Environment and Social Psychology (2025) Volume 10 Issue 7
doi: 10.59429/esp.v10i7.3872

ISSN: 2424-8975 (O)
2424-7979 (P)

RESEARCH ARTICLE

Trust issues and the pace of skill acquisition in environmental science instruction: Educator perspectives on the integration of artificial intelligence

Jason V. Ang [1*], Yoradyl C. Dizor[2], Shallene Faye A. Mendoza[3], Perly L. Cortes[4]

[1] *School of Teacher Education, Biliran Province State University, Naval, Biliran, 6560, Philippines*

[2] *School of Engineering, Biliran Province State University, Naval, Biliran, 6560, Philippines*

[3] *School of Nursing and Health Sciences, Biliran Province State University, Naval, Biliran, 6560, Philippines*

[4] *School of Agribusiness and Forest Resource Management, Biliran Province State University, Naval, Biliran, 6560, Philippines*

*** Corresponding author:** Jason V. Ang, jason.ang@bipsu.edu.ph

ABSTRACT

This study examines how artificial intelligence (AI) influences trust and skills-acquisition pace in environmental science instruction, a field increasingly shaped by digital tools yet understudied in terms of ethical and pedagogical impact. Guided by two research questions, it investigates (1) the trust-related concerns instructors face when integrating AI, and (2) the perceived effects of AI on students' learning pace. Drawing on Human-Centered AI principles and Mindset Theory, the research involved semi-structured interviews with 25 college instructors in Eastern Visayas, Philippines. Thematic analysis revealed key concerns about reliability, algorithmic bias, and the erosion of interpersonal dynamic s, balanced by recognition of AI's potential for adaptive instruction, real-time feedback, and STEM engagement. Educators emphasized that trust in AI is shaped by transparency, ethical awareness, and the instructor's openness to innovation. They also warned that unequal digital access and superficial engagement can limit AI's educational impact. The findings suggest that meaningful integration depends on balancing AI's technical advantages with pedagogical control, equity, and critical reflection. This study affirms that AI is most effective when positioned not as a replacement, but as a supportive and transparent tool in the instructional process.

Keywords: pedagogical trust; adaptive learning systems; instructional equity

1. Introduction

There has been growing interest in integrating artificial intelligence (AI) into environmental science education, particularly in enhancing teaching effectiveness and learning outcomes[1]. However, despite its potential benefits, AI integration raises critical concerns, particularly surrounding trust among both educators and learners. These concerns often stem from issues such as data privacy, algorithmic bias, and a perceived loss of human interaction in the learning process[2,3]. As a result, the successful adoption of AI in educational settings depends not only on technological capabilities but also on psychological and social acceptance[4].

ARTICLE INFO
Received: 3 July 2025| Accepted: 18 July 2025 | Available online: 30 July 2025

CITATION
Ang JV, Dizor YC, Mendoza SFA, et al. Trust issues and the pace of skill acquisition in environmental science instruction: Educator perspectives on the integration of artificial intelligence. *Environment and Social Psychology* 2025; 10(7): 3872. doi:10.59429/esp.v10i7.3872

Trust in AI is not monolithic; it varies depending on users' mindsets, prior experiences, and institutional support structures. Individuals with a growth mindset are more likely to perceive AI devices, especially intelligent personal assistants, as human-like and less threatening, due to their openness to new experiences and greater adaptability[5]. Teachers, in particular, may hesitate to incorporate AI tools if they doubt their reliability, accuracy, or alignment with pedagogical goals[6].

While these factors are well-documented in general AI education research, there is limited empirical exploration of how trust issues specifically affect AI integration in content-intensive and socially embedded disciplines like environmental science. Existing studies often center on AI use in STEM or language learning[7], leaving a gap in our understanding of AI's role in disciplines that require value-laden, place-based instruction, such as environmental science. Moreover, few studies investigate how AI impacts the pace of skills acquisition, especially in resource-constrained educational settings.

Various countries, including those in Europe and North America, have promoted national initiatives to support AI integration in classrooms[8], but significant disparity can still be seen in how these technologies are adopted across different demographic and socio-cultural contexts. In the Philippines, particularly in the Eastern Visayas region, understanding the local factors that affect AI adoption is crucial. Challenges of implementing AI tools like ChatGPT in education include concerns about the accuracy and reliability of information generated by the tool, and overreliance of students on the tool, which can negatively affect their independent thinking and academic integrity[9] Positive emotions, such as excitement and confidence, significantly influence continued AI use and students' willingness to engage in autonomous learning[10].

This study addresses these critical gaps by focusing on environmental science instructors in Eastern Visayas, Philippines, an underrepresented region in AI-in-education research, to understand how trust issues and perceptions of learning pace shape AI's role in instruction. By analyzing teacher experiences, this study aims to provide context-sensitive and evidence-based insights for fostering a more inclusive and effective AI-supported educational environment in environmental science.

2. Literature review

AI in Education: Opportunities and Challenges. Artificial intelligence (AI) is increasingly recognized as a transformative force in education, offering tools for automation, personalization, and real-time feedback[1]. In content-heavy disciplines like environmental science, AI's potential lies in its ability to process large datasets, visualize ecological models, and provide adaptive learning experiences. However, its application in environmental education remains limited in scope, with existing studies focusing more on general STEM fields or language acquisition[7]. This underrepresentation highlights a need for research that explores how AI functions in subject areas that require both conceptual rigor and values-driven instruction. AI's integration also brings to the fore issues of pedagogical control and user agency. Instructors increasingly report tensions between the efficiency AI promises and the demands of meaningful engagement and mentorship[11]. Such concerns are particularly relevant in environmental science, where human values, local contexts, and scientific precision intersect. Thus, while AI may enhance learning outcomes, its successful implementation depends on context-sensitive, discipline-specific insights.

Trust, Transparency, and Human-Centered AI. Trust remains a cornerstone in AI adoption, especially in education. According to Selwyn[12], educators assess AI through perceived usefulness, fairness, and transparency. Trust is not solely technical, it's relati onal and ethical, especially when student learning and assessment are affected[13]. Educators may fear that opaque algorithms, misinformation, or biased outputs will erode their professional autonomy[2,3]. The concept of Human-Centered AI, technology that augments rather than replaces educators, is central to trust formation[14]. When instructors understand and can explain how AI tools function, including their limitations, transparency increases[15]. Moreover, ethical concerns such as surveillance, algorithmic bias, and content inaccuracy demand that AI be deployed with clear guidelines and explainable outputs[16,17]. In this light, trust is not merely a barrier but a mediating factor, shaping how and whether instructors use AI to improve instruction or feel compelled to defend pedagogical values against technological determinism.

Cognitive and Emotional Dimensions in AI Use. Mindset Theory[18] particularly the distinction between fixed and growth mindsets, shapes how users engage with AI. Individuals with growth mindsets are more likely to perceive AI as a collaborative tool rather than a threat[5]. This perspective influences both willingness to use AI and the depth of critical engagement with its outputs. Emotional responses to AI, such as confidence, anxiety, or enthusiasm, also shape its impact in classrooms. Wang and Li[10] found that positive affect correlates with greater persistence in AI-supported environments. This aligns with Attentional Control Theory (ACT), which posits that emotional regulation influences one's ability to stay goal-oriented amidst cognitive distractions[19]. The interplay between emotional state and technological engagement becomes especially relevant in fast-paced or feedback-driven systems, which can overwhelm learners not emotionally prepared or digitally fluent[20]. Thus, both emotional and cognitive readiness act as moderators in the effectiveness of AI tools. Teachers who understand these factors are better positioned to mediate AI's influence on learning outcomes.

Cultural, Regional, and Equity Considerations. Despite global enthusiasm, AI adoption remains uneven, with significant disparities between the Global North and Global South[21]. In the Philippines, particularly in Eastern Visayas, AI implementation faces cultural and infrastructural challenges, from limited digital literacy to skepticism toward automated systems[9]. Studies have shown that when educators lack training or contextual resources, they are less likely to experiment with AI tools, even if they believe in their potential[22,23]. Equity is also a concern. AI can unintentionally amplify privilege if systems assume uniform access to technology or ignore linguistic and cultural diversity[13]. This "digital divide" not only limits access but also marginalizes local knowledge systems that are critical to environmental education. Instructors in developing regions must therefore adapt AI tools to their own cultural and pedagogical realities, rather than importing foreign models wholesale.

Personalized Learning and Instructional Differentiation. AI's greatest pedagogical strength arguably lies in its capacity to personalize instruction[24]. Adaptive systems offer differentiated tasks, multimodal content delivery, and responsive feedback, all of which support diverse learning styles. Students who struggle in traditional formats benefit from simulations, visual models, and text-to-speech interfaces, while advanced learners can self-direct through enriched content[25,11]. However, personalization can also create dependency. Learners may become accustomed to instant answers without developing analytical rigor or resilience[26]. Teachers therefore must calibrate how much agency is delegated to AI systems, especially in courses that require reflective and experiential learning, such as environmental science. Ultimately, AI supports but does not substitute for differentiated pedagogy, it can scaffold instruction, but educators must design how, when, and for whom it is deployed.

Summary of Gaps and Research Justification. While existing literature addresses trust, personalization, and AI equity in general educational contexts, few studies explore their combined influence in content-heavy, ethically oriented fields like environmental science. Moreover, most empirical research originates from high-resource settings, overlooking the realities of institutions in underrepresented regions. There is a pressing need for qualitative, localized investigations that highlight teacher perspectives, not just student performance metrics. This study seeks to fill this gap by exploring the interplay of trust issues and skill-acquisition pace in AI-supported instruction, specifically within environmental science classrooms in the Eastern Visayas region of the Philippines.

3. Methodology

3.1. Research design

This study employed a qualitative descriptive-exploratory research design, which is particularly suited for investigating emerging, context-dependent phenomena[27,28] such as educator trust in artificial intelligence and its influence on skill acquisition. Rooted in an interpretivist ontology and epistemology, this approach assumes that knowledge is constructed through subjective experiences and social interactions. It emphasizes understanding participant perspectives in their natural contexts rather than testing predetermined hypotheses[29]. This design was chosen to capture the nuanced, value-laden, and affective dimensions of how environmental science instructors perceive and navigate AI use in their teaching. Trust and instructional pacing are inherently complex constructs that cannot be meaningfully reduced to quantifiable measures without losing contextual depth. By using semi-structured interviews and inductive analysis, the research aligned with its philosophical orientation and ensured methodological coherence.

3.2. Sampling and participants

The study used purposive sampling, identifying instructors with relevant experience to provide rich, targeted insights into AI use in environmental science instruction[30]. Participants were selected from public and private colleges and universities across the Eastern Visayas region of the Philippines. The inclusion criteria were: (1) a minimum of one year teaching environmental science at the tertiary level and (2) prior exposure to or actual use of AI tools in instruction. Recruitment began with email invitations sent to departmental chairs and faculty mailing lists. Instructors who responded positively were sent consent forms and information sheets. Snowball sampling was also employed to expand the pool, allowing referred participants to join. A total of 25 participants were included. Data saturation was monitored throughout the process, interviews were continuously reviewed, and no new themes emerged after the 22nd participant, supporting the adequacy of the sample size. The sample included a balanced representation across gender and age groups (see **Table 1**), suggesting broad coverage of perspectives within the targeted region.

Table 1. Respondents Demographics

No. of Participants	Gender	Age	Age Group Description
Participants 1-5	Female	28	Young Adult
Participants 6-8	Female	25	Young Adult
Participants 9-14	Male	29	Young Adult
Participants 15-18	Male	32	Early Middle Age
Participants 19-22	Male	30	Early Middle Age
Participants 23-25	Female	26	Young Adult

3.3. Instruments

A semi-structured interview guide was used to elicit in-depth responses aligned with the study's two main objectives. Questions were open-ended, neutral, and piloted with two educators before deployment. **Table 2** presents the alignment between the research objectives and the corresponding interview questions, illustrating how each prompt was conceptually grounded.

Table 2. Research Instrument

Research Objectives	Research Questions	Justification
Determine trust issues in the use of AI for Environmental Science instruction	1. What are some of the trust issues you have in allowing the use of AI in your environmental science courses? Explain each.	Explores instructors' perceptions of AI reliability, transparency, and ethical risks
	2. In what way does AI affect learnings in environmental science if AI is allowed to be used? Elaborate more	Shows how trust influences perceptions of effectiveness, touching on both concerns and outcomes
	3. Beyond, the trust issues, how do you mitigate the trust issues created by the use of AI in environmental science instruction? Explain further.	Gathers strategies for overcoming trust barriers
Determine the effects of AI on the learning pace in teaching environmental science.	1. What do you observed about your environmental science learners in terms of their learning pace when they use AI? explain further.	Investigates observed changes in student speed, engagement, or retention
	2. How do you think the use of AI can affect the skills-acquisition pace of the learners? Narrate your experiences.	Directly connects AI to perceived acceleration or delay in skill-building
	3. What particular aspects of AI can affect the skills-acquisition pace of the environmental science learners? Explain further.	Identifies which features impact learning progression

3.4. Data gathering

Interviews were conducted over a one-month period via online video conferencing platforms (e.g., Zoom, Google Meet). Each session lasted approximately 30 to 45 minutes and followed a semi-structured protocol. With participant consent, all sessions were audio-recorded and transcribed verbatim for analysis. While online interviews allowed logistical flexibility and expanded regional access, limitations included potential digital fatigue, inconsistent internet connectivity, and reduced rapport-building opportunities. These challenges were mitigated by ensuring that sessions were scheduled at the participant's convenience, using icebreaker questions to build comfort, and offering follow-up clarifications post-interview when needed. All ethical protocols were observed. Informed consent was obtained, and participants were assured of anonymity, confidentiality, and their right to withdraw at any time.

3.5. Data analysis

The data were analyzed using thematic analysis, which allowed for the systematic identification and interpretation of patterns within the qualitative interview responses[31]. This process began with multiple close readings of the transcripts to establish familiarity with the content. Initial codes were generated by identifying meaningful units of text that reflected key concepts relevant to trust and skill acquisition in AI-assisted instruction. These codes were then grouped into broader categories, which were iteratively reviewed and refined to uncover underlying relationships and emergent patterns.

Themes were developed through an inductive approach, guided by the constant comparative method, wherein new data were continually compared against previously coded segments to ensure internal coherence and conceptual clarity. Throughout the process, analytical decisions were documented and organized to ensure transparency. To enhance the reliability of theme development, interpretations were reviewed for consistency, and efforts were made to cross-check emerging categories for conceptual alignment. Analytical rigor was maintained by engaging deeply with the data and by ensuring that the resulting themes were firmly grounded in the participants' narratives and experiences.

4. Results

4.1. Research objectives 1. Determine trust issues on the use of AI for environmental science instruction

Question No. 1. A. What are some of the trust issues you have in allowing the use of AI in your environmental science courses? Explain each.

4.1.1. Fear of loss of human element in teaching

Fifteen (15) respondents (60%) expressed concern that increasing reliance on AI in instruction could compromise the relational and dialogic aspects of environmental science education. They viewed face-to-face engagement, not just as a delivery method, but as a vital part of mentorship, critical thinking, and collaborative problem-solving. The potential erosion of interpersonal dynamics was seen not merely as a pedagogical shift but as a threat to the formative human experiences that support students' intellectual and emotional development. These concerns reflect an underlying desire to preserve the instructor's role as a facilitator of nuanced, value-laden discussions that AI tools may not be able to replicate.

> "As a teacher, I worry about AI taking away the personal connection I have with my students. Environmental science involves a lot of discussions, debates, and a shared understanding of real-world problems."

> "While AI offers incredible benefits in terms of automating tasks, analyzing data, and providing immediate access to resources, the personal connection between instructors and students remains irreplaceable."

4.1.2. Accuracy and reliability of AI-generated information

Ten (10) respondents (40%) expressed the need for caution when using AI tools in a content-intensive and evidence-driven field like environmental science. The central concern was not with AI as a concept, but with the accuracy and timeliness of the information it provides, especially given the rapid pace at which scientific knowledge evolves. Respondents viewed the potential for outdated or generalized content as a serious risk in a discipline where decisions can influence policy and public behavior. The theme underscores the importance of treating AI as a supplemental resource, one that must be critically evaluated rather than accepted at face value. Participants advocated for a balanced approach, where AI supports instruction without replacing the human capacity for discernment and contextual judgment.

> "One of my biggest concerns is the accuracy of the information AI provides. AI models are only as good as the data they're trained on, and there's always the risk of misinformation or outdated content being presented."

> "Policy decisions, conservation efforts, and climate action plans are often based on scientific findings, and misinformation, whether we deliberate or inadvertent, can have severe consequences."

Question No. 2. In what way does AI affect learnings in environmental science if AI is allowed to be used? Elaborate more.

4.1.3. Time efficiency for teachers

Twenty (20) respondents (80%) emphasized AI's practical value in alleviating the administrative burdens that often consume instructional time. Many instructors interpreted "learning" not only in terms of student outcomes, but also in terms of how efficiently instruction could be delivered to facilitate those outcomes. AI was seen as enabling teachers to automate time-consuming tasks, such as tracking student performance, generating summaries, or managing classroom data, allowing them to redirect energy toward higher-order teaching responsibilities. Rather than spending time on paperwork, instructors reported being better positioned to engage students in meaningful discussions, adapt content in real time, and address learning gaps more responsively. This gain in instructional flexibility was perceived as indirectly improving student learning quality and depth.

> "AI's ability to organize and present this information in digestible formats allows us to manage our time more effectively."

> "This would allow me to identify at-risk students more quickly and adjust my teaching strategies accordingly, leading to more efficient and effective instruction in environmental science."

4.1.4. Encouraging interest in STEM

Five (5) respondents (20%) described AI's role in reshaping how environmental science is taught and perceived, particularly among students who may feel disconnected from traditional STEM instruction. Through simulations, real-time data analysis, and scenario modeling, AI tools were seen as bridges between abstract content and concrete applications. Respondents emphasized that these interactive learning experiences foster greater accessibility and inclusivity, especially for students from underrepresented groups. The ability of AI to increase motivation and personal relevance was linked to long-term interest in STEM careers, including environmental science and data science.

> "This could encourage more students, especially girls and underrepresented minorities, to pursue careers in environmental science, data science, and related fields."

> "By using AI to expose students to real-world data and environmental challenges, providing interactive learning experiences, and fostering inclusivity, AI can inspire more students, particularly girls and underrepresented minorities, to pursue careers in environmental science, data science, and related fields."

Question No. 3. Beyond, the trust issues, how do you mitigate the trust issues created by the use of AI in environmental science instruction? Explain further.

4.1.5. Transparency and clarity

Thirteen (13) respondents (52%) expressed that fostering trust in AI among students begins with clear communication and hands-on engagement. Rather than presenting AI as a black-box solution, instructors emphasized the importance of demystifying its role in the learning process. By openly explaining how AI tools are used, what they are designed to do, and how they support, rather than replace, critical thinking, educators aimed to promote a sense of agency and understanding. Encouraging students to interact directly with AI systems further supported this goal, allowing learners to explore the technology's functions, test its limitations, and critically assess its outputs. This theme reflects a proactive instructional approach in which transparency and guided exploration are used to position AI as a visible, explainable, and student-centered tool.

> "I encourage my students to interact with the AI tools themselves so they can see how they work. By engaging with the technology, they become more familiar with its capabilities and limitations."

> "One way to mitigate trust issues is by being transparent about how AI tools are being used in the classroom. I make sure my students understand that AI is a resource to enhance learning, not to replace critical thinking or human insight."

4.1.6. Combining AI with human interaction

Twelve (12) respondents (48%) said that trust in AI is strengthened when the technology is clearly positioned as a supplement to, rather than a replacement for, human instruction. Rather than allowing AI tools to function in isolation, educators deliberately paired AI-generated content with collaborative learning activities such as group discussions, fieldwork, and real-world case studies. This blended approach not only contextualized AI outputs but also preserved the social and interpersonal dimensions of environmental science education. Respondents reported that integrating AI into cooperative settings encouraged critical thinking and team-based interpretation of data. By framing AI as one of many tools in a shared learning environment, instructors reinforced its role as a support system, not an autonomous authority, in the classroom.

> "I encourage students to see AI as a tool they can use to support their own learning, but not as the sole authority on environmental issues. When we work with AI simulations, I often pair students with different backgrounds and strengths so they can collaborate on interpreting the data."

> "To build trust, I ensure that AI is never the sole source of instruction. It should complement my teaching, not replace it. I combine AI-generated data and simulations with group discussions, hands-on activities, and real-world case studies."

4.2. Research objectives 2. Determine the effects of AI on the learning pace in teaching environmental science

Question No. 1. What do you observed about your environmental science learners in terms of their learning pace when they use AI? Explain further.

4.2.1. Tension between speed and understanding in AI-Supported learning

Sixteen (16) respondents (64%) acknowledged AI's capacity to accelerate learning, but also raised questions about how this speed influences the depth of student engagement, an issue closely tied to instructors' trust in AI as a sustainable teaching tool. Participants reported that AI tools have significantly accelerated students' learning processes by providing quick access to information, enabling more autonomous and self-paced exploration of complex topics. However, this increase in speed raised pedagogical concerns about the potential trade-off between efficiency and depth of understanding. Instructors observed that some students, drawn to the instant feedback and convenience of AI, may bypass critical engagement with the scientific process, relying instead on surface-level answers. This shift in learning behavior risks undermining essential skills such as analysis, reflection, and evidence-based reasoning. Still, respondents emphasized that when properly guided, students can use AI in tandem with traditional inquiry-based methods, harnessing its advantages while maintaining meaningful cognitive engagement with environmental issues.

> "I've noticed that my students generally progress faster when using AI. They can ask questions directly and get answers in real-time, which speeds up their understanding of complex concepts. AI tools also allow them to explore topics at their own pace, revisiting materials as needed."

> "I've observed that some students may focus too much on the speed of getting answers rather than developing a deeper understanding of the processes behind those answers. This could result in them missing key insights into environmental issues."

4.2.2. Differentiated pacing through digital proficiency

Nine (9) respondents (36%) noted that while AI tools can significantly accelerate learning, students' digital confidence plays a major role in determining who benefits most from these technologies. Those already comfortable with technology often showed greater independence and depth in exploring environmental concepts. In contrast, students with limited digital skills tended to struggle with AI interfaces and the fast pace of automated feedback. Instructors responded by differentiating AI tool use based on students' digital readiness, offering varying levels of complexity and personalized guidance. This approach allowed students to engage with AI in ways that matched their comfort levels, promoting a more inclusive learning environment. Rather than pushing all learners through the same digital pathway, educators used AI to scaffold critical thinking and self-paced exploration, making technology a flexible bridge to deeper learning rather than a barrier.

> "AI has definitely accelerated learning for many of my students. I've observed that those who are familiar with technology tend to learn faster, exploring environmental topics more deeply and engaging with simulations and models on their own."

> "Some students might be ready for more complex simulations or data analysis tasks, others might benefit from simpler, introductory tools. Providing options for their students to choose the level of complexity that suits their comfort with technology allows for a more personalized learning experience."

Question No. 2. How do you think the use of AI can affect the skills-acquisition pace of the learners? Narrate your experiences.

4.2.3 Personalized learning

Twenty-one (21) respondents (84%) emphasized that AI's greatest instructional value lies in its ability to adapt to individual learning needs in real time. Through dynamic feedback, customized resources, and self-paced progression, AI tools helped close gaps for struggling students while offering enrichment for those ready to advance. This flexible responsiveness allowed educators to support diverse learners without compromising the pace or quality of instruction. Participants noted that such personalized learning environments not only increased retention but also boosted students' confidence, enabling them to engage more actively and consistently with complex environmental science content. Rather than a one-size-fits-all approach, AI introduced a scalable means of differentiating instruction, making skill development more efficient and accessible for all learners.

> "I've observed that with AI-driven tools, students who previously struggled with specific concepts are now able to work at their own pace, receiving additional support or challenges where necessary."

> "By offering personalized learning pathways, immediate feedback, and tailored resources, AI can significantly accelerate the pace at which learners acquire new skills. The ability to adjust the learning experience in real-time, based on individual progress, is a game-changer in education".

4.2.4. Support for diverse learning styles

Four (4) respondents (16%) expressed that AI's capacity to present content in varied formats, text, video, simulations, and visuals, makes it an effective tool for addressing the diverse learning preferences found in today's classrooms. Students who may not engage fully in traditional lecture-based environments were observed to thrive when given access to multimodal resources that aligned with their cognitive strengths. Instructors noted that this adaptability was particularly valuable for learners with disabilities or non-dominant learning styles, who often face systemic barriers in conventional instructional settings. By tailoring content delivery to meet different sensory and cognitive needs, AI not only fosters deeper engagement but also accelerates the pace of learning for students who would otherwise be left behind. This theme illustrates AI's potential to make environmental science education more inclusive while supporting differentiated skill development across a wide learner spectrum.

> "AI can cater to various learning styles by offering content in multiple formats, videos, text, simulations, and more."

> "AI tools can automatically adapt to present complex topics with relevant visuals, helping students connect abstract concepts with concrete representations."

Question No. 3. What particular aspects of AI can affect the skills-acquisition pace of the environmental science learners? Explain further**.**

4.2.5. Collaborative learning and Peer-to-Peer interactions

Eleven (11) respondents (44%) expressed that AI tools have the potential to enrich collaborative learning by facilitating more structured and purposeful peer-to-peer interactions. Instructors observed that environmental science students benefited from working together on AI-supported simulations and projects, which mirrored the interdisciplinary teamwork common in professional environmental fields. AI's capacity to analyze written content using natural language processing (NLP) was seen as especially useful for promoting effective feedback and improving scientific communication. Participants noted that AI could help identify mismatches between claims and evidence, suggest revisions for clarity, or recommend collaboration partners based on complementary strengths. These functions supported not only academic growth but also the development of teamwork, critical reasoning, and communication skills essential to environmental science. Rather than replacing human interaction, AI served as a mediator that made collaboration more intentional and academically rigorous.

> "An AI system could identify areas where a student's argument lacks clarity or where additional data can support their conclusions."

> "My students work together on projects and simulations, encouraging teamwork and communication, critical skills for environmental science professionals who often work in interdisciplinary teams."

4.2.6. Expanding global perspectives through AI and open educational resources

Fourteen (14) participants (56%) answered that AI significantly broadens access to global knowledge by integrating real-time data, international case studies, and open educational resources into classroom instruction. These tools enabled students to examine how different regions address complex environmental challenges, thereby fostering a more informed and globally conscious approach to learning. Respondents highlighted that AI-driven communication platforms also facilitated cross-cultural collaboration, allowing students to exchange insights with peers and professionals beyond their local contexts. However, educators cautioned that without guided instruction, the abundance of accessible content may lead to superficial learning. To maximize the value of these global resources, instructors emphasized the importance of teaching students to critically assess the credibility of sources and engage deeply with the material. In this way, AI serves not only as a gateway to international perspectives, but also as a catalyst for critical inquiry and comparative environmental understanding.

> "We must guide students in evaluating the credibility of sources and ensure that AI tools don't encourage superficial learning but support critical engagement with the

material. AI makes it easier for them to incorporate up-to-date, real-world examples into their curriculum, providing students with global perspectives on environmental issues."

"AI tools in environmental science education offer exciting opportunities for global collaboration, real-time data analysis, and exposure to diverse environmental contexts."

5. Discussion

Research Objectives 1. Determine trust issues on the use of AI for environmental science instruction.

Interview responses highlighted a complex set of issues ranging from technological accuracy to the preservation of human elements in education. One of the most cited concerns was the reliability of AI-generated information, particularly in a discipline like environmental science that demands accuracy and up-to-date data. This aligns with earlier findings indicating that trust in AI is diminished when systems provide generalized or outdated content, potentially misleading students and undermining learning outcomes[32]. However, participants also emphasized that distrust in AI was not simply technical but emotional and relational. Teachers feared a weakening of their pedagogical agency, especially in resource-limited regions like Eastern Visayas, where instructors often serve as the main academic and affective anchors for students.

Concerns also extended to ethical dimensions, such as data privacy, algorithmic bias, and the fear that AI could erode essential soft skills like empathy and collaboration if relied upon too heavily. These apprehensions reflect broader anxieties around AI adoption in education, consistent with discussions by Binns[33] and Abdallah[3]. Instructors also raised concerns about the impersonal nature of AI-mediated instruction, particularly its impact on mentorship and face-to-face interaction. These themes suggest that trust issues are not limited to technical functionality but are deeply embedded in pedagogical and relational dynamics. These findings resonate with the framework of Human-Centered AI, which advocates for technologies that enhance, not displace, human roles. Participants' concerns suggest that unless AI aligns with this principle, it will continue to face resistance from educators.

The theoretical framing of Mindset Theory also illuminates these concerns. Teachers with a fixed mindset toward technology were more likely to see AI as a threat to instructional quality, while those with a growth-oriented mindset described ways they actively explored AI's potential through trial-and-error and guided use. Transparency emerged as a critical factor in mitigating these trust issues. Participants emphasized the importance of explaining to students how AI tools function, what data they process, and how outputs are generated. This perspective reinforces the long-standing position that transparency is foundational to responsible AI use[34]. Educators who practiced transparent communication strategies were often those who had begun to trust AI in specific, bounded classroom applications, particularly for content generation and formative feedback.

Notably, several participants viewed AI not as an adversary but as an assistant. Many acknowledged its value in personalizing instruction and assisting with data analysis and classroom engagement[35,1]. The interviews confirm that trust can be developed gradually through consistent exposure, hands-on exploration, and guided student interaction with AI tools. Instructors often adopted a cautious but curious stance, willing to experiment with AI so long as they retained pedagogical control and oversight. This further reinforces Human-Centered AI theory as a guiding lens for future integration. Overall, trust was not framed as a binary condition but as an evolving relationship influenced by individual beliefs, institutional support, and cultural expectations of teaching

Research Objectives 2. Determine the effects of AI on the learning pace in teaching environmental science.

Participants consistently reported that AI tools accelerated learning for many students, particularly through features like instant feedback, adaptive instruction, and interactive simulations. These findings support prior studies that highlight AI's role in enabling learners to grasp complex topics more efficiently when compared to conventional instruction methods[1]. However, instructors did not universally equate speed with comprehension. The interviews revealed a more nuanced understanding of "pace", as both a cognitive and emotional construct, varying by student disposition, digital fluency, and classroom context.

This interpretation aligns with Attentional Control Theory, which highlights the role of emotional regulation and mental focus in sustaining learning amid high-paced environments. Teachers observed that digitally confident students benefited most from AI tools, showing increased engagement and content mastery. In contrast, students with lower digital literacy or difficulty managing distractions struggled to keep up, suggesting that AI-enhanced learning amplifies preexisting gaps without supportive structures. While tech-savvy students often progressed quickly, others faced challenges due to low digital proficiency, underscoring the need for differentiated instruction and teacher support. This reflects the necessity of pairing adaptive AI tools with human oversight to ensure equitable access and prevent disparities in learning outcomes.

AI's potential to individualize instruction based on real-time assessment was widely praised. Instructors highlighted how adaptive systems adjust content delivery based on student progress, maintaining engagement and optimizing difficulty, features critical to skill development[36]. Additionally, AI-driven analytics helped teachers intervene more effectively by identifying learning gaps and tailoring instructional responses. However, instructors noted that this system only worked well when students had the metacognitive awareness to reflect on AI-generated feedback, not merely react to it.

Yet participants also warned of the risk of superficial engagement. The speed of AI-assisted learning can sometimes encourage students to prioritize quick answers over conceptual understanding. Instructors pointed out that without structured guidance, students may bypass reflective learning processes, raising concerns about long-term retention and depth of knowledge. This challenge reflects a broader concern in the AI age: mitigating cognitive overload is not only essential for effective learning but also crucial for human well-being and societal resilience, as it bridges near-term harms and long-term risks[37]. Thus, while AI may quicken the learning pace, it also places greater demand on educators to scaffold deeper engagement.

One particularly insightful but under-emphasized finding was that AI use encouraged student interest in STEM fields. Five instructors noted that access to real-world simulations and datasets made environmental science more engaging, especially for learners from underrepresented groups. This matches international trends where AI-supported tools foster STEM motivation among girls and rural learners[38]. In a region like Eastern Visayas, where many students lack early exposure to data-driven technologies, AI appears to function not just as an instructional tool but as a gateway to future-oriented learning paths.

Nonetheless, the findings affirm AI's capacity to support self-paced, critical, and authentic learning, particularly when integrated thoughtfully. Simulation tools, real-world datasets, and peer-to-peer platforms allow students to apply knowledge in context, accelerating not just recall but the development of higher-order thinking skills[7]. As such, AI holds promise for transforming environmental science instruction into a more responsive and skill-oriented domain, provided that educators maintain pedagogical control and ethical oversight. The evidence suggests that successful AI integration depends not only on the tool's capabilities, but also on the educator's mindset, the learner's emotional readiness, and the infrastructural realities of the learning environment.

6. Limitation and future research

This study is limited by its small, region-specific sample of 25 instructors from Eastern Visayas, which may restrict the generalizability of the findings to other contexts. As it relied solely on self-reported qualitative data, the results may reflect subjective interpretations shaped by individual experience. The use of online interviews may have also excluded voices affected by digital access disparities. Despite these limitations, the study offers a foundation for future research. Broader regional comparisons, especially across other Philippine regions with differing digital access, linguistic diversity, or instructional cultures, could reveal contextual nuances in how AI is perceived and implemented. Longitudinal studies may trace how instructor trust and student skill acquisition evolve with sustained AI use. Additionally, mixed-method approaches integrating classroom observations, student performance data, and teacher reflections could deepen insights on AI's impact on learning pace, engagement, and instructional equity.

7. Conclusion

This study explored how AI integration in environmental science instruction is both promising and problematic, particularly in the context of a regional Philippine setting. The results indicate that while AI tools offer notable advantages, such as personalized instruction, instant feedback, and interactive simulations, they also introduce significant trust-related challenges. Participants voiced concerns about the reliability of AI-generated content, potential bias in algorithms, and the risk of diminishing critical thinking due to over-reliance on automated tools. Such concerns were not merely technical, but also relational and pedagogical, reflecting how AI interacts with deeply held instructional values and human-centered teaching practices.

These trust concerns emphasize the importance of transparency, ethical design, and professional agency, key tenets of Human-Centered AI. The findings also illustrate how educators' openness to AI is shaped by mindset: those with a growth-oriented approach actively explored AI's pedagogical possibilities, while others remained cautious. Furthermore, variations in student learning pace highlighted the relevance of Attentional Control Theory, as emotional regulation and digital readiness significantly influenced learners' ability to benefit from AI.

Importantly, this study found that AI use may foster greater interest in STEM among students, particularly in rural or underrepresented groups. However, such gains must be weighed against risks of superficial engagement, inequitable access, and inconsistent teacher preparedness. These insights, though situated in Eastern Visayas, offer broader implications for other Philippine regions and similarly positioned education systems navigating AI adoption under uneven digital conditions.

Educators are therefore encouraged to use AI not as a replacement but as a complement to human instruction, focusing on ethical application, transparency, and digital literacy. Tailoring AI use to accommodate diverse learning needs, while fostering critical engagement with AI-generated content, remains essential for maximizing its educational value.

Ultimately, the study affirms that the success of AI in environmental science instruction hinges not on its technical capabilities alone, but on the strength of the trust, context, and pedagogy that surround it. A balanced, human-centered approach provides the most sustainable path toward equitable, high-impact innovation in education.

Conflict of interest

The authors declare no conflict of interest

References

1. Luckin, R., Holmes, W., Griffiths, M., & Forcier, L. B. (2016). Intelligence Unleashed: An Argument for AI in Education. Pearson.
2. Baker, R. S., et al. (2021). Artificial Intelligence in Education: A Review. Educational Technology & Society.
3. Abdallah, S. (2023, March 4). Transforming Education: The Promises and Perils of AI Integration. https://www.linkedin.com/pulse/transforming-education-promises-perils-ai-integration-abdallah
4. Murray, J., Pritchard, R., & Tilley, S. (2021). Trust in Artificial Intelligence: The Role of Transparency and Accountability. Journal of Business Ethics, 172(2), 301–314.
5. Chen, Q., & Yi, Y. (2024). Mindsets and mirrors: How growth mindsets shape anthropomorphism in AI-enabled technologies. Psychology & Marketing. https://doi.org/10.1002/mar.22108
6. Miller, T. (2019). Explanation in artificial intelligence: Insights from the social sciences. Artificial Intelligence, 267, 1–38.
7. Zawacki-Richter, O., et al. (2019). Systematic review of research on artificial intelligence in higher education. International Journal of Educational Technology in Higher Education, 16(1), 39.
8. European Commission. (2021). Ethics Guidelines for Trustworthy AI. https://digital-strategy.ec.europa.eu/en/library/ethics-guidelines-trustworthy-ai
9. Guarin, G., Jugar, G., Gudelos, J., Boco, N., Cantal, M., Durano, M., Robel, E., Tundag, T., & Mabitad, B. (2025). Perspectives, Practices, and Challenges of ChatGPT Utilization at Eastern Visayas State University. IJRISS. https://doi.org/10.47772/ijriss.2025.9010325
10. Wang, L., & Li, W. (2024). The Impact of AI Usage on University Students' Willingness for Autonomous Learning. Behavioral Sciences, 14. https://doi.org/10.3390/bs14100956
11. Gandoul, R., Chafiq, N., & Ghazouani, M. (2024). Towards adaptive learning: AI chatbot for users profiling and learning styles. International Journal on Technical and Physical Problems of Engineering, 16(59), 167–174.
12. Selwyn, N. (2019). Should Robots Replace Teachers? AI and the Future of Education. Polity Press.
13. Marsan, G. A. (2021). Artificial Intelligence in South East Asia: Upskilling & Reskilling to Narrow Emerging Digital Divides in the Post-Pandemic Recovery.
14. Karangara, R. (2023, July 11). The future of AI: How to ensure that AI systems are transparent and accountable. Medium. https://medium.com/@rajathk2003/the-future-of-ai-how-to-ensure-that-ai-systems-are-transparent-and-accountable-d766e05aae07
15. Marr, B. (2024, May 28). Examples that illustrate why transparency is crucial in AI. Bernard Marr. https://bernardmarr.com/examples-that-illustrate-why-transparency-is-crucial-in-ai/
16. Mørch, A. I., & Andersen, R. (2023). Human-Centred AI in education in the age of generative AI tools. CEUR Workshop Proceedings, 1613, 0073.
17. Sapru, A. (2025). Psychological Resistance to AI: How Regulatory Focus Fuels AI Anxiety and Negative Attitudes Toward AI. SSRN. https://doi.org/10.2139/ssrn.5295832
18. Dweck, C. S. (2006). Mindset: The New Psychology of Success. Random House.
19. Burgoyne, A., & Engle, R. (2020). Attention Control: A Cornerstone of Higher-Order Cognition. Current Directions in Psychological Science, 29, 624–630. https://doi.org/10.1177/0963721420969371
20. Nikolopoulou, K. (2024). Generative artificial intelligence in higher education: Exploring ways of harnessing pedagogical practices with the assistance of ChatGPT. International Journal of Changes in Education, 1(2), 103–111.
21. Mannuru, N. R., Shahriar, S., Teel, Z. A., Wang, T., Lund, B. D., Tijani, S., ... & Vaidya, P. (2023). Artificial intelligence in developing countries: The impact of generative artificial intelligence (AI) technologies for development. Information Development. https://doi.org/10.1177/02666669231200628
22. Vaidya, B. (2024). Harnessing AI for STEM Education in South Asia: Impact, Opportunities, and Challenges. Journal of Development Innovations. https://doi.org/10.69727/jdi.v8i2.113
23. Konecki, M., Baksa, T., & Konecki, M. (2024). Teachers' Perception of AI and Their Attitudes Towards AI. CSEDU (1), 564–568.
24. Bianchi, L., & Rossi, S. (2025). The Role of Artificial Intelligence in Everyday Applications in Education. International Journal of Emerging Trends in Information Technology (IJEIT), 1(1), 13-27.
25. Assunção, G. M. S. (2024). Emotional Competence and Adaptability in Artificial Intelligence (Doctoral dissertation, Universidade de Coimbra).
26. Chen, X., Wang, Y., & Chen, G. (2021). The impact of artificial intelligence on personalized learning in environmental education. International Journal of Environmental Science and Education, 16(3), 123–134.
27. Bhat, A. (2024, April 16). Exploratory Research: Types & Characteristics. QuestionPro. https://www.questionpro.com/blog/exploratory-research
28. Swedberg, R. (2020). Exploratory Research. In Cambridge University Press eBooks (pp. 17–41). https://doi.org/10.1017/9781108762519.002

29. Creswell, J. W., & Poth, C. N. (2018). Qualitative Inquiry and Research Design: Choosing Among Five Approaches. SAGE Publications.
30. Dovetail Editorial Team. (2023, February 5). What Is Purposive Sampling? https://dovetail.com/research/purposive-sampling
31. Chavez, J. V., & Prado, R. T. D. (2023). Discourse analysis on online gender-based humor: Markers of normalization, tolerance, and lens of inequality. Forum for Linguistic Studies, 5(1), 55–71.
32. Baker, R. S., et al. (2020). The role of trust in the use of AI in education. Journal of Educational Technology & Society, 23(1), 11–22.
33. Binns, R. (2018). Fairness in machine learning: Lessons from political philosophy. In Proceedings of the 2018 Conference on Fairness, Accountability, and Transparency (pp. 149–158).
34. Friedman, B., & Nissenbaum, H. (1996). Bias in computer systems. ACM Transactions on Information Systems, 14(3), 330–347.
35. Kukulska-Hulme, A. (2020). Will mobile learning change language learning? Language Learning & Technology, 24(1), 1–11.
36. Baker, R. S., & Inventado, P. S. (2014). Educational data mining and learning analytics. In Handbook of Educational Data Mining (pp. 3–19). CRC Press.
37. Lahlou, S. (2025). Mitigating Societal Cognitive Overload in the Age of AI: Challenges and Directions. arXiv preprint arXiv:2504.19990.
38. Kim, J. & Wargo, E. (2025). Empowering educational leaders for AI integration in rural STEM education: Challenges and strategies. Frontiers in Education, 10, Article 1567698