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Article

Challenges and Opportunities in Integrating Artificial Intelligence into Early Childhood Education Pedagogy: Insights from Isabela State University

Ginalyn Acoba- Rivera
Isabela State University
Correspondence: ginalyn.a.rivera@isu.edu.ph

Abstract

The research discussed the possibilities and problems arising in artificial intelligence for enriching teaching, learning, and administration within the Bachelor of Early Childhood Education curriculum in Isabela State University. From the review and synthesis of findings, it shall outline the role that artificial intelligence may play in shifting instruction techniques: facilitating the means by which each learner gets customized, in-time, or feedback-assessed education tailored to meet specific learning requirements. Furthermore, AI-based platforms promote interactive and immersive learning experiences by allowing gamified content, such as virtual simulations, which engages students while concurrently improving understanding. The study also emphasizes the ability of AI to reduce bureaucratic workloads, such as grading, attendance tracking, and performance monitoring, which reduces operational inefficiency. However, a couple of challenges include the complexity of technology, inadequate AI training, and limited resources that make it difficult for AI to be fairly integrated into the program. However, based on the above findings, the study recommends investments in technological infrastructure, with the implementation of AI-focused training programs for faculty and students. AI literacy also needs to be considered as part of the curriculum, providing a friendly culture that aligns well with implementing AI. The study concludes that, if properly supported and strategically intervened into teaching, learning, and administrative processes at Isabela State University, AI can improve dramatically both the educational experience and the efficiency of the institution.

Keywords: *Opportunities, Challenges, Artificial Intelligence, Elementary Education, Pedagogy*

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Introduction

The rapid advancement of Artificial Intelligence (AI) has redefined multiple sectors, including education, where it is increasingly viewed as a catalyst for innovation in teaching and learning. In higher education, particularly in teacher education programs, the integration of AI offers new possibilities for personalized instruction, adaptive learning environments, and efficient administrative systems (Zawacki-Richter et al., 2019). For elementary and early childhood education, where foundational skills are nurtured, AI can revolutionize pedagogy by fostering student engagement, streamlining teacher workloads, and providing timely feedback (Chen et al., 2020).

However, while global trends highlight AI's promise, local realities often reveal technological potential and practical implementation gaps. In the Philippine context, under-resourced state universities like Isabela State University (ISU) face unique challenges such as limited infrastructure, uneven faculty readiness, and resistance to technology-driven reforms (Cruz & Biana, 2021). This study examines the opportunities and challenges of integrating AI into the Bachelor of Early Childhood Education (BECEd) program at ISU. It aims to identify barriers to AI adoption, assess its pedagogical benefits, and propose strategies that align with Sustainable Development Goal (SDG) 4: Quality Education, which emphasizes inclusive and equitable education for all (United Nations, 2015).

The integration of AI in education has been extensively studied in recent years, with scholars underscoring its transformative potential in enhancing personalized learning. AI-powered systems can analyze student data to tailor learning pathways, accommodating diverse learning styles and paces (Holmes et al., 2019). Similarly, AI-driven tools can support teachers in assessment and classroom management by automating repetitive tasks, allowing them to focus more on higher-order instruction (Luckin, 2018).

Empirical studies highlight that AI increases student engagement through interactive platforms, gamification, and real-time feedback mechanisms (Chen et al., 2020). These features enhance learning outcomes and promote differentiated instruction, an essential component in early childhood education. Furthermore, using AI aligns with constructivist teaching principles by creating dynamic and adaptive learning environments (Schiff, 2021).

Despite its promise, AI adoption in education faces significant challenges. Inadequate infrastructure, lack of teacher preparedness, and cultural resistance are among the most cited barriers (Zawacki-Richter et al., 2019; Cruz & Biana, 2021). Teacher education programs are called to integrate AI not only as a technical skill but

also as a critical competency that prepares future educators to address technology's ethical, social, and pedagogical implications (Holmes et al., 2019).

In the Philippine setting, studies emphasize disparities in technological access across state universities and colleges (SUCs), which affect the readiness of both faculty and students to embrace AI-driven education (Cruz & Biana, 2021). This situation is compounded in early childhood education, where technological integration is often undervalued compared to content-focused instruction. Addressing these challenges requires institutional leadership, adequate funding, and professional development programs for educators (Salac & Kim, 2016).

While global research consistently demonstrates AI's potential to personalize learning, increase student engagement, and improve instructional efficiency (Holmes et al., 2019; Chen et al., 2020), there is limited empirical evidence focusing on its integration within early childhood teacher education programs in under-resourced contexts such as the Philippines. Most existing studies broadly examine AI in higher education, without narrowing its application to programs like the BECEd, where foundational pedagogy is critical.

Furthermore, the literature on AI adoption in the Philippine educational system primarily discusses general challenges in digital transformation (Cruz & Biana, 2021; Salac & Kim, 2016) but lacks specific investigations into teacher preparation programs and their role in shaping future educators' readiness for AI integration. There is also insufficient research on institutional strategies that can bridge the gap between AI's technological promise and the constraints of resource-limited universities like ISU.

This study addresses these gaps by exploring the barriers and opportunities of AI adoption in the BECEd program at Isabela State University. It contributes to the discourse on educational innovation in developing contexts. It provides practical recommendations for integrating AI into teacher education, advancing SDG 4's vision of inclusive and equitable quality education.

Objectives of the Study

1. To identify and analyze the challenges educators and students face in integrating artificial intelligence into the Bachelor of Early Childhood Education pedagogy at Isabela State University.
2. To explore the opportunities presented by artificial intelligence in enhancing teaching strategies, learning experiences, and administrative processes in the Bachelor of Early Childhood Education program at Isabela State University.

3. To propose actionable strategies and frameworks for effectively integrating artificial intelligence into elementary education pedagogy at Isabela State University.

Methods of the Study

The paper focuses on the experiences and perspectives of key stakeholders regarding integrating AI into the pedagogy of the BECEd program of Isabela State University. Based on a qualitative phenomenological study, the faculty members, the pre-service teachers, and administrators were purposively selected, including 10 faculty members, five pre-service teachers, and five administrators. Semi-structured interviews and focus group discussions were conducted in-person and virtually, lasting 45-60 minutes for interviews and 90 minutes for focus groups. The interview guide probed participants' views on AI, challenges, and strategies for enhancing AI's impact on pedagogy. All sessions were audio-recorded and transcribed for analysis.

Thematic analysis, based on Braun and Clarke's framework, was used to identify patterns in the data. The study focused on the cultural and institutional factors influencing AI integration at ISU. The Institutional Review Board approved the study, and informed consent was obtained from participants, ensuring confidentiality. Member checking and triangulation were used to validate the findings. This methodology offers a comprehensive understanding of AI integration, providing actionable insights for improving elementary education pedagogy at ISU.

Results and Findings of the Study

Challenges Faced by Educators and Students

Integrating Artificial Intelligence (AI) in higher education, particularly in teacher preparation programs such as the Bachelor of Early Childhood Education (BECEd) at Isabela State University, can enrich teaching practices, personalize learning, and streamline administrative functions. However, its adoption is hindered by multifaceted barriers that limit educators and learners from fully benefiting from technological advancements. Among these are technological limitations, including unstable internet connectivity, outdated facilities, and unequal access to devices, which restrict the efficient use of AI tools in the classroom. Beyond infrastructure, the absence of systematic training programs for faculty and students perpetuates a knowledge gap that fosters underutilization and resistance to AI integration. Psychological barriers, such as fear of redundancy and skepticism toward nontraditional methods, further complicate adoption, especially when compounded

by financial and institutional constraints. Faculty and student testimonies underscore these concerns, highlighting frustration over disrupted learning, lack of competence in using AI, and uncertainty regarding institutional support. These interlinked challenges illustrate that AI integration in ISU's BECEd program cannot be reduced to a purely technological upgrade but instead requires a holistic approach that addresses infrastructure, training, cultural readiness, and sustainable funding. Without such an approach, the promise of AI to transform early childhood education into an inclusive, dynamic, and globally competitive program remains unrealized.

Technological Limitations of AI Integration

Integrating AI in the educational sector requires a strong technological infrastructure, such as access to devices, strong internet connectivity, and updated software and tools. At Isabela State University, these basic needs are not consistently met, greatly limiting the efficient application of AI in the Bachelor of Early Childhood Education program.

Respondent responses:

A faculty member expressed frustration, saying, We cannot fully utilize AI tools in our teaching because the internet connection is often unstable, disrupting the learning flow.

A student pointed out the unequal access and distribution issue, saying that some of us do not even have personal devices or computers, so how can we benefit from AI when we cannot log in?

The technological constraints at Isabela State University are the basic barriers to adopting AI. With limited infrastructure, educators and students cannot take full advantage of AI. Overcoming these problems will require massive investment in modernizing facilities, ensuring stable and high-speed internet, and equipping classrooms with the appropriate devices and tools. Bridging this technological gap is important to ensure an inclusive and effective learning environment.

Lack of Training and Knowledge in AI Usage

Even when technology is available, a lack of awareness and training often prevents educators and students from using AI. Without a structured approach to capacity building, AI becomes an underutilized resource for the Bachelor of Early Childhood Education program.

Most lecturers do not know how AI tools work or how to apply them in an educational setting easily. From that, fear and resistance to adopting new technologies are born. Students are not taught about AI tools early enough during their academic paths. It reduces their ability to enhance their learning experiences with these

technologies. The university offers limited workshops or professional development opportunities focused on AI literacy and its practical applications in education.

Respondent Responses:

An educator emphasized the need for support, stating,*" We need comprehensive training on how to incorporate AI into our teaching methods. Right now, we are just guessing or avoiding it altogether".*

A student echoed this concern: "We do not know where to start with AI tools. They feel too advanced for us, and no one has explained how they work."

The lack of training creates a cycle of underutilization and fear of AI technologies. Faculty members hesitate to integrate AI into their teaching due to a perceived lack of competence, while students miss opportunities to develop essential 21st-century skills. There needs to be significant curricular overhauls, which must introduce AI literacy as a core curriculum, a well-designed, specific training program in AI for all teachers, as well as the facility of hands-on experience with tools in AI to support a constructive and well-educated academic community towards changing education.

Resistance to Change and Resource Constraints

Introducing AI in education is a matter of technical resources and changing the mindset of teachers, students, and administrators. Fear, skepticism, and preference for traditional teaching foster resistance to change. The financial and material constraints discourage the availability and sustainability of AI resources.

Many teachers feel threatened by AI, which renders them redundant or disrupts the prevailing teaching methods. This fear is compounded by ignorance of how AI can supplement and not supplant traditional teaching methodologies. The main challenge is a lack of funds to procure and maintain AI technologies, staff training, and infrastructure upgrades. It is most pronounced in public institutions with minimal funding. Lack of defined policies and management's unwillingness make any initiative regarding AI adoption appear disjointed and temporary.

Respondents' responses:

There is a feeling that AI would take the teacher's place. Because of that fear, not everyone is keen to adapt fully. -A Teacher

When introducing some AI-related tools, they are not fully integrated because they feel they will not be maintained, as the university lacks the resources.

These challenges interlink: change resistance and resources are limitations to introducing AI into education. It means that the university must make the stakeholders comfortable with the introduction by demonstrating the advantages of AI and

dispelling its myths. Lastly, securing adequate funds through partnerships, grants, and government support ensures the sustainability of AI initiatives in the university. Both the psychological and financial challenges will be met as the institution opens an avenue toward innovation and growth.

The underlying themes suggest complex challenges to infuse AI within the Bachelor of Early Childhood Education curriculum. It necessitates a multifaceted strategy addressing technological, educational, and institutional barriers to develop an all-rounded learning environment that will seize the opportunities created by AI to enhance teaching and learning outcomes.

Opportunities Presented by Artificial Intelligence in Enhancing Teaching Strategies, Learning Experiences, and Administrative Processes

Artificial Intelligence (AI) is reshaping the educational landscape by transforming teaching strategies, enriching student engagement, and streamlining administrative tasks. For teacher education programs such as the Bachelor of Early Childhood Education (BECEd) at Isabela State University, AI-driven tools provide opportunities to move beyond traditional, one-size-fits-all methods toward more adaptive and personalized approaches. Educators benefit from intelligent systems that generate customized lesson plans, track student performance, and deliver real-time feedback. At the same time, learners experience more interactive and engaging lessons through gamification, simulations, and virtual reality. Respondents in this study highlighted how AI-based tools make classes more dynamic and support diverse learning needs by identifying strengths, addressing weaknesses, and fostering inclusive participation. Beyond pedagogy, AI enhances institutional efficiency by automating routine processes such as grading, attendance, and scheduling, allowing teachers and administrators to devote more time to mentoring and innovation. These developments collectively illustrate AI's potential to revolutionize the BECEd program at ISU, empowering future educators with the skills and tools necessary to thrive in a technology-driven world while improving the overall quality of teaching and learning.

Transforming Teaching Strategies through AI-Driven Tools

Artificial intelligence transforms educators' teaching by providing innovative tools to personalize instruction, create adaptive learning pathways, and improve classroom engagement. This theme explores how AI can enhance teaching strategies by tailoring content to individual student needs, analyzing performance data, and offering real-time feedback.

Respondent Responses:

An educator opined that AI tools such as customized lesson planners and performance trackers help identify which student needs extra time and how best to adjust their teaching strategy accordingly.

A student avers that AI-based simulations and interactive lessons keep classes interesting while helping us comprehend complex concepts easily.

AI enables teachers to break free from the traditional, one-size-fits-all mentality. Intelligent tutoring systems and data analytics allow them to understand student strengths and weaknesses, so targeted interventions can be prepared. Moreover, AI-based content development tools make lesson planning easier, thereby saving time that educators can utilize for direct interaction with students. Finally, AI enhances teaching strategies and creates a vibrant and responsive learning environment that helps address diverse learning needs more effectively.

Improving Student Engagement and Learning Experience

AI can be a game-changer for Bachelor of Early Childhood Education program students because it can foster interactive and immersive learning environments. From virtual reality (VR) simulations to AI-powered chatbots, these tools make learning more engaging, collaborative, and effective.

Respondent Responses:

A student said, AI platforms with gamified content make learning enjoyable and encourage us to participate actively in class.

According to a faculty member, Interactive AI tools like virtual labs or storytelling apps help students explore concepts hands-on, even in online or hybrid settings.

AI offers a way of enriching experiences through learning as it allows adapting tools to meet students' learning needs and preferences. Experiential and interactive applications through gamification, VR, and AI-powered tutors ensure the acquisition of greater depth and retention of knowledge. Additionally, the AI tools can provide support through multiple languages and accessibility features besides adaptive content, catering to learners with varying requirements. These functions resonate with the mission of this program: educating future educators equipped with the means to utilize technology to teach different kinds of learners.

Streamlining Administrative Processes for Educational Efficiency

AI can really help streamline the administrative processes within the Bachelor of Early Childhood Education program. Routine tasks such as scheduling, grading, and attendance tracking can be automated, giving more time to teaching and

mentoring by educators and administrators. Respondent Responses: An administrator shared that AI tools like automated attendance systems and grading apps reduce our workload and help us focus on more impactful tasks.

According to a teacher, *AI usage in administrative work reduces errors and accelerates processes such as making reports or keeping track of the performance of students.*

AI streamlines operations by automating time-consuming administrative duties, enabling institutions to function more efficiently. Tools like AI-powered learning management systems (LMS) centralize data, provide real-time insights into student progress, and automate routine tasks, ensuring timely and accurate reporting. By reducing administrative burdens, educators and staff can dedicate more attention to instructional innovation and student support, thus enhancing the overall quality of education the program offers. The themes that emerge demonstrate the tremendous prospect that AI can bring to the Bachelor of Early Childhood Education program at Isabela State University. With its ability to enhance teaching techniques, enrich learning experiences, and optimize administrative processes, the educational approach of the program can thus be revolutionized. Thoughtful and inclusive integration of AI technologies may help future educators gain the necessary competencies to thrive in modern teaching environments, thus improving student outcomes and institutional efficiency.

Discussion

The findings of this study reveal a nuanced picture of Artificial Intelligence (AI) integration in the Bachelor of Early Childhood Education (BECEd) program at Isabela State University. On one hand, AI demonstrates significant potential in transforming teaching strategies, enhancing student engagement, and streamlining administrative functions. On the other hand, its adoption is hampered by technological, pedagogical, psychological, and institutional barriers that limit educators and students from fully realizing its benefits. These dual realities highlight the pressing need for a holistic approach to AI integration in teacher education that balances innovation with readiness and support.

Challenges in AI Adoption

The most pressing challenge identified in the study is technological limitation, particularly in terms of unstable internet connectivity, outdated facilities, and unequal access to devices. Faculty and student testimonies underscore how these constraints disrupt the teaching–learning process, echoing previous studies that link infrastructural deficits with slow technology adoption in higher education (Salac &

Kim, 2016). Such limitations hinder daily classroom operations and widen equity gaps, as students without personal devices are effectively excluded from AI-based learning opportunities.

Equally critical is the lack of training and knowledge in AI usage. Faculty members admitted to hesitancy and uncertainty in applying AI tools due to insufficient training, while students highlighted their limited exposure to AI literacy. This aligns with Zawacki-Richter et al. (2019), who stressed that teacher preparedness is a prerequisite for meaningful AI integration. Without structured professional development, AI becomes an underutilized resource, reinforcing fear and resistance rather than fostering innovation.

Resistance to change also emerged as a barrier, as some educators feared that AI might diminish their roles or disrupt traditional pedagogies. This psychological resistance, compounded by resource scarcity and institutional inertia, reflects Schiff's (2021) argument that successful AI adoption requires cultural shifts and strong policy support. The absence of clear institutional policies and inadequate funding at ISU further exacerbates these challenges, making integration appear temporary or unsustainable.

Opportunities for Educational Transformation

Despite these obstacles, the findings also illustrate the transformative opportunities AI offers. Respondents noted that AI-based tools can personalize instruction, support adaptive learning, and provide real-time feedback. These benefits align with the literature identifying AI as a driver of differentiated instruction and personalized learning pathways (Chen et al., 2020; Holmes et al., 2019). In the BECEd program, such capabilities are particularly vital as they allow future educators to experience firsthand how technology can address diverse learning needs in early childhood classrooms.

Students and faculty also reported that AI enhances engagement and interactivity through simulations, gamification, and virtual storytelling platforms. It resonates with research suggesting that AI-supported immersive technologies improve retention and motivation by making learning experiences more participatory (Luckin, 2018). Moreover, AI's role in streamlining administrative processes such as grading, scheduling, and attendance was acknowledged to reduce workload and enable educators to focus on higher-value activities like mentoring and instructional design.

Implications and Synthesis

These findings indicate that AI integration in ISU's BECEd program cannot be treated as a purely technological upgrade. Instead, it requires a comprehensive framework that addresses infrastructure gaps, provides systematic training, encourages cultural readiness, and ensures sustainable funding. Bridging these gaps is critical for improving the quality of teacher education at ISU and aligning with the broader mandate of Sustainable Development Goal (SDG) 4, which calls for inclusive and equitable quality education.

The challenges observed are not unique to ISU but reflect broader trends in resource-constrained higher education institutions across developing contexts. However, the opportunities identified demonstrate that even within these limitations, AI can foster innovation, inclusivity, and efficiency when thoughtfully integrated. This study thus contributes to the discourse by underscoring the importance of stakeholder collaboration among administrators, faculty, students, and policymakers in creating an ecosystem where AI can flourish. Ultimately, the results highlight that while AI holds immense promise for educational transformation, its realization depends on an intentional, inclusive, and context-sensitive approach.

Conclusion

The study revealed that artificial intelligence offers excellent opportunities to improve teaching strategies, learning experiences, and administrative processes in the Bachelor of Early Childhood Education program at Isabela State University. AI can transform teaching methods by allowing personalized instruction, adaptive learning pathways, and real-time performance tracking, thus creating a more inclusive and effective learning environment. Moreover, AI-based technologies, such as gamified learning platforms and virtual simulations, can significantly enhance the engagement of students by offering diversified learning styles that are interactive, immersive, and enhance comprehension and retention. The administrative side can also benefit from AI by simplifying routine tasks like grading, attendance, and performance tracking. It means fewer errors and more educators and administrators' attention to bettering educational outcomes. However, technological barriers, lack of training, and resource constraints make it difficult to exploit these advantages fully. Therefore, strategic interventions are necessary in education to take maximum advantage of AI.

Recommendations

Several strategic actions are recommended to fully benefit from AI in the Bachelor of Early Childhood Education program. First, the university should invest in

upgrading its technological infrastructure to ensure reliable internet connectivity, modern devices, and AI-compatible tools are available and accessible to all campuses. Second, regular training programs and workshops should be conducted to equip educators and students with the necessary skills and knowledge to use AI effectively. Moreover, integrating AI literacy within the curriculum prepares future educators to adapt to technological advancements within teaching practices. More importantly, an enabling culture would be instrumental in dispelling and correcting misinformation regarding AI as a tool only to displace human teaching or augment existing methodologies, seeking funding, technical support, and knowledge from government agencies, private organizations, and technology companies through partnerships. Lastly, a monitoring and evaluation system will ensure effectiveness, sustainability, and continuous improvement in integrating AI in the university. By pointing out these points, Isabela State University can spearhead the way in using AI in elementary education, hence enriching academic experience and output for the teachers and learners.

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