AI Emergence in Education: Exploring Formative Tensions Across Scholarly and Popular Discourse

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As education, technology, and society become increasingly intertwined with emerging forms of artificial intelligence (AI), the need to comprehend the potential consequences of its integration has reached a critical juncture. This study explores emerging, formative tensions in the integration of AI in educational contexts, using a comparative content analysis approach to review perspectives from both scholarly and popular discourse. It identifies four main tensions (Human, Ethical, Data, and Systems), providing an essential framework for understanding the challenges and opportunities of AI integration in education. Furthermore, the study emphasizes the importance of a balanced and nuanced approach that recognizes the potential benefits and risks of AI integration in education.

Keywords: artificial intelligence (AI), emerging technology, tensions, education, technology integration, learning and instruction

INTRODUCTION

The domain of education persistently functions as a crucial arena for the incorporation of innovative technologies. Among these, generative AI
technologies, notably large language models (LLMs), have recently garnered significant attention from many educational stakeholders. These advanced technologies promise to radically reshape education by redefining teaching and learning modalities. However, the impressive potential of AI is not without its hurdles. The brisk pace of technological advancements and the novelty of AI applications in educational contexts introduce many complex challenges. From ensuring equitable access and ethical use to addressing potential risks and unanticipated consequences, these challenges present intricate problems that defy easy or lasting solutions. Consequently, educators and researchers are engaged in a continual struggle to keep abreast with these developments, aiming to maximize the benefits of AI while mitigating associated risks.

Amid these intricate challenges and the continuing evolution of AI in education, insights from philosopher of science Thomas Kuhn (1977) provide a valuable lens to navigate the landscape. Kuhn’s concept of “essential tensions,” originating from his reflections on the evolution of science, offers a fitting analogy to the field of education as it grapples with the assimilation of AI technologies. Like the progress of science, educational advancements also pivot between traditional methodologies and the urge to innovate. The integration of AI into education embodies this tension - a push and pull between the comfort of established educational paradigms and the allure of AI-driven innovation. Similarly, while the benefits of AI, such as personalization and real-time feedback, are appealing, they also trigger concerns about privacy, ethics, and the potential for unforeseen consequences. Consequently, the understanding and resolution of these “essential tensions” emerge as a crucial component of the discourse on AI integration in education.

Kuhn (1977) introduced the concept of the “essential tension” as a driving force in scientific development, highlighting the interplay between established scientific paradigms and the need for revolutionary changes. When this concept is applied to the integration of AI in education, it illuminates the existence of deep-seated conflicts that intertwine within and between varied perspectives and expectations. These range from debates on the role of AI in teaching and learning to the tension between personalized learning and privacy concerns. As educators, researchers, policymakers, and other stakeholders increasingly acknowledge the pressing need to comprehend the possible impacts and implications of assimilating AI into education, their interest in probing these emerging tensions is intensifying. This exploration provides invaluable insights into the dynamics at work during this transformative phase of educational technology. Such understanding could guide
the development of more thoughtful, balanced, and effective approaches to AI integration in education, fostering a future where these emerging technologies truly enhance teaching and learning.

BACKGROUND AND LITERATURE REVIEW

Emerging technologies initially present as enigmas, their full implications for integration and systemic adoption often nebulous (Veletsianos, 2010). This study introduces ‘formative tension’ - a term inspired by Kuhn’s ‘essential tension’ - to encapsulate the conflict between change and the status quo during the early stages of an innovative technology’s development. This formative tension, or the early-stage stressor, plays a significant role in shaping the preliminary discussions, perceptions, and debates about the prospective advantages and pitfalls of a novel technology. When transformative technologies emerge, their potential impact on human activities and ethical development becomes a focal point of intense scholarly and public interest (Floridi & Cowls, 2019; Harmon & Mazmanian, 2013; Gurr & Metag, 2023; Jiang et al., 2022). Formative tensions, though potentially disruptive, can stimulate progress, catalyzing growth and transformation.

The study of formative tensions in emerging technology integration suggests that examining these conflicts, and understanding their core attributes, can fuel progress and deepen comprehension (Gurr & Metag, 2023). In education, for example, formative tensions may emanate from the clash between traditional pedagogical methods and innovative instructional technologies (Elwood & Savenye, 2015; Hemming et al., 2007; Plesch et al., 2013). Veletsianos (2010), in his discourse on online education, emphasized the importance of pedagogical considerations and learner needs while integrating technologies, acknowledging the inherent challenges of such an endeavor. Through engagement with these tensions, an enhanced educational model can be conceived, one that adeptly amalgamates traditional and contemporary methodologies.

A review of current academic and public perspectives poses an intriguing question: what formative tensions are shaping the discourse around AI’s integration in education? These tensions, born from conflicting viewpoints and expectations about AI’s potential role in education, often manifest as concrete challenges during implementation and usage. Identifying these tensions can shed light on the opportunities and obstacles facing innovative educational practices. By recognizing and proactively addressing these tensions, educators and policymakers can navigate the trajectory of AI devel-
opment towards ethical and responsible usage, while safeguarding the rights and privacy of learners and educators.

Examining formative tensions in the context of AI integration in education is essential for a nuanced understanding of the potential benefits and challenges associated with this process, and for identifying support mechanisms such as professional development, resource allocation, and policy adjustments (Boling & Beatty, 2014; Floridi & Cowls, 2019; Hemming et al., 2007). To ensure the ethical and responsible integration of AI into education, it is crucial to anticipate unintended consequences and address potential concerns while maximizing the benefits (Jobin et al., 2019; El Morr, 2023). Gaining insight into formative tensions can also foster a more inclusive approach to AI integration in education, one that respects and incorporates diverse perspectives (Srinivasan, 2022; Thongprasit & Wannapiroon, 2022). Analyzing discourse from both scholarly and popular sources can reveal these tensions and the assumptions, values, and expectations driving them (Kim et al., 2022; Zawacki-Richter et al., 2019). Such an approach can assist in devising strategies that address concerns, leverage benefits, and foresee unintended consequences of AI integration in education (Cramer & Kim, 2019; Renz & Hilbig, 2020).

**Study Purpose and Research Questions**

Through an exploration of the formative tensions that exist across and between scholarly and popular perspectives, this study aims to contribute to the growing body of knowledge on the integration of AI in education. By identifying the main tensions that are shaping this integration, the study seeks to build understanding from a broader spectrum of perspectives on the challenges and opportunities of AI integration in education. Additionally, the study emphasizes the importance of thinking broadly and deeply about developing balanced and nuanced approaches to AI integration that recognize both the potential benefits and risks of this technology. This study seeks to contribute to this effort by conducting a comparative content analysis of scholarly and popular discourse on AI integration in education, with the aim of mapping the interplay of tensions and perspectives that are currently at play.
METHOD

This study employed a qualitative research method called comparative content analysis (CCA) (Creswell, 2009; Esser & Vliegenthart, 2017; Gurr & Metag, 2023; Hopmann et al., 2017; Lock & Seele, 2015; Metag, 2016; Rössler, 2012; Schwaiger & Vogler, 2022). CCA involves analyzing and comparing the content of various texts, documents, or media sources to identify patterns, similarities, and differences. This methodology is frequently used in social science research to examine the frequency, profile, and prevalence of themes, messages, or ideas across diverse media platforms or contexts.

CCA is particularly helpful in comparing shared emphases and ideas across popular press and research domains. Researchers can analyze the content of articles or publications from both sources to identify common themes, ideas, or emphases (Gurr & Metag, 2023; Hopmann et al., 2017; Rössler, 2012). Studies of this type have also leveraged quantitative content analysis to generate empirical insights and identify patterns and trends in ethics research (Lock & Seele, 2015). In the present study, comparative content analysis was used to determine differences in the presentation and discussion of topics in popular press versus academic research publications (Lock & Seele, 2015; Schwaiger & Vogler, 2022).

The process of comparative content analysis involves coding the content of each text or media source based on specific categories or themes and then comparing the frequency and distribution of these codes across various sources. The resulting analysis can be used to draw conclusions about the similarities, differences, and patterns in the content of the sources being studied (Creswell, 2009; Gurr & Metag, 2023; Rössler, 2012). To apply comparative content analysis to a study of research and scholarly publication in relation to popular press perspectives on the integration of AI in education, several steps were taken.

Selection of texts

Relevant texts for the analysis were searched for and selected in both the research and scholarly publication channels and the popular press channels. Research and scholarly publications that adhered to peer-review were preferred, as were academic journals devoted to educational, technology, and computer science themes. Popular press channels consisted of news and special interest sites devoted to discussions of generative and emerging AI
technologies in relation to educational contexts and practices. Search terms included words, phrases, and iterations for phrases like “tensions in generative AI” and “AI in education.” The resulting collection included scholarly articles, research papers, and popular press articles that discussed the emergence and integration of AI in education. Special consideration was given to articles and resources focused on generative AI, particularly large language models such as OpenAI’s ChatGPT, Google’s Bard, and other variants. Consideration was also given to articles published after the release of ChatGPT (version GPT-3.5) in its publicly accessible version in November 2022.

**Coding scheme**

Next, a coding scheme was developed to identify themes, categories, or concepts that were relevant to the research question. For example, the coding scheme included categories such as “tensions in AI integration in education”, “potential benefits of AI in education,” “challenges to AI integration in education,” and “ethical concerns related to AI in education”.

**Coding**

Selected texts were then analyzed using the coding scheme. Each text was read carefully and coded according to the relevant categories. This process involved multiple iterations to ensure consistency and reliability in the analysis.

**Comparison**

Once the coding was complete, the data from each text was compared to identify similarities, differences, and patterns across scholarly, research, and popular press perspectives on the integration of AI in education.

**Analysis and interpretation**

Finally, the data was analyzed and interpreted to draw conclusions about the similarities, differences, and patterns identified in the data. This involved identifying common themes or ideas across the various sources.
and exploring how popular press perspectives differed from scholarly and research perspectives.

At the time of this writing, the CCA method used for this study identified 26 research and scholarly articles directly and indirectly pertaining to tensions related to the integration. Alternately, the CCA method identified 38 articles in the popular press that directly or indirectly focused on AI integration in educational contexts. It should be noted that in the approximately four and a half months since the release of ChatGPT to the public, countless articles have been written about its impacts and implications for society. The comparative content analysis in this study represents only a fraction of these articles, and this fact should be considered in any findings and conclusions drawn.

Findings

This study presents the results of a comparative content analysis of scholarly publications and popular press articles, aimed at identifying the primary tensions related to the use of artificial intelligence (AI). The analysis revealed four clusters of formative tensions: Human, Ethical, Data, and Systems. These tensions signify the complex and multifaceted nature of AI emergence in education, emphasizing the need for careful consideration of the technology’s implications and impacts across various domains. Figure 1 below is a visual representation of the four clusters, illustrating their overlap in terms of thematic and contextual matters. The following subsections delve into each cluster of formative tensions, referencing literature examples to illustrate key points and considerations.

Human Tensions

Findings from the applied CCA process underscore the importance of balancing AI technology with human expertise and interaction, as evidenced in the collected articles, opinions, and perspectives. The concept of Human Tensions denotes the balance between the roles of humans and AI in the learning process. The findings indicate the perceived challenge lies in leveraging the strengths of both AI and human educators, ensuring AI supplements rather than substitutes human interaction and expertise. Understanding the Human Tensions dimension is crucial to comprehending how
integrating AI can influence the learning process in higher education. This dimension emphasizes the potential tension between the roles of AI and human educators in learning. While AI boasts strengths like personalized learning and real-time feedback, it is imperative to ensure these advantages complement human interaction and expertise, rather than replacing them. Table 1 summarizes the themes found in Human Tensions, as seen in both research and popular press perspectives; fuller descriptions of each theme follow.

**Figure 1**

*Visual Representation of Overlap of Human, Ethical, Data, and Systems Tensions*
Table 1

Summary of Thematic Clusters for Human Tensions

<table>
<thead>
<tr>
<th>Theme</th>
<th>Description</th>
<th>Academic</th>
<th>Popular</th>
</tr>
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<tbody>
<tr>
<td>Automation and Human Control</td>
<td>This tension lies in balancing automation brought about by AI and maintaining human control in the learning process. A balanced interplay between AI’s capabilities and human educators’ skills is key to a successful learning environment.</td>
<td>Cramer and Kim (2019), Jiang et al. (2022)</td>
<td>Attiah (2023)</td>
</tr>
<tr>
<td>Transparency and Privacy</td>
<td>This tension explores the need for transparency in AI operations, balanced with the necessity for maintaining privacy. Ensuring this balance is crucial for the trustworthiness of AI in educational contexts.</td>
<td>Narayanan and Tan (2023); Cramer and Kim (2019)</td>
<td>Huang (2023)</td>
</tr>
<tr>
<td>Accountability and Responsibility</td>
<td>This theme delves into the tension between ensuring accountability in AI systems and maintaining responsibility, especially in user experience design with AI technologies.</td>
<td>Cramer and Kim (2019); El Morr (2023)</td>
<td>Bowman (2023)</td>
</tr>
<tr>
<td>Algorithmic Bias and Fairness</td>
<td>This tension focuses on the challenges in designing fair AI systems, concentrating on the balance between mitigating algorithmic bias and ensuring fairness. Stakeholder-centered solutions are proposed to address these tensions.</td>
<td>Park et al. (2022)</td>
<td>Chomsky (2023)</td>
</tr>
</tbody>
</table>

**Automation and Human Control.** Cramer and Kim (2019) underscored the necessity of addressing the tension between automation and human control when incorporating AI technologies into UX design, covering the balance between automation and human control, the necessity for transparency, and the challenge of maintaining accountability in AI systems. Similarly, Jiang et al. (2022) discussed these tensions within human-AI interaction and suggest a framework for designing AI systems that support situation awareness. The article provides insights into optimizing the interaction between humans and AI, highlighting the potential for improved col-
laboration and decision-making through a comprehensive understanding of the human-AI relationship.

A good example of popular press reflections on Human Tensions is Karen Attiah’s piece, “For writers, AI is like a performance-enhancing steroid” (2023). The article discussed AI’s impact on writers and editors, delving into the tension between writers, the art, craft, and value of writing, the emergence of effective AI-generated content, and how AI is increasingly integrating into news and information organizations. This piece mirrors discussions taking place in English, writing, and rhetoric programs in higher education. As a result, its comparative content analysis falls under the Human Tensions dimension as it explores the fear writers face being replaced by AI, the potential impact of AI on writers and editors, and the racial and gender disparities that AI can exacerbate.

**Transparency and Privacy.** Narayanan and Tan (2023) explored the tension in achieving explainable and trusted AI, emphasizing the need to address transparency and privacy to ensure AI’s trustworthiness. The authors discuss potential challenges and trade-offs associated with balancing the need for transparency and interpretability with the desire for trust and reliability in AI. Likewise, Cramer and Kim (2019) also highlighted the tension between transparency and privacy when designing UX with AI technologies, noting the imbalance between how AI technologies actually function and the general public’s knowledge of these technologies.

Popular press articles in this theme highlight the potential tension between the roles of AI and human educators in the learning process. For instance, Huang (2023) discussed how universities are revamping their teaching methods in response to AI chatbots like ChatGPT. Lonas (2023a) explored the impact of ChatGPT’s rising popularity on schools scrambling to preserve learning. Meckler and Verma (2022) reported on teachers’ heightened alertness for cheating after ChatGPT’s release, while Kelley (2023) discussed ways to prevent students from using AI tools in their classes. These articles underline the potential tension between the benefits and risks of AI integration in higher education and the need to ensure AI supplements rather than replaces human expertise.

**Accountability and Responsibility.** Cramer and Kim (2019) also discussed the tension between accountability and responsibility in UX design with AI technologies. El Morr (2023) examined these tensions when integrating AI technologies into society, emphasizing the need to balance AI’s benefits and risks. Bozkurt et al. (2023) offered a collaborative reflection on the potential futures of ChatGPT and generative AI in the field of education, highlighting the need for critical thinking, informed decision-making, and responsible implementation of these technologies.
From the popular press, Bowman’s (2022) article, “A new AI chatbot might do your homework for you. But it is still not an A+ student,” examined the potential benefits and risks of AI language tools like ChatGPT. While the tool has been a hit among students, educators have raised concerns about the potential transformations such AI systems could bring to academia. The article also discusses ChatGPT’s limitations, including its inability to indicate when it does not have the answer and the potential for fake generations that erode trust in citing science. Thus, the article underscores the tension between the potential benefits and risks of AI language tools, stressing the need for scrutiny and peer review.

Algorithmic Bias and Fairness. Park et al. (2022) discussed the tension in designing fair AI systems for human services and resource management, focusing on the balance between algorithmic bias already embedded in LLM datasets and objectives for fairness and equity of service. They proposed stakeholder-centered solutions to address these tensions, ensuring AI’s fairness, ethicality, and effectiveness. In turn, some articles adopted an optimistic view of AI integration in higher education that minimizes potential human tensions in favor of potential benefits to things like productivity and creativity. For instance, Kovanovic (2023) asserted that AI’s dawn is upon us and its implications for education are significant. The article highlighted the transformative potential of AI in various educational contexts, including personalized learning, adaptive assessment, and intelligent tutoring systems. Ramer (2023) suggested that ChatGPT calls for interdisciplinary action, and Shapiro (2023) expresses confidence in her students’ ability to use ChatGPT responsibly.

Ethical Tensions

Ethical Tensions arise during the integration of AI in education due to the necessity of balancing potential benefits against potential harms. Ensuring that AI development and usage are ethical, responsible, and respectful of learners’ and educators’ rights and privacy is paramount. Several research studies, scholarly perspectives, and popular press articles have underscored these ethical tensions, discussing various concerns including privacy, trust, explainability, and transparency. These perspectives also emphasize the challenges of designing AI systems aligned with ethical principles and social values. Table 2 summarizes the themes found in Ethical Tensions, as seen in both research and popular press perspectives; fuller descriptions of each theme follow.
Table 2

Summary of Thematic Clusters for Ethical Tensions

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<tr>
<th>Theme</th>
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<th>Academic</th>
<th>Popular</th>
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<tbody>
<tr>
<td>Privacy and Data Protection</td>
<td>Pertains to the concerns related to collecting and processing sensitive personal data through AI in education. The imperative is to respect learners’ privacy and data protection rights and to use data for legitimate purposes only.</td>
<td>El Morr (2023); Quach et al. (2022)</td>
<td>D’Agostino (2023); Khan (2023)</td>
</tr>
<tr>
<td>Bias and Discrimination</td>
<td>Centers on the potential for AI systems to perpetuate existing biases and discrimination, leading to unfair outcomes for certain groups of learners. It emphasizes the need to design and deploy AI systems fairly and to avoid perpetuating discrimination.</td>
<td>Floridi &amp; Cowls (2019)</td>
<td>Crawford (2016)</td>
</tr>
<tr>
<td>Transparency and Accountability</td>
<td>Focuses on the opacity of AI systems which can lead to a lack of transparency and accountability. The essential need is to design AI systems in a transparent and explainable manner and establish clear lines of accountability for errors or biases.</td>
<td>Narayanan &amp; Tan (2023)</td>
<td>Lock et al. (2018); Khan (2023)</td>
</tr>
<tr>
<td>Tradition and Innovation</td>
<td>Relates to the changes to pedagogical principles and practices due to AI in education; argues that the use of AI in education must align with established pedagogical principles and goals, even as it transcends their origins and applications.</td>
<td>Ali et al. (2021); Gao et al. (2022); Jobin et al. (2019); Qadir (2022); Zawacki-Richter et al. (2019)</td>
<td>Cole (2023); Ortiz (2023); Terry (2023); Broome (2023); Coy (2023)</td>
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**Privacy and Data Protection.** Like “Transparency and Privacy” in Human Tensions above, the use of AI in education may involve the collection and processing of sensitive personal data, and the literature reflects emerging concerns about privacy and data protection. It is crucial to respect learners’ privacy and data protection rights and collect and use data only for legitimate purposes. El Morr (2023), for example, discussed the ethical considerations that arise from the adoption of AI in healthcare, including the
need to balance privacy and data protection with the benefits of AI for patient care. Quach et al. (2022) addressed the ethical concerns that arise from using digital technologies in marketing, such as the collection and use of personal data. The authors argued that marketers must consider the ethical implications of their actions and ensure that their use of technology aligns with social and ethical norms.

Representing perspectives from the popular press, D’Agostino (2023) discussed the challenges and considerations involved in designing student assignments in the era of ChatGPT, examining such innovations as personalized feedback and student support. Similarly in an opinion for the New York Times, Khan (2023) argued for the regulation of AI and emphasizes the potential risks and concerns associated with privacy, bias, and concentration of power.

**Bias and Discrimination.** AI systems may perpetuate existing biases and discrimination, leading to unfair outcomes for certain groups of learners. It is necessary to ensure that AI systems are designed and deployed fairly and do not perpetuate discrimination. Floridi and Cowls (2019) emphasized the importance of fairness, transparency, interpretability, explicability, and accountability in AI systems. They argued that these principles provide a foundation for addressing the challenges and implications of AI in various societal domains. The article contributes to the discourse on AI ethics and provides a framework for guiding the development and use of AI technologies. Crawford (2016), in an op-ed for the New York Times predating the release of ChatGPT, discussed the issues of diversity and representation in the field of AI. The article’s title suggests it may focus on how AI, and the data used to train AI systems, can reflect and perpetuate societal biases, particularly related to race and gender. The author argued for greater diversity among AI practitioners and more inclusive practices in AI development.

**Transparency and Accountability.** AI systems can be difficult to understand and interpret, potentially leading to a lack of transparency and accountability. It is vital to design AI systems in a transparent and explainable manner and establish clear lines of accountability for errors or biases. Again, Narayanan and Tan (2023) examined the tension between explainability in AI, arguing that transparency and accountability are crucial for building trust in AI systems. Comparative content analysis revealed that these articles emphasize the importance of ethical considerations in the development and implementation of technology and AI systems. They also underscored the need for interdisciplinary research that considers the ethical, social, and cultural dimensions of technology use. Lock et al. (2018) explored the challenges and opportunities associated with adopting new as-
essment methods and pedagogical approaches. The authors discussed the need to balance accountability and creativity and the importance of aligning assessment strategies with intended learning outcomes. The article provides insights into navigating the tensions between innovative assessment and pedagogy to promote effective teaching and learning experiences in higher education. In the popular press, Khan’s (2023) opinion advocated for transparency, accountability, and antitrust measures, highlighting the importance of societal engagement and the role of government in shaping responsible AI development.

**Pedagogical Principles.** By far, one of the largest thematic clusters in the Ethical Tensions domain deals with concerns over changes to pedagogical principles and practices. Articles in this cluster broadly argue that the use of AI in education must align with established pedagogical principles and goals, even as it transcends their origins and applications. It is necessary to ensure that AI systems are designed and deployed in a way that enhances the quality of education and the learning experience, rather than detracting from it. This requires close collaboration between educators and AI researchers to ensure that the potential of AI is grounded in sound pedagogical principles. Some popular press articles focus on specific aspects of AI integration in educational contexts. For example, Cole (2023) reported on New York City banning students and teachers from using *ChatGPT*, whereas Ortiz (2023) discussed a class that requires *ChatGPT* usage and its surprising results. Taken together, these articles demonstrate both a wariness and an eagerness in the reception of AI capabilities.

Ethical concerns about the impact of AI technology range in scope and severity. The scholarly article “Children as Creators, Thinkers, and Citizens in an AI-Driven Future” (Ali et al., 2021) raised concerns on the importance of AI education for children to develop critical thinking skills, creativity, and ethical behavior when using AI technologies. This view aligns with larger societal concerns about the absence of robust ethical principles that can help guide AI development and integration. For example, Floridi and Cowls (2019) proposed a framework of five principles for AI in society, addressing concerns including transparency, explicability, responsibility, fairness, and sustainability to guide the development and deployment of ethical, transparent, and accountable AI systems. Zawacki-Richter et al. (2019) presented a systematic review of research on AI applications in higher education and advocate for greater collaboration between educators and AI researchers to ensure that AI’s potential is grounded in ethics-based pedagogical principles.

Popular perspectives from the study period frequently touch on ethical considerations related to the use of generative AI in the performance of
learning in formal educational contexts, particularly the issue of plagiarism. For instance, Gao et al. (2022) evaluated the quality of scientific abstracts generated by ChatGPT compared to original abstracts using an artificial intelligence output detector, a plagiarism detector, and blinded human reviewers. They found that ChatGPT-generated abstracts had a higher rate of plagiarism but were generally similar to original abstracts in terms of scientific content and readability. Jobin et al. (2019) provided an overview of the global landscape of AI ethics guidelines and underscore the need for effective guidelines that reflect diverse perspectives and contexts. Qadir (2022) explored the potential of generative AI, such as ChatGPT, for enhancing engineering education while also raising concerns about the reliability and accountability of AI-generated content. Terry (2023), in an opinion piece published in The Chronicle of Higher Education, provided the perspective of a student on the extensive use of ChatGPT in their academic life, discussing its role in various aspects, including research, writing assistance, and learning support. The piece is meant to illustrate the benefits and challenges of utilizing AI technologies like ChatGPT from a student’s point of view, while simultaneously emphasizing how unaware instructors may be of its prevalence. Broome (2023), in an opinion piece in the Washington Post, offered insights from a writing teacher’s experience with ChatGPT. Broome touches on plagiarism in the context of AI-generated text, the pedagogical implications of AI tools, and how AI can potentially reshape teaching and learning processes beyond its ability to generate text.

**Data Tensions**

The Data Tension dimension in this study encompasses a range of serious considerations and implications that can arise from the use, application, and proliferation of large language models. Data tensions are important when considering AI integration in education because they overlap with potential ethical concerns that can arise when using either personal or homogenized data in learning, instructional, and support processes. The integration of LLMs and other forms of machine learning into higher education can provide numerous benefits, such as improved learning outcomes and greater efficiency in administrative tasks. However, as seen in other tension clusters like Human and Ethical, AI can raise profound concerns related to data privacy, accuracy and interpretability of models, transparency and confidentiality, trust and control over data, and bias and fairness. The following are examples of how data tensions manifest during AI integration into higher
education contexts. Table 3 summarizes the themes found in Data Tensions, as seen in both research and popular press perspectives; fuller descriptions of each theme follow.

**Table 3**

**Summary of Thematic Clusters for Data Tensions**

<table>
<thead>
<tr>
<th>Theme</th>
<th>Description</th>
<th>Academic</th>
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<tbody>
<tr>
<td><strong>Privacy and Data Collection</strong></td>
<td>This pertains to the tension that arises when institutions gather large amounts of personal data from users, posing challenges in maintaining user privacy. Institutions must balance the benefits of data collection with the obligation to maintain user privacy.</td>
<td>Quach S. et al. (2022)</td>
<td>D’Agostino (2023); Khan (2023)</td>
</tr>
<tr>
<td><strong>Accuracy and Interpretability</strong></td>
<td>Describes the tension in AI and machine learning systems when the pursuit of precise predictions comes into conflict with the need for interpretability. Complex models may be opaque, making it difficult to determine any biases or other ethical concerns related to their use.</td>
<td>Floridi &amp; Cowls (2019)</td>
<td>Lock et al. (2018); Khan (2023)</td>
</tr>
<tr>
<td><strong>Transparency and Confidentiality</strong></td>
<td>Refers to the tension when institutions need to share data with other parties but must also protect sensitive information. Institutions must be transparent about their data practices while also ensuring the protection of confidential information.</td>
<td>Nguyen (2018)</td>
<td>Lock et al. (2018); Khan (2023); Huang (2023)</td>
</tr>
<tr>
<td><strong>Trust and Control</strong></td>
<td>Represents the tension when institutions collect data from users, who must then trust the organization to use that data responsibly. Organizations need to establish trust with users and provide them with control over their data.</td>
<td>Jiang et al. (2022)</td>
<td>Quach, K. (2023)</td>
</tr>
<tr>
<td><strong>Bias and Fairness</strong></td>
<td>This tension arises when machine learning models and algorithms yield biased outcomes that disproportionately impact certain groups. Institutions must ensure their models are devoid of bias and do not perpetuate systemic inequalities.</td>
<td>Narayanan &amp; Tan (2023); Quach S. et al. (2022)</td>
<td>Crawford (2016); Ramer (2023)</td>
</tr>
</tbody>
</table>
**Privacy and Data Collection.** This tension arises when institutions collect large amounts of personal data from users but struggle to maintain their privacy. For instance, social media platforms may collect users’ personal information for targeted advertising purposes, but users may feel uncomfortable with the amount of data being collected and the potential misuse of that data. As such, institutions must balance the benefits of collecting data with the need to maintain user privacy. Again, Quach S. et al. (2022) raised dilemmas related to the collection, use, and protection of personal data in the digital learning era.

**Accuracy and Interpretability.** This tension arises in AI and machine learning systems when the pursuit of accurate predictions conflicts with the need for interpretability. For example, a complex neural network may provide highly accurate predictions, but it may be difficult to understand why the network made those predictions. This lack of transparency can make it difficult to determine if the model is biased or if there are other ethical concerns related to its use. From a scholarly perspective, Floridi and Cowls (2019) argued that principles of fairness, transparency, interpretability, explicability, and accountability are central to addressing the challenges and implications of AI in various societal domains. They noted that without these, AI becomes subject to mistrust and misalignment with core human values and interests.

**Transparency and Confidentiality.** This tension arises when institutions need to share data with other parties but must also protect sensitive information. For example, a pharmaceutical company may need to share clinical trial data with regulatory agencies, but they must also ensure that confidential patient information is protected. It is therefore important for institutions to be transparent about their data practices while also protecting confidential information. From a higher education perspective, Nguyen (2018) examined the tensions and challenges faced by universities in a world of increasing digital capacities. The author discusses the impacts of digital technologies on higher education, such as online learning, digital resources, and changing student expectations, and highlights the need for universities to adapt to the digital era. They noted that while emerging university processes may require a certain level of transparency, student confidentiality can be compromised in the collection of learning analytics. Universities must negotiate new processes of student support and engagement while navigating challenges such as maintaining quality education, preserving human connections, and ensuring equitable access to technology.

**Trust and Control.** This tension arises when institutions collect data from users, and users must trust the organization to use that data respon-
sibly. For example, a fitness tracking app may collect users’ health data to provide personalized recommendations, but users may feel uncomfortable with the amount of control the app has over their data. Organizations must therefore establish trust with users and provide them with control over their data. Jiang et al. (2022) took a situation awareness perspective on the interaction between humans and AI systems, considering factors such as trust, decision-making, and system transparency. The article provided insights into optimizing the interaction between humans and AI, highlighting the potential for improved collaboration and decision-making through a comprehensive understanding of human-AI relationships. Within the popular press, Quach, K. (2023) discussed the availability of software that can detect essays generated by ChatGPT. The author highlights how universities are offering software tools to identify and deter plagiarism that may arise from the use of AI-generated content. The article reflects concerns about academic integrity and the efforts made by educational institutions to preserve the authenticity of student work. The opinion highlights potential concerns about the role of technology in addressing the challenges associated with AI-generated content. On a larger scale, Klein (2023a) discussed the perspectives of AI engineers on the development and impact of AI technologies. The author argued that AI development and control should not be left solely to tech giants like Microsoft, Google, and Facebook, but rather involve diverse voices and societal input. The article emphasizes the need for transparency, public participation, and ethical considerations in shaping AI technologies. It called for a broader conversation and engagement beyond the engineering community to ensure responsible and inclusive AI development.

**Bias and Fairness.** Findings indicate this tension arises when machine learning models and algorithms produce biased results that disproportionately affect certain groups. For instance, facial recognition algorithms may struggle to accurately identify people with darker skin tones, leading to systemic bias in law enforcement and other industries. As such, institutions must ensure that their models are free from bias and that they do not perpetuate systemic inequalities.

Institutions must balance the benefits of collecting data with maintaining user privacy, ensure that their models are transparent and interpretable while also being accurate, be transparent about their data practices while also protecting confidential information, establish trust with users and provide them with control over their data, and ensure that their models are free from bias and do not perpetuate systemic inequalities. By considering these tensions and developing strategies to address them, institutions can promote the responsible use of data while minimizing the potential for harm.
In the context of higher education, the Data Tensions dimension highlights the push and pull of potential challenges and benefits that can arise from the generative uses of large data models. These tensions may include concerns around privacy and the collection of personal information from students, faculty, and staff, as well as issues related to accuracy and interpretability of machine learning models and algorithms. Higher education institutions must also balance the need for transparency with the protection of confidential information, establish trust with stakeholders and provide them with control over their data, and address issues related to bias and fairness in their data practices. By acknowledging these tensions and developing strategies to address them, higher education institutions can promote the responsible use of data in ways that benefit their students and stakeholders while minimizing the potential for harm.

Narayanan and Tan (2023) argued that there is a tension between the need for explainability in AI systems and the need to protect the privacy of individuals whose data is used to train those systems. They pointed out that explainability and privacy are not mutually exclusive, but that achieving both requires careful consideration of the trade-offs between them. The authors suggested that institutions developing AI systems need to be transparent about their data collection practices and provide individuals with control over their data, while also using techniques like differential privacy to protect sensitive information.

Other perspectives focus on the misapplication of AI in service of burgeoning and increasingly powerful technical capabilities. Quach S. et al. (2022) examined the tension between privacy and data in the context of digital technologies, including AI. They argued that as data becomes more central to business operations, institutions need to balance the benefits of data collection with the risks to individuals’ privacy. The authors suggested that institutions should adopt a “privacy by design” approach, where privacy considerations are integrated into the design of new products and services from the outset. They also emphasized transparency and consent in data collection practices and the need for effective data governance frameworks.

**Systems Tensions**

This refers to tensions between the design and integration of AI systems and the needs of learners and educators. It also refers to the large impacts possible when established systems (e.g., education, societal, cultural, governmental) become intertwined with the emerging capabilities and ap-
plications of AI technologies. The challenge is to design AI systems that are user-friendly, customizable, and adaptable to different learning contexts and needs, while simultaneously being responsive to larger systems contexts.

Through CCA, it was possible to distinguish between intra-system tensions and inter-system tensions. Intra-system tensions refer to the tensions that exist within the development of AI-enhanced learning systems for learning and instruction, such as tensions between user-friendliness and personalization, or tensions between privacy and data collection.

On the other hand, inter-system tensions refer to the tensions that could exist between AI-enhanced learning systems and existing human systems of education, work, government, and culture. For example, there may be tensions between the use of AI in education and traditional teaching methods, or tensions between the ethical use of AI and existing cultural norms and values. Both types of tensions are important to consider in the development and integration of AI-enhanced learning systems.

CCP helped identify four broad intra-systems tensions across the selected research and popular press perspectives related to the creation and integration of AI for learning and instruction into educational contexts. Table 4 summarizes the themes found in Intra-systems Tensions, as seen in both research and popular press perspectives; fuller descriptions of each theme follow.

**User-friendliness and Complexity.** AI systems should be user-friendly and easy to use, but also capable of handling complex tasks. Cramer and Kim’s (2019) analysis of designing UX for AI systems falls under this cluster, as does D’Agostino’s (2023c) piece on the need for student guides in the face of seeming AI sentience. More abstractly, Marcus’s (2022) *Scientific American* piece explored the ease of use and potential dangers associated with AI platforms like ChatGPT. The author discussed the capabilities of AI language models and contrasts their ease of use with concerns regarding their potential misuse, spreading misinformation, and enabling malicious activities. The article emphasized the need for responsible development, ethical guidelines, and user awareness to mitigate the risks associated with AI platforms.

**Customizability and Standardization.** Different articles make the case for the benefits of personalized or customized learning platforms. A scholarly article by Srinivasan (2022) presented a vision for the future of AI and learning. The author discussed the potential of AI technologies to enhance educational practices and improve learning outcomes through innovations such as personalized learning, intelligent tutoring systems, and automated assessment. The article envisions a preferred future where AI is
integrated seamlessly into educational settings, empowering learners and educators alike. In this idealized context, AI systems would be customizable to meet the unique needs of different learners and educators, but also standardized enough to ensure consistency and fairness.

### Table 4

**Summary of Thematic Clusters for Intra-systems Tensions**

<table>
<thead>
<tr>
<th>Theme</th>
<th>Description</th>
<th>Academic</th>
<th>Popular</th>
</tr>
</thead>
<tbody>
<tr>
<td>User-friendliness and Complexity</td>
<td>Pertains to the tension that arises when AI systems should be user-friendly and simple to use, but also need to manage complex tasks.</td>
<td>Cramer &amp; Kim (2019)</td>
<td>D’Agostino (2023c)</td>
</tr>
<tr>
<td>Customizability and Standardization</td>
<td>This tension relates to the fact that AI systems should be customizable to meet the specific needs of different learners and educators, but also standardized enough to ensure consistency and fairness.</td>
<td>Kelley (2023)</td>
<td>Kovanovic (2023)</td>
</tr>
<tr>
<td>Adaptability and Stability</td>
<td>Denotes the tension when AI systems should be adaptable to various learning contexts and needs, but also stable enough to maintain reliability and consistency.</td>
<td>Nguyen (2018)</td>
<td>Huang (2023)</td>
</tr>
<tr>
<td>Transparency and Black Box</td>
<td>Reflects the tension when AI systems should be transparent in how they make decisions and function, but also need to handle complex and nuanced information that may not be easily understood.</td>
<td>Kelley (2023)</td>
<td>Ramer (2023); D’Agostino (2023c); Huang (2023)</td>
</tr>
</tbody>
</table>

In the popular press, Kovanovic (2023), writing in *The Conversation*, also noted the transformative potential of AI in various educational contexts, including personalized learning, adaptive assessment, and intelligent tutoring systems. The benefits and challenges associated with the integration of AI technologies in education are balanced with the need for educators and policymakers to adapt to the changing landscape.

**Adaptability and Stability.** Articles in this cluster emphasize that AI systems can and should be adaptable to different learning contexts and
needs, but also stable enough to maintain reliability and consistency. Thongprasit and Wannapiroon (2022) presented a framework for an artificial intelligence (AI) learning platform in education. The authors proposed a model that leverages AI technologies to support personalized learning, adaptive assessment, and intelligent tutoring. They discussed the components and functionalities of the framework and highlight its potential benefits in enhancing educational experiences. The article provides a foundation for the design and development of AI-driven learning platforms.

In the popular press, Huang (2023) reported in *The New York Times* on how universities are revamping their teaching methods to accommodate AI chatbots, such as *ChatGPT*. The article highlights the need for AI systems to be adaptable to different learning contexts and needs, emphasizes the rapidity in which changes and innovations are occurring, and notes the concerns for stability among faculty and administrators.

**Transparency and Black Box.** AI systems should be transparent in how they make decisions and operate, but also capable of handling complex and nuanced information. Again, the D’Agostino (2023c) piece discusses the need for guardrails around AI bots in education to ensure that they align with the needs of learners and educators. She emphasizes that the design of AI systems must consider the needs and limitations of users but notes that not all AI processes and capabilities are knowable. Similarly, In Kelley’s (2023) opinion piece for *Inside Higher Ed*, the author discussed ways to prevent students from using AI tools in their classes, emphasizing the need for AI systems to be customizable to different pedagogical approaches. Kovanovic (2023) explores the significant implications of AI in education and the need for AI systems to be designed with the learners’ and educators’ needs in mind. The author highlighted the importance of user-centered design principles in AI development. Lastly, Ramer’s (2023) article in *Times Higher Education* called for interdisciplinary action to address the design challenges posed by AI systems. The author emphasized the need for collaboration between different stakeholders in education to ensure that AI systems are designed with the needs of learners and educators in mind.

**Intersystem Tensions.** Inter-systems tension in AI-enhanced learning systems reflect the potential conflicts or contradictions that may arise between the development and implementation of AI systems and the existing human systems of education, work, government, and culture. For example, the use of AI systems in education may challenge traditional teaching methods and existing power dynamics between students and teachers, leading to tension and resistance from educators and institutions (Biesta, 2019). Moreover, AI systems may reproduce existing inequalities and biases in society,
potentially reinforcing discrimination, and exacerbating inequality (Crawford, 2016). Crawford (2016) noted that AI systems are often trained on biased datasets, and this can lead to AI systems that reflect and perpetuate the prejudices and biases of their human creators.

Additionally, the use of AI systems may also challenge existing ethical and legal frameworks, raising questions around issues such as privacy, consent, and accountability (Floridi & Cowls, 2019). Inter-systems tensions in AI-enhanced learning systems highlight the need to carefully consider the potential impacts of these systems on existing social, cultural, and legal frameworks, and to ensure that the development and implementation of AI systems are sensitive to emerging and evolving human values and rights. The following are examples of the kinds of inter-system tensions that can emerge from the frictions between AI and established human systems of activity. Table 5 summarizes the themes found in Inter-systems Tensions, as seen in both research and popular press perspectives; fuller descriptions of each theme follow.

**AI (Innovations) and Traditions (status quos).** One tension exists between AI and the status quo of traditions, which can hinder the adoption of AI in organizations (Benbya et al., 2021, p. 10). The fear of change, potential job displacement, and the uncertainty of outcomes associated with AI innovations can be barriers to the adoption of AI technologies in some organizations (El Morr, 2023). There are also questions around whether change can take hold in AI-dominated systems. Creely (2022) discussed the potential tension between the use of AI and creativity. While AI systems are good at identifying patterns and making predictions based on existing data, creativity involves generating ideas, insights, and solutions that may not fit pre-existing patterns. This creates a tension between using AI to facilitate creativity and the potential for AI to limit the exploration and development of innovations that challenge existing paradigms. Careful consideration is needed when integrating AI into creative processes to support rather than replace human creativity.

**AI and Socio-cultural Systems.** Analysis shows there is a tension between AI and socio-cultural systems due to the potential impact of AI on society, which may affect people’s lives, values, and beliefs (El Morr, 2023). Fourtané (2022) discussed the potential benefits and ethical concerns of integrating AI in education. She highlighted the potential of AI to improve personalized learning experiences and automate administrative tasks, but also points out cultural and ethical concerns, including the perpetuation of biases in grading and admissions processes, and the need for privacy and data security. The integration of AI in student services and resource man-
agement also raises concerns about algorithmic evaluation and fairness, while also highlighting AI’s potential for unbiased and evenly distributed supports (Park et al., 2022). Bubeck et al. (2023), in their early experimentation with ChatGPT-4, noted that LLMs can learn and adapt to new situations and thus be used to create harmful or dangerous new systems. The authors stressed the importance of ensuring that LLMs are safe and aligned with human values before they are widely used.

Table 5

Summary of Thematic Clusters for Inter-systems Tensions

<table>
<thead>
<tr>
<th>Theme</th>
<th>Description</th>
<th>Academic</th>
<th>Popular</th>
</tr>
</thead>
<tbody>
<tr>
<td>AI (Innovations) and Traditions (status quos)</td>
<td>This tension exists between AI and traditional methods and practices. It reflects the fear of change, potential job displacement, and the uncertainty of outcomes associated with AI innovations that can hinder the adoption of AI in organizations. There is also tension between using AI to facilitate creativity and the potential for AI to limit the exploration and development of innovations that challenge existing paradigms.</td>
<td>Benbya et al. (2021), El Morr (2023), Creely (2022)</td>
<td>Harari (2023); Hammond (2023); Heaven (2023)</td>
</tr>
<tr>
<td>AI and Socio-cultural Systems</td>
<td>There is a tension between AI and socio-cultural systems due to the potential impact of AI on society, affecting people’s lives, values, and beliefs. This includes the potential benefits and ethical concerns of integrating AI in education, such as perpetuating biases in grading and admissions processes, and the need for privacy and data security. The use of AI also raises concerns about algorithmic evaluation and fairness.</td>
<td>El Morr (2023), Fourtané (2022), Park et al. (2022), Bubeck et al. (2023)</td>
<td>Chomsky (2023)</td>
</tr>
<tr>
<td>AI and Political Systems</td>
<td>Tension arises due to the integration of AI in political systems, which may lead to power imbalances between those with access to AI and those without. AI can be used to manipulate public opinion, and its use in political campaigns raises concerns about privacy and security of individuals’ data.</td>
<td>El Morr (2023)</td>
<td>Heilweil (2022)</td>
</tr>
<tr>
<td>Theme</td>
<td>Description</td>
<td>Academic</td>
<td>Popular</td>
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<tr>
<td>AI and Economic Systems</td>
<td>AI can disrupt the labor market, leading to job displacement and potentially increasing economic inequality. Adoption of AI technologies in organizations can also lead to a digital divide between firms that can afford to adopt AI and those that cannot. AI also presents global challenges, such as AI and climate change, requiring careful navigation, responsible decision-making, and innovative solutions.</td>
<td>El Morr (2023), Benbya et al. (2021)</td>
<td>Friedman (2023)</td>
</tr>
<tr>
<td>AI and Government Systems</td>
<td>There are tensions between AI and government systems, particularly regarding regulation and oversight. The development of AI technologies raises questions about the responsibility of government agencies to ensure that AI is used ethically and safely.</td>
<td>El Morr (2023), Narayanan &amp; Tan (2023)</td>
<td>Chomsky (2023)</td>
</tr>
</tbody>
</table>

**AI and Political Systems.** The integration of AI in political systems may lead to power imbalances between those who have access to AI and those who do not (El Morr, 2023). AI can be used to manipulate public opinion, and the use of AI in political campaigns raises concerns about the privacy and security of individuals’ data (Heilweil, 2022).

**AI and Economic Systems.** AI can disrupt the labor market, leading to job displacement and potentially increasing economic inequality (El Morr, 2023). The adoption of AI technologies in organizations can also lead to a digital divide between firms that can afford to adopt AI and those that cannot (Benbya et al., 2021, p. 10). On a more global scale, Friedman (2023) discussed the simultaneous challenges of artificial intelligence (AI) and climate change. The author explored the potential risks and opportunities associated with these two pressing global issues, and emphasizes the need for careful navigation, responsible decision-making, and innovative solutions. Again, the tone of these articles taken together highlights optimism balanced with caution.

**AI and Government Systems.** There are tensions between AI and government systems, particularly regarding regulation and oversight (El Morr, 2023). The development of AI technologies raises questions about the responsibility of government agencies to ensure that AI is used ethically and safely (Narayanan & Tan, 2023).
Overall, these tensions suggest that the integration of AI in various systems requires careful consideration of ethical, social, and cultural implications, as well as the development of regulations and policies to ensure that AI is used safely and responsibly.

SUMMARY

The comparative content analysis presented in this study found four clusters of formative tensions within the integration of AI in education as evidenced in academic and popular discourse: Human, Ethical, Data, and Systems Tensions.

**Human Tensions** emerge from the evolving roles of humans and AI in education, especially regarding the balance of responsibilities, the potential impact on employment, and the importance of preserving human judgment in the learning process. It raises the need to delicately balance AI’s advantages and the educator’s unique role while planning for workforce transition to avoid job displacement and ensuring that the human-centric aspects of education remain intact.

**Ethical Tensions** revolve around the moral considerations and potential harm caused by AI’s use in education. The discourse is rooted in concerns about striking a balance between the benefits and potential harm of AI, addressing algorithmic bias, and ensuring fairness in AI applications. These tensions have catalyzed debates in both academic and popular discourse, emphasizing the need for ethical frameworks and transparency in AI systems while advocating for accountability and oversight in their use in education.

**Data Tensions** emerge from the dual nature of data usage in AI, which enhances learning processes but can pose significant privacy and security risks. While the collection of extensive data facilitates personalized learning and informs decision-making processes, it raises concerns about user privacy and data security. This tension also incorporates the interpretability of AI systems’ decision-making processes, emphasizing the need for transparency to gain user trust. To alleviate these tensions, robust data governance policies and efforts to improve the transparency and interpretability of AI systems are recommended.

**Systems Tensions** emerge from the challenges associated with incorporating AI systems into established societal, cultural, and governmental structures. These tensions embody the inherent difficulties within the design and operation of AI systems (intra-systems tensions) and those arising from
interactions between AI and established human systems (inter-systems tensions). Addressing these tensions necessitates an approach that respects the potential benefits, risks of AI integration, and involves continuous dialogue and collaboration with various stakeholders to ensure AI’s alignment with broader societal values and expectations.

STUDY LIMITATIONS

This study contains several limitations. First, while the comparative content analysis provided a comprehensive overview of different perspectives on AI integration in education, it was restricted to a fraction of the available literature and public discourse between January and April 2023. Given the narrow scope of time, it is possible that certain perspectives or aspects might not have been adequately represented or accessible in the analyzed resources, potentially introducing an element of bias.

Second, the findings and identified tensions are primarily qualitative in nature, and the interpretations are therefore subject to the subjective perspectives of the researcher conducting the study. While every effort was made to ensure a rigorous and systematic approach, different researchers might have interpreted or categorized the data differently. Similarly, while the study offered broad insights into the landscape of AI integration in education, it did not focus on specific educational settings or student populations. This general approach might not fully capture the nuances of particular contexts or adequately account for variations across different education levels, subject areas, or cultural backgrounds.

Last, the study does not account for the rapidly changing nature of AI technology. As AI evolves and new ethical and practical considerations emerge, the identified tensions and their respective implications might also change. The dynamic nature of this field suggests that continuous updates to the framework and its implications are necessary to maintain its relevance.

DISCUSSION AND FUTURE DIRECTIONS

The findings of this research offer potentially useful insights for practitioners, researchers, and stakeholders amid a larger understanding of AI integration in educational contexts. The framing that emerged from this analysis allows us to tie back to the initial literature review, addressing the identified gap in the field and providing a pathway for future research and practice. For practitioners in education, the identified Human, Ethical, Data,
and Systems tensions necessitate a thoughtful approach to integrating AI in their work. Practitioners need to focus on maintaining a balance between AI and human agency, incorporating AI as a supportive tool rather than a replacement for human capabilities. They also need to be aware of ethical concerns surrounding AI usage, taking steps to ensure fair and equitable use of technology. This involves respecting data privacy and ensuring robust data security measures are in place. Finally, practitioners should understand and acknowledge the broader societal, cultural, and governmental systems within which AI operates, designing their AI implementations to be responsive to these contexts.

Researchers, on the other hand, have the responsibility to further explore these tensions, contributing to the development of an ethical, responsible, and effective AI integration framework in education. They should direct their efforts towards studying and addressing algorithmic biases, ensuring equitable AI deployment, developing protocols for data privacy and security, and designing AI systems that are adaptable and responsive to larger societal and cultural contexts.

The identified tensions and perspectives also present substantial implications for the theory of AI integration in education. These findings contribute to a nuanced understanding of AI integration that goes beyond merely the technical aspects. It provides a theoretical basis for understanding how AI can be integrated in a way that acknowledges both its transformative potential and inherent risks. This research thus advances the existing body of literature and theory on AI in education, offering a more holistic and balanced approach to AI integration.

The results of this study thus not only align with the existing literature but also advance our knowledge by highlighting the intricate complexities of integrating AI into education. They provide a foundation upon which both practitioners and researchers can base their future work, allowing them to navigate the process of AI integration more effectively and responsibly. This study, therefore, serves as a critical step towards the development of comprehensive, even holistic approaches to AI integration in education, which consider not only the technical aspects of AI, but also the human, ethical, data, and systems dimensions.

The implications of this study extend beyond the present understanding of AI integration in education and suggest significant opportunities for future directions. The identified tensions and perspectives offer a comprehensive framework to guide policy, practice, and further research in the field. For policymakers and practitioners, the study underscores the importance of a holistic and balanced approach that prioritizes ethical considerations, human-centered design, data privacy and robust governance. Future efforts
should be directed towards developing guidelines and regulations that balance AI’s benefits with potential risks, and ensure fair, transparent, and accountable AI systems in education.

As a glimpse at perhaps the dawn of a new age of learning and instruction, these findings underscore the need for a conscientious approach to AI integration in education, one that centers on human needs, ethical considerations, and societal implications. It implores educators to help implement AI systems that are not only transparent, fair, and accountable but also firmly rooted in the needs and values of learners and educators. It invites deep engagement with the potential reverberations of AI systems within the broader tapestry of social, cultural, and legal fabrics, and to steadfastly uphold human rights and values in all developmental and implementation processes. Standing on the precipice of this AI-empowered era in education, teachers and researchers share responsibility for moving forward with caution, courage, and a commitment to nurturing an educational ecosystem that is both innovative and inclusive, progressive, and principled. This is the path towards a future where the transformative potential of AI in education can be fully realized without compromising the fundamental ethos of learning and teaching.

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