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Barriers to AI Adoption in Education: Insights from Teacher's Perspectives

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Artificial intelligence in education is capable of offering significant benefits in the form of content generation, personalized learning, assistance in administration, and analytical reports. Despite the benefits, the integration of AI in education faces several challenges hindering its integration. The barriers to AI adoption in education are critical to explore, as they affect the incorporation of innovative educational technologies. The study aimed to explore the perceived barriers to suggest practical recommendations to enable educators to embrace innovative AI technologies for teaching. This study employed a qualitative research design with a descriptive research approach. A purposive sampling method was applied to select public and private sector educators from schools, colleges, and universities in Pakistan. Data were collected using an open-ended questionnaire designed using Google Forms. Data were analyzed using thematic analysis to recognize and categorize patterns and themes in responses, gaining a thorough understanding of the key barriers to AI adoption. The insights revealed that integrating AI in education inherits barriers in user experience, technological, and skills limitations, content reliability, privacy and security concerns, and overdependence on AI a risk to reduce creativity and learning. To overcome the barriers, clear ethical guidelines and policies, a balanced integration of AI with pedagogy, AI literacy training, and support to enable teachers to effectively use AI in education are recommended.

Keywords: Artificial Intelligence; AI in education; AI literacy; Barriers to AI Adoption; Teachers' Perception of AI In Education.

Introduction:

AI in education encompasses a variety of algorithms and smart technologies designed to facilitate content creation, tailor learning experiences, provide adaptable assessments, and increase management efficiency [1]. AI is transforming education by revolutionizing traditional teaching methods. AI empowers educators to effectively manage complex classrooms more efficiently, provide individualized support to learners, and raise educational quality through data-driven decision-making. AI reduces and simplifies the administrative workload and improves teaching productivity [2]. Further, intelligent tutoring systems and virtual assistants augment the learning experience by offering immediate feedback and guidance, promoting a more engaging and broader educational environment.

However, despite these benefits, the integration of AI in education faces several challenges. These challenges include a lack of training and resources, handling inaccuracies and biases in AI-generated content, and concerns about how AI impacts teaching creativity and flexibility.

Artificial intelligence in education is capable of offering significant benefits, from personalized learning to administrative effectiveness. However, there exist some barriers that hinder the educators' adoption of AI technologies [3], [4] The barriers to the adoption of artificial intelligence in teaching are critical to explore, as they impact the incorporation of innovative educational technologies. This study emphasizes teachers' perceptions of these barriers underlining the human factor crucial for successful AI integration in education. By addressing this gap, the study aims to bridge technology and its practical application in teaching. [5], [6].

The primary objective of this research is to investigate the barriers to the adoption of AI tools in teaching. This research paper aims to explore the barriers to teachers' adoption of AI technologies. Emphasizing the challenges, difficulties, access to limited resources, and concerns on dependency on technology. By examining these issues, the paper pursues to offer practical insights for policy development and adequate resource allocation for effective integration of AI in teaching.

Research Questions:

- What challenges do teachers face in using AI tools for teaching?
- What difficulties arise from a lack of training or access to resources for utilizing AI tools?
- How do teachers handle the inaccuracies and biases in AI-generated responses?
- What are the drawbacks of using AI in teaching?
- What concerns do teachers have regarding the increasing use of AI tools in teaching?
- To what extent does AI negatively impact teaching?

Scope and Limitations:

The focus of the study is to explore the barriers to AI adoption in teaching from the perception of teachers. This comprises of challenges they face; difficulties arriving from not attending trainings, concerns and biases of AI-generated content, and possible negative effects of AI on the creativity of the educators. The study also considers the factors of gender, age, qualification, designation, and teaching experience in analyzing the barriers to AI adoption in teaching. The study solely focuses on the teachers' perspectives on barriers to AI adoption. As the domain of AI is ever-evolving rapidly, and its adoption may vary based on the education policies, and contextual factors, the findings may not be universally applicable across different educational levels or regions.

Historical Context of AI in Education: The application of Artificial Intelligence in education has a history of over 60 years [7]. Plato (Programmed Logic for Automatic Teaching Operations) developed in the 1960s, was among the first Intelligent Tutoring Systems (ITS).

This system offered personalized education with a Graphical User Interface (GUI) [8]. Later in the era, to evaluate automatic programming assignments, the Automatic Grader was designed. Both systems were rule-based and emphasized individualized teaching. In the 1970s, and 1980s with the advent of microprocessors, advancements were made in the rule base systems. Notable works included systems like TICCIT (Time-Shared Interactive Computer Controlled Instructional Television) a system that facilitated multimedia personalized content [8]. With the emergence of the World Wide Web (WWW) in the 1990s, machine learning models were incorporated with personalized learning services. This was augmented by Web 2.0 which enabled collaborative learning and social interactions [1];. The 21st century revolutionized education with significant improvements in hardware performance, big data mining, and AI models. The notable achievements included deep learning techniques and GPT (Generative Pre-Trained Transformers) in 2017 [9]. The ChatGPT introduced by OpenAI in 2022, advanced this by offering understanding and responding to natural languages [8]. The journey of AI applications in education with technological advancements from its early rule-based system to modern generative AI applications continues to enhance education.

Benefits of AI for Educators:

Artificial intelligence technologies offer several benefits to educators. AI enables access to a vast array of knowledge in different ways. They explain and present information in anticipated ways. Educators utilize AI to better prepare for the lessons. AI generates customized lesson plans and contents in line with the course [10]. AI generates content tailored to individual needs [11]. AI analytics continuously observes students' progress and provides useful insights to help educators make more informed decisions based on the insights to analyze students' performance and make adjustments in their teaching practices accordingly [12]. AI automates administrative tasks, routine tasks such as checking and grading assignments, attendance tracking, preparing reports, etc. are automatically done by AI [13]. AI not only enhances, and eases teachers' work but it also frees time for them to more focus on their teaching [11], [12]. AI holds great potential to improve the quality of education at all levels. Increases time and cost efficiency, and allows global access to quality educational resources [14].

Barriers to AI Adoption:

Educational technologies involving AI tools enhance the overall teaching and learning experiences boosting productivity and outcomes [15]. However, there remain many obstacles that prevent the adoption and utilization of these technologies. These obstacles are personal, technological, and organizational [16]. This is the digital literacy era where a person's technological self-efficacy and cognitive skills are utilized to search, assess, create, and disseminate information with the use of technology. Therefore, an individual must possess adequate cognitive and technological skills to utilize technology effectively.Unfortunately, teachers especially from developing countries, are not well prepared for embracing technology. Another obstacle is a misconception regarding the technology [17]. Beliefs regarding a reduction in creative skills as a result of relying on technology further restrict the adoption. Lack of awareness regarding the potential benefits of AI is another barrier to the adoption [18]. Additionally, the absence of training programs, resources, and organizational support further hinders AI implementation. Moreover, teachers' concerns about inaccurate and biased AI-generated content is another major obstacle.

Materials and Methods:

Research Design:

This study employed a qualitative research design with a descriptive research approach to investigate educators' perspectives on the barriers to AI adoption in education. The study focused on collecting in-depth insights from educators regarding the difficulties, and challenges they face, and their concerns about using AI tools.

Population and Sample:

The study employed a purposive sampling method to select the sample of the study. The study targeted public and private sector educators serving at higher educational institutes, schools, and colleges across Pakistan.

Data Collection:

An open-ended questionnaire was carefully designed using Google Forms to acquire teachers' perceptions and concerns about barriers to AI adoption. The questionnaire covered respondents' demographic information (gender, age), and professional and academic information (experience, and academic qualification). The study followed ethical guidelines for conducting the research [19]. The purpose of the research, the rights of the respondents, and guidelines to attempt the survey were included in the survey form. Furthermore, the study ensured the confidentiality, and privacy of the responses.

Data Analysis:

Collected data were analyzed using the QDA Miner 6 data analysis tool. The quantitative data were analyzed using descriptive analysis through frequencies and percentages. Descriptive analysis is an important characteristic of research methodology that presents statistics in a concise, meaningful summary [20]. Qualitative data in the form of open-ended responses were analyzed using qualitative research methods through thematic analysis to recognize and categorize patterns and repeated themes in responses, gaining a thorough understanding of the key barriers to AI adoption.

Results and discussion:

Demographics:

Table 1. Demographic characteristics of respondents (N=51)

Category	Group	Frequency	Percentage
Gender	Male	47	92.16%
	Female	4	7.84%
Age Group	Up to 30	19	37.3%
	31-40	20	39.2%
	Above 40	12	23.5%
Academic Qualification	BS/MA/MSc	24	47.06%
	MS/M.Phil.	22	43.14%
	Ph.D.	5	9.80%
Teaching Experience	16 or above years	11	21.56%
	6 to 15 years	18	35.28%
	Up to 5 years	22	43.16%

Table 1 shows demographic analysis of the respondents (N=51) showed that male participants comprised the majority (92.16%), while female respondents accounted for only 7.84% of the sample. The age distribution demonstrates a reasonably well-justified representation of age groups, with the largest age group of 31 to 41 years (39.2%), followed closely by the age group of up to 30 years (37.3%), and the age group above 40 years (23.5%). The distribution of academic qualifications among respondents indicates that nearly half of the sample (47.06%) holds BS/MA/MSc degrees, followed by MS/M.Phil. holders at 43.14%, while Ph.D. holders make up 9.80% of the sample. Regarding teaching experience, the majority of respondents (43.16%) had up to 5 years of experience, followed by those with 6 to 15 years (35.28%), while 21.56% had 16 or more years of experience.

Thematic Analysis: Thematic analysis is a systematic and adaptable qualitative research technique that recognizes and interprets patterns within data. Thematic analysis categorizes responses into meaningful themes. This technique reveals deep insights and supports evidence-based decisions by emphasizing key issues. Thematic analysis is an effective method for deriving meaningful insights and apprising effectual decisions in diverse disciplines. The responses were categorized in table 2 and themes were extracted from them to conclude.

Challenges in using AI tools in teaching.

Table 2. Categorization of perceived challenges

Theme	Responses	Frequency	Percentage
Theme 1: User experience 31.40%	Writing a prompt	8	15.70%
	Unexpected responses	6	11.80%
	Reduced teacher-student interaction	2	3.90%
Theme 2: No Challenges 29.40%	No challenge	15	29.40%
Them 3: Technical & accessibility 27.40%	Internet Issues	12	23.50%
	Not freely available	2	3.90%
Theme 4: Reliability of contents 11.70%	Not 100% reliable responses	2	3.90%
	Insufficient data on specific subjects	2	3.90%
	content not updated	2	3.90%
	Total	**51**	**100%**

The statistics on perceived challenges faced by educators in using AI for teaching highlighted a range of experiences. A significant 29.40% of respondants reported that they did not encounter any challenges. The remaining 70.60% of respondents reported a diversity of challenges notably internet issues 23.50%, writing an effective prompt 15.70%, and getting unexpected responses from the systems 11.80%. As illustrated by table 3, responses were grouped under themes which revealed that theme 1; user experience challenges were reported by 31.40% respondants, followed by theme 2 with no challenge experiencedby 29.40%, theme 3; technical and accessibility challenges faced by 27.40%, and theme 4; reliability of content challenges reported by 11.70%.

Difficulties arise from a lack of training or resources for AI tools:

Table 3. Categorization of perceived difficulties

Theme	Responses	Frequency	Percentage
Theme 1: Training and Support 39.20%	Difficulties regarding proper use, need training	16	31.40%
	Time-consuming in terms of learning to use	2	3.90%
	AI literacy is **a** must for the teachers at school level	2	3.90%
Theme 2: Effectiveness and Content 27.3%	Inability to address diversity	4	7.80%
	Inappropriate content	2	3.90%
	Less information on some topics	2	3.90%
	Inaccurate use of AI	2	3.90%
	may lead to the rapid circulation of incorrect information	2	3.90%

	Sometimes do not provide explanations	2	3.90%
Theme 3: No Difficulties 21.60%	No difficulties	11	21.60%
Theme 4: Technical and Functional 7.80%	Internet	2	3.90%
	limited functionality	2	3.90%
Theme 5: Reliability and Uncertainty 3.90%	Uncertainty always remains	2	3.90%
	TOTAL	**51**	**100%**

Considering perceived difficulties faced by educators in using AI for teaching due to the unavailability of training, the statistics revealed diverse experiences. Although 21.60% reported facing no difficulties, the remaining 79.40% reported a variety of difficulties most importantly, a substantial 31.40% reported that they encountered difficulties regarding proper utilization of tools due to not availing of training.

Handling inaccuracies or biases in AI-generated content:

Table 4. Categorization of handling inaccuracies and biases

Theme	Responses	Frequency	Percentage
Theme 1: Cross-referencing 45%	Crosscheck with other AI tools, and Internet sources	17	33.30%
	verify from articles	2	3.90%
	Verify from textbooks	2	3.90%
	Evaluate the source	2	3.90%
Theme 2: Critical Evaluation and Human Oversight 35.30%	Rewrite the prompt accurately	6	11.80%
	Through previous knowledge and critical thinking	6	11.80%
	Do more research to support the responses	2	3.90%
	Going through the material	2	3.90%
	monitor AI output	2	3.90%
Theme 3: Acknowledging Limitations 15.60%	No idea	4	7.80%
	Leave the response and do it manually	2	3.90%
	Some of the questions will not be accurate	2	3.90%
Theme 4: Technological Support 3.90%	It's handled to check the content by software	2	3.90%
	TOTAL	**51**	**100%**

Regarding handling inaccuracies and biases in AI-generated responses, the statistics revealed varied approaches. Particularly, one-third 33.30% of the respondents stated that crosschecking the data with other AI tools and Internet sources including search engines, YouTube, etc. Another 11.80 % stated to resolve this issue by correctly rewriting the prompt, and a similar no. of respondents stated that they use interpersonal critical thinking abilities and previous knowledge to tackle this. Importantly 7.80% also reported having no idea how to resolve this.

Drawbacks of using AI tools in teaching:

Table 5. Categorization of perceived drawbacks

Theme	Responses	Frequency	Percent

Theme 1: Learning and Creativity 43.10%	Over-reliance on technology potentially decreases creativity	20	39.20%
	Book Reading habits will slow down	2	3.90%
Theme 2: No Drawbacks 25.50%	No drawbacks	13	25.50%
Theme 3: Accuracy and Reliability 11.70%	This may lead to the circulation of wrong information	2	3.90%
	Provides same answers	2	3.90%
	Some provide inaccurate content.	2	3.90%
Theme 4: Human Interaction and Engagement 7.80%	Lack of emotional attachments	2	3.90%
	Lack of human interaction	2	3.90%
Theme 5: Ethical and Societal 7.80%	Negative uses can cause destruction	2	3.90%
	Sometimes unethical data	2	3.90%
Theme 6: No Idea 3.90%	No idea	2	3.90%
	Total	**51**	**100%**

Regarding the perceived drawbacks of using AI for teaching, the statistics revealed diverse perspectives. Notably, a significant 39.40% perceived the overreliance on technology to decrease human creativity as the biggest drawback. Another significant 25.50% of respondents perceived no drawbacks of using AI for teaching.

Concerns regarding the increasing use of AI tools in teaching:

Table 6. Categorization of perceived concerns

Theme	**Responses**	**Frequency**	**Percentage**
Theme 1: Impact on Human Creativity and Learning Habits 47.00%	Reduces human creativity	18	35.30%
	The enthusiastic approach of research consulting different sources vanished	2	3.90%
	It affects the book-reading habit	2	3.90%
	It will have negative concerns in education	2	3.90%
Theme 2: Over-Dependence on AI 17.60%	Over-reliance on technology	5	9.80%
	It should only be used for science subjects	2	3.90%
	Can damage the relationship between teacher and students	2	3.90%
Theme 3: No Concerns 15.70%	No concerns	6	11.80%
	It is great because it Improves writing formats	2	3.90%
Theme 4: Accuracy, Reliability, and Security 11.70%	Privacy and security issues	2	3.90%
	It has some mixed and inaccurate data	2	3.90%
	widening the digital divide	2	3.90%
Theme 5: Uncertainty 3.90%	Not sure	2	3.90%
Theme 6: Need for AI Literacy 3.90%	Students and teachers need training	2	3.90%

	TOTAL	**51**	**100%**

Analyzing the perceived concerns regarding the educators' use of AI for teaching, the statistics revealed varied viewpoints. Though 11.80% perceived no concerns, a substantial 35.30% viewed concern on reducing human creativity, and another 9.80 also perceived concern of overreliance on technology.

The negative impact of AI tools on teaching creativity or flexibility:

Table 7. Categorization of perceived negative impact

Theme	Responses	Frequency	Percentage
Theme 1: No Negative Impact/ Positive Impact 53.00%	No negative impact on creativity and flexibility	24	47.10%
	Increasing creativity and flexibility	3	5.90%
Theme 2: Over Reliance Can Cause Reduced Potential 39.20%	Over-reliance can negatively affect creativity and flexibility	18	35.30%
	It may reduce teaching potential.	2	3.90%
Theme 3 Negative Social Impact: 3.90%	Decreases social interactions	2	3.90%
Theme 4: Uncertainty 3.90%	Not sure	2	3.90%
	TOTAL	**51**	**100%**

Regarding the perceived negative impact of using AI for teaching, the statistics revealed that nearly half of the respondents 47.10% believe that there is no negative impact of using AI in teaching, while another significant 35.30 perceive overreliance on technology resulting negative impact on human creativity and flexibility.

Discussion:

The integration of AI into teaching offers both opportunities and barriers. Concerning challenges of using AI, although, a significant no of teachers report no challenges, others face several challenges. The major challenges are related to the user experience [21] technical accessibility, reliability of AI content, and the difficulty in proper use of AI tools. These findings emphasize the need for AI literacy in educators. The usefulness of these technologies depends on how easily teachers can access, understand, and utilize them for education. Regarding measures or strategies to deal with inaccuracies and biases of AI-generated responses, nearly half of the educators crosscheck the responses for confirmation with other AI tools, the internet, and academic sources. Another significant no of responding teachers also used their interpersonal natural capabilities and prior knowledge to overview the responses and prompts. This reflects teachers' responsibility and. awareness of AI limitations. Although AI tools respond in no time their responses are not always correct, and reliable. This highlights the need for measures to enhance the reliability of generative AI content. Interestingly, a significant number of educators are unsure how to navigate this challenge. It is deeply concerning that a significant number of educators worldwide are unaware of strategies to address the limitations of AI tools in generating biased data.This further urges the need for training and support [22]. A key drawback of AI use by educators is the over-reliance on AI, which is seen as a major concern due to its potential to diminish learning and creativity skills [23] [24].

Other drawbacks include the accuracy and reliability of AI-generated content [25] [26] [27], reduced human interaction, and destructive ethical, and social impact [27]. The perceived drawback of learners' over-reliance on AI consequently resulting in reduced learning, and creativity is justifiable. If learners largely depend on AI, this may not reduce their problem-

solving and critical-thinking skills. Learners should be guided to use AI as an additional tool for learning rather than a substitute. Regarding concerns about the increasing use of AI, nearly half of the responding educators perceived a negative effect on human creativity and learning [26]. Other major concerns include over-dependence on AI, reliability, and accuracy of the content, and security and privacy of using AI were also perceived [25] [28] [26] [29] [23] [24]. No concerns were also reported by a notable no of respondents. These insights reflect divided concerns regarding the trust in AI. This underscores the importance of well-defined policies for AI integration, upholding privacy, security, and human creativity. Regarding negative impacts of AI, a significant no. of respondents perceived either no negative impact or positive impact of AI. Another notable group of respondents perceived over-reliance on AI to subsequently cause reduced potential in teaching, and creativity [29] [27]. The mixed responses suggested the impact of AI use for education depends on how it is used. Excessive reliance on AI may undermine educators' role in fostering creativity and problem-solving skills among learners. Therefore, maintaining a balanced integration of AI in teaching practices is essential.

Conclusion:

The integration of AI in education inherits certain barriers to adoption. While some teachers experience no difficulties at all, many teachers face challenges in user experience, technical limitations, and reliability of content. Some of these challenges include lack of proper training, fear of AI inaccuracy, privacy and security risks, and overdependence on AI that reduces creativity and learning. Educators further identify AI's negative impact on human interaction alongside ethical concerns. To mitigate these barriers, teachers recommend balanced AI integration, ethical guidelines for AI adoption in teaching and training, and support to facilitate AI literacy for teachers to make AI adoption in education effective and ethical.

The limitation of the study is that teachers' adoption of AI in education varies across cultures and institutions. In a culture where traditional teacher-led instruction is preferred, teachers fear adopting AI technology, believing that such technologies weaken their authority and personal connection with learners. Whereas, in a culture of widely embracing digital technology, teachers may be confident and willing to utilize AI in education. Institutions with well-defined policies, and ethical guidelines for AI integration, urge educators to embrace technology, however, in the absence of clear policies, guidelines, and support for AI integration within institutions educators restrain themselves from using AI technologies. Future studies should focus on the cultural, and institutional differences to influence AI adoption and identify the best solutions for different domains.

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