
A Survey of AI in Interdisciplinary Education: Engineering and Liberal Arts Students' Perceptions

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Abstract

This survey paper examines the integration of artificial intelligence (AI) in interdisciplinary education, focusing on the perceptions of engineering and liberal arts students. It explores how AI is reshaping pedagogical frameworks, enhancing learning experiences, and promoting creativity, particularly in design education. The study highlights the importance of participatory design approaches in engaging students and incorporating their values in AI problem formulation. Understanding student perceptions is crucial for developing effective AI education strategies, as it influences engagement and satisfaction with AI tools. The paper emphasizes the need for ethical frameworks to harness AI's potential for improving human welfare while avoiding negative societal impacts. Additionally, it discusses the AID Framework for disclosing AI tool usage, supporting academic integrity and ethical research practices. The user-centered framework for explainable AI addresses communication gaps between AI systems and non-expert users, underscoring the importance of social interaction in education. However, the survey warns that without significant changes in participatory engagements, the benefits for marginalized communities may remain unfulfilled. In conclusion, the findings underscore the necessity of integrating student perceptions into AI educational strategies to create inclusive, effective, and ethically grounded learning environments that prepare students for the complexities of an AI-driven world.

1 Introduction

1.1 Structure of the Survey

This survey systematically investigates the integration of artificial intelligence (AI) in interdisciplinary education, emphasizing student perceptions from engineering and liberal arts backgrounds. The introduction underscores the significance of AI education and the necessity of understanding diverse student perspectives. Subsequent sections provide a comprehensive background, defining foundational concepts such as AI, interdisciplinary studies, and the educational approaches across disciplines.

The section on AI Education in Engineering and Liberal Arts evaluates the current landscape of AI education, focusing on curriculum design, teaching methodologies, and student learning outcomes. This is complemented by a discussion on interdisciplinary approaches, examining AI integration across various fields, associated challenges, and supportive frameworks.

A thorough analysis of student perceptions of AI education considers factors such as prior knowledge, cultural influences, and career aspirations, which significantly shape their engagement with AI learning tools in higher education [1, 2, 3, 4]. A comparative analysis highlights the strengths and weaknesses of engineering and liberal arts disciplines in delivering AI education.

The survey concludes with implications for future AI education, offering recommendations for innovative pedagogical strategies that utilize generative AI tools like ChatGPT while addressing ethical considerations and promoting equitable access to technology [5, 2, 6, 3, 7]. Key findings

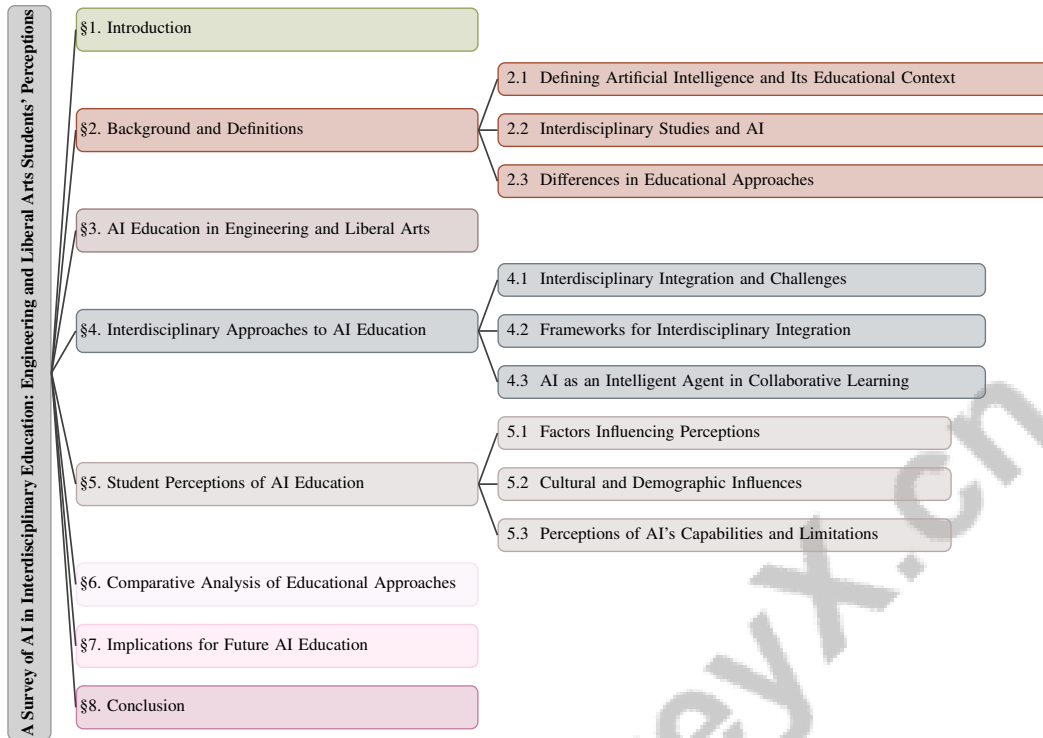


Figure 1: chapter structure

are synthesized, emphasizing the importance of understanding student perceptions to enhance AI education across disciplines.

1.2 Contextualizing AI in Education

The integration of artificial intelligence (AI) in education represents a transformative shift in pedagogical practices, influencing knowledge dissemination across disciplines. The emergence of generative AI, particularly large language models (LLMs), has prompted a reassessment of educational strategies, compelling educators to adapt to these technological advancements [8]. This evolution encompasses not only curriculum modifications but also policy changes within higher education institutions, which are increasingly aligning with the dynamic landscape of AI technologies [6].

Cultural dimensions of AI, especially in language and vision technologies, highlight the necessity of understanding how cultural contexts affect both human and AI behaviors [9]. Such cultural awareness is crucial for developing AI systems that cater to diverse educational environments, fostering inclusivity. Initiatives empowering children, such as those in Nigeria, emphasize the importance of recognizing diverse student perceptions in AI education [10].

Transparency in deploying generative AI tools in educational settings is essential to ensure ethical usage and build trust among students and educators [11]. Generative AI also lowers barriers for researchers in computational social sciences, allowing those with limited programming skills to engage more meaningfully with the field [12]. However, reliance on AI for quick solutions necessitates the establishment of responsible usage guidelines and educational frameworks that encourage critical engagement with AI outputs [5].

In higher education, AI functions both as a subject of study and as a tool for enhancing learning experiences. The role of AI assistants, such as ChatGPT, raises important questions regarding academic integrity and the efficacy of traditional teaching methods [1]. Additionally, the exploration of Human-Centric eXplainable AI (HCXAI) in education underscores the need for improved learning outcomes, trust, and transparency in AI-driven tools [13].

Thus, the broader context of AI in education is characterized by its dual role as a catalyst for innovation and a subject of critical inquiry. As AI continues to advance, its impact on educational

practices and student learning outcomes will require ongoing assessment and adaptation to ensure that AI technologies contribute positively to the educational landscape [3]. The following sections are organized as shown in Figure 1.

2 Background and Definitions

2.1 Defining Artificial Intelligence and Its Educational Context

Artificial Intelligence (AI) encompasses systems designed to perform tasks requiring human-like intelligence, such as perception, reasoning, and decision-making [14]. In education, AI is both a research focus and a transformative tool, enhancing pedagogical outcomes through personalized learning and intelligent tutoring systems (ITS), benefitting diverse learners, including Deaf and Hard of Hearing (DHH) students [15]. AI applications in education employ machine learning to prepare engineering students for future careers and address sustainability challenges [16]. This preparation is crucial as AI evolves, influencing employment and organizational strategies by developing responsible AI systems adhering to ethical principles [17]. The emphasis on Responsible AI underscores the need for educational frameworks incorporating ethical guidelines to consider AI's societal implications [17].

AI also aids in content creation and assessment, exemplified by generating quality multiple-choice questions (MCQs) to evaluate programming concepts [18], enhancing educational efficiency and effectiveness. Despite these benefits, concerns about overreliance on AI persist, potentially hindering critical thinking and decision-making skills [19]. Equitable access to AI tools is vital, especially for marginalized communities experiencing disparities in AI's benefits and drawbacks [20].

2.2 Interdisciplinary Studies and AI

Interdisciplinary studies are crucial for integrating AI across academic fields, fostering collaboration to address complex societal challenges. By acknowledging cultural contexts influencing human behavior and AI technology implications, these studies promote innovative solutions reflecting diverse values. Frameworks like the Artificial Intelligence Disclosure (AID) and the AI Ecological Education Policy Framework enhance transparency and guide responsible AI use in education [11, 9, 21, 6], enriching the educational landscape by bridging technical and non-technical disciplines.

Participatory design activities, such as those involving teachable machines, highlight the significance of interdisciplinary approaches in AI education by incorporating diverse perspectives, including children's [10]. This method demystifies AI concepts, promoting active engagement and critical thinking. The development of generative AI tools in computational social sciences exemplifies practical applications supporting interdisciplinary education, facilitating coding automation and multimodal data analysis [12].

Explainable AI (XAI) is vital to interdisciplinary studies, emphasizing a user-centered approach to enhance understanding in healthcare, finance, and education [22]. Ethical considerations and frameworks for Human-Centric eXplainable AI (HCXAI) systems ensure AI technologies remain accessible to non-technical users [13], broadening AI's educational applications and fostering inclusivity and equity.

Experiential learning enriches AI integration into interdisciplinary studies, particularly in design education [23]. By incorporating AI into experiential exercises, educators create adaptive frameworks addressing diverse student needs, enhancing educational experiences and preparing students for an AI-driven world.

Collaboration across disciplines is essential for shaping AI ethics, necessitating public discourse on AI's underlying values [20]. Such collaboration ensures AI development is guided by ethical considerations, promoting responsible and equitable AI education. Leveraging AI's potential enhances learning, cultivating inclusive, dynamic, and responsive environments equipping students for future challenges.

2.3 Differences in Educational Approaches

Educational approaches to AI in engineering and liberal arts exhibit distinct characteristics, reflecting each field's unique objectives and methodologies. Engineering education emphasizes technical proficiency and problem-solving, focusing on applying AI tools to complex challenges. This requires a deep understanding of AI's technical aspects, including data interpretation and critical assessment of AI-generated outputs [24]. Engineering students often engage in hands-on experiences, enhancing their ability to innovate and apply AI solutions practically [25].

Conversely, liberal arts education prioritizes critical thinking, creativity, and interdisciplinary exploration, positioning AI as a tool to enhance these skills. The integration of AI in liberal arts curricula involves examining AI's societal and ethical implications, encouraging analysis of AI's impact on human life [26]. This approach fosters an environment where students question and debate AI's broader implications, promoting a nuanced understanding of its societal role [27].

Both approaches face challenges related to AI's complexity and the need for unbiased data in AI model training [28]. Engineering students must develop robust analytical skills to navigate AI's technical landscape, while liberal arts students need tools to critically engage with AI, enabling articulate perspectives when interacting with AI systems [29].

Personalized education presents unique challenges in both disciplines, requiring accurate data interpretation to cater to individual learning behaviors [4]. Engineering education may use AI to tailor learning based on technical competencies, while liberal arts education might focus on personalizing content to align with students' interests and ethical considerations.

In recent years, the integration of artificial intelligence (AI) into educational frameworks has garnered significant attention, particularly within the fields of engineering and liberal arts. This evolution necessitates a comprehensive examination of the hierarchical structure that underpins AI education. As illustrated in Figure 2, the figure delineates the current state of AI education, encompassing various curriculum and teaching methods, as well as the resulting learning outcomes and student experiences. The visual representation emphasizes primary categories and subcategories, thereby highlighting the multifaceted integration of AI in educational settings. Furthermore, it underscores the implications for technical skills development, societal impacts, and overall educational efficiency. Such a structured approach not only aids in understanding the complexities of AI education but also serves as a foundation for further research and discussion in this rapidly evolving domain.

3 AI Education in Engineering and Liberal Arts

3.1 Current State of AI Education

The integration of artificial intelligence (AI) in education has led to diverse pedagogical strategies tailored to the objectives of engineering and liberal arts disciplines. In engineering, AI enhances technical skills and problem-solving through the incorporation of machine learning (ML) into curricula, boosting student engagement and understanding of complex concepts [16]. Tools like ChatGPT are used to assess mechanical engineering exam responses, showcasing AI's potential in educational and professional contexts [24]. This reflects AI's role in augmenting traditional teaching methods, emphasizing technical proficiency and experiential learning.

Conversely, liberal arts education emphasizes the societal and ethical implications of AI, encouraging students to critically analyze AI's effects on human interactions and decision-making. LLM-powered AI tutors highlight AI's potential to provide personalized support, particularly for Deaf and Hard of Hearing (DHH) learners, while addressing accessibility challenges [15]. Experiential exercises in design education have proven more effective than conventional methods, fostering a nuanced understanding of AI's implications in creative domains [23].

Despite advancements, challenges in AI education persist, particularly regarding content reliability and ethical considerations. AI-generated multiple-choice questions (MCQs) through models like GPT-4 aim to streamline assessments in programming courses, aligning them with specific learning objectives [18]. However, reliance on AI for assessments raises concerns about academic integrity and the need for AI tools to complement traditional pedagogical methods.

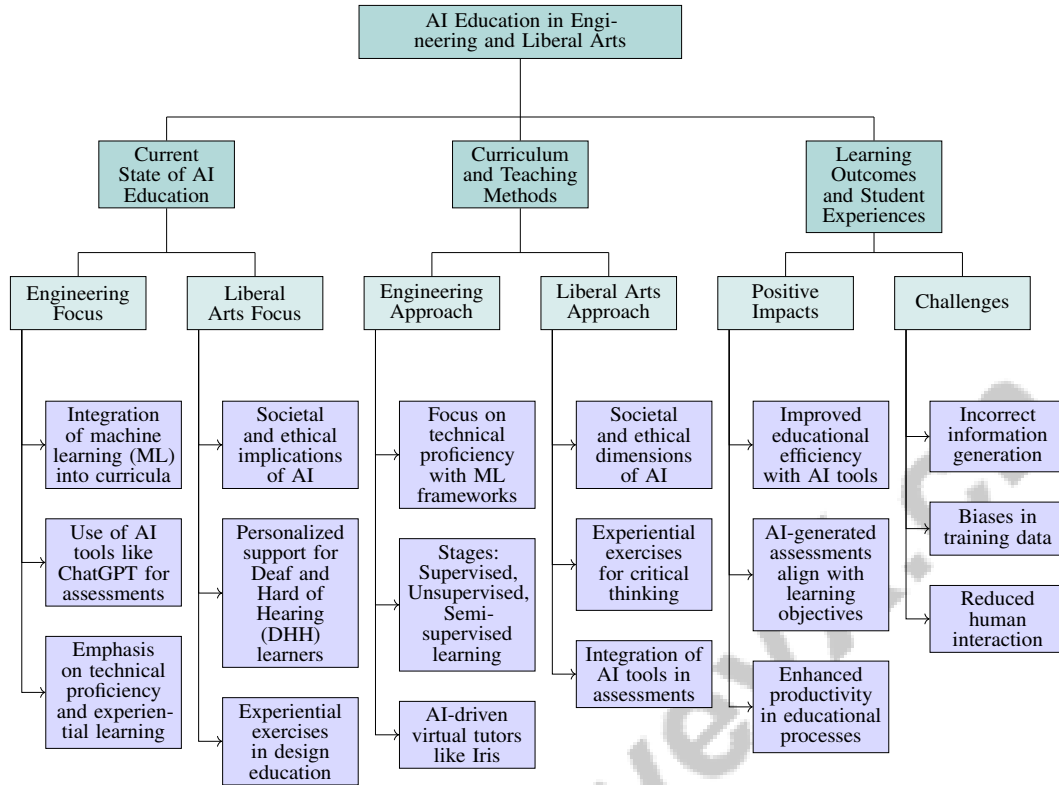


Figure 2: This figure illustrates the hierarchical structure of AI education in engineering and liberal arts, highlighting the current state, curriculum and teaching methods, and learning outcomes and student experiences. It delineates primary categories and subcategories, emphasizing the integration of AI in educational settings and its impact on technical skills, societal implications, and educational efficiency.

The current landscape of AI education reveals a dynamic interplay of opportunities and challenges across engineering and liberal arts. As generative AI technologies like ChatGPT gain traction—evidenced by over 100 million users within two months of launch—educators face the challenge of integrating these tools into curricula effectively. This integration must enhance learning outcomes while maintaining rigorous academic standards and addressing ethical issues like data privacy and bias. Higher education institutions (HEIs) must develop comprehensive policies, reassess learning objectives, upskill faculty, and adapt assessment methods to mitigate risks associated with irresponsible AI use [3, 7]. A multidisciplinary approach is essential to tackle these challenges and foster inclusive and equitable learning environments.

3.2 Curriculum and Teaching Methods

Curriculum design and teaching methodologies in AI education are crucial for shaping student learning experiences and outcomes across engineering and liberal arts. In engineering, AI curricula focus on technical proficiency, utilizing machine learning (ML) frameworks to enhance scientific assessments. These applications are categorized into stages—supervised, unsupervised, semi-supervised learning, pre-trained models, and zero-shot learning—each contributing uniquely to the educational process [30]. Such categorization aids educators in selecting methodologies that align with specific learning objectives and student capabilities.

Innovative teaching methods, including AI-driven virtual tutors like Iris, exemplify the integration of AI into curriculum design. Iris uses a chat interface to provide personalized assistance in programming exercises, adapting to individual learning needs [31]. This highlights AI's potential to enhance traditional teaching methods by creating interactive and adaptive learning environments.

In liberal arts, the emphasis often shifts to the societal and ethical dimensions of AI, encouraging critical engagement with technology. Experiential exercises, organized by interactional affordances and relationality, guide educators in incorporating AI into curricula [23]. These exercises foster critical thinking and interdisciplinary exploration.

AI's integration into educational assessment is exemplified by methods combining Knowledge Tracing and Option Tracing, providing comprehensive evaluations of student knowledge [32]. This ensures assessments align with educational goals, offering insights into student progress and areas for improvement.

Additionally, the use of large language models (LLMs) for generating MCQs marks a significant advancement in AI-driven assessment methodologies. These models produce questions that are clear and aligned with educational objectives, streamlining the assessment process while upholding academic rigor [18].

The interplay of technical and ethical factors shapes curriculum design and teaching methodologies in AI education, addressing diverse student needs in engineering and liberal arts. Frameworks like the AI Ecological Education Policy Framework emphasize pedagogical strategies to enhance learning outcomes while addressing privacy and accountability concerns. The integration of AI tools like ChatGPT in computer science education necessitates adaptive teaching methods to mitigate academic misconduct while leveraging AI's capabilities for educational advancement. Furthermore, the AI Assessment Scale (AIAS) provides a structured means for educators to ethically incorporate generative AI into assessments, ensuring alignment with desired learning outcomes while fostering a fair educational environment [6, 1, 2].

As illustrated in Figure 3, the hierarchical structure of AI education methods categorizes them into engineering and liberal arts focuses, along with AI assessment tools. The engineering focus includes machine learning frameworks, AI-driven tutors, and AI in assessments, while the liberal arts focus emphasizes societal dimensions and experiential exercises. AI assessment tools cover LLM-generated multiple-choice questions and the AI Assessment Scale. By embracing innovative AI-driven tools and experiential learning approaches, educators can create inclusive and responsive educational environments that prepare students for an AI-driven world.

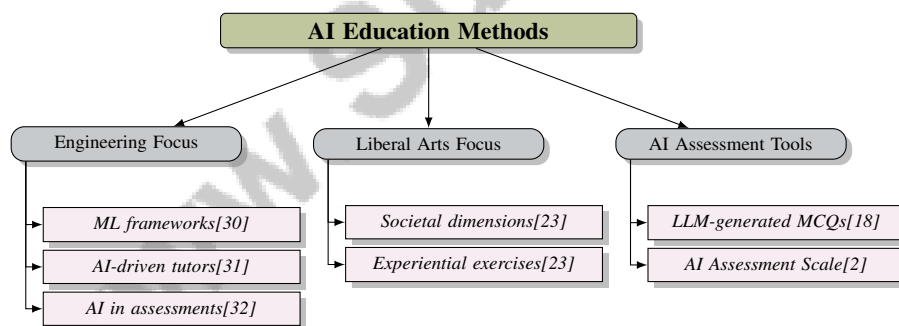


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3.3 Learning Outcomes and Student Experiences

The integration of artificial intelligence (AI) in educational settings has notably influenced learning outcomes and student experiences, particularly in AI-focused courses. AI-driven tools, such as chatbots and large language models (LLMs), have significantly improved educational efficiency and quality. For instance, the implementation of an AI-powered Bot has resulted in substantial reductions in homework completion times, with students in the 50th-80th percentile saving over 30 minutes per assignment [33]. This efficiency gain underscores AI's potential to streamline educational processes and enhance productivity.

Moreover, the use of LLMs for generating MCQs has shown that AI-generated assessments can match the quality of those crafted by human educators, with improved alignment to learning objectives [18]. This highlights AI's role in producing tailored educational content that meets specific pedagogical goals, enhancing the precision and relevance of assessments.

Despite these advancements, challenges persist in AI integration in education. Studies indicate significant limitations, including incorrect information generation, biases in training data, and potential for reduced human interaction [7]. These issues necessitate a cautious approach to AI deployment, ensuring AI tools complement rather than replace human educators, preserving the quality of interpersonal interactions and critical engagement.

The relationship between learning outcomes and student experiences in AI courses is characterized by both significant opportunities and notable challenges. The widespread adoption of generative AI tools like ChatGPT, integral to tasks such as assignment writing and exam preparation, necessitates that higher education institutions (HEIs) carefully navigate the implications of these technologies. This includes developing stringent policies, adjusting curricula, and training instructors to mitigate potential misuse and enhance the educational experience. Insights from computer science education reveal concerns regarding academic integrity and the long-term effects on students' cognitive development, emphasizing the need to adapt course materials to leverage AI's capabilities while addressing ethical considerations [1, 3]. While AI technologies promise enhancements to educational efficiency and content quality, their successful integration requires careful consideration of ethical implications and potential biases. By addressing these challenges, educators can harness AI's potential to create inclusive and effective learning environments that prepare students for the demands of an AI-driven world.

4 Interdisciplinary Approaches to AI Education

4.1 Interdisciplinary Integration and Challenges

Integrating artificial intelligence (AI) into interdisciplinary education presents both challenges and opportunities that require strategic approaches. A primary concern is the anxiety about the appropriate use of generative AI (GenAI) tools, with fears of academic misconduct prevalent among educators and students [2]. This underscores the need for clear guidelines and educational frameworks to ensure responsible AI use and uphold academic integrity.

Cultural mismatches complicate integration, as AI systems may not align with diverse cultural values, leading to misunderstandings [9]. Developing culturally sensitive AI systems is crucial for effective deployment in varied educational contexts. Furthermore, AI's limited conceptual understanding, biases in training data, and privacy concerns exacerbate integration challenges [7].

Design education faces challenges from situated design creativity analytics, necessitating innovative strategies for effective AI implementation [34]. Incorporating children's perspectives into AI problem formulation requires participatory design approaches to ensure diverse representation [35]. These issues highlight the need for frameworks supporting collaborative and inclusive AI development processes.

Participatory engagements often exhibit an extractive nature, limiting marginalized communities' ownership and control over their contributions [20]. This highlights the need for inclusive approaches empowering all stakeholders in AI integration. Current studies frequently lack comprehensive frameworks for interdisciplinary machine learning (ML) education, resulting in gaps in student understanding and application [16].

Interdisciplinary AI integration can benefit from frameworks categorizing existing end-user development (EUD) methods for AI into dimensions like composition paradigms and target users, facilitating effective cross-disciplinary integration [29]. Initiatives like MEGA, which promote deeper engagement and responsible AI usage, can enhance student motivation and encourage ethical AI practices [5].

Addressing interdisciplinary AI integration challenges requires a multifaceted approach considering cultural, ethical, and technical dimensions while promoting inclusive practices. By establishing comprehensive strategic frameworks and leveraging technologies like generative AI (GAI), educators can create dynamic educational environments that enhance personalized learning experiences and equip

students with critical skills for an AI-driven world, as evidenced by the transformative implications of tools like ChatGPT in higher education institutions [4, 3, 7].

4.2 Frameworks for Interdisciplinary Integration

Frameworks supporting interdisciplinary AI education integration are crucial for addressing the complexities involved across diverse academic fields. The AI Ecological Education Policy Framework is a prominent example, categorizing research into pedagogical, governance, and operational dimensions [6]. This structured approach facilitates effective AI integration by addressing curriculum design, policy development, and institutional operations, ensuring alignment with technological advancements and societal needs.

As illustrated in Figure 4, these frameworks highlight the interconnectedness of the pedagogical, governance, and operational dimensions, which collectively support comprehensive educational strategies while ensuring ethical practices. The pedagogical dimension emphasizes developing AI-inclusive curricula, underscoring the importance of interdisciplinary collaboration in creating educational content that is both technically robust and socially relevant. This approach encourages educators to design courses that impart essential technical skills while critically examining AI's ethical and societal ramifications. By fostering a comprehensive understanding of AI's implications, educators can promote responsible usage and prepare students from various fields to navigate AI complexities in their future careers, particularly in light of generative AI's transformative impact on higher education [1, 13, 3].

The governance dimension involves establishing policies that guide the ethical use of AI in education, addressing biases in AI systems, enhancing explainability, and exploring pathways to general AI [28]. This dimension ensures responsible and transparent AI education, fostering trust and accountability among educators, students, and stakeholders.

The operational dimension focuses on the practical implementation of AI technologies within educational institutions. Incorporating AI-driven tools and platforms that facilitate interdisciplinary learning enhances the ability to provide personalized, interactive, and innovative educational experiences. As institutions integrate generative AI technologies like ChatGPT, they must evaluate the implications of AI usage, implementing strategies that support responsible use, safeguard academic integrity, and promote meaningful learning [5, 2, 6, 3, 7].

Frameworks like the AI Ecological Education Policy Framework provide valuable guidance for interdisciplinary AI education integration. By addressing pedagogical, governance, and operational dimensions, these frameworks support the development of comprehensive educational strategies that leverage AI's potential while ensuring ethical practices. Through interdisciplinary collaboration and strategic implementation of advanced educational technologies, educators can create dynamic and inclusive learning environments that personalize education, enhance engagement, and equip students with essential skills for an interconnected and technologically driven world. By utilizing insights from data on academic performance and learning preferences, educators can develop customized learning pathways that address individual needs while preparing students for modern societal complexities [4, 6, 13, 3, 7].

4.3 AI as an Intelligent Agent in Collaborative Learning

AI's role as an intelligent agent in collaborative learning environments is crucial for enhancing interdisciplinary education. AI systems, such as the Collaborative Learning Artificial Intelligence System (CLAIS), act as active participants within learning groups, facilitating peer learning and co-construction of knowledge [36]. This integration allows AI to serve as both a mediator and participant, fostering dynamic learning atmospheres where students from diverse backgrounds engage in meaningful dialogue and problem-solving.

AI's capability to process and analyze large datasets in real-time is essential for providing immediate feedback and insights in collaborative learning. By identifying patterns and gaps in understanding, AI can facilitate group discussions, recommend tailored resources, and propose targeted solutions that align with participants' specific needs. Generative AI enhances this capability by automating complex data analysis and generating insightful content, streamlining the collaborative process and making sophisticated tools accessible to users regardless of technical expertise. Additionally, AI-assisted

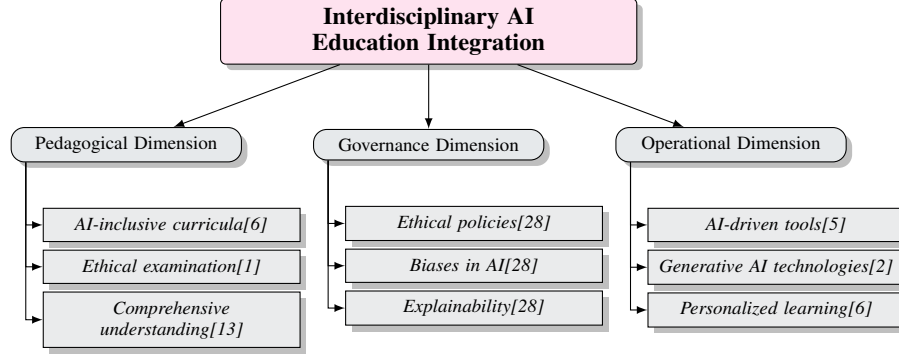


Figure 4: This figure illustrates the frameworks for interdisciplinary AI education integration, highlighting the pedagogical, governance, and operational dimensions that support comprehensive educational strategies while ensuring ethical practices.

writing tools can predict user needs and offer real-time suggestions, enriching the quality of ideas while maintaining clarity, ultimately fostering a collaborative environment where users feel ownership over their contributions [12, 21]. This support not only deepens students' understanding of complex concepts but also cultivates critical thinking and analytical skills across disciplines.

AI also facilitates the integration of diverse perspectives, allowing students from various fields to contribute unique insights. This interdisciplinary engagement is vital for addressing complex, real-world challenges that require multifaceted understanding and information synthesis, as seen in frameworks like the AI Ecological Education Policy Framework, which addresses pedagogical, governance, and operational dimensions of AI integration in education. Such frameworks enhance teaching and learning outcomes while promoting transparency and accountability, equipping stakeholders to navigate AI technologies' implications in academic settings [11, 13, 21, 6].

The use of AI in collaborative learning offers opportunities for personalized experiences. By adapting to individual learning styles and preferences, educational platforms can create inclusive environments that meet diverse student needs. This approach employs data mining techniques to analyze academic performance and learning behaviors, enabling the customization of educational experiences. The integration of Human-Centric eXplainable AI (HCXAI) enhances transparency and trust in AI-driven tools, ensuring meaningful engagement for educators and students alike. Consequently, AI supports personalized learning while fostering equitable educational opportunities, transforming the learning landscape to accommodate all learners [4, 13, 3]. This personalization boosts student motivation and engagement, leading to improved learning outcomes.

AI as an intelligent agent in collaborative learning embodies a transformative approach to interdisciplinary education. By harnessing the advanced capabilities of generative AI tools like ChatGPT to foster peer learning and collaborative knowledge construction, educators can cultivate dynamic and inclusive learning environments. These environments engage students in personalized, interactive experiences while preparing them to navigate the complexities of an interconnected global landscape. This approach emphasizes responsible AI use, advocating for structured learning over quick solutions and supporting the development of critical thinking skills essential for academic success and future challenges [5, 3, 7].

5 Student Perceptions of AI Education

5.1 Factors Influencing Perceptions

Student perceptions of AI education are shaped by a range of factors including familiarity with AI tools, cultural contexts, and perceived effectiveness in educational settings. Confidence in using AI for learning is often hindered by a lack of understanding of its functionalities and risks, emphasizing the need for educational strategies that boost student confidence and engagement [19]. In design education, ambiguity surrounding AI capabilities challenges student engagement [23]. Timely and relevant feedback from AI systems, such as personalized tools like Iris, is crucial for fostering positive perceptions and encouraging student interaction with AI [24].

AI's role as a collaborative partner in education enhances students' appreciation of its contributions to interdisciplinary learning, though challenges like over-reliance, potential academic misconduct, and maintaining academic integrity persist [19]. Ethical considerations, equitable access, and transparency in AI application further influence perceptions. Establishing ethical guidelines and promoting accountability are vital for building trust and fostering positive student perceptions. Cultural and infrastructural barriers, particularly the limited representation of diverse cultural perspectives in AI design, underscore the need for educational approaches that encourage active participation and creativity [23].

Understanding the diverse factors shaping student perceptions is essential for developing effective educational strategies that cater to students' unique needs across disciplines. By acknowledging the multifaceted influences of AI and educational technology, including tools like ChatGPT, educators can create inclusive learning environments that enhance engagement and improve outcomes. This approach facilitates personalized education, offering tailored learning experiences that address individual needs and foster a more equitable educational landscape [4, 13, 3, 7].

5.2 Cultural and Demographic Influences

Cultural and demographic factors significantly shape student perceptions of AI education, influencing engagement with AI technologies across diverse backgrounds. Concerns about AI's impact on human self-determination necessitate educational frameworks that are culturally sensitive and promote ethical AI practices [37]. Cross-cultural differences in perceptions, such as trust and reliance, are evident in studies comparing OECD countries and India, highlighting the need for culturally tailored educational strategies [38].

In Nigeria, participatory activities involving students from various ethnic backgrounds illustrate the importance of integrating local cultural narratives into AI education, encouraging critical reflection on AI's societal implications [10]. The need for increased education on AI technologies and their societal implications is emphasized by studies on text-to-image generation [39]. Ethical frameworks are essential to ensure AI systems align with societal values, promoting responsible AI development [17].

Understanding cultural and demographic influences is crucial for developing effective educational strategies. By addressing the multifaceted factors involved in AI integration, educators can create inclusive learning environments that enhance engagement and equip students with the skills necessary to navigate AI's challenges and opportunities. This approach is supported by advancements in personalized education, human-centric explainable AI systems, and the transformative impact of generative AI tools like ChatGPT, emphasizing tailored learning experiences, user trust, and ethical considerations [4, 36, 13, 3, 7].

5.3 Perceptions of AI's Capabilities and Limitations

Student perceptions of AI in education are informed by their understanding of its capabilities and limitations. Concerns about overreliance on AI tools highlight the challenge of balancing AI use as an educational aid while ensuring the cultivation of independent critical thinking [33]. AI systems like Iris enhance understanding of programming concepts but are viewed as complements to human tutors, indicating awareness of AI's limitations [31]. Experiences with AI-driven teaching assistants like Ethel, which sometimes provide inaccurate answers, underscore the need for human oversight [25].

AI's interpretive limitations suggest a need to view it as a tool requiring human collaboration for meaningful educational outcomes [40]. Cultural influences shape perceptions of AI's capabilities, with cross-cultural studies revealing differences in trust and responsibility attribution [38]. Enhancing human-AI interactions is crucial for mitigating risks such as societal bias, with diverse interactions enriching educational experiences [26]. The lack of consensus on ethical standards remains a challenge in defining AI's educational role [17].

Students recognize AI's strengths and weaknesses, viewing it as a complementary resource that enhances human instruction. They advocate for a balanced approach that leverages AI's capabilities, such as personalized learning, while remaining mindful of its limitations, including accuracy and ethical considerations. This perspective aligns with research promoting Human-Centric eXplainable

AI systems and comprehensive frameworks addressing AI integration's pedagogical, governance, and operational dimensions. By acknowledging these factors, students support the idea that AI should enrich rather than replace traditional teaching methods [1, 13, 6, 7]. Addressing these perceptions and integrating ethical considerations will enable educators to better harness AI's potential to enhance learning outcomes while ensuring students retain critical problem-solving skills.

6 Comparative Analysis of Educational Approaches

6.1 Educational Approaches and Student Engagement

The integration of artificial intelligence (AI) into educational frameworks significantly impacts student engagement and learning outcomes across disciplines. In engineering education, AI tools like virtual teaching assistants enhance technical proficiency and problem-solving skills by offering personalized feedback, thereby boosting student motivation and active engagement [25]. Conversely, liberal arts education emphasizes the societal and ethical implications of AI, fostering critical analysis and interdisciplinary exploration. This approach encourages students to debate AI's broader societal roles, thus enhancing their engagement and understanding [27].

AI-driven personalized learning experiences are crucial for maintaining student engagement. Adaptive AI systems cater to individual learning styles, promoting inclusivity and motivation, particularly in interdisciplinary contexts where diverse academic backgrounds require tailored educational experiences [24]. However, challenges such as potential overreliance on AI tools and risks of academic misconduct persist. Strategies to uphold academic integrity and ensure AI complements rather than replaces traditional pedagogical methods are essential [19]. Additionally, the complexity and ambiguity of AI technologies may affect student perceptions and willingness to engage, necessitating targeted strategies to build confidence and understanding [23].

Educational approaches must align AI education with the specific needs of each discipline. By addressing the unique challenges and opportunities AI presents, educators can enhance student engagement and learning outcomes, fostering trust in AI-driven tools and enabling personalized learning experiences. Advancements in Human-Centric eXplainable AI and data mining offer insights into student performance, preparing learners for the demands of an AI-driven world. Implementing responsible use strategies, such as reward-based learning systems, can further encourage deeper engagement and critical thinking skills [4, 13, 5, 7].

6.2 AI Pedagogical Adaptations

Incorporating AI into educational practices requires innovative pedagogical adaptations across disciplines. In physics education, AI-driven teaching assistants like Ethel enhance learning by providing tailored educational materials, thereby enriching the learning experience and underscoring AI's potential to augment traditional teaching methods [25]. In engineering, tools like ChatGPT serve as benchmarks for evaluating AI's role in curriculum development, offering insights into effective integration strategies that support student learning outcomes [24]. Aligning AI tools with educational objectives ensures they complement existing pedagogical strategies.

Liberal arts education focuses on AI's societal and ethical implications, encouraging critical engagement and interdisciplinary exploration. This approach enhances student comprehension of AI's multifaceted role in society. Recent research highlights AI's potential as a collaborative learning partner, enriching pedagogical and content knowledge. Integrating explainable AI systems fosters trust and transparency, allowing educators and students to navigate AI technologies effectively. As generative AI tools like ChatGPT become prevalent, they offer opportunities for personalized learning and interactive feedback, transforming traditional educational practices. Responsible and structured AI usage facilitates a deeper understanding of complex societal issues while preparing students for an AI-driven world [5, 36, 13, 3, 7].

Effective AI integration across disciplines requires aligning AI tools with specific educational objectives and harnessing AI's capabilities for personalized learning while fostering critical engagement. Developing a comprehensive AI education policy framework addressing pedagogical, governance, and operational dimensions is vital for stakeholder accountability. Flexible assessment strategies that leverage AI while maintaining academic integrity and prioritizing human-centric explainable AI systems will foster trust and transparency in educational contexts [1, 2, 6, 13, 3]. Embracing

these adaptations will create dynamic and inclusive learning environments, equipping students for the complexities of an AI-driven world.

7 Implications for Future AI Education

7.1 Innovative Pedagogical Strategies

Incorporating artificial intelligence (AI) into education requires innovative pedagogical strategies to boost student engagement and enhance learning outcomes. Structured storyboarding emerges as an effective method, fostering creative expression and critical thinking within interdisciplinary AI education, while addressing cultural harms and promoting inclusivity in AI development [10, 39]. Reward-based learning systems further enhance critical thinking by guiding students through structured problem-solving, ensuring a thorough understanding of AI concepts [5]. AI-driven tools like Iris demonstrate the potential of virtual tutors to increase engagement through personalized feedback [15]. Enhancements in AI teaching assistants, such as Ethel, particularly in handwriting and graphics recognition, significantly enrich educational experiences by providing tailored support [25].

Future research should refine educational frameworks to incorporate explainability in data mining, multimodal learning, and the use of large language models (LLMs) for generating multiple-choice questions (MCQs). Examining the effectiveness of LLM-generated MCQs in classrooms and enhancing the generation process can improve question quality and assessment accuracy [18]. Additionally, AI's role in supporting critical academic decisions, as seen with thinking assistants aiding prospective graduate students, highlights its potential in fostering informed and reflective learning experiences [24].

7.2 Ethical and Equitable AI Education

Ensuring ethical considerations and equitable access in AI education is crucial for fostering inclusive and responsible learning environments. Developing robust ethical guidelines and compliance mechanisms is essential to align AI development with societal values and promote responsible use [17]. These guidelines must be operationalized within educational contexts, considering local circumstances that influence harm manifestations [41]. Promoting equitable access involves intentionally including diverse voices in AI design, ensuring marginalized groups, like Nigerian children, have opportunities to engage with AI technologies [10]. Addressing societal biases in AI training data and developing models with multi-dimensional preference spaces are vital [26]. Collaborative efforts among educators, developers, and policymakers are necessary to create equitable and effective educational tools, addressing ethical considerations throughout AI development [13].

Future research should focus on developing standardized curricula for machine learning (ML) education across disciplines, exploring emerging ML trends, and examining AI's ethical implications in engineering [16]. The exploration of comprehensive compliance frameworks and enhanced stakeholder collaboration are critical for advancing AI ethics [17]. Understanding the sociotechnical context in AI reliance research and developing standardized measures are essential for addressing existing gaps in AI education [19]. As AI evolves, integrating generative AI tools in educational settings, especially for social scientists, requires robust evaluation frameworks to ensure ethical and equitable AI education [12]. Addressing these ethical considerations and promoting equitable access enable the creation of inclusive learning environments, preparing students for the complexities of an AI-driven world.

8 Conclusion

This survey highlights the profound influence of artificial intelligence (AI) on interdisciplinary education, illustrating the diverse perceptions and pedagogical strategies employed by students from engineering and liberal arts disciplines. The integration of AI into educational frameworks holds the potential to significantly enrich learning experiences by providing actionable feedback and fostering creativity, particularly in design-oriented education. Engaging students through participatory design approaches is vital, allowing them to incorporate their values and creativity into the formulation of AI-related problems.

Understanding student perceptions is essential for crafting effective AI education across various disciplines, as these perceptions heavily influence their engagement and satisfaction with AI tools. Establishing ethical frameworks is crucial to harness AI's potential for societal advancement while minimizing negative consequences. The AID Framework plays a supportive role by promoting transparency in the utilization of AI tools, thereby enhancing academic integrity and ethical research practices.

Furthermore, the development of a user-centered framework for explainable AI aims to bridge communication gaps between AI systems and non-expert users, highlighting the importance of social interaction in educational settings. However, the survey warns that without significant progress in participatory engagements, the potential advantages for marginalized communities may remain unrealized.

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References

- [1] Tianjia Wang, Daniel Vargas-Díaz, Chris Brown, and Yan Chen. Exploring the role of ai assistants in computer science education: Methods, implications, and instructor perspectives, 2023.
- [2] Mike Perkins, Leon Furze, Jasper Roe, and Jason MacVaugh. The ai assessment scale (aias): A framework for ethical integration of generative ai in educational assessment, 2024.
- [3] Stefanie Krause, Bhumi Hitesh Panchal, and Nikhil Ubhe. The evolution of learning: Assessing the transformative impact of generative ai on higher education, 2024.
- [4] Zhang Xiong, Haoxuan Li, Zhuang Liu, Zhuofan Chen, Hao Zhou, Wenge Rong, and Yuanxin Ouyang. A review of data mining in personalized education: Current trends and future prospects, 2024.
- [5] Aditi Singh, Abul Ehtesham, Saket Kumar, Gaurav Kumar Gupta, and Tala Talaei Khoei. Encouraging responsible use of generative ai in education: A reward-based learning approach, 2024.
- [6] Cecilia Ka Yuk Chan. A comprehensive ai policy education framework for university teaching and learning. *International journal of educational technology in higher education*, 20(1):38, 2023.
- [7] David Baidoo-Anu and Leticia Owusu Ansah. Education in the era of generative artificial intelligence (ai): Understanding the potential benefits of chatgpt in promoting teaching and learning. *Journal of AI*, 7(1):52–62, 2023.
- [8] James Prather, Paul Denny, Juho Leinonen, Brett A. Becker, Ibrahim Albluwi, Michelle Craig, Hieke Keuning, Natalie Kiesler, Tobias Kohn, Andrew Luxton-Reilly, Stephen MacNeil, Andrew Peterson, Raymond Pettit, Brent N. Reeves, and Jaromir Savelka. The robots are here: Navigating the generative ai revolution in computing education, 2023.
- [9] Vinodkumar Prabhakaran, Rida Qadri, and Ben Hutchinson. Cultural incongruencies in artificial intelligence, 2022.
- [10] Cornelius Adejoro, Luise Arn, Larissa Schwartz, and Tom Yeh. Empower children in nigeria to design the future of artificial intelligence (ai) through writing, 2023.
- [11] Kari D. Weaver. The artificial intelligence disclosure (aid) framework: An introduction, 2024.
- [12] Yongjun Zhang. Generative ai has lowered the barriers to computational social sciences, 2023.
- [13] Subhankar Maity and Aniket Deroy. Human-centric explainable ai in education, 2024.
- [14] Spyros Makridakis. The forthcoming artificial intelligence (ai) revolution: Its impact on society and firms. *Futures*, 90:46–60, 2017.
- [15] Haocong Cheng, Si Chen, Christopher Perdriau, and Yun Huang. Llm-powered ai tutors with personas for d/deaf and hard-of-hearing online learners, 2024.
- [16] Andrew Schulz, Suzanne Stathatos, Cassandra Shriver, and Roxanne Moore. Utilizing online and open-source machine learning toolkits to leverage the future of sustainable engineering, 2023.
- [17] Virginia Dignum. *Responsible artificial intelligence: how to develop and use AI in a responsible way*, volume 2156. Springer, 2019.
- [18] Jacob Doughty, Zipiao Wan, Anishka Bompelli, Jubahed Qayum, Taozhi Wang, Juran Zhang, Yujia Zheng, Aidan Doyle, Pragnya Sridhar, Arav Agarwal, Christopher Bogart, Eric Keylor, Can Kultur, Jaromir Savelka, and Majd Sakr. A comparative study of ai-generated (gpt-4) and human-crafted mcqs in programming education, 2023.
- [19] Sven Eckhardt, Niklas Kühl, Mateusz Dolata, and Gerhard Schwabe. A survey of ai reliance, 2024.

-
- [20] Samantha Dalal, Siobhan Mackenzie Hall, and Nari Johnson. Provocation: Who benefits from "inclusion" in generative ai?, 2024.
- [21] Carlos Alves Pereira, Tanay Komarlu, and Wael Mobeirek. The future of ai-assisted writing, 2023.
- [22] Luca Longo, Mario Brcic, Federico Cabitza, Jaesik Choi, Roberto Confalonieri, Javier Del Ser, Riccardo Guidotti, Yoichi Hayashi, Francisco Herrera, Andreas Holzinger, Richard Jiang, Hassan Khosravi, Freddy Lecue, Gianclaudio Malgieri, Andrés Páez, Wojciech Samek, Johannes Schneider, Timo Speith, and Simone Stumpf. Explainable artificial intelligence (xai) 2.0: A manifesto of open challenges and interdisciplinary research directions, 2023.
- [23] Dave Murray-Rust, Maria Luce Lupetti, Iohanna Nicenboim, and Wouter van der Hoog. Grasping ai: experiential exercises for designers, 2023.
- [24] Matthew Frenkel and Hebah Emara. Chatgpt mechanical engineering: Examining performance on the fe mechanical engineering and undergraduate exams, 2023.
- [25] Gerd Kortemeyer. Ethel: A virtual teaching assistant, 2024.
- [26] Francisco Castro, Jian Gao, and Sébastien Martin. Human-ai interactions and societal pitfalls, 2023.
- [27] Soya Park, Hari Subramonyam, and Chinmay Kulkarni. Thinking assistants: Llm-based conversational assistants that help users think by asking rather than answering, 2024.
- [28] HLEG AI. High-level expert group on artificial intelligence. *Ethics guidelines for trustworthy AI*, 6, 2019.
- [29] Andrea Esposito, Miriana Calvano, Antonio Curci, Giuseppe Desolda, Rosa Lanzilotti, Claudia Lorusso, and Antonio Piccinno. End-user development for artificial intelligence: A systematic literature review, 2023.
- [30] Xiaoming Zhai. Ai and machine learning for next generation science assessments, 2024.
- [31] Patrick Bassner, Eduard Frankford, and Stephan Krusche. Iris: An ai-driven virtual tutor for computer science education, 2024.
- [32] Suyeong An, Junghoon Kim, Minsam Kim, and Juneyoung Park. No task left behind: Multi-task learning of knowledge tracing and option tracing for better student assessment, 2022.
- [33] J. D. Zamfirescu-Pereira, Laryn Qi, Björn Hartmann, John DeNero, and Narges Norouzi. 61a bot report: Ai assistants in cs1 save students homework time and reduce demands on staff. (now what?), 2024.
- [34] Ajit Jain, Andruud Kerne, Hannah Fowler, Jinsil Seo, Galen Newman, Nic Lupfer, and Aaron Perrine. How could ai support design education? a study across fields fuels situating analytics, 2024.
- [35] Utkarsh Dwivedi, Salma Elsayed-Ali, Elizabeth Bonsignore, and Hernisa Kacorri. Exploring ai problem formulation with children via teachable machines, 2024.
- [36] Gyeong-Geon Lee, Seonyeong Mun, Myeong-Kyeong Shin, and Xiaoming Zhai. Collaborative learning with artificial intelligence speakers (clais): Pre-service elementary science teachers' responses to the prototype, 2023.
- [37] Mariarosaria Taddeo and Luciano Floridi. How ai can be a force for good. *Science*, 361(6404):751–752, 2018.
- [38] Vishakha Agrawal, Serhiy Kandul, Markus Kneer, and Markus Christen. From oecd to india: Exploring cross-cultural differences in perceived trust, responsibility and reliance of ai and human experts, 2023.
- [39] Jonas Oppenlaender, Aku Visuri, Ville Paananen, Rhema Linder, and Johanna Silvennoinen. Text-to-image generation: Perceptions and realities, 2023.

-
- [40] Remy Demichelis. The hermeneutic turn of ai: Is the machine capable of interpreting?, 2024.
- [41] Wm. Matthew Kennedy and Daniel Vargas Campos. Vernacularizing taxonomies of harm is essential for operationalizing holistic ai safety, 2024.

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