



# AI, Brain, and Child: navigating the intersection of artificial intelligence, neuroscience, and child development

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## Abstract

In an era marked by rapid advancements in artificial intelligence (AI) and cognitive neuroscience, the intersection of these fields holds transformative potential for child development and educational practices. This launch editorial introduces *AI, Brain and Child (ABC)*, an open-access journal dedicated to exploring the dynamic interplay between AI, neuroscience, and child education. By fostering an interdisciplinary dialogue among educators, researchers, clinicians, and policymakers, *ABC* aims to examine the multifaceted roles of AI and neuroscience in shaping cognitive, social, and emotional growth among children. The journal seeks to democratize access to high-quality research, addressing both the beneficial applications and ethical challenges posed by AI and neuroscience technologies. Through this platform, *ABC* aspires to promote evidence-based practices, enhance educational outcomes, and tackle pressing developmental and educational issues. By welcoming diverse contributions—from empirical research to policy analysis—*ABC* endeavors to bridge the gaps between theory and practice, equipping stakeholders with the insights needed to navigate the complexities of educating children within a technologically enriched landscape. This new scholarly endeavor marks a new era of global community to partake in the crucial conversation surrounding the opportunities and responsibilities inherent in integrating AI and neuroscience into education.

## Introduction

Rapid advancements in artificial intelligence (AI) and cognitive neuroscience are transforming the landscape of learning, education, and child development. This intersection demands an interdisciplinary platform for rigorous examination of AI's profound implications, particularly its impact on children's cognitive, social, and emotional growth and the ethical considerations surrounding its use. Therefore, we are launching *AI, Brain and Child (ABC)*, an open-access journal dedicated to fostering collaboration among educators, researchers, clinicians, and policymakers. By democratizing access to high-quality research and promoting ethical scholarship, *ABC* will empower practitioners with evidence-based approaches, ensuring they remain at the forefront of integrating AI and neuroscience into educational practices for the benefit of all children.

## AI, Brain and Child: the new ABCs for educators in the AI era

As the Co-EiCs, we are thrilled to introduce *AI, Brain, and Child*, a pioneering open-access journal committed to exploring the intersection of artificial intelligence (AI), cognitive neuroscience, developmental sciences, and educational practices. In a rapidly evolving landscape marked by unprecedented technological advancements and a growing understanding of the human brain, *ABC* emerges as a vital platform for fostering interdisciplinary dialogue and enhancing our knowledge of learning, teaching, and educational outcomes in the digital age. Therefore, the genesis of *ABC* is not only timely but also essential in navigating the complexities of a world where AI is increasingly woven into the fabric of our daily lives. As AI technologies become increasingly embedded in educational design and frameworks, there is a pressing need to understand their multifaceted roles in shaping children's learning experiences. This inquiry extends to both the positive contributions of AI—such as personalized learning and adaptive educational tools—and its potential drawbacks, including ethical concerns and implications for educational and social equity. Thus, *ABC* is driven by the necessity for empirical rigor and ethical foresight in

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evaluating the implications and outcomes of emergent educational technologies.

ABC aims to engage in rigorous discourse about how AI and neuroscience intersect with educational practices to inform and improve how educators can teach and individuals learn. The journal is designed to connect scholars, educators, policymakers, and practitioners, fostering a robust network that promotes dialogue, research collaboration, and the sharing of innovative practices. Our mission is to facilitate the synthesis of knowledge and insights, ultimately leading to transformative changes in educational approaches and frameworks. Central to our mission is a commitment to dismantling the silos that have historically segmented various fields of study. The convergence of AI and neuroscience offers unprecedented opportunities to transform education across all stages of life, encompassing early childhood education, K-12, higher education, and lifelong learning. By providing a platform for interdisciplinary collaboration, ABC facilitates the exchange of ideas that can contribute to developing practical educational tools, strategies, and policies that cater to diverse learners.

Recent research underscores the profound impact of early experiences on children's brain development, shaping cognitive, emotional, and social trajectories (Center on the Developing Child at Harvard University, 2016). Key findings highlight the rapid synaptic formation and pruning in early childhood, with enriched environments and sensitive caregiving promoting executive function skills such as working memory and cognitive flexibility. Conversely, adverse childhood experiences can negatively alter brain architecture and function, increasing vulnerability to later mental health challenges (Shonkoff et al., 2012). Future research directions include examining the long-term effects of early interventions, the influence of technology and cultural contexts on brain development, and further exploration of neuroplasticity to inform targeted interventions. Interdisciplinary approaches integrating neuroscience, psychology, AI, and education are crucial for advancing our understanding of child development and optimizing children's outcomes. The growing interdisciplinary research trend necessitates collaborative platforms supporting emerging transdisciplinary work. Therefore, open-access, interdisciplinary journals like ABC are urgently needed.

Accordingly, the scope of ABC is deliberately broad, encouraging a diverse range of contributions that reflect the myriad ways in which AI and neuroscience intersect with education. We welcome empirical research studies, theoretical perspectives, methodological advancements, case studies, and policy analyses. This inclusivity not only enriches the content of the journal but also ensures that it remains relevant to educators, researchers, and practitioners actively engaged at the forefront of educational technology and child development.

Our commitment to open access is a fundamental aspect of ABC. By making research freely available to all—educators, parents, policymakers, researchers, and the general public—we promote transparency, democratize knowledge, and enhance active engagement with the scientific community. This accessibility facilitates the application of research findings to educational practice, ensuring that innovations in AI and neuroscience can be effectively harnessed by those who will benefit from them most.

In addition, we are dedicated to establishing a distinguished editorial board of leading experts in AI, education, psychology, neuroscience, computer science, and ethics. This board exemplifies our commitment to fostering international collaboration and incorporating diverse scholarly perspectives. By assembling a community of thought leaders, ABC is strategically positioned to address pressing questions surrounding the nexus of AI, brain science, and education, and to contribute to pioneering research that actively shapes the future landscape of educational practices.

Consequently, ABC stands at the forefront of a new scholarly wave that seeks to understand and harness the powerful intersection of AI and neuroscience for the benefit of children and educational outcomes. Through thoughtful inquiry, an unwavering commitment to accessibility, and an emphasis on ethical considerations, we aim to make significant contributions that empower educational practices, promote inclusivity, and enhance developmental trajectories for young learners.

## **Generative AI and its revolutionary impact on education**

Generative AI's transformative influence on learning and teaching has profound implications for children, teachers, parents, and schools, significantly shaping educational experiences and cognitive development. This multifaceted shift necessitates empirical research and theoretical exploration and underscores the importance of large-scale, open-access platforms like ABC to disseminate such findings. This section will address the impact of generative AI across various stakeholders in education.

### **The impact of generative AI on children**

Recent generative AI (GenAI) advancements have ushered in revolutionary educational changes that deeply affect child development and cognitive processes. These technologies, utilizing sophisticated algorithms to analyze data and customize content, are reshaping how children learn and interact with educational material. Understanding GenAI's impact on children's development is crucial as it raises essential questions about the academic, psychological, and neurological effects on young minds.

## The rise of personalized learning

At the forefront of GenAI's impact is its capacity to create personalized learning experiences tailored to the unique needs of individual students. Intelligent tutoring systems (ITS), powered by GenAI, assess student performance and adapt instructional content accordingly. This personalization allows the creation of quizzes, assignments, and study materials that align with each learner's pace and style (Luo et al., 2024; Gligorea et al., 2023). Targeted approaches can enhance engagement, making learning more relevant and accessible. When students encounter materials that match their skill levels, it boosts their motivation and encourages them to embrace challenges, driving cognitive growth. Research indicates that nearly 50% of educators incorporate AI technologies in their classrooms, showing a significant trend toward personalized education. Real-time responsiveness of AI tools helps ensure that learners are neither under-challenged nor overwhelmed, fostering a supportive learning environment conducive to developmental success (Luo et al., 2024).

## Enhancing cognitive engagement

GenAI is pivotal in fostering engagement. Children thrive in environments that cater to their individual preferences and learning styles. Personalized experiences boost students' emotional investment in their education and contribute to improved cognitive retention. AI-driven methods allow educators to identify and address specific knowledge gaps, creating structured learning paths that optimize engagement and retention. Furthermore, AI technologies provide immediate feedback on assessments, allowing students to learn from mistakes in real time. Studies demonstrate that timely feedback enhances self-reflection, a critical skill for effective learning. Traditional educational models often suffer from delayed feedback, leading to repeated mistakes without understanding; GenAI changes this dynamic by enabling students to correct errors and comprehend material more deeply.

## The role of AI in social learning and development

AI is transforming collaborative learning. AI-enhanced platforms enable students to participate in group projects, automatically organizing teams based on skills and interests. This collaborative approach promotes social skills such as communication and teamwork, which are essential for child development (Gkintoni et al., 2025). Immersive learning experiences facilitated by AI can simulate real-world scenarios, connecting academic concepts to practical applications and encouraging active exploration of complex problems. Integrating AI in collaborative settings fosters a niche where

children can develop critical thinking and problem-solving abilities essential for their future academic and professional endeavors.

## Neurodevelopmental considerations

As researchers and educators incorporate AI into educational systems, understanding its implications for developing brains becomes essential. Children's brains exhibit neuroplasticity—the ability to reorganize synaptic connections in response to learning experiences (Rose & Meyer, 2020). AI personalization promotes the formation of new neural pathways linked to specific knowledge and skills. However, concerns regarding over-reliance on technology may lead to cognitive overload and attention deficits (Wu et al., 2024). Children today are bombarded with information from various sources, which could inhibit deep learning. It is imperative that AI tools cultivate essential cognitive functions—such as critical thinking, creativity, and analytical skills (Stewart, 2023). Balancing AI integration with traditional pedagogical practices that promote collaboration and debate will be vital for optimal educational outcomes. A scoping review by Wu et al. (2024) shows that early digital experiences affect brain development positively and negatively, requiring mindful guidance and evidence-based policies to ensure children's digital well-being.

## Ethical considerations in AI implementation

The educational applications of generative AI raise significant ethical implications, particularly regarding child development (UNESCO, 2024a, 2024b). Key ethical dimensions, as highlighted in the AI Competency Framework for Teachers and the AI Competency Framework for Students, warrant careful consideration in our discourse at ABC.

Data privacy is a major concern, as educational institutions collect vast amounts of student data for personalized learning experiences. It is crucial to navigate these parameters responsibly, ensuring the security and confidentiality of this information (Ismail & Alosi, 2025). Algorithmic bias poses another critical issue; unmonitored AI systems may reinforce existing stereotypes or inequalities. Therefore, educators and policymakers must ensure that AI applications are developed and implemented ethically, prioritizing equity and inclusivity in educational settings (Baracas et al., 2023). Failure to do so could exacerbate existing educational disparities, leaving marginalized or underrepresented student populations at a disadvantage.

## Bridging the digital divide

The digital divide is an associated challenge that raises critical questions about access to technology in education. As AI-enhanced education becomes more prevalent, assessing whether all children have equal opportunities to benefit from these innovations is vital. Socioeconomic disparities in access to technology can widen achievement gaps, particularly among vulnerable populations. Strategies for providing access to high-quality resources and training for educators in low-income areas are necessary to bridge this divide (Roshanaei et al., 2023).

## The future of learning in the age of AI

As AI technologies continue to advance rapidly, their influence on the future of education will expand. Advocates suggest that personalized learning environments will emerge as essential cornerstones of contemporary education, supporting diverse needs and fostering adaptive learning strategies. Future research must understand the implications of AI integration into educational curricula, investigating how best to equip educators with the training to leverage AI responsibly (Luo et al., 2024). Moreover, the potential for AI to enhance lifelong learning initiatives is significant. As the job market evolves, critical skills such as problem-solving, creativity, and collaboration will increasingly be valued. Evolving educational practices that utilize AI strategically can prepare students for these demands, ensuring they possess essential skills for success in an interconnected landscape.

AI is rapidly transforming education and making a lasting impact on child development and cognitive processes. From fostering personalized learning experiences that engage and motivate to pioneering collaborative environments that nurture essential social skills, the benefits of AI are significant. However, addressing the ethical challenges associated with its implementation is crucial to ensuring that education remains equitable and inclusive while protecting students' digital well-being. As we embrace the future of learning, stakeholders must remain committed to balancing innovation with responsibility and cultivating an educational environment where AI enhances, rather than detracts from, developmental goals. By harnessing the transformative potential of generative AI, we can elevate educational outcomes and foster a brighter future for all children.

## The interplay of artificial intelligence and neuroscience

The rapid evolution of AI has profound implications for neuroscience, impacting research methodologies, therapeutic interventions, and our understanding of the human brain.

This section examines the multifaceted interplay between AI and neuroscience, highlighting both the transformative potential and the ethical considerations that demand careful attention.

## AI-driven advancements in brain research

AI is revolutionizing brain research by enhancing the accuracy and precision of data analysis. Researchers leverage machine learning algorithms to analyze vast datasets from neuroimaging techniques such as fMRI and EEG. These advanced analytical tools excel at identifying subtle patterns and correlations within complex neurological data, exceeding the capabilities of traditional methods. This enhanced capacity is contributing to earlier and more accurate diagnoses of neurological conditions such as Alzheimer's and Parkinson's disease. Furthermore, AI's predictive capabilities are being integrated into diagnostic processes. By modeling neural activities and cognitive processes, machine learning can assist practitioners in predicting health outcomes, paving the way for personalized medicine tailored to individual neurobiological profiles (Zeb et al., 2024).

## Brain–computer interfaces: a new frontier

Brain–computer interfaces (BCIs) represent a groundbreaking application of AI, creating direct communication pathways between the brain and external devices. BCIs enable individuals to control prosthetics or digital interfaces using neural signals, offering transformative possibilities for those with mobility impairments or severe disabilities. AI plays a critical role in enhancing BCI effectiveness by improving the decoding of brain activity patterns and translating neural signals into actionable commands. However, the development and implementation of BCIs present ongoing challenges. Ensuring user comfort and safety, accurately interpreting complex neural data, and addressing ethical considerations related to privacy and consent are crucial for responsible advancement in this field.

## AI's influence on cognitive function and development

Beyond technological applications, AI's influence extends to cognitive functions and child development. AI-powered educational tools offer personalized and adaptive learning experiences, potentially enhancing engagement and knowledge acquisition. However, concerns remain regarding the long-term cognitive effects of extensive reliance on AI for learning. Studies suggest that prolonged interaction with AI technologies may impact memory retention and attention spans, potentially fostering dependence on AI systems for information retrieval (Loka & Sabila, 2024). Therefore, striking a balance between leveraging AI's educational potential and

fostering essential cognitive skills such as critical thinking and problem-solving is crucial. Integrating pedagogical approaches like gamification can promote active learning while harnessing AI's personalized learning capabilities.

### Ethical implications of AI in neuroscience

The integration of AI in neuroscience raises complex ethical considerations. The collection and use of sensitive brain data necessitate robust safeguards for privacy, consent, and security (Huang, 2023). Furthermore, algorithmic bias in AI systems significantly threatens equity and fairness. Biased datasets can lead to inaccurate or discriminatory outcomes, potentially exacerbating existing inequalities in healthcare and education (Baracas et al., 2023). Thus, ethical frameworks and guidelines are essential to ensure responsible AI development and deployment, prioritizing inclusivity and equitable access. Open discussions involving researchers, ethicists, policymakers, educators, and families are crucial to navigating these complex ethical challenges and establishing boundaries that promote healthy interactions with AI.

### Fostering interdisciplinary collaboration

Realizing the transformative potential of AI in neuroscience requires interdisciplinary collaboration. Bringing together neuroscientists, computer scientists, educators, psychologists, ethicists, and other stakeholders is essential to navigate the complexities of AI integration and maximize its benefits while mitigating risks. Collaborative research efforts can address critical questions about AI's impact on cognitive development, brain health, and ethical considerations, leading to the development of responsible guidelines and best practices for AI application in neuroscience and education. This interdisciplinary approach will be instrumental in shaping a future where AI enhances human well-being and fosters a deeper understanding of the human brain.

### Bridging AI, neuroscience, and education: ABC's call for research

The rapid integration of AI and neuroscience into education presents transformative opportunities and necessitates rigorous investigation into their combined impact on learning, teaching, and child development. AI, Brain and Child (ABC) seeks to publish high-quality research that explores this dynamic landscape, focusing on the following key areas:

1. Neurocognitively informed personalized learning: ABC encourages submissions that examine how AI, informed by neuroscientific principles, can facilitate personalized learning experiences. This includes research on:

- (1) Adaptive learning technologies and intelligent tutoring systems that consider individual neurocognitive profiles (Luo et al., 2024; Gligorea et al., 2023);

- (2) AI-driven tools that support learners with specific neurodevelopmental needs;

- (3) The impact of AI-powered personalization on brain function and cognitive development.

2. AI-enhanced assessment and feedback, aligned with neuroscience: ABC welcomes studies that investigate how AI can transform assessment practices by incorporating neuroscientific insights:

- (1) Development of neurocognitive assessments using AI-powered tools;

- (2) Real-time analytics that tracks student progress and identifies neurocognitive strengths and weaknesses;

- (3) AI-driven feedback mechanisms that are tailored to individual learning styles and neurocognitive profiles (Halkiopoulos & Gkintoni, 2024).

3. Ethical and responsible AI integration, considering neuroethical implications: recognizing the ethical complexities of AI in education, ABC prioritizes research that addresses:

- (1) Ethical considerations specific to the use of AI in neuroscience research and educational applications (Huang, 2023);

- (2) Neuroethical implications of data privacy and security in AI-driven educational contexts (Roshanaei et al., 2023).

- (3) The potential impact of AI on brain development and the importance of responsible implementation (Stewart, 2023).

### Neuroscience-informed AI for learning and cognition

ABC is interested in research that explores the intersection of AI and neuroscience in human learning and cognitive development:

- (1) The interplay between AI systems and human cognitive processes, informed by neuroscientific findings;

- (2) Leveraging AI to understand and enhance neuroplasticity for improved learning outcomes;

- (3) The impact of AI on different neurocognitive functions, such as attention, memory, and executive function (Loka & Sabila, 2024);

- (4) Neuroscience-backed AI tools for fostering creativity, critical thinking, and problem-solving skills

5. Collaborative frameworks for AI and neuroscience in education: ABC encourages research exploring collaborative approaches to integrate AI and neuroscience in education:

- (1) Interdisciplinary partnerships between educators, neuroscientists, technologists, and policymakers;



(2) Development of frameworks for integrating neuroscientific principles into designing and implementing AI in educational settings (Gkintoni et al., 2025).

ABC believes that rigorous, interdisciplinary research in these areas is essential to harnessing the combined potential of AI and neuroscience to create more effective, equitable, and enriching learning experiences for all students. We invite contributions from scholars and practitioners across disciplines to join us in this critical endeavor.

**Welcome to join ABC** in shaping the future of learning and child development in the age of AI. We invite scholars and practitioners to contribute research that bridges the gap between theory and practice, exploring the intersection of AI, neuroscience, and education to empower every child. ABC is committed to fostering a global community dedicated to ethical, inclusive, and impactful research that addresses the complexities of personalized learning, classroom integration, and the long-term implications of AI. Together, let us unlock the transformative potential of these fields to create a more equitable and enriching educational landscape for all learners, now and into the future. Please submit your work to ABC or join us as an editorial board member and reviewer, becoming a part of this vital conversation.

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## Declarations

**Conflict of interest** The authors claimed no conflicts of interest or funding support for this work.

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