Teachers' Perceptions on the Use of Artificial Intelligence Tools in Teaching Science Research

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ABSTRACT

This study explores high school science teachers' perceptions, benefits, challenges, and strategies regarding the integration of artificial intelligence (AI) tools in science research instruction in the Philippines. Employing a qualitative research design, data were collected through written interviews with purposively selected science research teachers and analyzed using thematic coding. Findings reveal that teachers recognize the potential of AI tools (i.e., ChatGPT, Scite, and Litmaps) to enhance instructional efficiency, personalize learning, and facilitate research processes. However, significant barriers persist, including limited technological infrastructure, insufficient training, and ethical concerns related to plagiarism and over-reliance on automation. Teachers adopt collaborative and adaptive strategies, such as peer learning and professional development, to navigate these challenges and emphasize the importance of guiding students in responsible AI use. The study emphasizes the need for holistic support (i.e., encompassing technical, pedagogical, and ethical dimensions) to maximize the benefits of AI in science education while safeguarding academic integrity. Insights from this research can inform policy, curriculum development, and professional learning initiatives aimed at equitable and effective AI integration in Philippine schools.

INTRODUCTION

Background of the Study

The integration of Artificial Intelligence (AI) into educational settings has been a transformative force, offering innovative tools that enhance teaching practices, streamline administrative processes, and support personalized learning experiences (Almasri, 2024). In the realm of science education, AI tools such as ChatGPT, Scite, and Litmaps have gained popularity for their ability to analyze data, simulate experiments, and provide citation mapping, thereby facilitating more effective science research instruction (Juárez & Baumgartner, 2024). However, the successful adoption of these tools depends significantly on teachers' perceptions and readiness to integrate them into their teaching practices. Teachers play a crucial role in mediating the impact of AI on student learning outcomes, and their attitudes toward technology can either facilitate or hinder its effective integration (Akram et al., 2022).

The educational landscape in many countries, including the Philippines, is gradually embracing AI technologies, but it faces challenges such as technological limitations and ethical concerns (Estrellado & Miranda, 2023; Kotsis, 2024). Despite these challenges, there is a positive outlook toward AI's potential to transform science education by providing personalized learning experiences and enhancing research capabilities (Kotsis, 2024). Understanding teachers' perceptions of AI tools is essential for developing strategies that address these challenges and maximize the benefits of AI in education.

Objectives of the Study

1. To explore science teachers' perceptions of using AI tools in teaching science research.
2. To identify perceived benefits of AI tools in science research instruction.

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3. To examine challenges encountered by teachers when integrating AI tools into their teaching practices.
4. To investigate strategies used by teachers to overcome challenges in AI integration.
5. To provide recommendations for other high school teachers on effectively integrating AI into science research education.

Significance of the Study

This study contributes to the growing body of knowledge on AI integration in education by focusing on high school science teachers' perspectives. It aims to inform policymakers, curriculum developers, and educators about the potential benefits and barriers to using AI tools in teaching science research. The findings can help optimize AI adoption strategies to improve teaching effectiveness and student learning outcomes.

Scope and Limitations of the Study

The study focuses exclusively on high school science teachers who teach science research subjects. It does not target specific schools but includes participants who have consented to share their experiences through written interviews conducted via Google Forms. The study is qualitative in nature and limited to exploring perceptions rather than measuring quantitative outcomes.

REVIEW OF LITERATURE AND STUDIES

Artificial Intelligence in Education

The role of Artificial Intelligence in science education is rapidly evolving, with a growing body of research indicating its potential to enhance learning outcomes and instructional practices (Almasri, 2024). A systematic review by Almasri (2024) highlights AI's impact on science education, noting its ability to automate tasks, create quizzes, assess student work, and predict academic performance. However, the integration of AI tools is not without challenges, as teachers often face barriers such as inadequate technological infrastructure and insufficient training (Akram et al., 2022).

Teaching Science Research

Research conducted by Arıcı (2024) suggests that AI in science education is still in its developmental stages, with the United States leading in publications. The study emphasizes the focus on learning outcomes, with tools like GPT being widely utilized. Similarly, Juárez and Baumgartner (2024) discuss the increasing use of AI applications such as ChatGPT, Scite, and Litmaps in education and scientific research. These tools offer advantages like rapid data analysis and citation mapping but require human verification to ensure accuracy and prevent plagiarism.

Teachers' Perceptions of Technology Integration

Teachers' perceptions of technology integration are generally positive, as they believe it enhances instructional practices and keeps learners motivated (Akram et al., 2022). However, challenges such as slow internet access and lack of infrastructure hinder effective integration. Dinçer (2024) examines science teachers' Technological Pedagogical Content Knowledge (TPACK) and identifies significant deficiencies in their ability to integrate technology effectively. This highlights the need for improved training and support to enhance teachers' technological competencies.

Challenges and Opportunities in AI Integration

In the context of the Philippines, the integration of AI tools in education faces challenges such as technological limitations and the digital divide (Estrellado & Miranda, 2023; Kotsis, 2024). Despite these challenges, there is a positive outlook toward AI's potential to transform science education by providing personalized learning experiences and enhancing research capabilities (Kotsis, 2024). Filipino teachers have shown readiness to

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integrate AI tools into their teaching practices, with institutional support being a crucial factor in facilitating this adoption (Sibug et al., 2024).

Contextual Studies

Studies on prospective science teachers in the Philippines highlight the importance of effective teacher education programs to enhance science education quality (Antipolo & Rogayan, 2021). Additionally, research at the Philippine Science High School indicates that teachers maintain a positive view of research's role in their professional development, demonstrating strong planning and writing skills in research activities (Galdonez, 2023). This underscores the potential for AI tools to support teachers in these areas by providing advanced data analysis capabilities and personalized learning pathways.

METHODOLOGY

Research Design

This study employs a qualitative research design, utilizing thematic analysis to explore high school science teachers' perceptions of AI tools in teaching science research.

Participants

The participants in this study were high school science teachers who taught science research subjects, selected through purposive sampling based on their relevance to the study's objectives. All participants were residents of the Province of Bukidnon and ranged in age from 25 to 35 years old. The participants consisted of 62.5% female and 37.5% male teachers. All were actively engaged in secondary-level teaching, with 12.5% holding a Master's degree and 37.5% currently pursuing graduate studies in a Master of Science program. Their teaching experience varied, spanning from 8 months to 7 years and 2 months, providing a range of insights from novice to moderately experienced educators.

Data Collection Methods

Data were collected via Google Forms through written interviews, which were structured around five guiding research questions;

1. What are your perceptions of the use of AI tools in teaching science research?
2. What are your perceived benefits of using AI tools in teaching science research?
3. What challenges do you encounter in integrating AI tools into science research instruction?
4. What strategies did you use to overcome challenges in AI integration?
5. What are your recommendations to other high school teachers integrating AI into teaching science research?

Data Analysis

Thematic analysis was employed to examine teachers' responses, following Braun and Clarke's (2006) six-phase framework. After collecting written interview data through Google Forms, the researcher carefully reviewed and familiarized themselves with the responses, reading them multiple times. Codes were initially generated by identifying recurring ideas, key phrases, and patterns in the text related to each research question.

Adopting an inductive, data-driven approach, the initial codes were organized into broader categories that reflected shared patterns of meaning among participants. Based on the instruction of the course instructor, the analysis focused on narrowing multiple categories into a single overarching theme per research question. To ensure clarity and coherence, this iterative process was supported by a large language model (GPT), which assisted in synthesizing and refining the emerging themes.

To enhance credibility and trustworthiness, themes were verified by checking them against raw responses and participant quotes. Selected quotations are included in the results to support each theme, ensuring that findings are grounded in the participants' lived experiences and perspectives.

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Ethical Considerations

They received formal invitations to participate and were informed of their right to decline or withdraw at any stage. Data collected were treated with utmost confidentiality throughout the research process.

RESULTS AND DISCUSSION

What are the perceptions of high school teachers regarding the use of AI tools in teaching science research?

Theme: Balanced Integration of AI Tools in Science Research Education

Teachers generally perceived AI tools as beneficial yet emphasized the need for responsible and balanced integration. Many highlighted AI's utility in streamlining research-related tasks and enhancing efficiency in science classrooms.

"AI can make work easier, especially in teaching science research, as it can assist with data analysis, literature reviews, and generating research ideas with less hassle."

Another teacher praised AI's capacity to save time while improving accuracy.

"A simple prompt or question is answered immediately with the AI considering a wide range of sources… tasks that used to take hours or days are now done in minutes."

However, several teachers raised concerns about overreliance and its impact on teaching quality and student learning.

"It limits your own capability to teach and the ability to become an effective and efficient teacher."

"Students rely on AI on their assignments and activities… they struggle to express their ideas and thoughts orally."

These reflections show that while teachers acknowledge AI's pedagogical potential, they remain cautious. Responsible guidance and critical oversight are needed to prevent misuse and ensure AI supports, rather than replaces authentic teaching and learning processes.

What are the perceived benefits of using AI tools in teaching science research?

Theme: Enhancing Efficiency, Personalization, and Accessibility in Science Research Education

Teachers described a range of benefits associated with AI use in science research instruction. A recurring sentiment was that AI tools drastically reduce the time needed for complex tasks such as research design, data analysis, and information retrieval.

"Faster research like finding and analyzing data, instant feedback… make teaching simpler and fast."

"Nowadays, for any—and I mean every—single task, there is an AI assistant or generator for it."

Another educator highlighted how simulations and AI-supported platforms simplify abstract science concepts.

"I am using PhET Simulation… a great application where difficult topics in science become much easier."

Beyond efficiency, AI's ability to personalize learning experiences stood out. Teachers appreciated how AI adapts content to student needs.

"AI offers personalized experiences through interactive simulations and real-time feedback… helping students grasp complex concepts."

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Accessibility was also noted, particularly in addressing learning gaps and providing automated support.

"AI automates administrative duties like feedback and grading… it improves fairness and accessibility."

Overall, AI tools were seen as transformative, enabling both teachers and students to engage more deeply and efficiently in the science research process.

What challenges do teachers face in integrating AI tools into science research instruction?

Theme: Multifaceted Challenges in Integrating AI Tools into Science Research Instruction

Participants cited numerous barriers to AI integration, ranging from technical to pedagogical. Chief among them were issues related to infrastructure and access.

"The most pressing issue is internet access and unavailability of ICTs… we haven't even finished previous developments due to frequent policy changes."

"In remote areas, unstable internet connections make it difficult for students to access AI tools."

Lack of training and digital literacy among both teachers and students was another major concern.

"Many educators feel unprepared and lack the skills and confidence to employ AI effectively."

"Making the proper command using AI is a challenge… and some students just copy and paste answers."

Teachers also worried about AI undermining critical thinking.

"AI shows you everything, but the credibility and authenticity of outputs may be invalid."

"Students forget that they are still learning and need to develop their thinking abilities."

These challenges illustrate the complex nature of AI adoption in under-resourced contexts and reinforce the need for comprehensive training, clearer policies, and digital infrastructure support.

What strategies do high school teachers use to overcome challenges in AI integration?

Theme: Collaborative and Adaptive Strategies for Overcoming AI Integration Challenges

In response to the challenges above, teachers employed practical, resourceful strategies. One key strategy was peer collaboration.

"Collaboration with colleagues… 'two heads are better than one'—this leads to a productive approach."

"LAC sessions are a great way to start this… I've been implementing AI and plan to guide others."

Another common strategy was professional development, both formal and informal.

"Attending trainings, watching instructional videos, and seeking self-directed learning helped us cope."

"I actively pursue specialized courses and resources to teach more efficiently and prepare students."

To address ethical concerns, teachers implemented direct rules and reminders.

"I consistently remind students not to rely entirely on AI and to maintain academic integrity."
"We use tools to verify if outputs were just copied and pasted from AI."

Teachers in low-resource areas adapted creatively.

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"We pre-download materials and encourage group work with shared devices."

These findings show that teachers are not passive recipients of technology—they actively strategize to make AI work in their unique teaching contexts.

What are your suggestions and recommendations?

Theme: Guiding Responsible AI Use in Education

Although only a few responses were recorded, a clear recommendation emerged: Teachers must actively guide students on the responsible use of AI.

"If you allow your students to use AI, please guide them on its proper use. Emphasize that this tool is meant to enhance their knowledge… not to replace their efforts."

This sentiment reflects broader ethical concerns raised throughout the study and reinforces the need for explicit policies and values-based instruction around AI use.

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