

AI in Education: Cognitive, Social, Affective, and Ethical Impacts on Human Behavior based on Human-Computer Interaction Theories

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ABSTRACT

Incorporating Artificial Intelligence (AI) in education is reforming the dynamics of teaching and learning. Due to this, behavioural changes among students and educators triggered by using AI technologies must be studied. In this research, these behavioural changes among individuals in the academe were investigated, particularly in the cognitive, social, affective, and ethical dimensions of Human-Computer Interaction (HCI) theory. Based on a comprehensive literature review, this study examines how AI tools affect cognitive engagement, social interaction, emotional responses, and ethical decision-making. These impacts on behaviour in the educational setting were examined through HCI theories like Distributed Cognition, CASA (Computers as Social Actors), Affective Computing, and Socio-Technical Theory. Positive behavioural outcomes include enhanced cognitive support through reduced mental load, improved collaboration via AI-mediated platforms, increased emotional engagement through adaptive content, and tougher academic integrity enabled by AI-driven proctoring and plagiarism detection systems. However, the paper also identifies critical negative consequences such as cognitive over-reliance, diminished metacognitive reflection, reduced interpersonal interactions, cultural misinterpretation of emotions, and ethical concerns such as surveillance and algorithmic bias. The findings suggest that while AI tools can support human learning and teaching processes, their design and deployment must be guided by ethical principles and pedagogical considerations to allay risks. The study concludes with a call for thoughtful, human-centred AI integration in education that upholds fairness, engagement, and ethical standards.

Keywords

Artificial Intelligence
Ethical Impacts
Human Behavior
Human-Computer Interaction

APSA

Advances in Psychological Sciences and Applications

Vol. 1, No. 03, pp. 108-119

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Article history

Received 25 July 2025
Revised 29 August 2023
Accepted 7 September 2025

journal.iistr.org/index.php/APSA
DOI: 10.56741/apsa.v1i03.1297



Introduction

The birth of OpenAI's ChatGPT or Chat Generative Pre-Trained Transformer on November 30, 2022 [1] was a momentous technological progress [2]. AI systems like it are revolutionizing the way people do things. In the educational landscape, AI is swiftly changing and redesigning how students learn and how educators impart knowledge [3]-[5]. Intelligent learning platforms, chatbots, recommendation systems, and writing assistants are now often integrated into everyday educational workflows to augment educational processes, offer tailored learning experiences and instantaneous feedback, and support efficient administrative duties [6]-[9].

As the use of AI tools becomes even more widespread, it is important to understand the impact of these tools on human behaviour within the academe. It is imperative to identify the impact of AI utilization among students and educators in terms of cognitive engagement, social interaction, affective responses, and ethical considerations as part of the larger implications of AI in educational experience [10][11]. Understanding the behavioural change brought about by AI in terms of cognitive engagement will allow educators to design better curricula and learning experiences that encourage critical thinking and deep cognitive engagement, while reducing shallow pedagogy [12]. Similarly, regarding behavioural change in social interaction, learning about AI's effects in this dimension can help educators create a learning experience that improves interpersonal skills and lifts collaborative learning [13]. On AI's impact on affective responses, recognizing behavioural change in this aspect will allow educators to design a curriculum that will not overly rely on AI usage, which can lessen feelings of anxiety and overconfidence among students and teachers [14]. Lastly, finding out about AI's effect on ethical behaviour change can help educators determine ways to reduce plagiarism and bias in education, while improving fairness and academic integrity in the overall learning and teaching experience [15]-[17].

This research study seeks to answer how AI tools affect behaviour changes among students and educators in HCI's cognitive, social, affective, and ethical dimensions. HCI studies and designs how people interact with computers and other digital devices or systems, emphasizing interactions' cognitive, social, affective, and ethical dimensions [18]. It aims to describe the impact of AI educational technology on the behaviour changes of people in the academe based on HCI theory on cognitive engagement, social interaction, affective responses, and ethical considerations. Figure 1 shows the conceptual framework of the study on how the independent variable (AI use in education) interacts with the dependent variable (behaviour change) in the framework of HCI. This diagram depicts how the independent variable affects the dependent variable based on HCI concepts on cognitive, social, affective, and ethical scopes of interactions.

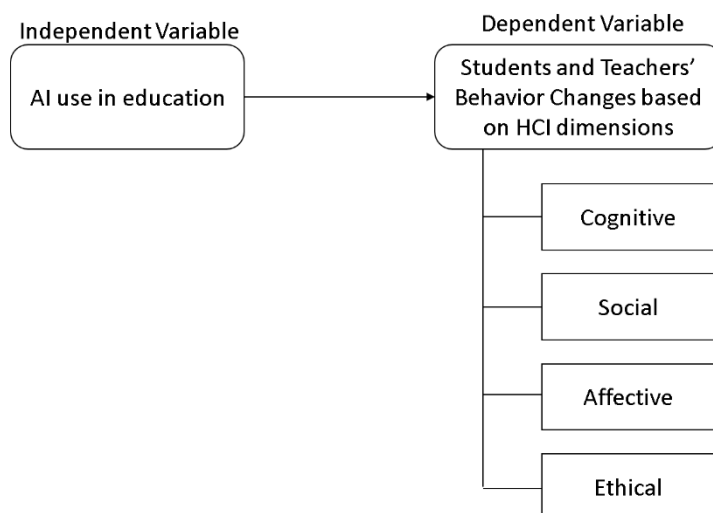


Fig. 1. Conceptual Framework of the study

Literature Review

AI is described as the ability of information systems to complete tasks characteristically associated with human intellect, like learning, reasoning, problem-solving, perception, and decision-making [19]. The application of AI systems has been wide and varied, so it can be considered a general-purpose technology affecting pre-existing social and economic structures [20]. In education, the application of AI systems is called AIEd or Artificial Intelligence in Education [21]. AIEd uses AI tools such as generative AI chatbots in education [21]. However, the field also encompasses the fundamentals of generative AI, data-driven decision-making, AI ethics, data privacy, and AI literacy [22].

According to the Regional Education Laboratory (REL) Northwest of the Institute of Education Sciences (IES) of the U.S. Department of Education [23] and other references, applications of AIEd are categorized into the following:

- AI-driven Instruction and Tutoring [13] [24] [25][26];
- Personalized Learning [7][27];
- Assessment and Feedback [28][29][30];
- Predictive Analytics and Learning Insights [31][32]; and
- Administrative and Logistical Support [28][33].

Instruction and Tutoring driven by AI refers to information systems that can deliver real-time and automated personalized instructions and explanations that mimic one-on-one support [13][24]-[26]. Personalized Learning, on the other hand, talks about how AI can help educators to create a customized curriculum, while for students, AI can analyze individual data to develop learning content that can adapt to individual needs [7][27]. Then, assessment and feedback with the help of AI automatically produce assessment items and adjust student assessment [29] with

some form of this AI system, which can also generate automated assessment scoring and instant formative feedback for students [29][30]. In addition to this list, predictive analytics and learning insights refer to the application of AI models to anticipate student performance and to support data-driven intervention by the teachers [31][32]. Lastly, administrative and logistical support through AI emphasizes streamlining classroom functions such as assigning, grading, and scoring assignments, scheduling classes, managing attendance, and other routine tasks [28][33].

Through the lens of HCI theory (encompassing cognitive, social, affective, and ethical dimensions), the above applications of AI in education are examined in terms of the changes in human behaviour, particularly among students and teachers. HCI is a framework because it provides a comprehensive and human-centred lens for analysing how learners and educators interact with technology [11][18]. The cognitive dimension of HCI refers to how technology affects how people think, remember, and process information [18]. Then, the social dimension of HCI discusses how AI affects communication and collaboration among people in the academe [18]. Affective dimension of HCI, on the other hand, focuses on how technology impacts people's emotions and motivations [18]. Lastly, the ethical dimension of HCI talks about the moral implications of using technology [34].

The cognitive dimension of HCI is based on the theoretical frameworks of Distributed Cognition by Edwin Hutchins [35]. Distributed Cognition in HCI states that cognition is circulated across social and technological artifacts such that cognition happens not just in the head, but between a person and their devices (e.g., computers, AI tutors, calculators) [35]. Whereas the social dimension of HCI is based on the theoretical framework, CASA (Computers Are Social Actors) by Byron Reeves and Clifford Nass [36]. It states that interaction with technology is not just functional but social, such that people apply the same social rules and expectations to computers that they apply to human beings [36]. Then, the affective dimension of HCI is based on the theoretical framework, Affective Computing by Picard [37]. This theory focuses on how computers can recognize, interpret, and respond to human emotions [37]. Lastly, the basis of the ethical dimension of HCI was adopted from the Socio-technical theory by Eric Trist and Ken Bamforth [38]. The ethical dimension of HCI relates to socio-technical theory as the foundation of technical design in social accountability, user rights, and value-sensitive development. Both highlight that practical and functional technologies must be fair, inclusive, and aligned with human values [38].

In the context of the cognitive dimension of HCI, the focus of the use of educational technologies powered by AI is on their interaction with their users and how these interactions affect and are affected by the cognitive processes in learning [18][39]. This means that AI in education is designed to assist in acquiring knowledge and actively influence how students process and internalize information. AIED has the potential to reshape cognitive processes by

providing a tailored learning experience that adapts to the needs and preferences of a student. This aligns with the cognitive dimension of HCI, which studies how interfaces influence memory, attention, and problem-solving in users, particularly in learning environments [18]. For example, AI-driven Instruction and Tutoring can guide student learning by adjusting the pace and difficulty of content delivery based on individual students' performance. This way, it can create a personalized learning experience that provides immediate and on-demand assistance, reducing cognitive load and allowing higher-order thinking and problem-solving [40]. This idea is also consistent with cognitive load theory and HCI principles that promote effective scaffolding in learning interfaces [40][41]. Leveraging AI can also reduce educators' cognitive load by automating repetitive administrative tasks, which allows them to focus on instructional design and personalized student engagement [41]. Generating assessments and providing immediate feedback are also made easy for educators [8]. Tracking learning progress of students and providing resources tailored to learners' needs through predictive analysis and learning insights from AI also reduces mental effort on monitoring and planning for diverse learners [42]. These advancements align with HCI theories emphasizing the relevance of interaction design in facilitating meaningful and efficient learning and teaching experiences, which is stated in Norman's [39] principles on usability and cognitive support in interaction design. These principles accentuate how an effective interaction design can minimize cognitive load and allow deep learning.

However, using AIEd also comes with risks such as over-reliance, which can impair decision-making, analytical thinking, and critical judgment skills [43]. According to research by MIT, if AI is not used correctly, it could be detrimental to long-term brain development, as AI users showed lower neural engagement, diminished executive control, poorer memory, and less creative thinking [44]. This research from MIT also suggested that using AI, particularly Large Language Models like ChatGPT, can be more harmful to young learners [44].

In the context of the social dimension of HCI, the emphasis is on how AI use affects social interaction between and among students and educators in the class setting. On a positive note, AI use in education, such as that through AI chatbots and virtual tutors, can enhance participation from students, especially for shy students [41]. It can also foster a stronger teacher-student interaction with teachers' less workload driven by AI [21]. However, if not used properly, the application of AI in education can also negatively impact social interaction behaviour by creating a Parasocial relationship with AI systems, especially for students [45], which can reduce empathy, social trust, and interaction quality.

Whereas, in the affective dimension of HCI, AI systems that are emotionally responsive can be seen to improve motivation and persistence in learning [21][37]. AI systems with affective feedback response in education can also create a safe emotional space for learning [41]. For

teachers, it can help monitor classroom emotional climate through affective analytics [46], eventually leading to increased affective sensitivity among the educators [11]. On the other hand, affective behaviour can vary in various cultures, and an AI system could misinterpret and overgeneralize emotional reactions [45]. Emotion detection technology powered by AI, like biometrics, also poses privacy concerns [47]. Lastly, over-reliance on AI-generated affective feedback can weaken a teacher's affective intuition and eventually weaken authentic emotional bonds with students [49].

Finally, in the context of the ethical dimension of HCI, the usage of AI tools in education, such as plagiarism checkers and exam proctoring software, has shown positive effects on promoting fairness [21] [45], integrity, and equity [41]. However, poor designs of these systems and misuse of them can reduce transparency [45], increase surveillance, and undermine autonomy [47].

Results and Discussion

Summarized below in the provided tables are the results of the reviewed literature on behavioural changes related to the HCI dimensions—cognitive, social, affective, and ethical—triggered by AI in education. Table 1 outlines the positive effects of AI tools on students and educators, respectively, while Table 2 presents the negative impact of AI usage on students and teachers, respectively.

Table 1. Positive Behavioural Changes Triggered by AI in Education based on HCI dimensions for Students and Educators

No.	Positive Effects	HCI Dimension	Theoretical Framework	Brief Explanation
1	Extension of human memory and thinking [35][41]	Cognitive	Distributed Cognition Theory	AI systems can offload cognitive load for both students and educators. In this way, distributed memory is supported, allowing students and teachers to focus on higher-order thinking [35][41].
2	Facilitating collaborative cognition [11]	Cognitive	Distributed Cognition Theory	AI collaborative tools like Google Workspace with AI assist can mediate interaction, which enables cognition between people (through shared understanding and joint problem-solving) and an AI-enhanced environment [11]
3	Real-time feedback for cognitive regulation [21]	Cognitive	Distributed Cognition Theory	AI tutors can offer real-time or instant and customized feedback for learners, which can help self-correct and regulate individual understanding, a significant cognitive strategy [21].
4	Cognitive decision-making	Cognitive	Distributed Cognition Theory	AI-powered dashboards can help teachers with insights about

No.	Positive Effects	HCI Dimension	Theoretical Framework	Brief Explanation
	enhanced by AI analytics [42]			students' performance, which can help in instructional planning for students [42].
5	Enhanced student engagement and confidence [41]	Social, Affective	CASA (Computers as Social Actors), Affective Computing	Interactions with AI chatbots and virtual tutors can foster comfort and engagement compared to human teachers. This can lead to the creation of a safe space for learning, which can boost confidence and participation [41]. Students with anxiety, low self-esteem, or neurodiverse conditions can benefit from an AI system that incorporates affective feedback [41].
6	Improved communication channels [42]	Social	CASA (Computers as Social Actors)	Translation and transcription tools powered by AI can be perceived as social facilitators, which can help students and teachers communicate across language barriers, improving inclusivity and mutual understanding [42].
7	More time for human interaction [21]	Social	CASA (Computers as Social Actors)	AI's tasks can allow more time for social-emotional interactions between students and teachers [21].
8	AI-supported Collaboration [11]	Social	CASA (Computers as Social Actors)	Groupings that AI facilitates are often trusted as neutral and intelligent, which helps students accept group recommendations and thus engage more positively in teamwork [11]
9	Enhance Emotional Engagement [21]	Affective	Affective Computing	Through emotion-aware AI systems, the learning experience can be designed to adapt its content or pacing accordingly, which helps in maintaining positive emotional states [21].
10	Teacher insights through affective analytics [46]	Affective	Affective Computing	AI dashboards with affective analytics can help classroom management through efficient classroom emotional climate [46].
11	Enhanced teacher reflection and emotional awareness [11]	Affective	Affective Computing	When educators can utilize an AI system in a way that they can understand how students emotionally respond to content or assessment, AI in this manner can increase the teachers' affective sensitivity [11].
12	Promoting academic integrity [11]	Ethical	Socio-technical theory	The use of AI detection tools for plagiarism and exam proctoring can uphold academic honesty [11]
13	Raising ethical awareness [41]	Ethical	Socio-technical theory	AI-based learning platforms that embed ethical decision-making scenarios in the curriculum can help students reflect on moral dilemmas, thus developing their ethical reasoning [41].

No.	Positive Effects	HCI Dimension	Theoretical Framework	Brief Explanation
14	Encourage ethical teaching practices, feedback, and fair assessment [21] [45]	Ethical	Socio-technical theory	When ethically designed, AI can help educators promote fairness, justice, transparency, and equity [21]. IT can strengthen ethical pedagogy by avoiding subjective biases and assumption-based decisions[45].

Table 2. Negative Behavioural Changes Triggered by AI in Education based on HCI dimensions for Students and Educators

No	Negative Effects	HCI Dimension	Theoretical Framework	Brief Explanation
1	Cognitive over-reliance and automation bias [45][48][49]	Cognitive, Ethical	Distributed Cognition Theory, Socio-technical theory	Overdependence on AI-generated answers and recommendations undermines critical thinking and judgment skills, which is an unhealthy distribution of cognition because AI, in this case, overpowers rather than supports [45]. This also promotes ethical laziness, mainly when used to create shortcuts in learning, breaking the balance between technical ease and social responsibility [48][49].
2	Reduced metacognitive reflection [49]	Cognitive	Distributed Cognition Theory	If AI offers solutions without reflection, learners may engage in shallow processing instead of deep learning [49].
3	Fragmented attention and multitasking [47]	Cognitive	Distributed Cognition Theory	Some AI-support systems, like alerts, suggestions, or adaptive content, can disrupt focus and hinder cognitive effort and reflection [47].
4	Mismatch between AI design and human cognition [35]	Cognitive	Distributed Cognition Theory	AI tools must fit naturally into the cognitive workflow of an individual because they may cause cognitive dissonance or misguide the learning process [35].
5	Reduce face-to-face interaction [49]	Social	CASA (Computers as Social Actors)	When humans treat AI tools as substitutes for human interaction, it may lead to social withdrawal and underdeveloped interpersonal skills [49].

No	Negative Effects	HCI Dimension	Theoretical Framework	Brief Explanation
6	Depersonalization of education [45]	Social, Affective, Ethical	CASA (Computers as Social Actors), Affective Computing, Socio-technical theory	As AI in education is treated as a social actor, empathy is expected. Hence, failure to meet this expectation can cause emotional disconnect [45]. Also, when AI systems replace judgment in sensitive areas like discipline or grading, it may reduce opportunities for empathy, forgiveness, and moral teaching [45] [47].
7	Equity and inclusion challenges [48]	Social, Ethical	CASA (Computers as Social Actors), Socio-technical theory	When AI systems are biased, they can create a social divide and damage trust [48].
8	Surveillance Concerns [47]	Social, Affective, Ethical	CASA (Computers as Social Actors), Affective Computing, Socio-technical theory	Monitoring emotions or behaviours through AI can be seen as judgmental and invasive, stifling open expression and authenticity [47]. This can also trigger stress or emotional discomfort [47]. Moreover, AI monitoring is often done without transparent consent from users, which undermines an individual's rights and agency, which is unethical [47].
9	Emotion misinterpretation and overgeneralization [45]	Affective	Affective Computing	Since emotional expressions can vary from culture to culture, AI systems might inaccurately read emotional states, resulting in inappropriate interventions [45].

Conclusion

From these findings, it can be concluded that even though there are benefits to the usage of AI in education in terms of behavioural changes related to cognition, social skills, affective skills, and ethical values, poor design and mismanagement of these AI systems can lead to negative consequences such as shallow pedagogy, data privacy issues, isolation, and many other concerns. Therefore, AI tools in education are thoughtfully designed to be user-centred, fair, with clear guidelines and accountability. These systems must also regularly undergo evaluation tests for effectiveness, carefully considering their benefits while minimizing potential harm.

Conflict of Interest

The authors declare that there is no conflict of interest.

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