AI Concerns Among Educators: A Thematic Analysis

Claudia Myrna Méndez Alarcón[1]*, Olusiji Adebola Lasekan[2], Margot Teresa Godoy Pena[3]

[1]Universidad Autónoma de Baja California, Mexicali, Mexico, [2]Universidad Católica de Temuco, Temuco, Chile, [3]Universidad de La Frontera, Temuco, Chile. *Corresponding Author's Email: claudia.mendez23@uabc.edu.mx

Abstract

This qualitative study investigates educators' concerns about the adoption of Artificial Intelligence (AI) in education by utilizing social media as a primary data source. The study adopts the Concerns-Based Adoption Model (CBAM) and Protection Motivation Theory (PMT) to structure its investigation, providing a comprehensive understanding of how educators perceive and react to AI integration. Through thematic analysis of discussions on platforms such as Reddit, the study identifies various degrees of concern, stages of concern, and types of risks/concerns associated with AI integration. Findings reveal that a significant majority of educators and stakeholders report high levels of concern, with over fifty percent indicating they are 'very concerned' on a Likert scale. The majority are in the 'consequence' stage of concern, where the impact on student outcomes is a significant worry. Functional risks, such as the potential decline in critical thinking and problem-solving skills due to AI reliance, emerged as the most prevalent concern. Other significant concerns include social risks related to the alteration of traditional educational roles and information risks from potential inaccuracies in AI-generated content. The study underscores the complexity of AI adoption in educational settings and highlights the need for targeted interventions to address these multifaceted concerns.

Keywords: Artificial Intelligence in Education, Concerns-Based Adoption Model, Educator Concerns, Protection Motivation Theory (PMT), Social Media Data, Thematic Analysis.

Introduction

Artificial Intelligence (AI) is revolutionizing the educational landscape by enhancing teacher roles with tools that personalize learning, automate grading, and improve content delivery. AI-driven personalized learning tools analyze student data to tailor educational experiences, enhancing engagement and outcomes (1). Automated grading systems reduce teacher workload by providing timely feedback, even in complex assessments like essays (2). AI also enhances the delivery of instructional materials, making them interactive and adaptive to meet diverse learning needs (3), and intelligent tutoring systems provide personalized instruction and feedback, adjusting in real-time to student responses (4). Despite its transformative potential, navigating AI's challenges, such as privacy and equitable access, is essential for maximizing its benefits in education.Teachers play a pivotal role in the successful adoption and implementation of artificial intelligence (AI) technologies in educational settings. Their attitudes and acceptance of AI significantly influence how these technologies are integrated into classrooms and perceived by students. Research has shown that teachers' positive attitudes towards AI are crucial for its effective use in education, as these attitudes directly affect their willingness to engage with and deploy AI tools (5). Furthermore, studies indicate that future teachers' perceptions of AI, particularly when they are less favorable than those of the general population, highlight the need for enhanced AI-related teacher training (6). This training can prepare them better for the integration of AI in teaching, ensuring they are equipped to handle the associated challenges and optimize the benefits of AI in educational practices. The success of AI integration in education, therefore, largely depends on addressing teacher concerns, enhancing their AI literacy, and fostering a positive attitude towards the use of AI in their teaching methodologies. The adoption of Artificial Intelligence (AI) in education, spearheaded by teachers, is fraught with concerns regarding privacy, job security, effectiveness, and ethical implications. Privacy

issues arise from the extensive data AI systems require, potentially leading to breaches and misuse (7). There's apprehension about AI automating teaching roles, possibly devaluing traditional teaching methods and threatening job security (8). Educators also question whether AI can genuinely match the effectiveness of conventional teaching (9), and ethical dilemmas like bias and lack of emotional engagement further complicate AI's integration into education (10). Addressing these issues requires a concerted effort from all stakeholders to ensure AI's responsible use in enhancing educational practices. In the realm of Artificial Intelligence (AI) in education, significant research gaps persist, particularly regarding its adoption by teachers. Studies often fail to capture the evolving nature of educators' concerns, from initial apprehension to more practical issues of integration and efficacy, a progression not often tracked in longitudinal studies despite the application of models like the Concern-Based Adoption Model (CBAM, 11). Furthermore, research lacks differentiation among the various types of concerns such as ethical implications, job security, and impacts on pedagogical autonomy (12). Additionally, there is a notable deficiency in the concept of 'degree of concern' reflects how emotionally or cognitively engaged teachers are with the issue of AI, predicting their involvement and acceptance of AI technologies in educational settings. This concept, used across various fields can be used to understand and address educators' concerns effectively, thus facilitating more targeted and beneficial AI integration strategies (13). Addressing these gaps requires a nuanced research approach that includes detailed stage-based models and employs longitudinal methodologies to better understand the barriers and facilitators of AI adoption in educational settings, thereby enabling more effective integration strategies that are responsive to the needs and concerns of educators.The integration of artificial intelligence (AI) in education has sparked a range of ethical, pedagogical, and professional concerns among educators, who are pivotal to the successful adoption of these technologies. Ethical issues such as data privacy and algorithmic bias raise apprehensions about compliance with regulations like GDPR and the perpetuation of inequalities in education (14). Pedagogical concerns include fears of diminishing human interaction, essential for fostering emotional intelligence, and the potential stifling of critical thinking skills due to over-reliance on AI tools (15, 16). Professionally, teachers worry about job displacement and shifts in their roles, necessitating significant professional development to acquire the skills required for AI integration (17, 18). Despite these concerns, many studies focus on the potential benefits of AI while inadequately addressing these multifaceted teacher apprehensions, particularly their progression and intensity over time. This gap underscores the need for a nuanced exploration of teachers' concerns. The findings will offer actionable insights into addressing these complexities and ensuring that AI integration aligns with educators' needs and ethical educational practices. Thus, this study aims to thoroughly analyze these concerns by quantifying the level of the concerns to gauge levels of resistance or acceptance, identifying the stages of concern throughout the AI adoption process, and categorizing the types of concerns to pinpoint specific themes such as ethical, practical, or technological issues. Understanding these aspects is crucial for developing targeted interventions, providing timely support, and fully harnessing AI's potential to enhance educational outcomes. This research is crucial as it aids educational institutions in tailoring AI implementation strategies to better align with educators' needs, thereby enhancing the uptake and effectiveness of AI tools. Insights from this study provide policymakers with a deep understanding of educators' concerns, supporting the development of informed policies that promote ethical AI adoption and address potential reservations. Additionally, this research guides technology developers in designing AI tools that are user-friendly and meet the specific needs of the educational community, ensuring innovations are practical and sensitive to the professional environment of teachers. By bridging the gap between AI capabilities and educational needs, this study helps in crafting informed policies, designing appropriate training programs, and developing AI tools that are better aligned with teacher needs and apprehensions, facilitating an environment where AI can be used effectively and ethically within educational systems. In the context of a study on AI adoption, it is practical to consider risks and concerns together because they both

influence decision-making processes. Understanding the risks helps in quantifying and strategizing for potential negative outcomes, while understanding concerns helps in addressing stakeholder sentiment and ethical implications. Both risks and concerns drive the need for regulatory frameworks, ethical guidelines, and communication strategies. For instance, addressing the risk of algorithmic bias also alleviates concerns about fairness and justice in AI systems. By treating risks and concerns as related, a study can adopt a holistic approach to AI adoption, including not only mitigating specific risks through technical and procedural measures but also addressing concerns through transparency, stakeholder engagement, and ethical practices. To address the complexities of AI adoption in education, this study examines the concerns expressed by stakeholders on Reddit, recognizing the platform's open and anonymous nature. While educators are the primary focus, the term "stakeholders" is used broadly to account for the diverse perspectives of individuals who may engage in discussions about education and AI on the platform, including parents, policymakers, and school administrators. This inclusive approach acknowledges the limitations of verifying commenter identities while capturing a wide range of views. By analyzing these discussions, the study aims to provide a comprehensive understanding of the concerns surrounding AI in education, offering valuable insights for targeted interventions and policy recommendations.

Theoretical Framework

This study is built upon the integration of Protection Motivation Theory (PMT) and the Concerns-Based Adoption Model (CBAM). This combined framework provides a comprehensive approach to understanding and addressing the multifaceted concerns associated with the adoption of AI in educational settings. PMT is utilized to examine how educators perceive potential threats from AI technologies and how they evaluate coping mechanisms to mitigate these perceived threats. Simultaneously, CBAM maps the progression of educators' concerns about AI from initial awareness to advanced stages of integration and optimization (19). This dual-framework approach allows the study to capture both the emotional and cognitive responses of educators as they navigate through the various stages of AI

adoption, providing insights into the development of targeted interventions that enhance both acceptance and effective use of AI in teaching practices. By understanding how threat perceptions influence educators' stages of concern and their practical engagement with AI, the research aims to support the development of AI integration strategies that are sensitive to the needs and apprehensions of educators (19, 20).

Conceptual Framework

We argue that the integration of the Concerns-Based Adoption Model (CBAM) and Protection Motivation Theory (PMT) can comprehensively assess the concerns associated with AI adoption among educators and stakeholders. This framework employs PMT to evaluate the intensity of concerns, correlating them with perceived threats and efficacy beliefs (both self-efficacy and response efficacy) which significantly influence the degree of concern (20). Concurrently, CBAM is utilized to delineate the evolutionary progression of concerns through stages ranging from initial awareness to informational, personal, management, consequence, collaboration, and refocusing stages (19), capturing how these concerns develop as educators and stakeholders gain experience with AI. Additionally, the framework categorizes concerns into types such as ethical considerations, privacy issues, and potential impacts on pedagogy and teacher-student dynamics, providing insights into the primary vulnerabilities and uncertainties. By integrating CBAM and PMT, the framework facilitates a detailed examination of how these concerns are perceived, reacted to, and managed, aiding in the formulation of targeted interventions and informed policy-making in educational technology adoption. Thus, as shown in Figure 1, our framework consists of three main components: the Degree of Concerns (DoC), Stages of Concerns (SoC), and Types of Concerns (ToC). The DoC is informed by the Protection Motivation Theory (PMT), while the SoC is based on the Concerns-Based Adoption Model (CBAM). The framework connects these components to provide a comprehensive understanding of how teachers' and stakeholders' concerns evolve and manifest in various types, facilitating a structured approach to addressing these concerns in the context of AI implementation in education.
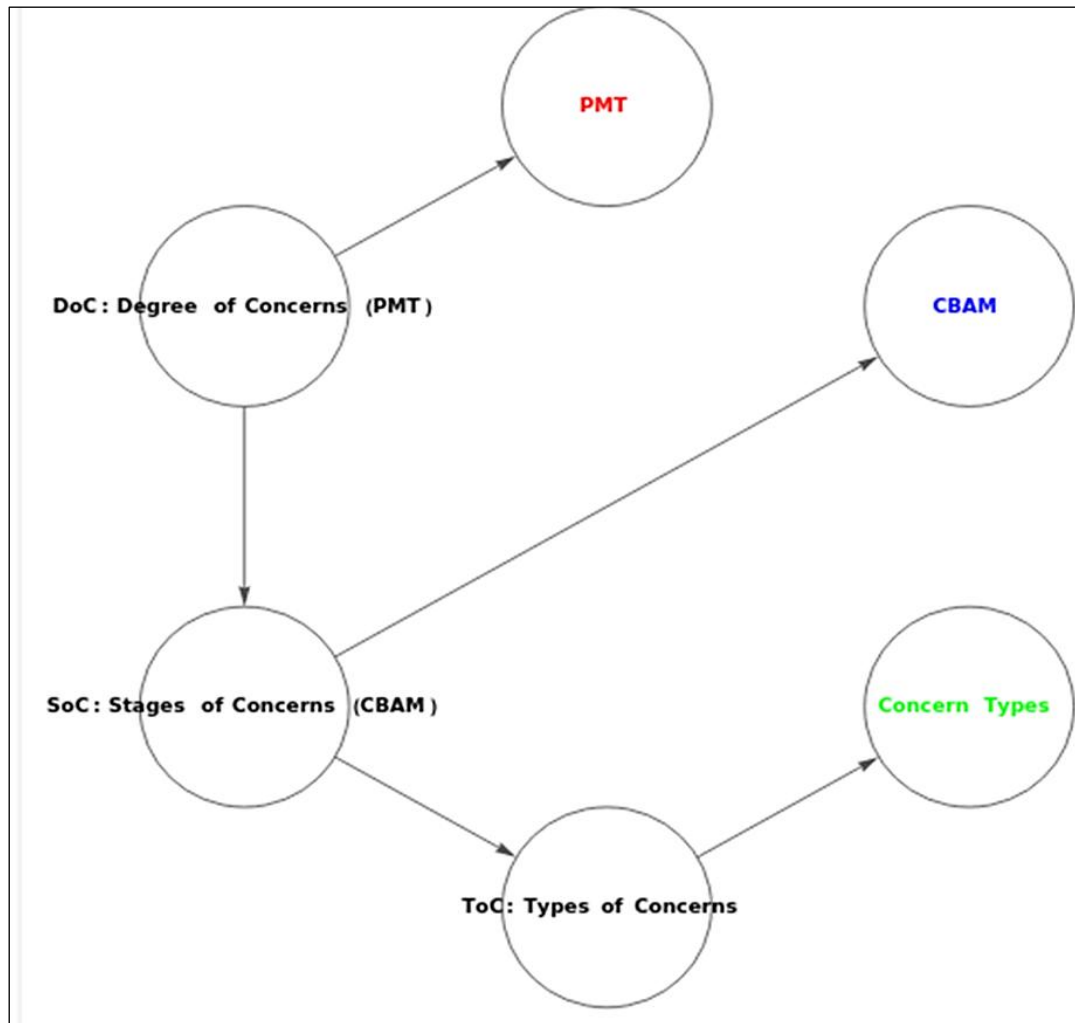
Figure 1: AI Adoption Concerns Framework

Educator and stakeholder concerns regarding the adoption of AI by teachers within educational settings draws upon both the current utilization of AI technologies and the historical adoption level and patterns. AI in education has progressively evolved to integrate various learning sciences with AI technologies, enabling adaptive learning environments that cater to diverse learning needs. These environments are equipped with tools that accommodate the unique challenges introduced by the latest digital technologies such as tablets and cloud computing. Historically, the adoption of AI in education has seen a varied trajectory, with initial integrations focusing on basic computer technologies and gradually advancing towards more sophisticated AI-driven systems that enhance personalized learning experiences and support the cognitive development of students by mimicking human interaction and problem-solving skills. Researchers discuss the adoption features that influence AI integration in educational systems, including perceived compatibility and relative advantage, which significantly affect user acceptance and the effective implementation of AI technologies(21). Educator and stakeholder concerns primarily revolve around the implications of AI on teaching methodologies, the ethical use of AI, and the potential for AI to replace human roles, which necessitates an ongoing dialogue to address these concerns effectively. The integration of AI into educational practices also raises questions about the preparedness of institutions to adopt such technologies and the readiness of educators to utilize these advanced tools effectively. These factors point towards the need for targeted professional development and strategic implementation plans that consider both the advantages and the potential challenges posed by AI in education, helping to alleviate the concerns of educators and stakeholders as AI continues to evolve as a central component of educational

technology (22, 23). The degree of concerns regarding AI adoption by educators and stakeholders in educational settings reveals a variety of perspectives, measured through quantitative assessments and surveys. A survey assessing both educators' and students' perspectives on the impact of generative AI on assessments in higher education, identifying moderate usage of AI and highlighting educators' concerns over academic integrity and the need for assessment reforms to focus on higher-order thinking skills is conducted (24). Structural equation modeling was utilized to analyze the adoption of AI in Indian higher education, noting significant concerns related to governance and the accuracy of decisions made by AI systems (25). Moreover, explored ethical concerns was explored in AI usage in distance-based higher education through workshops and surveys, underscoring the varied concerns across multiple stakeholder groups including students, teachers, and institutions (26). These studies collectively emphasize the complexity of AI adoption in education and highlight the importance of addressing the nuanced concerns of all educational stakeholders. The Concerns-Based Adoption Model (CBAM) has proven instrumental in understanding and addressing the evolving concerns regarding AI adoption in educational settings (11). The author used CBAM to identify predominant concerns in Evaluation, Information, and Management among teachers post an AI induction seminar, indicating crucial areas for intervention to facilitate AI integration. Similarly, researchers in the past documented the shift from personal concerns to impact concerns over time among teachers participating in a pedagogical innovation program, highlighting a common trajectory in educational technology adoption (27). Additionally, a study adapted CBAM for school-based consultants to facilitate the implementation of research-based practices effectively, by targeting interventions at specific stages of concern (28). These studies collectively underscore CBAM's utility in managing the transition towards advanced educational technologies by pinpointing where concerns are most intense and where targeted support is most needed. Studies on the types of concerns about AI adoption in education, structured around the perceived risk types (29), highlights various risk categories including physical, social, functional, time loss, financial, opportunity cost, and information risks. Social risks concern the potential impact on interpersonal dynamics and a reduction in human interaction, a major ethical concern (30). Functional risks are related to the effectiveness and reliability of AI tools (31), while time loss risks involve the time required to integrate and familiarize these technologies within educational settings (32). Financial risks reflect the costs of adoption and maintenance (33), and opportunity cost risks consider the potential trade-offs of investing resources in AI over other educational needs. Lastly, information risks highlight concerns about data security and privacy, emphasizing the need for stringent data protection measures (34). Researchers in the past explored how these perceived risks influence teacher resistance to AI adoption, noting that clearer communication about AI's capabilities and limitations may reduce perceived functional and time loss risks(35). Addressing these concerns requires a multi-faceted approach that includes ethical guidelines, rigorous functionality testing, comprehensive educator training, and proactive stakeholder communication to align AI integration with educational goals effectively. Previous studies often conflate the degree of concern (how much concern individuals feel) with the stages of concern (the progression of concerns over time as individuals interact with technology). This overlap complicates the ability to develop targeted interventions at each stage of technology adoption. Moreover, while much of the existing literature focuses on surveys and interviews, there is a lack of comprehensive analysis using social media data to understand real-time, unfiltered expressions of concern by educators and the public about AI adoption in educational settings. therefore, the primary inquiries of this investigation are as follows: This research explores the degree and evolution of concerns among educators and stakeholders regarding AI adoption in education. It examines the prevalent stages of concern over time and analyzes the types of concerns—physical, social, functional, and others—expressed by educators and the general public on Reddit, aiming to provide insights into the challenges and perceptions surrounding AI integration in educational settings.

Methodology

Data collection

In this study, Reddit is used as a primary source for collecting qualitative data to understand the various concerns of educators and stakeholders regarding the adoption of AI technologies in educational settings. Reddit, a platform known for its diverse and active user base, is specifically chosen due to its structured community format, which facilitates focused discussions on niche topics, including education and technology. Reddit provides access to real-time, authentic user-generated content, making them valuable resources for capturing public sentiment and discourse surrounding emerging technologies like AI (36). It is advantageous for academic research because it organizes content into subreddits—dedicated forums where specific topics are discussed in depth. This organization allows researchers to easily access concentrated discussions relevant to AI in education, offering a breadth of qualitative data that is reflective of a wide range of opinions and experiences (37).To systematically collect data, keywords such as "AI in education" and "teacher and AI" are used to search within relevant Reddit subreddits, including r/Education, r/Teachers, and other tech-focused communities. These keywords help in identifying posts and comments that discuss AI adoption concerns directly or indirectly related to educational contexts. The use of exportcomments.com is crucial for efficiently scooping comments from identified Reddit threads. This tool is specifically designed to extract large volumes of comments from Reddit platform, preserving the integrity and structure of the data, including timestamps and user interaction metrics. Its utility in research is justified by its ability to automate the collection process, significantly reducing the time and effort required to manually gather data and ensuring a comprehensive capture of discussions, which might otherwise be missed due to the fleeting nature of Reddit content (38). some the posts are about the perceived underestimation of AI's impact on education by educators, real-life anecdotes of students using AI to complete assignments and expressions of anxiety by educators about integrating AI into their teaching practices amongst others.

Data Screening and Selection

The data screening and selection process is a critical step to ensure the relevance and quality of the data collected from Reddit. Over 2000 comments were initially extracted using specific keywords, and a two-stage screening process was necessary to focus on those most pertinent to AI-related concerns in education. The data collection spanned a period of three months, from January 2024 to March 2024, ensuring a sufficient sample size and capturing diverse perspectives over time. The screening of comments is essential to refine the dataset, eliminating irrelevant or off-topic entries and ensuring that the analysis remains focused on the primary research objectives. This process helps in managing the vast amount of data efficiently, reducing noise and increasing the accuracy of the findings (39). Additionally, it aids in identifying specific patterns or themes that are significant to the research question, such as explicit expressions of concern about AI risks in education (40). Atlas.ti, a qualitative data analysis software, was utilized to manage and screen the comments effectively. The first stage of screening involved removing comments that did not directly relate to AI in education, such as those containing links, promotional content, or discussions unrelated to education and AI. Comments were also excluded if they were excessively brief or lacked sufficient context to be meaningful. This step reduced the dataset to 504 comments. The second stage involved a more focused screening using keywords "fear of AI" and "risk of AI" to identify comments that explicitly or implicitly expressed concerns about AI. Additional criteria included identifying posts that demonstrated relevance to educators' experiences, perceptions of AI's impact on teaching and learning, and its ethical implications. This stage was crucial for capturing the depth of sentiment and apprehension surrounding AI technologies among educators and stakeholders, leaving 22 highly relevant comments for in-depth analysis.

Thematic Analysis

A thematic analysis was conducted to dissect and understand the various dimensions of concerns related to AI adoption. This analysis utilized Atlas.ti, a powerful tool for qualitative data analysis, which enabled the coding and categorization of comments based on predefined

themes aligned with the study's research objectives and questions.

Coding and Categorization Process

The thematic analysis began with the coding of 22 comments extracted from Reddit, specifically focused on expressing the intensity of concerns regarding AI in education. Each comment was coded according to a 5-point Likert scale ranging from "very concerned" to "not concerned." This method mirrors the approach used in the study (41), which effectively quantified the tone and intensity of concerns.

Stages of Concern

To further refine the analysis, the study adopted the seven stages of concern framework (42). This framework categorizes the emotional and informational trajectory of stakeholders when faced with new innovations, specifically:

- Awareness: Minimal concern or involvement with AI.
- Informational: General awareness and interest in AI.
- Personal: Uncertainty about AI's demands.
- Management: Concerns about processes and resource utilization.
- Consequence: Focus on AI's impact on students.
- Collaboration: Coordination with others about AI usage.
- Refocusing: Exploring broader benefits of AI

Risk Analysis

The thematic analysis also incorporated a risk analysis framework based on categories identified by (29) which are pertinent to new technology adoption. These risk categories include:

- Physical risk: Threats to safety and well-being.
- Functional risk: Probability of AI failing to perform as expected.
- Social risk: Effects on the individual's social standing.
- Time-loss risk: Potential for time wastage.
- Financial risk: Financial cost considerations.
- Opportunity cost risk: Risks associated with not choosing the best alternative.

- Information risk: Risks related to asymmetrical information (29).

Reliability and Trustworthiness

Inter-coder reliability was achieved through a systematic and iterative process. Following the initial coding phase, the coders were employed to identify and reconcile discrepancies. These discrepancies were thoroughly discussed, and a consensus was reached on the coding scheme. This iterative approach, combining the use of Atlas.ti and in-depth discussions, ensured high inter-coder reliability and contributed to the robustness of the research findings.

Ethical Consideration

In the thematic analysis of Reddit comments, strict ethical guidelines are followed to ensure the integrity and ethical soundness of the study. All data extracted from Reddit is anonymized to maintain privacy and confidentiality, in accordance with the guidelines by the Association of Internet Researchers (43). Although the public nature of Reddit means individual consent for using comments is not typically required, the study includes only data from forums where users expect public visibility, adhering to ethical practices (44). The research avoids psychological harm by conducting purely observational analysis without commenter interaction, following the minimization of harm principle. Data security is managed under strict protocols with all personal information securely stored and inaccessible beyond the research team.

Results

This study aims to determine the level of the concerns, identifying the stages and types of concerns of teachers and stakeholders. Figure 2 illustrates the distribution of teacher comments regarding their concerns about the adoption of AI in education. The data shows that a significant majority of teachers express high levels of concern, with 11 comments categorized as "Very Concerned" and 6 comments as "Moderately Concerned." In contrast, fewer teachers expressed lower levels of concern, with 2 comments marked as "Somewhat Concerned," 1 comment as "Slightly Concerned," and 1 comment indicating "Not Concerned." This distribution indicates a predominant apprehension among teachers towards AI integration in educational settings.
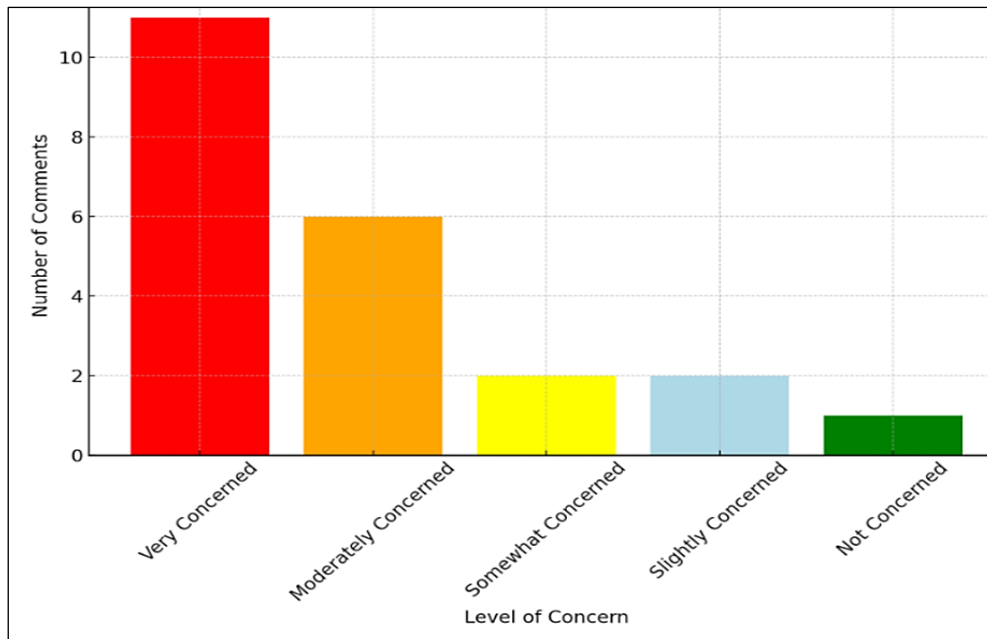
Figure 2: Intensity of Sentiment on AI Adoption by Teachers

Figure 3 presents a pie chart that maps teacher perceptions to various stages of concern regarding AI adoption in education. The largest segment, representing 47.8% of responses, is categorized under "Consequence," indicating that nearly half of the teachers are primarily concerned about the potential outcomes and impacts of AI on education. The second-largest category, "Management," accounts for 21.7% of responses, highlighting concerns related to the practical aspects of AI implementation. "Informational" concerns constitute 13.0%, showing a need for more knowledge and understanding about AI. Both "Personal" and "Awareness" concerns are equally represented at 8.7% each, while there are no responses in the "Collaboration" and "Refocusing" stages. This distribution underscores a predominant focus on the consequences and management aspects of AI adoption among teachers.
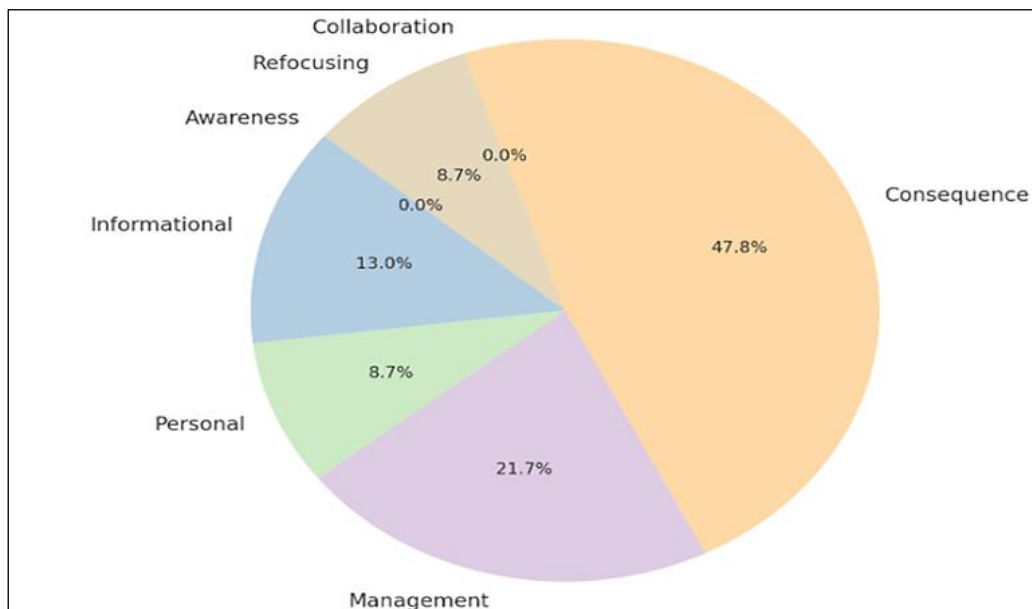

Figure 3: Mapping Teacher Perceptions to Stages of Concern About AI Adoption

Figure 4 displays a bar chart quantifying the different types of concerns and risks expressed by teachers and stakeholders regarding AI adoption in education. The most frequently mentioned concern is "Functional Risk," with 10 comments, indicating significant apprehension about the practical functionality and effectiveness of AI systems. "Social Risk" and "Information Risk" both

have 4 comments each, reflecting worries about social implications and information security, respectively. "Time-Loss Risk," "Opportunity Cost Risk," and "Physical Risk" have fewer mentions, with 2, 2, and 1 comments, respectively, indicating that these concerns, while present, are less prominent. This distribution highlights that functional and social aspects are the primary areas of concern among educators and stakeholders.
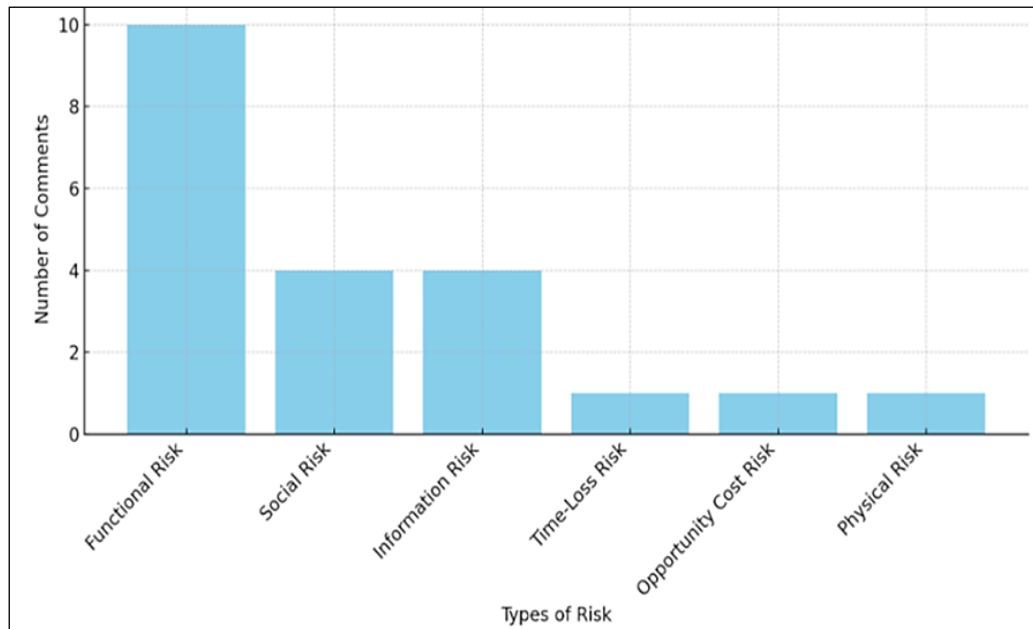

Figure 4: Quantifying Concerns/Risks Expressed by Teachers and Stakeholders

Risk Categories and Perceptions

Our analysis identified a diverse range of concerns among educators and stakeholders regarding the adoption of artificial intelligence (AI) in education. These concerns were categorized into seven primary risk areas: Functional, Social, Information, Time-Loss, Financial, Opportunity Cost, and Physical Risks. Each category reflects specific fears and perceived threats associated with the integration of AI technologies in educational settings.

Functional Risks

Functional risks were the most frequently cited concerns, highlighting fears about the diminution of complex problem-solving abilities and critical thinking skills due to AI reliance (Figure 4). Stakeholders voiced several poignant perceptions:

● Perception 1: Expressed fear about losing the ability to solve complex problems and think deeply.
● Perceptions 10, 20, 21, and 22: Questioned the future of critical thinking and wisdom in the age of AI.
● Perceptions 2 and 6: Addressed performance and dependence issues, worrying that AI's unreliability might foster an over-reliance, diminishing intellectual engagement.

● Perceptions 3, 7, and 29: Discussed the risk of deskilling and superficial learning, indicating concerns about AI leading to a lack of genuine learning and increased academic dishonesty.

Social Risks

Social risks focused on the potential for AI to alter the traditional roles of educators and impact cultural comprehension within educational practices:

● Perceptions 18 and 35: Addressed fears of AI replacing teachers or devaluing their roles.
● Perceptions 5, 14, 11, 19, and 36: Highlighted concerns about cultural nuances and the potential for AI to exacerbate educational inequalities.

Information Risks

Information risks involved fears of AI providing inaccurate or misleading information:

● Perceptions 33, 40, and 41: Expressed worries about the dissemination of confidently presented but incorrect information.
● Perception 36: Noted the perpetuation of biases through AI algorithms.

Time-Loss Risk

Time-loss risk was encapsulated by a single comment, Perception 9, which critiqued the

inefficiency of AI applications that fail to provide meaningful learning experiences.

Opportunity Cost Risk

Opportunity cost risks were articulated through Perception 24, suggesting that reliance on AI might divert educational practices away from more enriching and engaging methods.

Physical Risk

Physical risks, primarily concerned with psychological well-being, were implied through Perception 30, reflecting anxiety associated with interactions with AI.

In sum, except for financial risk, all the established risks were expressed as a spectrum of concerns that educators and stakeholders have regarding the integration of AI in educational environments. These concerns range from the impact on cognitive and educational processes to socio-economic and psychological effects.

Discussion

Achieving our first research objective, which was to determine the intensity or level of concern about AI adoption among teachers, our study examining the intensity of concerns about AI adoption among educators reveals that over 50% of social commenters, primarily educators, are very concerned. Incorporating a global perspective into the discussion on AI adoption in education, it becomes evident that concerns among educators are not isolated to any specific region but are rather widespread across the global teaching community. A pivotal study (24, 45) highlights the international scope of these concerns, pointing out that educators worldwide are apprehensive about the rapid integration of AI technologies into teaching and learning environments. According to the authors, there is a critical need for addressing the ethical, practical, and pedagogical implications of AI to mitigate the apprehensions of the global educator community. This global concern underscores a common thread of caution that educators around the world share, stemming from potential risks to pedagogical integrity, student equity, and the overarching quality of education. Such universal concerns necessitate international collaboration and standard-setting to ensure that AI tools are developed and deployed in ways that genuinely support and enhance educational outcomes without compromising ethical standards or educational equity. With respect to research

objective 2 that involve determine stages of concern about AI adoption among teacher and stakeholders as defined in the Concerns-Based Adoption Model (CBAM), our data indicates that the majority show that a significant majority of educators, comprising 47.8% of social commenters, are in the consequence stage, primarily concerned with AI's impact on student outcomes. This concern is followed by 21.7% in the management stage, focusing on logistics and resources required for AI integration, and 13% in the informational stage, indicating a desire to learn more about AI (11). These stages reflect a progression identified in prior studies, where educators move from personal concerns to impact concerns as their engagement with new technologies deepens (27). Moreover, the effective application of CBAM further validates the model's effectiveness in addressing concerns at various stages by providing tailored support (28). Our analysis suggests that interventions should be stage-specific. For example, educators in the informational stage, it is crucial to provide clear, accessible information about AI technologies through workshops, seminars, and webinars that introduce AI's capabilities, potential benefits, and practical applications in education. This can help reduce uncertainty and build a foundational understanding of AI, using case studies and examples of successful AI integration to further enhance understanding (11). At the management stage, educators' concerns about the logistics of integrating AI into their teaching practices can be addressed by offering hands-on training sessions focused on the technical aspects of using AI tools, alongside readily available support services like IT helpdesks or technical support teams. Developing a resource hub that provides easy access to troubleshooting guides, FAQs, and best practice tips can also empower educators to manage AI resources more effectively (27). In the consequence stage, where educators are primarily concerned with how AI will impact student outcomes, it is beneficial to provide research-based evidence and results from pilot studies demonstrating the effectiveness of AI in improving learning outcomes. Engaging educators in pilot programs to witness the positive effects of AI on student engagement and performance, and establishing feedback mechanisms to refine AI applications based on educators' experiences, are

crucial steps in addressing these concerns (28). Beyond addressing individual stages, it is crucial to adopt an overarching strategy that includes continuous assessment and feedback mechanisms. This allows institutions to monitor the effectiveness of the interventions and make necessary adjustments. Regular feedback from educators on their experiences with AI adoption can inform ongoing support and refinement of implementation strategies. Our answer to research question 3 shows that educators and stakeholders express a spectrum of concerns regarding the adoption of artificial intelligence (AI) in education. These concerns are primarily categorized into seven risk areas: Functional, Social, Information, Time-Loss, Financial, Opportunity Cost, and Physical Risks. Notably, functional risks emerged as the most prevalent, with educators fearing the diminution of critical thinking skills and complex problem-solving abilities due to increased AI reliance. The predominant fear under Functional Risks pertains to the potential diminishment of essential cognitive skills such as complex problem-solving and critical thinking due to reliance on AI. This echoes past study (31), which have highlighted concerns about the effectiveness and reliability of AI tools compromising educational quality by fostering dependency that could lead to intellectual disengagement. The risk of deskilling, where AI might induce superficial learning and increase academic dishonesty, aligns with emerging research suggesting that AI technologies could inadvertently lead to a reduction in rigorous educational practices if not adequately managed. Also, social risks concern AI altering the traditional roles of educators and impacting cultural comprehension within educational practices, highlighting significant socio-cultural implications. This mirrors findings from (30), who discuss AI's potential to disrupt interpersonal dynamics and the cultural fabric of educational settings, leading to a possible devaluation of teachers' roles. Information Risks include fears that AI may disseminate incorrect or biased information, undermining the trustworthiness of educational content. This concern is also emphasized in earlier studies such as those by (34), who highlighted the necessity for robust data protection measures to guard against the misuse of information. Time-Loss and Opportunity Cost Risks reflect concerns about the inefficient use of AI that may not yield meaningful learning outcomes and could divert resources from more enriching educational methods. These findings resonate with the literature on technology integration challenges in education, where the integration of new technologies often requires significant time investment that may not always correspond to tangible educational benefits (46). Lastly, Physical Risks relate to the psychological well-being concerns associated with AI interactions, underscoring the need for careful consideration of how technology affects learners' mental health, reflecting an emerging area of research that examines the psychological impacts of digital learning tools. Collectively, these risks underscore the multifaceted nature of educators' concerns and the necessity for comprehensive strategies to address these challenges effectively (30, 31, 46). To mitigate the risks associated with the adoption of AI in education, it is crucial to design AI tools that complement rather than replace critical thinking and interpersonal interactions, ensuring they enhance rather than diminish educator roles and student engagement (47). Robust data protection measures are essential to secure personal and educational data and maintain content accuracy (48). Time efficiency must be optimized in AI implementations, with regular evaluations to assess impact and real value (49). Furthermore, the physical and psychological well-being of users must be monitored, with AI applications designed to be user-friendly and mindful of health impacts (50). This comprehensive approach will enable culturally responsive, beneficial, and sustainable integration of AI in educational settings. The findings of this study have significant implications for both educators and policymakers as they navigate the integration of AI in educational settings. For educators, the results highlight the importance of targeted professional development programs that address the functional, ethical, and pedagogical challenges associated with AI (51). Training should focus on equipping teachers with the skills to use AI effectively while preserving essential human elements like emotional intelligence and critical thinking in their teaching practices. Policymakers, on the other hand, must prioritize the development and enforcement of robust ethical guidelines to mitigate concerns related to data privacy, algorithmic bias, and the equitable use of AI (52).

Additionally, policies should ensure adequate funding and infrastructure for schools to support AI integration, especially in underserved regions, to prevent widening educational inequalities. Collaboration between students, educators and policymakers is crucial to fostering a balanced approach where AI serves as a supportive tool rather than a replacement, aligning technological advancements with educational values and goals (53). By addressing these implications, stakeholders can ensure that AI is implemented in a way that enhances educational outcomes while addressing the multifaceted concerns of educators and other stakeholders. Comparatively, the literature review and our findings share common concerns across risk types, including the profound implications of functional and social risks on educational practices. However, our study uniquely highlights the predominance of functional risks, suggesting that this area may require particularly focused attention to mitigate fears related to AI's impact on cognitive skills. The contrast in the prominence of different risk types suggests variability in risk perception across different educational contexts and highlights the need for targeted communication strategies to address specific educator concerns effectively. The integration of Protection Motivation Theory (PMT, 20) and the Concerns-Based Adoption Model (CBAM, 19) provides a foundational basis for understanding and addressing the diverse concerns of AI adoption in education. PMT helps examine educators' perceptions of potential AI threats and their coping mechanisms (20), while CBAM tracks the evolution of these concerns from initial awareness through to stages of advanced integration, providing a systematic framework for understanding where educators stand in their adoption journey (19). Together, these models enhance the study's validity by connecting educators' emotional and cognitive responses to AI with established theoretical frameworks, thereby aiding in the development of targeted interventions that align with educators' readiness and apprehensions at various stages. This dual-framework approach not only deepens the analysis of how concerns such as the fear of diminished critical thinking (functional risks) or altered educator roles (social risks) develop and affect AI adoption but also supports the formulation of informed policies and effective educational

technology strategies that are sensitive to both the cognitive and emotional facets of adopting new technologies in educational settings (20).

Conclusion

This study provides a comprehensive analysis of educator and stakeholder concerns about the adoption of AI in educational settings, revealing significant apprehensions that span functional, social, informational, time-loss, financial, opportunity cost, and physical risks. The findings highlight those functional risks, particularly the potential diminution of critical thinking and complex problem-solving abilities, are the most prevalent concerns among educators. Additionally, the study identifies the stages of concern as outlined in the Concerns-Based Adoption Model (CBAM), with a notable number of educators in the consequence stage, focused on AI's impact on student outcomes. By integrating the Protection Motivation Theory (PMT) and CBAM, the research underscores the importance of understanding both the emotional and cognitive responses of educators as they navigate AI adoption. This dual-framework approach provides valuable insights for developing targeted interventions that enhance the acceptance and effective use of AI in educational practices. Addressing the identified concerns is crucial for the successful integration of AI, ensuring that it enhances rather than undermines educational quality. While this study provides valuable insights into educators' concerns regarding AI adoption in education, it is important to acknowledge its limitations. The reliance on a relatively small dataset and a single data source, Reddit, constrains the representativeness and generalizability of the findings. Despite the robust methodology, the use of data from social media platforms like Reddit may skew the diversity of perspectives captured, potentially overrepresenting voices familiar with digital forums. The limited sample size also raises concerns about the robustness of the conclusions. Furthermore, the study's cross-sectional design limits its ability to track changes in educators' concerns over time, suggesting a need for longitudinal research to monitor evolving attitudes as AI becomes more entrenched in educational practices. Readers are advised to interpret the data cautiously, keeping these limitations in mind. Future research should consider incorporating diverse data sources, larger

sample sizes, and longitudinal designs to enhance the validity and applicability of the findings, while also exploring statistical methods for further validation. Moreover, future studies should aim to explore these longitudinal changes and also include diverse educational settings and populations to garner a more comprehensive understanding of global educator concerns. Research might also benefit from integrating quantitative methods to complement the qualitative insights, providing a broader statistical base to the subjective interpretations of concern. Recommendations include urging teachers to engage in professional development concerning AI, advocating for student transparency in AI's educational use, and urging policymakers to enforce ethical AI usage regulations to ensure equity and privacy in educational AI applications. These steps will help balance AI integration with human-centric values, fostering an educational environment where technology and tradition coexist harmoniously.

Abbreviation
Nil.

Acknowledgement
Nil.

Author Contributions
All authors have equally contributed.

Conflict of Interest
Author has declared there is no conflict of interest.

Ethics Approval
Ethical clearance for this study was based on the provision of informed consent from all participants, ensuring their voluntary participation and understanding of the research's purpose and procedures.

Funding
This research received no external funding.

References

1. Akavova A, Temirkhanova Z, Lorsanova Z. Adaptive learning and artificial intelligence in the educational space. In EDP Sciences; 2023. p. 06011.
2. Matthews K, Janicki T, He L, Patterson L. Implementation of an automated grading system with an adaptive learning component to affect student feedback and response time. Journal of Information Systems Education. 2012;23(1):71–84.
3. Chatwal M, Garg V, Rajput N. Role of AI in the Education Sector. Lloyd Business Review. 2023;1–7.
4. Grace E, Vidhyavathi P, Malathi P. A study on" AI in education: opportunities and challenges for personalized learning. Industrial Engineering Journal. 2023;52(05):750–9.
5. Al Darayseh A. Acceptance of artificial intelligence in teaching science: Science teachers' perspective. Computers and Education: Artificial Intelligence. 2023;4:100132.
6. Lipovec A, Flogie A. Empowering Future Teachers: Unveiling Their Attitudes and Knowledge about AI in Slovenian K-12 Education. In IEEE; 2023. p. 1–4.
7. Phattanaviroj T, Moslehpour M, Walawalkar AM. Data Ethics and Privacy. In: Challenges in Large Language Model Development and AI Ethics [Internet]. IGI Global; 2024 [cited 2024 Nov 15]. p. 321–53. Available from: https://www.igi-global.com/chapter/data-ethics-and-privacy/354400
8. Liang CJ, Le TH, Ham Y, Mantha BR, Cheng MH, Lin JJ. Ethics of artificial intelligence and robotics in the architecture, engineering, and construction industry. Automation in Construction. 2024;162:105369.
9. Alghamdy RZ. Pedagogical and Ethical Implications of Artificial Intelligence in EFL Context: A Review Study. English Language Teaching. 2023;16(10):1–87.
10. Bu Q. Ethical Risks in Integrating Artificial Intelligence into Education and Potential Countermeasures. Science Insights. 2022;41(1):561–6.
11. Jong MSY. Pilot study on concerns of teachers of using artificial intelligence in learning and teaching. In IEEE; 2022. p. 209–11.
12. Pokrivcakova S. Pre-service teachers' attitudes towards artificial intelligence and its integration into EFL teaching and learning. Journal of Language and Cultural Education. 2023;11(3):100–14.
13. Trapani B, Annunziato A. Using the Concerns Based Adoption Model (CBAM) to Accelerate Understanding by Design Implementation. Journal of instructional pedagogies. 2018;21.
14. Farooqi MTK, Amanat I, Awan SM. Ethical considerations and challenges in the integration of artificial intelligence in education: A systematic review. Journal of Excellence in Management Sciences. 2024;3(4):35–50.
15. CHISEGA-NEGRILĂ AM. Teaching and Learning in an AI-powered world. Bulletin Of" Carol I" National Defence University. 2024;13(3):105–16.
16. Chung JY, Jeong SH. Exploring the perceptions of Chinese pre-service teachers on the integration of generative AI in English language teaching: Benefits, challenges, and educational implications. Online Journal of Communication and Media Technologies. 2024;14(4):e202457.
17. Nikitina I, Ishchenko T. THE IMPACT OF AI ON TEACHERS: SUPPORT OR REPLACEMENT? Scientific Journal of Polonia University [Internet]. 2024 [cited 2024 Dec 30];65(4). Available from: http://pnap.ap.edu.pl/index.php/pnap/article/download/1347/1285

18. Daskalaki E, Psaroudaki K, Fragopoulou P. Navigating the Future of Education: Educators' Insights on AI Integration and Challenges in Greece, Hungary, Latvia, Ireland and Armenia [Internet]. arXiv; 2024 [cited 2024 Dec 30]. Available from: http://arxiv.org/abs/2408.15686

19. Hall GE, Hord SM. Change in schools: Facilitating the process. Suny Press; 1987.

20. Rogers RW. A protection motivation theory of fear appeals and attitude change1. The journal of psychology. 1975;91(1):93–114.

21. Alhumaid K, Naqbi S, Elsori D, Mansoori M. The adoption of artificial intelligence applications in education. International Journal of Data and Network Science. 2023;7(1):457–66.

22. Alam A, Alam S. Evolution of Artificial Intelligence in Revolutionising Web-Based and Online Intelligent Educational Systems. SPAST Abstracts. 2021;1(01).

23. Hamal O, El Faddouli NE, Harouni MHA, Lu J. Artificial intelligent in education. Sustainability. 2022;14(5):2862.

24. Smolansky A, Cram A, Raduescu C, Zeivots S, Huber E, Kizilcec RF. Educator and student perspectives on the impact of generative AI on assessments in higher education. In 2023. p. 378–82.

25. Chatterjee S, Bhattacharjee KK. Adoption of artificial intelligence in higher education: A quantitative analysis using structural equation modelling. Education and Information Technologies. 2020;25:3443–63.

26. Holmes W, Iniesto F, Anastopoulou S, Boticario JG. Stakeholder Perspectives on the Ethics of AI in Distance-Based Higher Education. International Review of Research in Open and Distributed Learning. 2023;24(2):96–117.

27. Tunks J, Weller K. Changing practice, changing minds, from arithmetical to algebraic thinking: An application of the concerns-based adoption model (CBAM). Educational Studies in Mathematics. 2009;72:161–83.

28. Roach AT, Kratochwill TR, Frank JL. School-based consultants as change facilitators: Adaptation of the concerns-based adoption model (CBAM) to support the implementation of research-based practices. Journal of Educational and Psychological Consultation. 2009;19(4):300–20.

29. Jacoby J, Kaplan LB. The components of perceived risk. ACR special volumes. 1972;

30. Holmes W, Porayska-Pomsta K, Holstein K, Sutherland E, Baker T, Shum SB, et al. Ethics of AI in education: Towards a community-wide framework. International Journal of Artificial Intelligence in Education. 2022;1–23.

31. Stuck RE, Walker BN. Risk perceptions of common technologies. In SAGE Publications Sage CA: Los Angeles, CA; 2019. p. 1316–20.

32. Khan S, Alamri S. Technology integration in education. Imam Journal of Applied Sciences. 2017;2(1):1–7.

33. Cocosila M, Archer N, Yuan Y. Early investigation of new information technology acceptance: A perceived risk-motivation model. Communications of the Association for Information Systems. 2009;25(1):30.

34. Rizvi M. Exploring the landscape of artificial intelligence in education: Challenges and opportunities. In IEEE; 2023. p. 01–3.

35. Pazmiño MA. Inteligencia artificial en la educación: Explorando los beneficios y riesgos potenciales. 593 Digital Publisher CEIT. 2023;8(3):892–9.

36. Goodwin S, Dwyer M, Caliva S, Burrows C, Raiff B. Using Reddit as a recruitment strategy for addiction science research. Journal of Substance Use and Addiction Treatment. 2023;148:209011.

37. Zapcic I, Fabbri M, Karandikar S. Using Reddit as a source for recruiting participants for in-depth and phenomenological research. International Journal of Qualitative Methods. 2023;22:16094069231162674.

38. Adams NN. 'Scraping'Reddit posts for academic research? Addressing some blurred lines of consent in growing internet-based research trend during the time of COVID-19. International journal of social research methodology. 2022;

39. Grob R. Qualitative research on expanded prenatal and newborn screening: robust but marginalized. Hastings Center Report. 2019;49:S72–81.

40. Derickson R, Osatuke K, Teclaw R, Ramsel D. Processing Large Quantities of Qualitative Data in Organizational Surveys: Challenges, Solutions, and Applications. Journal of Organizational Psychology. 2014;14(2).

41. Golder V, Ooi JJY, Antony AS, Ko T, Morton S, Kandane-Rathnayake R, et al. Discordance of patient and physician health status concerns in systemic lupus erythematosus. Lupus. 2018 Mar;27(3):501–6.

42. Chen YH, Jang SJ. Interrelationship between stages of concern and technological, pedagogical, and content knowledge: A study on Taiwanese senior high school in-service teachers. Computers in Human Behavior. 2014;32:79–91.

43. Markham A, Buchanan E, with feedback from the AOIR Ethics Working Committee. Ethical decision-making and internet research: Recommendations from the AoIR Ethics Working Committee (Version 2.0). 2012;

44. Sugiura L, Wiles R, Pope C. Ethical challenges in online research: Public/private perceptions. Research Ethics. 2017;13(3–4):184–99.

45. Aggarwal D, Sharma D, Saxena AB. Adoption of Artificial Intelligence (AI) For Development of Smart Education as the Future of a Sustainable Education System. Journal of Artificial Intelligence, Machine Learning and Neural Network (JAIMLNN). 2023;3(6).

46. Im I, Kim Y, Han HJ. The effects of perceived risk and technology type on users' acceptance of technologies. Information & management. 2008;45(1):1–9.

47. Garvey C. Ai risk mitigation through democratic governance: Introducing the 7-dimensional ai risk horizon. In 2018. p. 366–7.

48. Liluashvili GB. Cyber risk mitigation in higher education. Law & World. 2021;17:15.

49. Talluri S, Kull TJ, Yildiz H, Yoon J. Assessing the efficiency of risk mitigation strategies in supply chains. Journal of Business logistics. 2013;34(4):253–69.

50. Burov O, Pinchuk O. Extended reality in digital learning: influence, opportunities and risks' mitigation. Educational Dimension. 2021;5:144–60.

51. Al-Zyoud HMM. The role of artificial intelligence in teacher professional development. Universal Journal of Educational Research. 2020;8(11B):6263–72.

52. Miao F, Holmes W, Huang R, Zhang H. AI and education: A guidance for policymakers [Internet]. Unesco Publishing; 2021. Available from: https://books.google.cl/books?hl=es&lr=&id=yyE7EAAAQBAJ&oi=fnd&pg=PA3&dq=ai+ethical+guideline+for+policymakers&ots=cBj7G7ymN8&sig=Z4QNYC5jBLrJNTJy649aHgBVKAk

53. Ifenthaler D, Majumdar R, Gorissen P, Judge M, Mishra S, Raffaghelli J, et al. Artificial Intelligence in Education: Implications for Policymakers, Researchers, and Practitioners. Tech Know Learn. 2024 Dec;29(4):1693–710.