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Analyzing artificial intelligence in education with critical-constructive perspectives: The Vechta Venn

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Against the background of differing disciplinary understandings of AI in education, we suggest a theoretical framework – the Vechta Venn – as an analytical lens. The Venn informs theoretical discussion on AI in education and is applicable for empirical research. Drawing on contemporary research from educational sciences, media studies, and cultural studies and moreover identifying disciplinary overlaps, we introduce a rather theoretical-

analytical approach than an empirically study on AI. In doing so, we follow a theoretical three-step of argumentation. First, we introduce the main lines of thought for each of the three disciplinary perspectives in their differences and specialties. Second, we focus on the intersections and overlapping of each pair of perspectives, respectively. Third, having outlined the respective synergies, we get to the core of the Venn, combining all three perspectives, interrogating the Venn's applicability.

Vor dem Hintergrund unterschiedlicher disziplinärer Perspektiven auf KI in der Bildung entwickeln wir einen theoretischen Bezugsrahmen – das Vechta Venn – als analytische Linse, die sowohl zur theoretischen Reflexion als auch zur empirischen Untersuchung von KI im Bildungsbereich dient. Informiert durch Studien und disziplinäre Zugänge aus den Erziehungswissenschaften, Medienwissenschaften und Kulturwissenschaften identifizieren wir thematische Schnittmengen. Unsere Argumentation folgt einem Dreischritt. Zunächst stellen wir die wichtigsten Denkansätze für jede der drei disziplinären Perspektiven in ihren Unterschieden und ihrer Spezifik vor. Zweitens konzentrieren wir uns auf die Überschneidungen zwischen je zwei Perspektiven. Nachdem wir die jeweiligen interdisziplinären Synergien skizziert haben, kommen wir in einem dritten Schritt zum Kern des Vechta Venn. Wir verbinden alle drei Perspektiven miteinander und fragen nach der Anwendbarkeit des Venn.

1. Analyzing artificial intelligence in education with critical-constructive perspectives: The Vechta Venn

Artificial intelligence (AI) as a keyword is heavily used to point to a diverse set of algorithmically shaped communication as well as socio-technical systems based on large language modeling (Chiu 2024; Lindgren 2023; Nemorin et al. 2023). In educational policy

discussions and strategic papers at the European and German-speaking levels (EC EACEA 2023; EC: JRC 2023; SWK 2024), AI often serves as a seemingly all-encompassing label that excludes further specification. Instead of addressing the complexity inherent in AI systems, these discussions frequently reduce AI to simplified concepts such as a helpful tool, a valuable assistant, or a straightforward recommendation system. This reductionist framing obscures the nuances of what is being discussed or decided, allowing for superficial and overly optimistic portrayals that fail to account for their broader implications and limitations. The complex mechanisms of AI systems, including their algorithmic dependencies, data biases, and socio-technical entanglements (Couldry & Mejia 2019; D'Ignazio & Klein 2020; Introna 2016; Kitchin 2021), are often overlooked. The different understandings of AI are at the same time extensively related to disciplinary perspectives and differently accessed.

Interdisciplinary approaches are rare and the conceptual vagueness comes with multiple challenges, which form the starting point for this paper. As a research group, we integrate perspectives from educational science, media studies, and cultural studies to support a critical-constructive approach to analyzing AI in educational settings. We conceptualize "critical-constructive perspectives" – informed by Klafki (2007) – as a framework that combines two essential modes of inquiry and reasoning. On the one hand, it involves a critical respectively criteria-based examination of existing discourses and developments surrounding AI in educa-

tion, systematically questioning their assumptions, implications, and societal impact. On the other hand, it emphasizes the constructive development of practice-oriented, ethical, and democratic approaches to engaging with AI in education, particularly within the structural and technological conditions shaped by AI.

When looking at education in general or educational settings in particular, researchers are often confronted with an opaque perspective on AI that, for example, does not give insights to the AI model used within a specific technology or the data it was trained with (Crompton et al. 2022; Michels 2023). Furthermore, due to the plural understandings of AI within practical pedagogical settings, the definitions remain vague: What exactly is referred to as AI? To chat-assistants or image generation, learning or communication tools, or a mix of all of these exemplary aspects?

Following this rather broad observations of the inaccurate discussion of research on AI in educational settings, we propose a Venn diagram as a useful theoretical framework for educational, media, and cultural studies research. Since a Venn outlines the overlapping and differences between specific, limited numbers of sets or frameworks, this concept is productive for sharpening the analytical perspectives, and we can articulate more precisely what exactly we are referring to when we talk about “AI” in education. Though our approach is a theoretical not a methodological one, the introduced Venn may inform empirical research on AI in education. In addition, we show that with a combination of these per-

spectives a better understanding of AI in education can be reached and translated into a re-shaping of educational practices.

The paper refers to research considering AI in education as an analytical object and less so discusses the possibilities of AI as a working tool for the research process in general. We therefore suggest the Venn as an analytical lens that informs theoretical discussion and empirical research on AI in education. Drawing on contemporary research from educational, media, and cultural studies and moreover identifying disciplinary overlaps, we introduce a theoretical-analytical approach rather than an empirical study on AI in education. We follow a theoretical three-step of argumentation. First, we introduce the main lines of thought for each of the three disciplinary perspectives in their differences and specialties. Second, we focus on the intersections and overlapping of each pair of perspectives. Third, having outlined the respective synergies, we get to the core of the Venn, combining all three perspectives, interrogating the Venn's applicability for research as well as for pedagogical contexts.

2. Introducing three perspectives on AI in Education

In the following we introduce (1) an educational science perspective, (2) a media studies perspective, and (3) a cultural studies perspective on AI in education. As a reference point for our framework, we draw on models that provide a general interdisciplinary framework for addressing digital education, such as the "Frank-

furt Triangle" (Brinda et al. 2021) and TPACK ((Hava & Babayiğit 2025; Mishra & Koehler 2006; Schmid & Petko 2020).

While the Frankfurt Triangle (Brinda et al. 2021) offers a broad framework for understanding digitalization in educational contexts, it does not specifically address the complexities and particularities of AI. Similarly, the TPACK model (Hava & Babayiğit 2025; Mishra & Koehler 2006; Schmid & Petko 2020) focuses primarily on modeling teachers' knowledge – with a well-fitting expansion on AI aspects – and is not intended to serve as a heuristic framework for research.

Building on these foundations, the framework of the Vechta Venn systematically and iteratively addresses AI's technological, social, and ethical dimensions, offering a holistic approach to their understanding and evaluation. In contrast to dominant discourses in Artificial Intelligence in Education (AIED) research – where AI is often examined from singular disciplinary perspectives, particularly those rooted in engineering and computational sciences (Zawacki-Richter et al. 2019) – our approach integrates perspectives that remain underrepresented in AI-related educational research.

While AIED scholarship frequently prioritizes technological pilot studies, there is still a significant lack of research considering AI's pedagogical, social, and cultural implications in education.

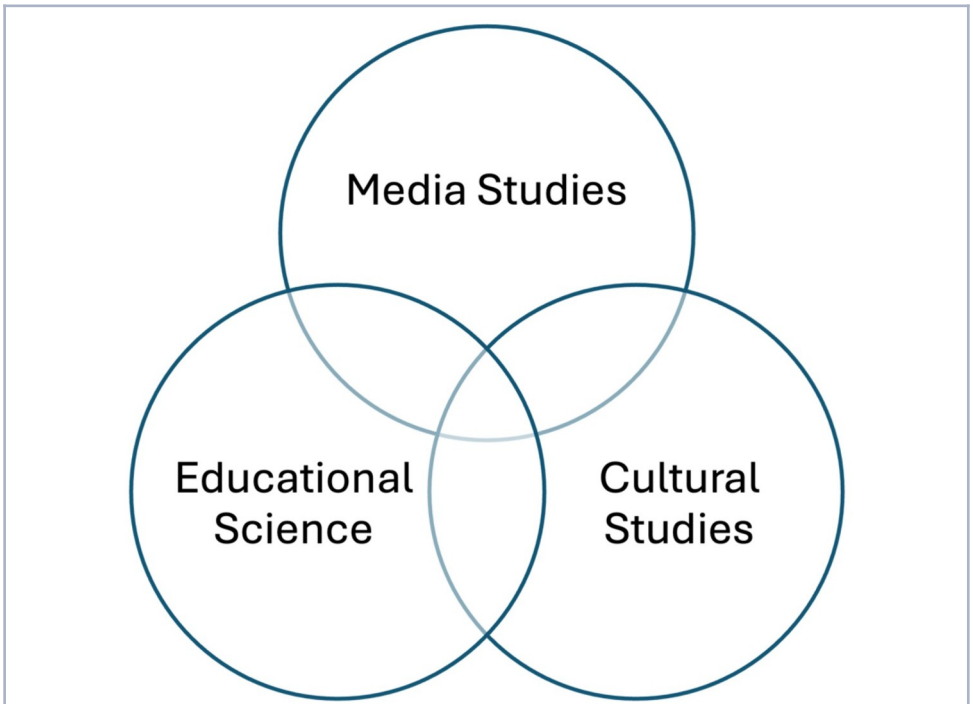

Abbildung 1: The Vechta Venn

Our use of the term holistic in this context refers to this broader integration of disciplines, moving beyond technical feasibility and beyond one-dimensional disciplinary views and fostering multi-perspective and responsible research on AI in the context of education While computational and information sciences provide crucial insights into AI's functionality, our focus lies in understanding how AI transforms educational practices, media ecologies, and cultural frameworks and how these transformations, in turn, shape AI's role in education or education in general. Against this background, our framework enables a nuanced understanding of how AI in education is approached from different disciplinary perspectives.

2.1 An Educational Science Perspective

From an educational science perspective, researching AI within educational contexts is particularly relevant in three key areas. One focuses on teaching and learning situations, exploring how AI as a tool can enhance educational practices. The second focuses on developing competencies and fostering learning processes, which promotes the ability to engage responsibly with AI and critically assess its implications. The third focuses on the structural conditions that are critically analyzed to understand how AI transforms and challenges existing educational systems and frameworks.

(1) The *focus on teaching and learning situations with AI* emphasizes how AI can be integrated to improve educational practices (Zawacki-Richter et al. 2019; Bond et al. 2024). Following existing educational technologies, AI is primarily seen as a useful help or tool, e.g., as a working tool for learners, a teaching tool for educators, or an organizational tool for educational administrators. When it is regarded as a working tool, for instance, this approach explores access to generative AI and its use, e.g. generating feedback or supporting complex problem-solving (Fu et al. 2020). Addressing AI as a teaching tool, this approach examines questions about how AI can be used to optimize tasks, for example, by differentiating them according to varying levels of difficulty. By using AI as an organizational tool, educators can – according to the optimistic discussion of EDTech – reduce administrative workloads and gain more time for pedagogical activities (Selwyn 2019). This

instrumental focus on using AI emphasizes a design-based-oriented approach that seeks to bridge the gap between theory and practice in education, producing both actionable knowledge for practitioners and theoretical insights for researchers through including multiple stakeholders in producing outputs, results or recommendations (Petko 2011) by designing, testing, and scientifically evaluating scenarios to ensure AI tools effectively enhance learning outcomes.

(2) The *focus on competence development processes* highlights how individuals can gain the skills necessary to understand and use AI in a socially responsible and reflective manner (Ng et al. 2023). This approach does not view AI as a neutral tool but as a relevant subject, aligning with broader goals of digital literacy and media education (Tulodziecki 2024). The goal is to promote appropriate, autonomous, creative, and socially responsible actions concerning AI in its various forms in media and technology. In this regard, media education emphasizes action-oriented approaches (Schorb 2020; Tulodziecki 2024) that draw on individuals' experiences and address them in creative and reflective formats to foster the development of competencies. Increasingly, interdisciplinary approaches (Brinda et al. 2021) enrich these methods, incorporating knowledge about technological systems, algorithms, and their potential effects.

(3) *The focus on structural conditions* of education examines how AI-driven transformations and narratives reshape systemic frameworks, such as policies, governance structures, and the ethical

foundations of education. It engages in a criteria-based analysis – following on from earlier work on media criticism (Niesyto & Moser 2019; Selwyn 2013; Weller 2022) – of the changing conditions for learning and education in the context of AI developments. The focus of this analysis is on overarching discussions and developments. For instance, this approach explores the extent to which educational policy objectives and techno-optimistic promises are actually aligned with educational challenges, or how educational technology providers market their products through specific narratives (Weller 2022). At a conceptual level, such analysis clarifies how specific linguistic patterns help us to understand that AI as a learning tool sparks different discussions than AI as a service.

2.2. A Media Studies Perspective

The media studies perspective explores how AI technologies shape educational content, formats, and processes. This perspective draws on critical app studies and EdTech studies and includes a focus on technology, on media appropriation and the entangled ethics.

(1) The *focus on technology* addresses how AI – in the form of socio-technical systems with agency – alters the dynamics between educators and students (Hansen & Komljenovic 2023; Williamson et al. 2023). Questions are raised, such as, how these systems reshape interactions, using AI-supported communication tools to foster collaboration and exchange (Porter & Grippa 2020). The aim is to understand how these technologies transform educa-

tion and redefine learning through the automation of routine tasks (Decuypere et al. 2023). Also of interest is the blend of physical and digital spaces facilitated by AI, and how these hybrid environments alter our understanding of classroom interactions, collaboration, and teamwork. In the realm of education and learning, this means recognizing how digitality in the form of 'AI' shapes pedagogical frameworks, informing both content delivery and the broader educational experience.

(2) The *focus on media appropriation* addresses the entanglement of structures and functions of digital phenomena and artifacts created by the ongoing digitization of the world and the way users engage with media. By engaging in the active (co-)design and reflection of technological and media phenomena, individuals are enabled to understand their opportunities, restrictions or responsibilities in a digitally shaped world. This aspect extends to analyzing technology affordances, data practices, and automation, while considering their influence on collective social desires and expectations (Crompton et al. 2022; Perrotta et al. 2021; Wagener-Böck et al. 2022). This media studies informed view involves scrutinizing how AI tools shape everyday interactions, media practices, and cultural narratives. A reflective approach to digital systems includes examining the underlying values and assumptions embedded within technologies and how they mitigate perceptions or practices, e.g. by analysing how data dashboards produce compelling, persuasive and convincing narratives that may impact how teachers think about students, leading educators

do perform datafied teaching (Jarke & Macgilchrist 2021; Krein & Schiefner-Rohs 2021).

(3) The *focus on ethics entangled with media appropriation* addresses the ethical considerations related to the use of AI in education by delving into the nuanced implications of integrating socio-technical systems within learning environments (Hillman 2023; Williamson et al. 2023). It involves critically examining issues such as data privacy, focusing on how student information is collected, stored, and used, as well as algorithmic bias, which can reflect and perpetuate existing societal inequities. The impact of AI on teacher autonomy is explored by looking at how these technologies influence decision-making processes and professional practices, while student agency is assessed in terms of empowerment and participation in learning pathways. Additionally, this perspective includes analyzing guidelines and frameworks that govern AI's responsible and ethical use, ensuring they align with educational values and principles. The ongoing dialogue around these ethical dimensions is essential for fostering a reflective and conscious approach to AI integration in education.

2.3 A Cultural Studies Perspective

When looking at AI in education, the cultural studies perspective focuses on the broader contexts of social, cultural, and ethical dimensions in their connections. It therefore questions the shaping of AI and learning practices in both directions: How are the practices and actions of human and non-human actors related to one another and how do they influence each other? Data, algorithms

(including AI), and infrastructures are deeply connected to practices and relations humans and non-humans engage with, and none of the elements of this assemblage can be understood in solitude (Aragona & Rosanna 2018; Beck 2019; Hepp et al. 2022; Suchman 2007; Vepřek 2024). Agency, data, and technologies are interwoven in data practices and discourses on data-driven relationships.

(1) Focus on the specific assemblages with AI in education: In educational settings, the weaving of human and non-human agency is realized in a specific form, since more than most areas of social life, education takes place in powerful, restricted settings including compulsory schooling, curricula that define the scope of teaching contents, school organization that pre-structures educational settings and methods, and much more. These governmental structures (following Foucault 1982; 1991) can only be understood in their discursive contexts (Keller 2018). Nevertheless, (more-than-)human actors strongly influence the everyday practices realized within these normative settings (Amelang & Bauer 2019; Dippel & Warnke 2024; Sørensen & Schank 2020), ranging from, hard- and software available or internet connections to technical competences and creative adaptations of structural and organizational settings, e.g. in project-based schooling.

(2) In order to understand the interwoven practices in their contexts, the discourses surrounding and structuring them need to be taken into account. This *focus involves investigating the cultural narratives, values, and practices embedded in AI technologies*. At the

same time, it includes exploring how these technologies reinforce societal norms, biases, and power dynamics. Accordingly, examining the societal metatrend of datafication in education in its specific form can make use of perspectives on datafication (Houben & Prietl 2018; Kitchin 2014; Schäfer & van Es 2017) and algorithmization (Christin 2020; Mackenzie 2005; Vepřek et al. 2023) in cultural studies and anthropology. The narratives and powerful structures surround AI as cultural inscriptions that shape the assemblage and its practices as political and public discourses.

(3) From a cultural anthropology, science and technology studies and critical code and data studies perspective, this angle heavily relies on *a focus on ethnographic methods in their enhancement within and through digital technologies*. Therefore, research methods and research foci are interwoven in reflexive, careful, and experimental ways (Dietzsch et al. 2024; Franken 2023a) and are often be realized in participatory, collaborative research designs. Since data are never neutral and embedded with algorithms, AI and datafication need to be examined in human-technology-relations: in interactions between individuals, groups, society, and AI technologies (Crowder et al. 2020; Edmond 2020; Lindgren 2020; Poirier 2021) in educational contexts. With digital technologies, it can be examined how AI tools are shaped by social practices, cultural values, and institutional structures, focusing on the interactions between individuals, groups, society, digital systems, soft- and hardware against the backdrop of digitalization and the cultural change involved in that.

3. Identifying intersections

After summing up the main lines of argument within the three disciplines, we now aim to identify overlaps and synergies between the different disciplinary perspectives.

3.1 Linking Media and Educational Studies Perspectives

The two disciplines share an interest in the transformation of educational contexts through AI and the need to critically and constructively reflect on the use of AI. Intersections are particularly evident in relation to (1) the integration and impact of AI in education, (2) the promotion of AI skills, (3) the critical examination of AI, and (4) the changes to learning environments brought about by AI.

Firstly, both perspectives emphasize that AI technologies are changing the way education is brought about. They examine how these technologies are used as tools in educational processes, be it in didactic, organizational or communicative functions. Secondly, both the educational science and media studies perspectives point out the requirement to promote skills in dealing with AI. While the former emphasizes the acquisition of media literacy, the latter focuses on the active reflection and appropriation of media-related phenomena. Thirdly, both perspectives see the need to critically scrutinize the implementation and impact of AI in education. This includes analyzing the technological and social embedding as well as ethical dimensions, such as data protection and algorithmic biases. Finally, both viewpoints address how AI is

changing the dynamics and framework conditions of learning environments. The educational science perspective focuses on the didactic design and learning processes and asks: “What can and should teachers and learners do with AI in the educational context?”, while the media studies perspective examines the combination of physical and digital learning spaces and their implications for collaboration and participation, focusing on the question: “What does AI do to teachers and learners in the educational context?”

3.2 Linking Cultural and Media Studies Perspectives

Both cultural and media studies closely link the technological dimension and the use of AI in education with the social, cultural, and ethical issues raised by AI technologies. Intersections are particularly evident in the interest in (1) the interactions and dynamics changed by AI, (2) the cultural and social embedding of AI, (3) the ethical questions in relation to AI in the educational context, and (4) the discursive and structural framework conditions.

First, both perspectives examine how AI technologies change the interactions and dynamics between humans and technology. The media studies approach considers how AI changes classroom interactions through the use of technology, while the cultural studies approach focuses on the interdependencies of human and non-human actors to understand how these interactions reflect cultural and social structures. Secondly, both address the cultural and societal implications of AI by examining how technological systems are shaped by societal norms, values, and power struc-

tures. The media studies look at how narratives and practices in society are forged by AI technologies, while the cultural studies look at the metatrend of datafication and algorithmic processes in a broader cultural context of meaning-making and transformation. Third, both perspectives have a strong interest in the ethical considerations related to the use of AI in education. Both question ethical dimensions such as data protection and algorithmic bias and call for a reflective approach to AI. Finally, both media and cultural studies analyze the discursive and structural frameworks that the use of AI in (educational) institutions entails. Power relations structure educational environments in both discourses and practices as well as through the cultural inscriptions within technologies. While media studies focus on the role media and technology play, cultural studies start with the practices and interactions taking place. They both place an emphasis on AI not being neutral, but deeply socially and culturally embedded.

3.3 Linking Educational Science and Cultural Studies Perspectives

The two disciplinary perspectives of educational and cultural studies emphasize the need to consider possible implications of AI for institutional contexts with a critical, informed, and interdisciplinary approach. There are shared overlaps in terms of (1) the need to foster a critical perspective on AI in educational contexts, (2) an interest in learning from each other's expertise in order to better understand and shape educational settings and concepts, (3) a focus on ethical and social implications.

First, both perspectives recognize the necessity of translating the analytic perspectives on AI to an integration into education. Concrete educational settings, worked out by educational science concepts, can be enriched with cultural studies perspectives as these foster a broader and deeper understanding of the practices that the involved actors are interwoven with. Secondly, expertise coming from cultural studies can be included in educational concepts while educational studies perspectives enrich cultural studies since they empower a better understanding of educational settings, practices, and constellations of actors within. Educational concepts can easier and deeper be researched from a cultural studies perspective if their perspectives are understood and further developed together. Third, both perspectives shed light on the ethical and social consequences of AI in cultural and societal contexts. Educational science analyzes the potentials and conditions associated with the use of AI in education, while cultural studies deal with questions of power, social influence, and attitudes that are shaped by AI technologies. A key element in both is empowerment – by engaging critically with AI technologies in order to actively involve in shaping these technologies and their usage. While cultural studies focus on the critical analytical framework by understanding and co-creating practices through enhanced ethnographic methods, educational studies focus on changing concrete educational settings using approaches like design-based research. Both share an interest in understanding and changing society in concrete terms.

4. Getting to the core of the Vechta Venn

The aforementioned vagueness of language and imprecise use of what is meant when we talk about AI in education becomes evident in the combination of the perspectives pointed out above. For all of them, AI is not only a tool, but an actor, a technical framework as well as an occasion for social and cultural discourses. In the synopsis of the three perspectives, several central themes emerge that are repeatedly emphasized in educational, media, and cultural studies: (1) collaborative interdisciplinary research is necessary, where (2) not only technological, but also social, cultural, and ethical dimensions need to be taken into account, and therefore (3) a constructive, but critical companionship of AI implementation is possible.

First, all three perspectives emphasize the need for an interdisciplinary approach in order to understand the full scope of the implications of AI in education (Brinda et al., 2021). Collaborative, interdisciplinary research is therefore necessary for a deeper and at the same time broader understanding of the emerging phenomena, which simultaneously asks fundamental questions and (further) develops solutions for educational settings (Perrotta 2020). This interlinking of research and practice is enormously important, especially in complex technological fields, which can hardly be understood from one perspective alone (Franken 2023b).

Secondly, each of the disciplines stresses the importance of considering technological, social, cultural, and ethical dimensions in their combinations and intersections in order to grasp the com-

plexity of AI implementations (Hillman 2023). With these different dimensions considered, AI technologies are seen as changing the dynamics and interactions in educational contexts. This also includes a focus on changing practices by educational agents that are questioned through this newly emerging technology (Vepřek 2024). The disciplines differ in their conclusions, but all recognize that AI influences practices, interactions as well as organizational structures of educational institutions.

Third, the three perspectives share a common understanding that the implementation of AI in education must be accompanied constructively and at the same time critically (Macgilchrist 2021). Therefore, a critical examination of discourses surrounding AI is needed. This includes an analysis of techno-optimistic promises and their political instrumentalization as well as cultural narratives and their influence on social norms and power structures within educational governance (Bock et al. 2024; Grimaldi & Ball 2021; Selwyn et al. 2020). It also involves a strong focus on the ethical implications of making use of AI in educational settings, including algorithmic distortions and datafication processes taking place within the power relations at work (Kinder-Kurlanda & Fahini 2024).

The three disciplinary perspectives presented here each propose a specific angle on the relationship between humans and technology, the differences between which emerge when viewed together in a Venn: What do humans do with technology, what does technology do with humans, what do humans and technology

jointly transform (Hengartner 2012)? With the model presented, we offer a research heuristic on AI in education that allows different disciplinary perspectives to be interwoven. Through the entanglement and the focus on intersections, a change of perspective is enabled which gives an added value to research perspectives. In this sense, interdisciplinarity is necessary for a richer analytical understanding of the role, function, and application of AI in educational settings.

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