Extending Socio-Technical Theory: A Holistic View of Human – AI Interaction in Education

Badr-un-nisa Chand, University Canada West, Canada
Min Beom Kay, University Canada West, Canada
Ozen Asik, University Canada West, Canada
Michele Vincenti, University Canada West, Canada

The European Conference on Education 2025
Official Conference Proceedings

Abstract

This article explores how the collaboration between internal stakeholders – educators, students, and administrators – and artificial intelligence (AI) can reform the field of education through the application of Sociotechnical Systems Theory (STS). A conceptual framework is illustrated and later described to outline how this alliance will work in practice. While emphasizing collaboration, the framework delineates the distinctive roles of internal stakeholders and AI applications. The framework proposes that educators and administrators should be the handlers of complex issues, balancing innovation with ethical consideration, critical thinking, problem-solving, and ensuring fairness for student satisfaction. At the same time, AI as a technical system is portrayed as the facilitator of routine tasks within the social system of education, including predicting class demand, scheduling, planning, technical support, preparation and assessment. The paper points out that inadequate technological infrastructure and a lack of training can pose significant challenges to successfully implementing this collaborative model. The article concludes with recommendations for implementing hybrid teaching models (combining AI tools and traditional teaching methods) to handle issues with IT disruptions, conducting periodic reviews of AI applications and outputs to ensure accuracy, fairness and transparency, and organizing AI training for all stakeholders.

Keywords: AI in education AIED, sociotechnical systems theory, internal stakeholders, educators, students, administrators

iafor

The International Academic Forum
www.iafor.org

Introduction

Decades of research on Artificial Intelligence (AI) and related technological advancements resulted in a transformative breakthrough a few years ago with the introduction of ChatGPT and similar software. While concerns regarding its responsible usage (e.g., privacy, security, originality issues) and its long-term implications persist (Amo et al., 2019; Min et al., 2024; Peters, 2022), AI has proven to be an undeniable technological force that is revolutionizing how the world operates and how individuals interact.

As AI becomes more integrated into society, it is critical to understand the interplay between technological advancements and the societal context in which they materialize. One of the representative theories that has explored this relationship is the socio-technical systems (STS) theory. Originating in the Tavistock Institute, STS theory examines how the technological and societal elements operate together to shape broader societal systems (Interaction Design Foundation, 2024a; Kudina & van de Poel, 2024). By placing technological development in the backdrop of societal contingencies, STS theory illustrates how societal forces and technological advancements interact closely to foster readiness for adoption.

One important societal domain where AI has had a profound impact is education, where the adoption of AI has been met with both optimism and concern. While some educators have raised concerns about the over-reliance on AI (Abbas et al., 2024; Bastani et al., 2024; Selwyn, 2022), others have focused on its benefits as well as the need for proper preparation and inclusion of AI in the educational backdrop (Celik et al., 2022; Su & Yang, 2023; Wang et al., 2023). Despite mixed reception, the consensus in the education landscape is that AI is a transformative and inevitable force that needs to be embraced.

As a result, a new domain of research is growing to study the impact of AI within the education system: AIED. Building on this line of thought, this paper aims to address the following research questions:

> Q1: How can the collaboration between AI and internal stakeholders of educational institutions redefine the traditional boundaries between social and technical systems?
> Q2: How can the Sociotechnical systems theory be applied to the educational institutions' internal stakeholders, including educators, students, and administrators?

By addressing these research questions, this paper seeks to contribute to the growing body of literature by proposing a framework that integrates STS into the evolving education ecosystem shaped by AI tools. This framework emphasizes the importance of critically evaluating AI outputs and highlights AI tools that can facilitate the processes of preparation, assessment, and critical thinking for all stakeholders involved. In doing so, it outlines a collaborative model between AI and various internal stakeholders in education (educators, students, and administrators) and underscores that AI is not a threat to job security for educators but a transformative tool capable of fostering meaningful innovation in education.

In what follows, the paper engages with the literature to highlight inadequate engagement on AIED–STS collaboration. The contribution section proposes a framework that aims to bridge this gap. Given that this is a new area of research, the limitations and challenges of the AIED–STS collaborative model are outlined. The paper concludes with recommendations and final remarks.

Socio-Technical Systems Approach (STS)

Researchers have used STS theory to underpin the cases of technology implementation in varied work settings (Bednar & Welch, 2020). The STS approach helps understand the shifts in work patterns and organizational activity over a period of time through the implementation of newer technologies (Mutch, 2008). Earlier studies assert that the foundation of socio-technical systems is based on three elements: technology, users, and institutions (Kroes et al., 2006). To this end, STS theory – rooted in general systems theory – outlines the contingencies between technology, social structures, context, and users and establishes how the technological and societal elements operate together to shape the societal systems (Interaction Design Foundation, 2024a; Kudina & van de Poel, 2024), for effective change management. While studying the interlinkage between the technological and organizational structures, researchers have emphasized various aspects of both technology and organization. Where one stream of the literature has overstated the material characteristics of technology (Orlikowski, 2007), the other stream overemphasizes the power vested in workplace policies – rules, norms, and alternative work choices available to the organizational actors – that fundamentally shapes the user's perception about the work activities (Geels, 2004: p. 899).

The STS theorization is an original work of researchers from the Tavistock Institute of the University of London (Trist, 1981). This team, led by Eric Trist, tried to study the effect of replacing manual labour practices in the coal mining field with technology. Although the team thought the new mechanized practices would result in increased productivity and time-saving, the initial results indicated a sharp decrease in production levels. According to Trist (1963), this polarized/contradictory outcome was a result of workers' inability to accept the drastic change in the work itself, and long-standing social practices associated with it. As mining jobs are hazardous and performed in distant, isolated locations, the workers developed a strong social bond with each other, including discussing work-related matters, sharing routine stories, collecting wages in person from the supervisors, and cleaning the site at the end of a working day. This routine was disrupted by technology implementation and pushed workers back into isolation due to a lack of interaction opportunities in the technological production process. While in this pioneering study, the technological implementation failed to deliver the desired results, it has duly highlighted the significance of the co-existence of social and technical systems where technology does not disrupt but supports and improves the existing social aspects of jobs (Kudina & van de Poel, 2024).

Against this historical backdrop, the STS perspective does still prove to be helpful in explaining the theoretical foundations of the human-technology interface, especially within the current pace of technological evolution, which includes the meteoric rise of Artificial Intelligence (AI). Since its inception around the mid-twentieth century, AI research has focused on the study of the human brain and steadily paved the way for today's technologies that are capable of learning from past data by emulating human thought processes (Interaction Design Foundation, 2024b). This further led to the development of algorithms keeping track of human interaction data, as well as offering new modes of interaction such as smart agents, intelligent systems, chatbots, and eventually, generative AI (Interaction Design Foundation, 2024b).

While this fast pace is fascinating on the technology front, the impact that AI has made on the social front is ripe for discussion. As a potentially disruptive force, AI is not only capable of learning, adapting, and interacting, but it's also autonomous and has the ability to transform society in the long run. To this end, the STS perspective may be useful in identifying AI as

part of the larger socio-technical systems and helping develop the institutions, culture, and governance associated with its growth (Kudina & van de Poel, 2024). As such, it may be fair to say that AI has emerged in the conditions ripe for its adoption – AI is not just technology but also a frame of mind.

Against this background, it would be important to recognize the role of AI in education. As one of the primary institutions in society, education constitutes the backbone of teaching and learning activities, developing the future generations' skills and knowledge in a wide variety of disciplines. There is no doubt that AI has already made an impact in the educational field. It is, therefore, crucial to examine the collaboration between AI and educators and how it is going to shape the new STS in light of the various economic, political, and social forces fuelling the change (Alshahrani et al., 2024; Linderoth et al., 2024; Williamson, 2024).

AI Technology in Education - AIED

The increasing use of educational technologies (EdTech) has dominated the second half of the twentieth century. Starting with simple information systems used for recording, storing, and disseminating data, and evolving through the use of collaborative technologies, social media, and virtual reality, all the way to the use of artificial intelligence (Alshahrani et al., 2024). The advanced capabilities of AI are considered an enormous support to educators and students alike since:
- For educators, AI has the potential to act as a personal assistant to help them plan and design the content, delivery, and assessment of learning more effectively (Celik et al., 2022; Keppler et al., 2024; Mollick & Mollick, 2024); and
- For students, AI may help ensure a more personalized learning experience and more effective retention and application of learning, provided it is designed to act as a learning aide or tutor (Abbas et al., 2024; Bastani et al., 2024; Su & Yang, 2023).

The growing use of AI has prompted researchers to conduct many studies to identify how educators make use of generative AI in their teaching-related activities, as well as its effectiveness. Keppler et al. (2024) conducted a case study of US high school teachers to determine how they made use of generative AI (if at all) as support in their course planning phase. Their findings showed that teachers were distinctly distributed into three groups of gen-AI usage, the first consisting of those who use gen-AI for input and output, the second of those who use gen-AI for output only, and the third of those who don't use gen-AI at all. In the terminology of the study, input seeking was defined as exploring or iterating thoughts and ideas as regards the course planning process, and output seeking was defined as generating materials or activities to be used as part of the class. Keppler et al. (2024) observed that the first group reported the highest productivity gains as regards their work quality and workload.

The fact that some educators are keen to adopt AI while others are AI-averse may be the result of their level of AI readiness. Wang et al. (2023) define AI readiness as "the state of preparedness among teachers in terms of their cognition, ability, vision, and ethical considerations with respect to the use of AI in education" (p.2). Their study further revealed that teachers with higher AI readiness perceived lower threats from AI and demonstrated higher levels of innovation about using AI in education, as well as higher job satisfaction. Similarly, Celik et al.'s (2022) study underscored the role of educators as orchestrators of the learning process and the need to incorporate the advantages of using AI in course planning, monitoring, and assessing student learning and performance rather than keeping away from and fearing AI's potential negative consequences.

Paper Contribution: Extended STS Framework

The main criticism of the role of AIED in its current form stems from its technological dominance, where many studies have overemphasized the power of technology and underscored the role of human agency and institutions in which these technologies are embedded. For instance, AIED has been viewed by some researchers as a replacement for educators in teaching roles (Solaiman et al., 2023), and the acquisition of advanced AI skills as the guarantors for the job security of professors (Umoru & Salami, 2024). This dominant view of AIED undermines the fact that AI technology is a part of a social system with the ability to impact or be impacted by the social aspects of teaching jobs. Furthermore, this technological determinism unintentionally positions AIED and educators against each other and prevents any possibility of collaboration.

While some recent studies have identified the need for adopting an STS approach to explore the role of AI as part of larger sociotechnical systems (Kudina & van de Poel, 2024), they have not specifically asked for locating the role of AI in the social structure of education. For most of these theorizations, the focus has been on the inclusion of AI as part of socio-technical systems. These studies have outlined the benefits that can be achieved by exploring the role of AI as embedded in social systems. According to them, "A socio-technical system perspective is important to better understand how AI systems function, what social and ethical challenges it raises, and how to best address these issues" (p. 02). Albeit useful, these theories do not provide a comprehensive account of AIED in their proposed integration of AI and sociotechnical systems.

This has led to a void in literature where one stream looks at the emerging role of AI in education (Umoru & Salami, 2024; Williamson, 2024), and the other suggests locating the role of AI as part of a bigger sociotechnical system generally and not specifically in the field of education (Kudina & van de Poel, 2024). To fill this gap, the article proposes the inclusion of AIED in the current STS theorization.

We illustrate our integration of AIED and STS in Figure 1. Our model does not present technology and social system of education as a threat to each other's existence or proclaim technology dominance over human agency and institutional social practices, and vice versa. Instead, the framework focuses on integrating both AI as a technical system and the field of education as a social system. The framework further highlights the potential benefits of this collaboration, specifically for internal stakeholders of the educational system, including educators, students, and administrators. The proposed framework also outlines some key challenges that warrant attention to ensure a successful AIED and STS collaboration.

Figure 1

Extended AIED – STS Framework Highlighting Human–AI Collaboration in Education
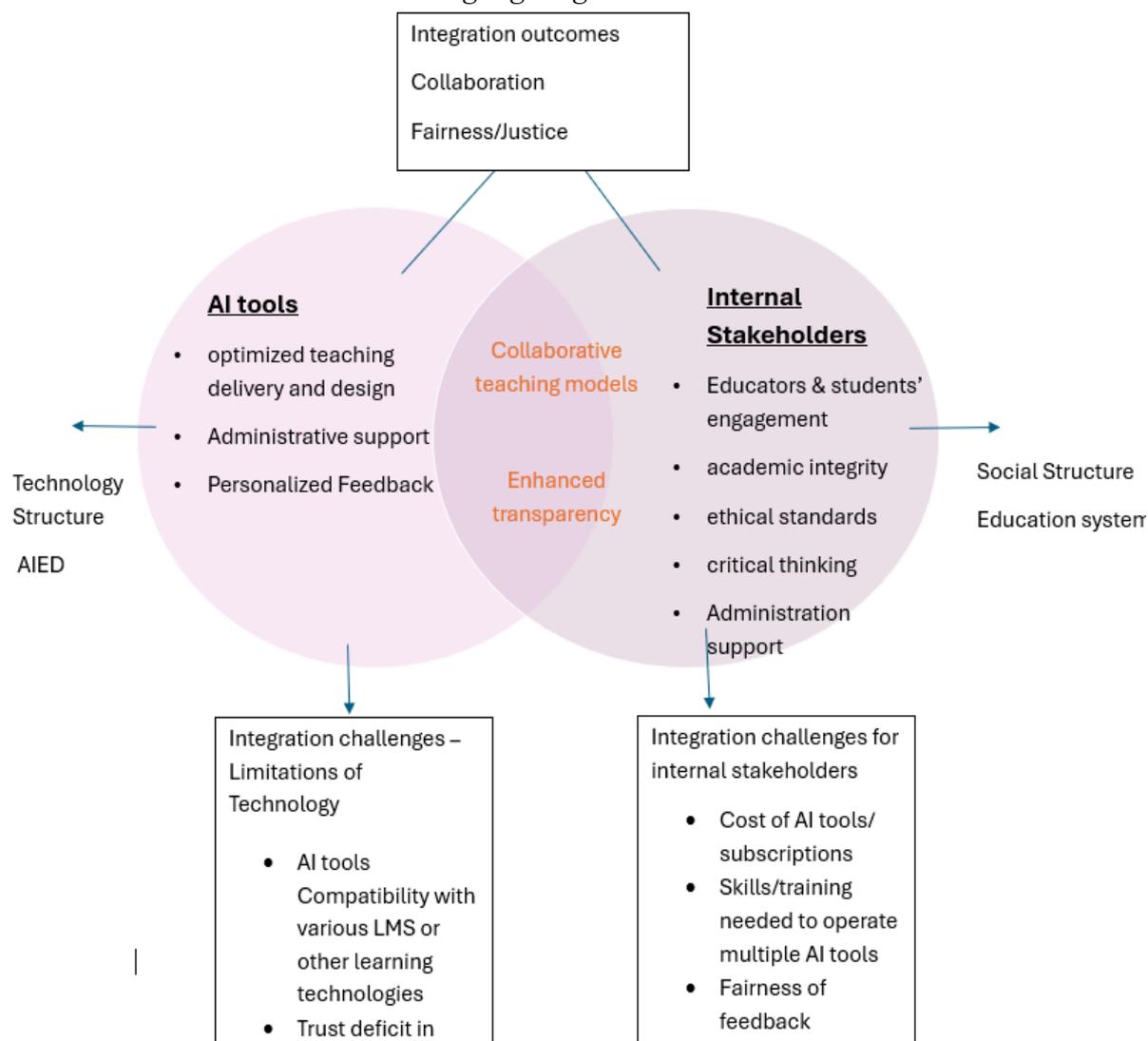
The authors further outline what integration outcomes can be achieved by combining AIED and STS in Table 1. The table clearly highlights the distinctive role of educators as handlers of complex issues such as ethics and fairness and promoters of critical thinking by applying innovative pedagogies. It also demonstrates how different AI applications/tools can support various aspects of classroom learning and educators' routine tasks, and other internal stakeholders, including students, administration, and management.

Table 1

The Framework for EdTech and Education System Collaboration

Internal Stakeholders' role/responsibilities	EdTech AI tools	Integration outcomes
	Educators and AI Collaboration	
PowerPoints creation	beautiful.ai tome.app canva.com gamma.app simplified.com decktopus.com slidesai.io	Scope of Technology: Helps instructors create graphically appealing PowerPoint lectures that are a level up from the standard publisher's slides. The role of educators: Educators need to share design ideas, preferred lecture themes, etc., for the improved class experience
Lesson Plans	lessonplan.ai ChatGPT openai.com kahoot.com edmodo.com teachmateai.com chalk.com wizer.me albert.io classtime.com curipod.com	Scope of Technology: Personalized and creative lecture plans that incorporate class activities, worksheets, and gamification. AI tools can also help with curriculum design The role of educators: To ensure that the personalization of lessons is well aligned with the student level and learning and course outcomes. Educators must all ensure that in-class activities are not just engaging but also relevant and appropriate.
Lecture Recordings Asynchronous/online lectures	descript.com murf.ai synthesia.io speechelo.com wellsaidlabs.com Play.ht adobe.com ispringsolutions.com clipchamp.com naturalreaders.com	Scope of Technology: Provides voice-over support for any missed classes. These voice-over lectures can be added as additional support materials in the LMS. The role of educators: Ensuring the quality and standard of voice-over lecture. Educators must also offer support and allocate additional time to the students to clarify the topics covered using voice-over lectures.
Incorporating multimedia for student engagement	synthesia.io podcast.adobe.com Dall.E – OpenAI Chat GPT – OpenAI Edpuzzle.com Thinglink.com Genially.com	Scope of Technology: Provides interactive activities and tools, fun quizzes, and virtual tours. Incorporates multimedia in the presentations The role of educators: Educators must ensure the required level of technical support and authorization are in place for the incorporated multimedia

Additional readings and resources	Elicit - AI for Research elicit.com Scholarcy – AI Summarizer scholarcy.com zotero.org mendeley.com perplexity.ai semanticscholar.org researchrabbit.ai paperpile.com wolframalpha.com	Scope of Technology: Assist instructors in generating a reading list relevant to the weekly topics covered in classrooms. The role of educators: Educators need to review the reading lists generated by AI tools to ensure quality and relevance.
Feedback from the educators on assessments	Socrative.com essaygrader.ai testmarkr.com gradergood.com coursebox.ai	Scope of Technology: AI can help provide detailed feedback on written work as well assigning letter grades Role of Educators: Feeding a rubric or sharing the grading criteria deemed appropriate for the student level. If the students show concerns with the grading, instructors must review and provide a rationale for the assigned grade.
Administrators and AI Collaboration		
Predicting the class demand	peak.ai netguru.com/blog/ai-based-demand-forecasting	Scope of Technology: Helps administrative and managerial level employees to forecast the demand for classes accurately using machine learning- applications. Based on the real-time data about the class demand, the administration can allocate resources. The role of Administrators: Administrators need to feed the institutional data such as historical enrollment numbers, demographic trends, and external factors like policy changes or economic conditions into these AI-based tools to get an accurate prediction.
Scheduling	clickup.com edval.education timetabler.com	Scope of Technology: Helps administrators schedule classes based on the total enrollment number, instructor availability, preferences, etc. Assigning last-minute classes. The role of Schedulers: Schedulers need to confirm the instructor's availability and preferred dates/times/courses and feed that data to the AI tools. The schedulers must also consider student preferences in finalizing scheduling

Student queries	magicschool.ai eduaide.ai hyperwriteai.com Mailmaestro maestrolabs.com	Scope of Technology: Can provide real-time feedback on student queries. Chatbots/similar to administrative assistants, can help students with different topics even in the after hours. Can write email responses to the student e-mails The role of administrative staff: Summarizing the issue for the AI and reviewing the auto-generated responses for clarity. Being available for face-to-face discussion if the students need in person support.
Students and AI Collaboration		
Upward Feedback: from students to the educators.	feedbackfruits.com mote.com peardeck.com	Scope of Technology: Helps students share their reflections on course learning in live settings or provide audio feedback. The role of Educators: To improve the teaching methodology and formative lesson plans in real-time based on student feedback
Troubleshooting support for students	humanizeai.io toolplate.ai	Scope of Technology: Can provide stepwise instructions to resolve many class/subject-related issues, including brainstorming, project queries, coding, and programming challenges The role of Educators: Willing to follow up with students on the status of the problem and offer a meet-up session to discuss further steps.
Brainstorming ideas for the completion of coursework, assignments and other deliverables.	Chat GPT – OpenAI Notion AI Scite.ai Elicit.org	Scope of Technology: Generate a list of ideas to ensure creativity in student output. Helps students find trending topics to write about. Summarize key concepts from various articles and essays so the students can filter out relevant readings and materials. The role of Educators: To educate the students on the safe use of AI tools to balance the need for innovation with maintaining ethics and upholding academic integrity. Share AI best practices with the students.

Challenges and Limitations

Artificial intelligence provides critical opportunities for educators to transform how they interact with learners, and, as illustrated in this paper, socio-technical theory offers a solid framework for analyzing this interaction. However, as with every framework, it also has some key limitations and challenges that warrant critical reflection.

The first limitation lies in the difficulty of clearly defining the boundaries of the social system within the educational context. Unlike the technical system, which can be clearly defined by identifiable components such as algorithms and software, the educational ecosystem is comprised of diverse stakeholders (e.g., educators, administrators, policymakers, and students) with divergent goals and operational priorities. For example, educators may prioritize using AI to design a holistic pedagogy that improves the effectiveness of learning, while students may want an individualized learning platform that caters to different learning styles. On the administrative side, the focus may be on the efficiency of AI, cost-reduction, and compliance with institutional and governmental policies, while policymakers may concentrate on the flexibility of AI to address diversity, ethics, and inclusion issues in education (Kudina & van de Poel, 2024). In summary, these conflicting goals make it challenging to define the boundaries within the social system (Trist, 1981), and this ambiguity in social boundaries inevitably translates to practical challenges in designing an educational AI system that aligns with the goals of stakeholders. Moreover, a misaligned framework can lead to unintended consequences like fragmentation, stakeholder resistance and/or inadvertent exclusion in the adoption process.

Another limitation stems from the pace at which AI technologies evolve. The rapid acceleration in AI capabilities often outstrips the capacity of educational institutions and researchers to conduct comprehensive socio-technical analyses or update regulatory and pedagogical frameworks accordingly. As a result, institutions may adopt AI systems without fully understanding their long-term implications, and this will limit not only the adaptability of the STS framework but also the predictive power in anticipating unintended consequences like bias and inequity (Obermeyer et al., 2019). To address this, the socio-technical framework must be continuously refined at a sufficient pace and regularly updated to new challenges posed by emerging AI technologies.

Beyond these conceptual limitations, there are also some practical challenges in adopting this framework for the use of AI in education. A central challenge involves the varying levels of trust in AI among stakeholders within the educational ecosystem. The success of any AI initiative in education is heavily dependent on this trust, and when stakeholders harbour mistrust or skepticism regarding the effectiveness, fairness, or transparency of AI systems, adoption is likely to be slow and fragmented. Such hesitancy can undermine the efficiency and scalability of implementation efforts (Raisch & Krakowski, 2021).

Closely related to this is resistance to change, which often stems from perceived threats such as diminished professional autonomy, job displacement, or skill obsolescence (Umoru & Salami, 2024; Williamson, 2024). These concerns can foster active or passive resistance among stakeholders, further complicating and limiting the integration process. For example, educators may feel that algorithmic systems limit their pedagogical freedom or reduce their role to that of mere facilitators rather than knowledge creators. Administrative staff may worry that automation will render their roles redundant or significantly alter traditional workflows without adequate support or retraining. Even students may resist the shift toward

AI-mediated learning if they perceive it as impersonal, overly standardized, or lacking in empathy and human connection. Resistance can also emerge from a lack of clarity about the goals of AI implementation, inadequate communication from leadership, or prior negative experiences with poorly designed digital tools. When stakeholders feel excluded from the design or decision-making process, they are more likely to disengage or push back against adoption. Therefore, addressing resistance requires not only technical solutions but also thoughtful and careful change management strategies that prioritize transparency, inclusivity, and ongoing support.

Lastly, the proposed framework must critically engage with the ethical and social challenges posed by AI in educational settings, particularly issues related to fairness, inclusivity, accountability, and transparency. Without addressing these concerns, AI tools risk reinforcing existing inequities, particularly in under-resourced schools or regions where access to advanced technologies is limited. Moreover, the ethical implications of using AI to monitor, assess, or predict student performance must be carefully examined. While predictive analytics may offer insights into learning patterns or dropout risks, they also carry the potential for stigmatization, profiling, and over-surveillance, especially for students from marginalized backgrounds. There is a danger that such systems could perpetuate biases encoded in the data, leading to unfair treatment or reinforcing systemic disadvantages.

To mitigate the challenges and ensure successful adoption, it is critical to adopt a holistic approach that prioritizes stakeholder engagement and trust building. Encouraging the active involvement of every stakeholder, from educators to policymakers, in the design and implementation of AI systems can ensure optimal alignment. Furthermore, emphasis on transparency should bolster trust and address equity concerns. Additionally, providing training opportunities for educators should raise AI readiness and minimize feelings of threat. Lastly, continuous evaluation of the impact of AI education tools should minimize unintended consequences and better address emerging challenges.

Recommendations

Technical failures can disrupt the educational process. Therefore, the overdependence on AI systems without proper backup procedures can halt class activities during outages. It is recommended to implement hybrid teaching models where educators maintain the traditional teaching methods alongside using AI tools.

Another issue raised in this paper is the possible loss of human oversight and, consequently, the rise of errors in AI-generated assessments. This is a serious issue, especially if educators overly trust AI outputs without reviewing them before they are made available to the students. The recommendation is to have the educator audit the AI-generated assessments, and by doing so, the grading accuracy can be preserved and, at the same time, maintain the educator's involvement.

Regarding the biases in AI systems that can generate an unfair treatment of the students since AI models are often trained using datasets that do not include diversity or comprehensive students' backgrounds, the recommendation is to use only audited datasets that have been tested for diversity and students' backgrounds. This recommendation enhances fairness and promotes inclusivity.

Regarding the finding that educators may lack the skills and competencies to use AI effectively due to insufficient training and integration of AI tools into pedagogical practices, the recommendation is to provide ongoing professional development programs. With more knowledge about the AI functionalities, educators will feel empowered to leverage AI effectively.

As mentioned in this paper, many feel that AI-generated content might reduce students' creativity and critical thinking, especially if the students rely heavily on the use of AI. To avoid this issue, assignments must be designed to require human creativity and reasoning. Moon (2004) recommends that students submit a self-reflection paper after submitting a research paper explaining the mental process they followed to complete the research. This practice forces students to articulate their learning journey. Herreid (2011) suggests giving students a complex, real-world case study and asking the students to evaluate options, justifying their recommendations. Kuhn (2005) suggests having pairs of students confront each other with opposing perspectives on controversial topics and argue both sides.

Conclusion

The exponential growth of AI is an inspiring transformational change in the field of education, with unprecedented opportunities for personalized learning, efficient administrative support, and innovative pedagogical approaches. Reflecting this trend, a burgeoning field of research on the role of AI in Education (AIED) is also emerging. However, a critical limitation of this research lies in its reliance on technological determinism, which often overemphasizes the capabilities of technology while overlooking the role of human agency and institutional context (Kudina & van de Poel, 2024). To address this gap, this paper adopts a socio-technical systems (STS) perspective (Trist, 1981) that offers a comprehensive lens on the relationship between social and technical dimensions of the education system.

The resulting theoretical framework highlights several contributions to the growing research. First, it provides a map for aligning the diverse goals of various stakeholders, such as educators, students, administrators, and policymakers, which in turn can foster collaboration in the adoption of AI. Secondly, the STS perspective further facilitates collaboration between educators and AI by emphasizing the complementary and supportive role of AI tools in improving teaching methods and learning outcomes rather than positioning it as a disruptive force that might replace humans (educators and administrative personnel). Third, it helps to build trust and reduce resistance among stakeholders by addressing the social and cultural dimensions of AI adoption. Lastly, this framework incorporates ethical implications, which can ensure that AI tools are designed and implemented with issues like equity and diversity in mind.

In summary, the STS framework provides a dynamic and holistic view of AIED that can not only enhance the adoption of AI tools but also ensure ethical and equitable integration for all stakeholders. By situating AI as a component of broader sociotechnical systems, education can be reimagined as a collaborative ecosystem where technology supports human agency and institutional goals rather than replacing them.

References

Abbas, M., Jam, F. A., & Khan, T. I. (2024). Is it harmful or helpful? Examining the causes and consequences of generative AI usage among university students. *International Journal of Educational Technology in Higher Education*, *21*, 10. https://doi.org/10.1186/s41239-024-00444-7

Alshahrani, B. T., Pileggi, S. F. & Karimi, F. (2024). A Social Perspective on AI in the Higher Education System: A Semisystematic Literature Review. *Electronics*, *13*, 1572. https://doi.org/10.3390/electronics13081572

Amo, D., Fonseca, D., Alier, M., García-Peñalvo, F. J., & Casañ, M. J. (2019). Personal data broker instead of blockchain for students' data privacy assurance. In Á. Rocha, H. Adeli, L. Reis, S. Costanzo (Eds.), *New Knowledge in Information Systems and Technologies. WorldCIST'19 2019. Advances in Intelligent Systems and Computing* (vol 932, pp. 371–380). Springer, Cham. https://doi.org/10.1007/978-3-030-16187-3_36

Bastani, H., Bastani, O., Sungu, A., Ge, H., Kabakcı, Ö., & Mariman, R. (2024). Generative AI Can Harm Learning. *The Wharton School Research Paper*. http://dx.doi.org/10.2139/ssrn.4895486

Bednar, P. M., & Welch, C. (2020). Socio-Technical perspectives on Smart Working: Creating Meaningful and Sustainable Systems. *Information Systems Frontiers*, *22*(2), 281–298. https://doi.org/10.1007/ s10796-019-09921-1

Celik, I., Dindar, M., Muukkonen, H., & Järvelä, S. (2022). The Promises and Challenges of Artificial Intelligence for Teachers: a Systematic Review of Research. *TechTrends*, *66*, 616–630. https://doi.org/10.1007/s11528-022-00715-y

Geels, F. W. (2004). From sectoral systems of innovation to socio-technical systems Insights about dynamics and change from sociology and institutional theory. *Research Policy, 33*(6-7), 897–920. https://doi.org/10.1016/j.respol.2004.01.015

Herreid, C. F. (2011). *Start with a Story: The Case Study Method of Teaching College Science*. NSTA Press.

Interaction Design Foundation. (2024a). December 22. *Socio-Technical Systems*. https://www.interaction-design.org/literature/topics/socio-technical-systems

Interaction Design Foundation. (2024b). December 22. *Human-AI Interaction (HAX)*. https://www.interaction-design.org/literature/topics/human-ai-interaction

Keppler, S., Sinchaisri, W., & Snyder, C. (2024). Backwards Planning with Generative AI: Case Study Evidence from US K12 Teachers. http://dx.doi.org/10.2139/ssrn.4924786

Kroes, P., Franssen, M., Van de Poel, I., & Ottens, M. (2006). Treating socio-technical systems as engineering systems: Some conceptual problems. *Systems Research and Behavioral Science*, *23*(6), 803– 814. https://doi.org/10.1002/sres.703

Kudina, O. & van de Poel, I. (2024). A sociotechnical system perspective on AI. *Minds and Machines*, *34*(21). https://doi.org/10.1007/s11023-024-09680-2

Kuhn, D. (2005). *Education for Thinking*. Harvard University Press.

Linderoth, C., Hulten, M., & Stenliden, L. (2024). Competing visions of artificial intelligence in education—A heuristic analysis on sociotechnical imaginaries and problematizations in policy guidelines. *Policy Futures in Education*, *22*(8), 1662–1678. https://doi.org/10.1177/14782103241228900

Min, S., Levina, N., & Lifshitz, H. (2024). Technology-Centric Contestation over Symbolic and Social Boundaries: The Social Justice Implications of Covid-19 Contact Tracing Technologies. *MIS Quarterly*, *48*(4), 1745–1770. https://doi.org/10.25300/MISQ/2024/18313

Mollick, E. R. & Mollick, L. (2024). Instructors as Innovators: a Future-focused Approach to New AI Learning Opportunities, With Prompts (April 22, 2024). *The Wharton School Research Paper*. http://dx.doi.org/10.2139/ssrn.4802463

Moon, J. (2004). *A Handbook of Reflective and Experiential Learning: Theory and Practice*. Routledge.

Mutch, A. (2008). (Ed.). *Managing Information and Knowledge In Organisations: A Literacy Approach*. Routledge.

Orlikowski, W. J. (2007). Sociomaterial Practices: Exploring Technology at Work. *Organization Studies*, *28*(9), 1435–1448.

Peters, N. R. (2022). The Golem in the Machine: FERPA, Dirty Data, and Digital Distortion in the Education Record. *Washington & Lee Law Review*, *78*(5), 1991–2029.

Selwyn, N. (2022). The future of AI and education: Some cautionary notes. *European Journal of Education*, *57*(4), 620–631. https://doi.org/10.1111/ejed.12532

Solaiman, I., Talat, Z. Agnew, W. Ahmad, L. Baker, D. Blodgett, S. U. Daumé, III. Dodge, J. & Evans, E. Hooker, S. Jernite, Y. Luccioni, A. Lusoli, A. Mitchell, M. Newman, J Png, M. Strait, A. & Vassilev, Al. (2023). Evaluating the Social Impact of Generative AI Systems in Systems and Society. https://doi.org/10.48550/arXiv.2306.05949

Su, J. & Yang, W. (2023). Unlocking the Power of ChatGPT: A Framework for Applying Generative AI in Education. *ECNU Review of Education*, *6*(3), 355–366. https://doi.org/10.1177/20965311231168423

Trist, E. (1981). *The Evolution of Socio-Technical Systems*. Ontario Ministry of Labour, Ontario Quality of Working Life Centre.

Trist, E. L. (1963). *Organisational Choice: Capabilities of Groups at the Coal Face Under Changing Technologies: The Loss, Rediscovery & Transformation of a Work Tradition*. Tavistock.

Umoru, T. A., & Salami, R. O. (2024). Advanced Digital Skills as Determinants of Business Educators' Job Security in Tertiary Institutions. *KWASU International Journal of Education (KIJE)*, *7*(1), 130–137.

Wang, X., Li, L., Tan, S. C., Yang, L., & Lei, J. (2023). Preparing for AI-enhanced education: Conceptualizing and empirically examining teachers' AI readiness. *Computers in Human Behavior*, *146*, Article 107798. https://doi.org/10.1016/j.chb.2023.107798

Williamson, B. (2024). The Social Life of AI in Education. *International Journal of Artificial Intelligence in Education*, *34*, 97–104. https://doi.org/10.1007/s40593-023-00342-5

Contact email: nisa.chand@ucanwest.ca