighted that there should be a balance between the technologization of education (Guilherme, 2019), and educational institutions should provide appropriate conditions to teachers so that they can adopt AI. Moreover, teachers should understand the role of technology in modifying society (De La Higuera, 2019), and this knowledge will motivate them to utilize AI in teaching. Besides the motivation, teachers also need thorough training to adopt AI and overcome the challenges associated

with it. Teachers can carry out the educational processes efficiently if they are trained properly for AI and its applications (Vlasova et al., 2019), but before training is essential to develop their attitude toward AI (Lindner and Berges, 2020) as their acceptance of this new technology can enable them to learn proactively.

Teachers have positively embraced artificial intelligence but merely 25% of them utilized it in teaching. Therefore, they should be provided with training at each stage that will equip them with diverse AI tools irrespective of ChatGPT which is commonly used (Galindo-Domínguez et al., 2024). The training programs should begin with functional principles and then emphasize the technical details along with highlighting the ethical and social consequences of AI (Lindner and Berges, 2020). Al-Mughairi and Bhaskar (2024) highlighted four perspectives that can motivate teachers to adopt ChatGPT (i.e., AI tool). These perspectives include the exploration of innovative educational technologies, time-saving and theme, personalization teaching and learning, and professional development. Moreover, they highlighted different inhibiting factors that include privacy, reliability, and reduction in human interaction. Furthermore, they mentioned that the least utilization of ChatGPT by teachers is due to the challenges faced by them. These challenges include the lack of institutional support, restrictions by universities, and lack of guidance. Therefore, teachers need proper training for the integration of ChatGPT into the teaching. Thus, trainers can train the teachers by focusing on the motivational and inhibiting factors. Furthermore, the outcomes highlighted that teachers collaborating with artificial intelligence and implementing it in their teaching will never be replaced with robots in the future (Fitria, 2021) and that AI adoption by teachers can improve their teaching effectiveness (Lin, 2022). Thus, teachers must be trained for AI, but trainers should develop the training program by keeping in mind the challenges that could be faced by the teachers. In addition, the results of the studies demonstrated that AI utilization among teachers is associated with will, skill, and tool factors (Polak et al., 2022), knowledge factors (Celik, 2023), and motivational factors (Al-Mughairi and Bhaskar, 2024). Therefore, trainers should emphasize all these factors while developing AI utilization training programs for teachers. Moreover, these training programs should be customized at each stage and incorporate different AI tools (Galindo-Domínguez et al., 2024).

3.2 Study quality appraisal

The quality appraisal for systematic review has systematically assessed whether the review meets the criteria. Moreover, it has evaluated the value and relevance of the review in the context under consideration. Therefore, to ensure the quality and relevancy according to the theme, qualitative and quantitative studies under consideration were scored by using CASP (2018) and EPHPP (2009) respectively. The score included "Strong = No Weak Ratings," "Moderate = On weak Rating," and "Weak = Two or more weak ratings." No study had a weak score as all of them were focused on the theme. The detail of scoring for each study is given in Table 3.

4 Discussion

The review has mainly focused on highlighting the challenges and best practices in training teachers to utilize artificial intelligence. Therefore, first, it has demonstrated the need for AI and its importance for teachers. Secondly, it has highlighted the challenges faced by teachers utilizing AI and trainers who train the teachers for AI adoption. Thirdly, it has explored the best practices that could be considered by trainers and can be included while designing training programs for teachers regarding AI utilization. The discussion of all these themes is given in the following subsections:

The adoption and use of AI in education are growing rapidly as they play an important role in developing effective adaptive learning platforms (Cukurova et al., 2023) and facilitate teachers in preparing lectures (Mollick and Mollick, 2023; Misnevs, 2024) and evaluating students (Chen et al., 2020; Vinay, 2023). Prior studies have not only highlighted the importance of AI adoption and utilization by teachers, but they have also emphasized the factors leading to the adoption and usage intention of AI among teachers and students (e.g., Kim and Lee, 2022: Lin et al., 2022; Raffaghelli et al., 2022; Clifford, 2024; Wu et al., 2022). However, some studies have considered AI as a curse, and a few took the perspective of teachers and highlighted that one day, teachers will be replaced by robots.

Despite the applications and growth of AI in education, the importance of relations between teachers and students in classroom settings cannot be ignored. Therefore, the educational system should

TABLE 3 Scoring based on EPHPP and CASP.

1st Author	Year	Quantitative	Qualitative	Total score EPHPP	Total score CASP
Guilherme, A	2019		X		Moderate
De La Higuera	2019		X		Moderate
Vlasova, E.	2019	X		Moderate	
Lindner, A	2020		X		Strong
Fitria, T. N.	2021		X		Moderate
Lin, H	2022	X		Strong	
Polak, S	2022		X		Strong
Celik, I.	2023	X		Strong	
Galindo-Domínguez, H	2024	X		Strong	
Al-Mughairi, H.	2024		X		Strong

be conditioned to use new technologies (Guilherme, 2019). Technology is automated and follows the commands provided by humans. Thus, the intelligence level of teachers cannot be matched as AI is also the product of the creative mind of human natural intelligence. Moreover, artificial intelligence can never compete with human natural intelligence, but it can benefit teachers as they can save time searching educational material (Fitria, 2021).

The adoption of artificial intelligence technology can provide teachers with adequate teaching services to monitor the learners' activities. Moreover, teachers can utilize AI to explore the suggestions of learners and provide them the valuable knowledge. Furthermore, they can do data mining and text analysis to develop the test papers and course contents (Lin, 2022), but still there is a paucity of literature on essential skills required by teachers to utilize AI in education. In addition, the teachers must possess knowledge about the pedagogical affordances and ethical usage of artificial intelligence (Celik, 2023). Thus, they should be trained to effectively utilize AI in teaching.

De La Higuera (2019) highlighted that data awareness is essential for the development of technology and society, and teachers must of aware of it to understand AI utilization. This awareness can originate from knowledge about AI-enabled algorithms. These algorithms can be useful for developing training programs (Fitria, 2021). Therefore, trainers can get recommendations for training teachers from AI-enabled algorithms. Vlasova et al. (2019) mentioned that teachers should be trained in the field of AI. Further, they suggested that bachelor's and master's students should be trained for AI adoption and utilization as they are future teachers. In addition, Lin (2022) argued that besides providing special training to teachers they should be introduced to the latest technologies. They should be provided with a trial option for technologies like data mining, virtual reality technology, and computer vision. Therefore, the trainers should not only emphasize the general training, but the training should involve the trial and introduction of the latest AI-based technologies that could be helpful for teachers.

5 Conclusion

The adoption of AI and its utilization is still an ongoing debate among researchers. Many qualitative and quantitative studies have focused on the adoption of AI in education and highlighted the factors influencing AI adoption and AI use intention among teachers. Moreover, extensive literature is available on the challenges faced by teachers in using AI. However, there is a paucity of research highlighting the challenges faced by trainers and best practices that could be adopted by them to train teachers. Therefore, this systematic review is the first to explore the challenges faced by trainers while training teachers for AI utilization and highlight the best practices that could be adopted by trainers. The review has identified the extensive literature and highlighted that lack of motivation among teachers is the main challenge faced by trainers. Motivation is an intrinsic human factor, and it is difficult for trainers to motivate teachers. However, trainers can motivate teachers by briefing them about its benefits and its uses, which can make it easier for them. Moreover, the findings reported that trainers should develop customized training programs for different subject teachers. In addition, training content can be developed by AI, and besides training, the trainers should provide the trail facility to the teachers. Therefore, future studies can develop a model based on the findings of this research and empirically investigate how motivation can influence the teacher's AI training and how AI-based training content can be helpful for trainers in developing training programs to train teachers about the adoption and use of AI in education.

6 Implications

The educational sector has been transformed by artificial intelligence and it has become essential for teachers to utilize AI in teaching. Teachers must be trained and motivated to adopt AI and effectively utilize it in education. However, trainers may face different challenges while training, and there is a need to understand the best practices for training AI utilization to teachers. Therefore, this systematic review has not only highlighted the challenges faced by trainers but has also focused on best practices that could be considered by trainers. The teachers working in higher educational institutions must use AI because it provides personalized learning through adaptive learning platforms and real-time feedback. Moreover, it enhances teaching efficiency, provides data-driven insights, supports diverse learning environments, innovates teaching methods, and enhances research capabilities. The teachers unaware of using AI or its applications must be trained because adopting AI is essential nowadays to survive in the evolving educational landscape, enhance student outcomes, and improve work-life balance. In addition, teachers working in primary and secondary educational institutions can use AI to develop curriculums based on the needs of students. Further, they can design creative strategies to engage students. The prior systematic reviews have either focused on highlighting the importance of AI in teaching or emphasized the challenges faced by teachers while adopting AI. However, this review significantly differs from the prior systematic reviews, as it has focused on the importance of AI and utilization among teachers, challenges faced by teachers, challenges faced by trainers, and strategies or best practices that could be adopted by trainers while training teachers. Moreover, the review has expanded the literature on artificial intelligence in education. The findings of this review can serve as a guideline for trainers training teachers to utilize AI. The trainers can formulate their training content based on the findings reported by the review. Moreover, the findings will be helpful for the human resource (HR) department of educational institutions; they can develop their training programs based on this research or include AI training in the professional development programs.

7 Limitations and recommendations

The systematic review has focused on the most neglected area of challenges and best practices in training teachers for AI. However, it has different limitations that can be considered by future studies. First, the study focused on the PRISMA approach, but studies in the future could consider any other method for conducting the review. Secondly, the review has considered the studies published between 2017 and 2024, and the studies in the future can expand the horizon by considering the literature published within the last 10 years. Thirdly, the review has provided the best practices that could be considered by the trainers for training teachers to utilize artificial intelligence. Future studies can develop a conceptual model based on the findings and evaluate it empirically. Fourthly, the studies considered for the review focused on the Republic of Sakha, Germany, China, Bulgaria, Italy, Greece, Turkey, Spain, and Oman. Therefore, future studies can focus

on any specific country. In addition, the review considered studies published in English, and future studies can expand the horizon of review by focusing on studies published in other languages.

Data availability statement

The original contributions presented in the study are included in the article/Supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

YA: Writing – original draft, Writing – review & editing.

Funding

The author(s) declare that no financial support was received for the research, authorship, and/or publication of this article.

Conflict of interest

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/feduc.2024.1470853/full#supplementary-material

References

Aggarwal, K., Mijwil, M. M., Al-Mistarehi, A. H., Alomari, S., Gök, M., Alaabdin, A. M. Z., et al. (2022). Has the future started? The current growth of artificial intelligence, machine learning, and deep learning. *Iraqi J. Comput. Sci. Mathematics* 3, 115–123.

Akgun, S., and Greenhow, C. (2021). Artificial intelligence in education: addressing ethical challenges in K-12 settings. *AI Ethics* 2, 1–10. doi: 10.1007/s43681-021-00096-7

Almelhes, S. A. (2024). Gamification for teaching the Arabic language to non-native speakers: a systematic literature review. *Front. Educ.* 9:1371955. doi: 10.3389/feduc.2024.1371955

Al-Mughairi, H., and Bhaskar, P. (2024). Exploring the factors affecting the adoption AI techniques in higher education: insights from teachers' perspectives on ChatGPT. *J. Res. Innov. Teach. Learn.* doi: 10.1108/JRIT-09-2023-0129

Al Shebli, A., and Alhosani, M. (2022). The role of school leadership practices in school culture; a systematic literature review. *J. Positive School Psychol.* 6, 6655–6663.

Ayanwale, M. A., Sanusi, I. T., Adelana, O. P., Aruleba, K. D., and Oyelere, S. S. (2022). Teachers' readiness and intention to teach artificial intelligence in schools. *Comput. Educ. Artif. Int.* 3:100099. doi: 10.1016/j.caeai.2022.100099

Bates, T., Cobo, C., Mariño, O., and Wheeler, S. (2020). Can artificial intelligence transform higher education? *Int. J. Educ. Technol. High. Educ.* 17, 1–12. doi: 10.1186/s41239-020-00218-x

Campbell, S. (2014). What is qualitative research? *Clin. Lab. Sci.* 27:3. doi: 10.29074/ascls.27.1.3

Celik, I. (2023). Towards intelligent-TPACK: an empirical study on teachers' professional knowledge to ethically integrate artificial intelligence (AI)-based tools into education. *Comput. Hum. Behav.* 138:107468. doi: 10.1016/j.chb.2022.107468

Chen, L., Chen, P., and Lin, Z. (2020). Artificial intelligence in education: a review. *Ieee Access* 8, 75264–75278. doi: 10.1109/ACCESS.2020.2988510

Clifford, P. L. R. (2024). AI in higher education: faculty perspective towards artificial intelligence through UTAUT approach. *J. Sci. Soc.* 14:2024. doi: 10.46223/HCMCOUJS.soci.en.14.4.2851.2024

Conati, C., Porayska-Pomsta, K., and Mavrikis, M. (2018). *AI in education needs interpretable machine learning: lessons from open learner modelling*. arXiv preprint arXiv:1807.00154.

Cook, D. J., Mulrow, C. D., and Haynes, R. B. (1997). Systematic reviews: synthesis of best evidence for clinical decisions. *Ann. Intern. Med.* 126, 376–380. doi: 10.7326/0003-4819-126-5-199703010-00006

Critical Appraisal Skills Programme. (2018). *CASP Qualitative research checklist*. Available at: https://casp-uk.net/wp-content/uploads/2018/01/CASPQualitative-Checklist-2018.pdf (Accessed January 25, 2018).

Cukurova, M., Miao, X., and Brooker, R. (2023). "Adoption of artificial intelligence in schools: unveiling factors influencing teachers' engagement" in *Artificial intelligence in education: 24th international conference, AIED 2023, Tokyo, Japan, July 3–7, 2023, proceedings*. eds. N. Wang, G. Rebolledo-Mendez and N. Matsuda (Cham: Springer Nature Switzerland), 151–163.

De La Higuera, C. (2019). A report about education, training teachers and learning artificial intelligence: overview of key issues. *Educ. Comput. Sci.* 18, 1–11.

Dhamija, P., and Bag, S. (2020). Role of artificial intelligence in operations environment: a review and bibliometric analysis. *TQM J.* 32, 869–896. doi: 10.1108/TQM-10-2019-0243

Duffy, M., and Chenail, R. J. (2009). Values in qualitative and quantitative research. *Couns. Values* 53, 22–38. doi: 10.1002/j.2161-007X.2009.tb00111.x

Edwards, C., Edwards, A., Spence, P. R., and Lin, X. (2018). I, teacher: using artificial intelligence (AI) and social robots in communication and instruction. *Commun. Educ.* 67, 473–480. doi: 10.1080/03634523.2018.1502459

Effective Public Health Practice Project. (2009). *Quality assessment tool for quantitative studies*. Available at: http://www.ephpp.ca/tools.html (Accessed March 6, 2024).

Fitria, T. N. (2021). Artificial intelligence (AI) in education: using AI tools for teaching and learning process. *Proc. Seminar Nat. Call STIE AAS* 4, 134–147.

Furman, J., and Seamans, R. (2019). AI and the economy. *Innov. Policy Econ.* 19, 161–191. doi: 10.1086/699936

Galindo-Domínguez, H., Delgado, N., Losada, D., and Etxabe, J. M. (2024). An analysis of the use of artificial intelligence in education in Spain: the in-service teacher's perspective. *J. Digit. Learn. Teach. Educ.* 40, 41–56. doi: 10.1080/21532974.2023.2284726

Gillani, N., Eynon, R., Chiabaut, C., and Finkel, K. (2023). Unpacking the "black box" of AI in education. *Educ. Technol. Soc.* 26, 99–111.

Guilherme, A. (2019). AI and education: the importance of teacher and student relations. *AI & Soc.* 34, 47–54. doi: 10.1007/s00146-017-0693-8

Holmes, W., Porayska-Pomsta, K., Holstein, K., Sutherland, E., Baker, T., Shum, S. B., et al. (2022). Ethics of AI in education: towards a community-wide framework. *Int. J. Artif. Intell. Educ.* 32, 504–526. doi: 10.1007/s40593-021-00239-1

Huang, J., Saleh, S., and Liu, Y. (2021). *A review on artificial intelligence in education*. Acad. J. Interdiscip. Stud. 10.

Jawabri, A. (2017). Job satisfaction of academic staff in the higher education: evidence from private universities in UAE. *Int. J. Hum. Res. Stu.* 7, 193–211. doi: 10.5296/ijhrs.v7i4.12029

Joshi, M. A. (2024). The advancement of artificial intelligence. *Soc. Sci. Electr. Pub. Res. Net.* 12:4735171. doi: 10.2139/ssrn.4735171

Kim, J., and Lee, K. S. S. (2022). Conceptual model to predict Filipino teachers' adoption of ICT-based instruction in class: using the UTAUT model. *Asia Pacific J. Educ.* 42, 699–713. doi: 10.1080/02188791.2020.1776213

Knox, J. (2020). Artificial intelligence and education in China. *Learn. Media Technol.* 45, 298–311. doi: 10.1080/17439884.2020.1754236

Kuleto, V., Ilić, M., Dumangiu, M., Ranković, M., Martins, O. M., Păun, D., et al. (2021). Exploring opportunities and challenges of artificial intelligence and machine learning in higher education institutions. *Sustain. For.* 13:10424. doi: 10.3390/su131810424

Lee, I., and Perret, B. (2022). Preparing high school teachers to integrate AI methods into STEM classrooms. *Proc. AAAI Conf. Artif. Int.* 36, 12783–12791.

Lindner, A., and Berges, M. (2020). Can you explain AI to me? Teachers' pre-concepts about artificial intelligence. In *2020 IEEE Frontiers in education conference (FIE)* (1–9). Piscataway, NJ: IEEE.

Lin, H. (2022). Influences of artificial intelligence in education on teaching effectiveness. *Int. J. Emerg. Technol. Learning* 17, 144–156. doi: 10.3991/ijet.v17i24.36037

Lin, H. C., Ho, C. F., and Yang, H. (2022). Understanding adoption of artificial intelligence-enabled language e-learning system: an empirical study of UTAUT model. *Int. J. Mobile Learn. Org.* 16, 74–94. doi: 10.1504/IJMLO.2022.119966

Miao, F., Holmes, W., Huang, R., and Zhang, H. (2021). *AI and education: A guidance for policymakers*. Paris: Unesco Publishing.

Misnevs, B. (2024). Basic teacher kit for developing lectures using artificial intelligence. *Step Fut.* 19, 92–94.

Mohd Nizar, N. N., Rahmat, M. K., Maaruf, S. Z., and Damio, S. M. (2018). Examining the use behaviour of augmented reality technology through MARLCARDIO: Adapting the UTAUT model. *Asian J. Univ. Educ.* 15:198. doi: 10.24191/ajue.v15i3.7799

Mollick, E. R., and Mollick, L. (2023). *Using AI to implement effective teaching strategies in classrooms: Five strategies, including prompts. The Wharton School Research Paper*.

Nazaretsky, T., Ariely, M., Cukurova, M., and Alexandron, G. (2022). Teachers' trust in AI-powered educational technology and a professional development program to improve it. *Br. J. Educ. Technol.* 53, 914–931. doi: 10.1111/bjet.13232

Nguyen, T. T., Thuan, H. T., and Nguyen, M. T. (2023). Artificial Intelligent (AI) in teaching and learning: A comprehensive review. *ISTES BOOKS*, 140–161.

Paiva, R., and Bittencourt, I. I. (2020). "Helping teachers help their students: a human-AI hybrid approach" in *Artificial intelligence in education: 21st international conference, AIED 2020, Ifrane, Morocco, July 6–10, 2020, proceedings, part I* (Cham: Springer International Publishing), 448–459.

Palmatier, R. W., Houston, M. B., and Hulland, J. (2018). Review articles: Purpose, process, and structure. *J. Acad. Mark. Sci.* 46, 1–5.

Petticrew, M., and Roberts, H. (2008). *Systematic reviews in the social sciences: A practical guide*. New York, NY: John Wiley & Sons.

Polak, S., Schiavo, G., and Zancanaro, M. (2022). "'Teachers' perspective on artificial intelligence education: an initial investigation," in *CHI Conference on Human Factors in Computing Systems Extended Abstracts*, 1–7.

Raffaghelli, J. E., Rodríguez, M. E., Guerrero-Roldán, A. E., and Bañeres, D. (2022). Applying the UTAUT model to explain the students' acceptance of an early warning system in higher education. *Comput. Educ.* 182:104468. doi: 10.1016/j.compedu.2022.104468

Romero Rodríguez, J. M., Ramírez-Montoya, M. S., Buenestado Fernández, M., and Lara Lara, F. (2023). Use of ChatGPT at university as a tool for complex thinking: Students' perceived usefulness. *NAER* 12, 323–339. doi: 10.7821/naer.2023.7.1458

Russel, S., and Norvig, P. (2010). *Artificial intelligence - a modern approach*. London: Pearson Education.

Schiff, D. (2022). Education for AI, not AI for education: the role of education and ethics in national AI policy strategies. *Int. J. Artif. Intell. Educ.* 32, 527–563. doi: 10.1007/s40593-021-00270-2

Tahiru, F. (2021). AI in education. *J. Cases Inf. Technol.* 23, 1–20. doi: 10.4018/JCIT.2021010101

Tao, B., Díaz, V., and Guerra, Y. (2019). Artificial intelligence and education, challenges and disadvantages for the teacher. *Arctic J.* 72, 30–50.

Vinay, S. B. (2023). Application of artificial intelligence (AI) in school teaching and learning process-review and analysis. *Inf. Technol. Manag.* 14, 1–5.

Vlasova, E. Z., Avksentieva, E. Y., Goncharova, S. V., and Aksyutin, P. A. (2019). Artificial intelligence-the space for the new possibilities to train teachers. *Espacios* 40:17.

Vuori, V., and Väisänen, J. (2009). *The use of social media in gathering and sharing competitive intelligence*. The 9th International Conference on Electronic Business, Macau.

Wamba-Taguimdje, S.-L., Fosso Wamba, S., Kala Kamdjoug, J. R., and Tchatchouang Wanko, C. E. (2020). Influence of artificial intelligence (AI) on firm performance: the business value of AI-based transformation projects. *Bus. Process. Manag. J.* 26, 1893–1924. doi: 10.1108/BPMJ-10-2019-0411

Wang, Y., Liu, C., and Tu, Y. F. (2021). Factors affecting the adoption of AI-based applications in higher education. *Educ. Technol. Soc.* 24, 116–129.

Williams, R., Park, H. W., and Breazeal, C. (2019). "A is for artificial intelligence: the impact of artificial intelligence activities on young children's perceptions of robots," in *Proceedings of the 2019 CHI conference on human factors in computing systems*, 1–11.

Wu, W., Zhang, B., Li, S., and Liu, H. (2022). Exploring factors of the willingness to accept AI-assisted learning environments: an empirical investigation based on the UTAUT model and perceived risk theory. *Front. Psychol.* 13:870777. doi: 10.3389/fpsyg.2022.870777

Zhai, X., Chu, X., Chai, C. S., Jong, M. S. Y., Istenic, A., Spector, M., et al. (2021). A review of artificial intelligence (AI) in education from 2010 to 2020. *Complexity* 2021:8812542. doi: 10.1155/2021/8812542

Zhang, K., and Aslan, A. B. (2021). AI technologies for education: recent research & future directions. *Comput. Educ. Artif. Int.* 2:100025.

Zhu, M., Sari, A., and Lee, M. M. (2018). A systematic review of research methods and topics of the empirical MOOC literature (2014–2016). *Internet High. Educ.* 37, 31–39. doi: 10.1016/j.iheduc.2018.01.002