

Lived Experiences and Challenges of Public Secondary Teachers in Utilizing Artificial Intelligence (AI) in Teaching Science: Basis for Training Design

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Abstract

Artificial Intelligence (AI) is increasingly integrated into education, yet its effective use in public secondary science classrooms depends on teachers' experiences, competencies, available resources, and institutional support. This study explored the lived experiences and challenges of public secondary science teachers in utilizing AI in teaching science and used the findings as the basis for developing a context-responsive training design. Anchored on the Input–Process–Output model, the study employed a qualitative phenomenological design involving eight science teachers from Mobo National High School selected through complete enumeration. Data were collected using a validated researcher-made semi-structured interview guide and analyzed through thematic analysis. Findings revealed three major dimensions of teachers' lived experiences: integration of AI in science teaching practice, improved classroom interaction and learning environment, and professional growth and pedagogical development. Teachers used AI tools for lesson planning, instructional material development, assessment preparation, organization of content, simplification of scientific concepts, and learner engagement. However, AI integration was constrained by unstable internet connectivity, inadequate devices and technological resources, insufficient practical training, limited institutional and technical support, unclear guidelines, and concerns regarding content reliability, privacy, plagiarism, academic dishonesty, student overreliance, and critical thinking. The study concludes that AI can enhance the efficiency and quality of science instruction when used as instructional support rather than as a replacement for teachers. It recommends sustained professional development, stronger institutional and technological support, responsible-use guidelines, content-verification practices, and implementation of the proposed school-based AI integration training design. The study primarily supports SDG 4 – Quality Education and SDG 9 – Industry, Innovation and Infrastructure by strengthening teacher capacity and responsible educational technology integration. Its sustainability impact centers on educational, technological, digital, and institutional sustainability by promoting competent, ethical, equitable, and context-responsive AI use in science education.

Keywords: Artificial Intelligence; AI Integration; Professional Development; Science Education, Teacher Experiences; Training Design

1. Introduction

Artificial Intelligence (AI) is increasingly transforming education by supporting lesson preparation, instructional material development, assessment, personalized learning, feedback, and classroom engagement. Its growing use is particularly relevant to science education, where teachers are expected to explain complex concepts, facilitate

inquiry, and provide adaptive learning experiences. Although AI offers opportunities to improve instructional efficiency and learner engagement, its integration also presents concerns involving technological access, teacher readiness, content accuracy, academic integrity, data privacy, and institutional support. These issues are especially significant in Philippine public schools, where digital infrastructure and professional development opportunities remain uneven. Within this context, the present study examines the lived experiences and challenges of public secondary science teachers at Mobo National High School in utilizing AI in science instruction and uses these experiences as the basis for developing a context-responsive training design.

Artificial Intelligence (AI) is increasingly transforming education, with growing global adoption among teachers for lesson planning, assessment, instructional materials, and classroom activities (The Global Statistics, 2026; AIPRM, 2024; Langreo, 2026; Espina-Romero et al., 2023). In science education, AI supports personalized instruction, simplification of complex concepts, inquiry-based learning, learner monitoring, feedback, and virtual simulations (Nazaretsky et al. (2022); Harry, 2023; Ayeni et al., 2024; Onesi-Ozigagun et al., 2024). These applications contribute to scientific literacy and informed decision-making, supporting SDG 4 and the broader goals of sustainable development (NRC, 2007; UNESCO, 2016). In the Philippines, AI use in education is expanding but remains constrained by inadequate infrastructure, limited funding, technical expertise, and connectivity (Naseeb & Bhatti, 2024; Yigitcanlar et al., 2023). DepEd has introduced policies and initiatives promoting responsible AI use, training, innovation, and AI literacy (DepEd, 2026; DepEd, 2025), although underfunding and weak internet access continue to affect implementation (Villanueva, 2025; Ramos, 2025). Additional concerns include outdated curricula, limited teacher preparation, content quality, privacy, and data security (Almethen, 2024; Cruz, 2020; Ramoso & Cruz, 2024; Garcia et al., 2025; Cayabas & Sumeg-Ang, 2023). These issues are particularly relevant given the Philippines' below-OECD-average science performance in PISA 2022 (OECD, 2023). Despite these challenges, AI can enhance engagement and reduce repetitive instructional work (Seo et al., 2021; Eden et al., 2024; Alipio et al., 2023; Gibson, 2023). At Mobo National High School, all eight science teachers have undergone AI-related professional development, yet their actual experiences, readiness, confidence, challenges, and adaptive practices in integrating AI remain underexplored. This gap provides the rationale for examining their lived experiences as a basis for developing a locally responsive training design.

The literature surrounding AI in education may be synthesized into four closely connected themes: instructional and pedagogical utility, teacher readiness and acceptance, ethical and operational challenges, and the need for sustained professional development. First, AI has become increasingly relevant to instructional planning and learning support. Approximately 37% of lower secondary teachers have used AI in professional activities such as lesson preparation, assessment, and instructional material development (OECD, 2024), while broader surveys indicate widespread adoption among K–12 teachers (Gallup & Walton Family Foundation, 2025, as cited in OECD, 2024). Intelligent tutoring systems, adaptive learning platforms, and virtual assistants can personalize learning and provide immediate feedback (Onesi-Ozigagun et al., 2024; Ayeni et al., 2024). Harry (2023) further emphasized the capacity of AI to analyze learning patterns and enable teachers to adapt lessons according to learner needs. AI may also automate routine tasks and support interactive simulations of scientific phenomena, thereby increasing instructional flexibility and engagement, as discussed by Tang, Chang, and Hwang (2023). AI can further personalize feedback according to individual learner requirements (Booth et al., 2024) and support collaborative instructional design involving teachers and learners (Parsons & Curry, 2024). Different approaches to AI-supported science education include game-based learning, problem-based learning, collaborative problem solving, and adaptive transitions between individual and group learning (C.-H.Chen & Chang, 2024; Heeg & Avraamidou, 2023; Gonzalez-Calatayud et al., 2021).

AI integration in education increasingly combines emerging technologies with personalized and multimodal learning, but its effectiveness requires curriculum planning, ethical frameworks, institutional support, and competent teachers (Eden et al., 2024; Hutson et al., 2022; Onesi-Ozigagun et al., 2024; AlBadarin et al., 2023). User-friendly systems also influence adoption (Niu et al., 2022), while teachers' self-efficacy, perceived usefulness, ease of use, and confidence affect their willingness to integrate AI (Al Darayseh, 2023; Nja et al., 2023; Kim and Kim, 2022; Park et al., 2023). Research further demonstrates AI's value in learning support, assessment, multimodal instruction, scientific reasoning, and improved learning outcomes (Almasri, 2024; Bewersdorff et al., 2025; Olatunde-Aiyedun, 2024; Park et al., 2023). However, AI presents ethical and instructional risks involving privacy, algorithmic bias, inaccurate content, academic integrity, transparency, student dependence, and possible changes in teachers' roles (Seo et al., 2021; Mohammed and Watson, 2019; Anders, 2023; Tlili, 2023; Eden et al., 2024; Chan & Tsi, 2023; Edwards & Cheok, 2018; Ayeni et al., 2024; Eden et al., 2024). These concerns emphasize the importance of verifying AI-generated information and maintaining content authenticity (Bataineh et al., 2025). Consequently, professional development must extend beyond basic tool use toward technological, pedagogical, and ethical competence (Lee and Perret, 2022). In the Philippines, AI integration remains promising but uneven because of inadequate devices, unstable connectivity, limited institutional support, and difficulties translating training into classroom practice (Cayabas and Sumeg-Ang (2023); Alipio et al., 2023; Dela Cruz, 2019). Nevertheless, AI can support personalized instruction, efficiency, and

interactive learning (Gibson, 2023; Arnaiz, 2023), particularly through emerging chatbots, learning platforms, decision-support systems, and analytics (Lo, 2023; Mai et al., 2024; Tang et al., 2023; Zhang & Aslan, 2021). Teacher attitudes also remain important (Santos et al., 2024) and L. Chenet et al., 202). Philippine studies show that successful implementation depends on preparedness, resources, leadership, and structured pedagogical preparation (Flores, 2025; Liboon et al., 2026; Antonio, 2025; de Vera et al., 2025). AI may improve participation and understanding in science classrooms (Garcia et al., 2025; Balasoto et al., 2025; Embang et al., 2025), but teachers continue to face infrastructure, training, policy, privacy, reliability, and academic integrity concerns (Morales and Jacob, 2025; Chinaman et al., 2026). Overall, effective AI integration requires teacher competence, sound pedagogy, ethical safeguards, adequate technology, and sustained institutional support.

Globally, the growing use of AI indicates an accelerating transition toward technology-mediated education (OECD, 2025). This trend is reinforced by evidence of substantial K–12 adoption (Gallup & Walton Family Foundation, 2025, as cited in OECD, 2025) and widespread learner access to generative applications within the Philippine context (Liboon et al., 2026). AI's instructional relevance lies particularly in its ability to support personalized instruction, learner monitoring, and adaptive educational experiences (Onesi-Ozigagun et al., 2024; Ayeni et al., 2024; Harry (2023). Multimodal and interactive technologies further extend these possibilities (Tang, Chang, & Hwang, 2023; Bewersdorff et al., 2025). Philippine science classrooms likewise demonstrate applications involving visualization, content creation, feedback, and support for demanding scientific subjects (Gibson, 2023; Arnaiz, 2023; Garcia et al., 2025; Balasoto et al., 2025). However, international concerns involving algorithmic bias, security, and inaccurate information remain significant (Seo et al., 2021; Mohammed & Watson, 2019; Eden et al., 2024). These concerns have intensified with generative AI and its implications for academic integrity and content authenticity (Anders, 2023; Tlili, 2023; Bataineh et al., 2025). In Philippine public education, global challenges are intensified by infrastructure inequities, connectivity limitations, device shortages, and the financial burden of technology adoption (Cayabas & Sumeg-Ang, 2023; Dela Cruz, 2019; Morales & Jacob, 2025). Teachers also confront uncertainty in institutional policies, technological changes, and the suitability of AI-generated information for classroom use (Morales & Jacob, 2025; Chinaman et al., 2026). Professional development is therefore central to responsible implementation. International scholarship advocates discipline-specific preparation that combines technological skills with pedagogical and ethical understanding (Onesi-Ozigagun et al., 2024; AlBadarin et al., 2023; Lee & Perret, 2022). Philippine evidence similarly indicates that structured interventions can strengthen AI-related teaching competencies (Antonio, 2025), although technology itself cannot guarantee higher-order thinking unless supported by suitable pedagogy (de Vera et al., 2025). Existing professional development may also lack sufficient depth, continuity, or contextual relevance (Alipio et al., 2023; Chinaman et al., 2026). At the local level, Mobo National High School provides a particularly relevant setting because its science teachers have already participated in AI- and digital-technology-related professional development. The remaining issue is not simply whether they have been introduced to AI, but how they experience its actual classroom integration, how they respond to limitations, and what forms of training can respond to their particular instructional context.

The study is anchored on the Input–Process–Output (IPO) model, which organizes the relationship between teachers' experiences, the systematic investigation of those experiences, and the development of an appropriate professional training response. The input consists of the lived experiences and challenges of public secondary science teachers in utilizing AI in science teaching. These include their actual uses of AI, perceptions of its instructional value, difficulties encountered during integration, and the contextual conditions influencing classroom implementation. The process involves gathering teachers' accounts through semi-structured interviews, transcribing and validating their responses, and organizing the qualitative information through thematic analysis. This process is intended to identify recurring patterns representing teachers' experiences, challenges, needs, and reflections regarding AI-supported science instruction. The output is a proposed school-based AI integration training design responsive to the experiences and difficulties identified among the teachers. The training is intended to strengthen foundational AI understanding, competence in lesson preparation and instructional material development, classroom application, confidence, and responsible use of AI. A feedback mechanism connects the output to the identified inputs so that the proposed training can be refined according to teachers' actual needs and classroom conditions. Thus, the conceptual framework positions teachers' lived realities, rather than technology alone, as the primary basis for professional development.

Although AI can enhance personalized learning, engagement, lesson development, assessment, and instructional efficiency (Tang et al., 2023; Harry, 2023; Onesi-Ozigagun et al., 2024; Ayeni et al., 2024; Chen & Chang, 2024), its effectiveness depends on teacher competence, readiness, professional development, and institutional support (AlBadarin et al., 2023; Hutson et al., 2022). Ethical concerns involving privacy, algorithmic bias, academic integrity, and content reliability also remain significant (Mohammed & Watson, 2019; Seo et al., 2021; Anders, 2023; Tlili, 2023; Eden et al., 2024). In Philippine schools, these concerns are compounded by limited infrastructure, devices, connectivity, and training opportunities (Dela Cruz, 2019; Cayabas & Sumeg-Ang, 2023; Alipio et al., 2023). While local studies recognize AI's instructional benefits (Gibson, 2023; Arnaiz, 2023; Co, 2025), limited qualitative research examines teachers' actual experiences, adaptive strategies, ethical concerns,

and classroom judgments (Kormos & Wisdom, 2021; Santos et al., 2024; Chen et al., 2020). Thus, this study examines the lived experiences and challenges of public secondary science teachers at Mobo National High School as a basis for developing a context-responsive training design. The study primarily supports SDG 4 – Quality Education by strengthening science teachers' competence, instructional quality, and responsible use of emerging technologies (NRC, 2007; UNESCO, 2016). It also contributes to SDG 9 – Industry, Innovation and Infrastructure, as sustainable AI integration requires adequate digital infrastructure, technical capacity, and institutional support (Naseeb & Bhatti, 2024; Yigitcanlar et al., 2023). Overall, the study promotes sustainable educational innovation through teacher capacity-building, ethical AI use, and appropriate technological support.

The study contributes principally to educational, technological and digital, institutional, and socio-economic sustainability. Its multidisciplinary relevance arises from the interaction between science education, artificial intelligence, teacher professional development, school governance, ethics, and digital infrastructure. For educational sustainability, understanding teachers' actual AI experiences can support instructional practices that remain relevant as educational technologies evolve. Sustainable integration requires teachers who can determine when AI strengthens learning, when its output requires verification, and when conventional or teacher-directed approaches remain more appropriate.

For technological and digital sustainability, the study recognizes that adoption cannot depend solely on access to emerging applications. AI use must be accompanied by technological competence, critical evaluation, content verification, ethical awareness, and appropriate infrastructure. This orientation promotes responsible rather than merely frequent use of digital technologies. For institutional sustainability, the study can provide an empirical basis for school-level professional development, resource planning, instructional support, and policy implementation. A training design based on teachers' identified needs may help reduce the gap between national AI initiatives and everyday classroom realities by directing institutional responses toward actual barriers experienced by teachers.

The study also bears relevance to socio-economic and community sustainability because science education contributes to human capacity and informed participation in increasingly technology-driven societies (NRC, 2007). Strengthening teachers' ability to use AI responsibly can support more equitable educational opportunities, particularly where infrastructure and professional development remain constrained. Overall, the study approaches sustainable AI integration as a balance among instructional quality, technological innovation, professional competence, ethical responsibility, equitable access, and institutional capacity. Its contribution therefore extends beyond the use of individual AI applications and toward developing a science education system capable of adapting responsibly to continuing digital transformation.

2. Material and methods

2.1 Research Design

The study utilized a qualitative research design, specifically phenomenology, to explore the lived experiences and challenges of public secondary science teachers in utilizing Artificial Intelligence (AI) in teaching science and to use the findings as a basis for developing a relevant training program. Phenomenological research seeks to understand how individuals experience a particular phenomenon in their everyday lives and focuses on interpreting the meaning of those experiences through rich descriptions provided by individuals who have directly encountered the phenomenon (Creswell, 2018; Moustakas, 1994; van Manen, 1990). This design was appropriate because AI integration in education is a relatively new and evolving phenomenon. It enabled the researcher to examine teachers' actual experiences, perceptions, difficulties, and reflections regarding AI use in science instruction and to identify common patterns and deeper insights that could inform the development of a context-responsive training program.

2.2 Locale of the Study

The study was conducted at Mobo National High School in the Division of Masbate Province. The school is located in Poblacion District II, Municipality of Mobo, Masbate, and is one of four secondary schools in the municipality. It occupies approximately 1.6 hectares and implements the K to 12 Basic Education Curriculum for Grades 7–10 and Grades 11–12, in addition to a Special Program in the Arts Curriculum. The school has one principal, one assistant to the principal, 74 nationally funded teachers, and 19 non-teaching personnel. Its facilities include 33 academic classrooms, 49 functional toilets, two computer laboratories, a school clinic, two administrative offices, a guidance office, and a school library, as indicated in the School Improvement Plan for SY 2023–2028. The Municipality of Mobo is approximately six kilometers from Masbate City and is connected to the city and neighboring municipalities through national, provincial, and municipal roads (PhilAtlas, n.d.). The locale was selected because its science teachers had participated in DepEd-sponsored training on AI and digital technology integration from School Years 2022 to 2025. Despite these training opportunities and the availability of ICT resources, limited evidence existed regarding how the teachers actually utilized AI in science instruction, the difficulties they encountered, and the strategies they employed in classroom integration.

2.3 Respondents of the Study

The participants were eight (8) public secondary science teachers currently teaching at Mobo National High School, Mobo North District, Schools Division Office of Masbate Province. The study focused only on science teachers who had exposure to AI tools in teaching during School Year 2025–2026. Teachers from other subject areas and schools were not included, and the study did not measure students' academic performance. To protect confidentiality and anonymity, the participants were assigned coded identifiers beginning with ST1, ST2, ST3, and succeeding codes. These identifiers were used throughout the presentation and analysis of the qualitative data so that responses could be attributed without disclosing participants' identities.

2.4 Sample and Sampling Procedure

The study employed complete enumeration sampling, in which every individual belonging to the specified population was included as a participant (Singh & Masuku, 2014). The technique was considered appropriate for the local setting (Zhang et al., 2007) because the total population of public secondary science teachers at Mobo National High School was small and manageable. Accordingly, all eight (8) qualified public secondary science teachers were included in the study. The inclusion of the entire target population provided comprehensive representation of the teachers' perspectives and reduced potential sampling bias, allowing the researcher to examine the range of experiences and challenges associated with AI utilization among science teachers within the school.

2.5 Research Instrument

The study used a researcher-made semi-structured interview guide with open-ended questions to explore participants' experiences, perceptions, classroom practices, challenges, and recommendations regarding AI use in science education. Semi-structured interviews are appropriate for phenomenological research because they allow participants to describe their experiences while enabling researchers to probe relevant issues systematically (Brinkmann and Kvale, 2015; Creswell and Poth, 2018; DiCicco-Bloom and Crabtree, 2006). The instrument covered teachers' understanding and use of AI, classroom integration, and encountered challenges. It underwent expert content validation for content validity, language quality, and overall quality using a five-point scale, with mean scores interpreted from High Acceptable to Unacceptable.

2.6 Data Gathering Procedure

Data collection began after approval from the Thesis Adviser, the institution's Officer-In-Charge for Research, Development, and Extension, the DepEd Masbate Schools Division Superintendent, and Mobo National High School administration. Participants were informed of the study's purpose, procedures, rights, and voluntary participation, and informed consent was obtained. Individual interviews lasted about 15–20 minutes and were audio-recorded with permission for verbatim transcription. Participant codes and secure data storage ensured anonymity and confidentiality, while a reflective journal documented observations and possible researcher bias. Transcripts and interpretations were returned to participants for validation to confirm the accuracy of their reported experiences.

2.7 Data Analysis Techniques

The interview data were analyzed through thematic analysis to identify, examine, organize, and interpret recurring patterns or themes within the qualitative responses. The analysis followed the six steps of thematic analysis by Braun & Clarke (2006), involving familiarization with the data, generation of codes, combining codes into themes, reviewing the themes, determining their significance, and reporting the findings. The researcher first became familiar with the data by repeatedly reading the interview transcripts. Preliminary codes were then generated from meaningful statements related to teachers' experiences, challenges, and recommendations concerning AI integration. Related codes were grouped into broader themes that represented shared meanings across participants. These themes were subsequently reviewed, refined, and interpreted to ensure that they accurately represented the participants' lived experiences in utilizing Artificial Intelligence in science instruction. This systematic process provided the basis for identifying the teachers' common experiences, difficulties, and professional development needs.

2.8 Ethical Considerations

Ethical standards were observed throughout the study in accordance with Republic Act No. 10173, or the Data Privacy Act of 2012, and CHED Memorandum Order No. 15, series of 2019. These provisions guided the protection of participants' rights, the processing and safeguarding of personal information, voluntary participation, and research accountability. Participants were informed about the nature, purpose, and scope of the research and were advised that participation was voluntary and that they could withdraw from the study at any stage without penalty. Informed consent was obtained before data collection. Personal information and interview responses were treated confidentially and were used solely for academic purposes. Audio recordings, transcripts, and related research documents were securely stored and accessible only to the researcher. Participant codes were used to maintain anonymity, and no identifying information was disclosed in the presentation and reporting of the findings.

3. Results and Discussion

3.1 Lived Experiences of Public Secondary Science Teachers in Utilizing AI in Teaching Science

The analysis generated three major themes describing teachers' lived experiences: Integration of AI in Science Teaching Practice, Impact of AI on Classroom Interaction and Learning Environment, and Professional Growth and Pedagogical Development. Examining lived experiences provides access to the shared realities of individuals directly engaged with a phenomenon and allows deeper contextual understanding of their experiences (Ranse et al. (2020)). The findings show that AI has become embedded in teachers' instructional routines and influences how they prepare lessons, interact with learners, and develop professionally.

3.1.1 Integration of AI in Science Teaching Practice

Science teachers reported using ChatGPT, Gemini, Canva AI, Gamma, Quizizz, Magic School AI, and Diffit for lesson planning, instructional material development, assessment preparation, organization of ideas, simplification of learning competencies, and student activities. Participants described AI as reducing the burden of manually preparing instructional materials and shortening preparation time. ST1 reported being able to prepare and organize lessons within a shorter period, ST2 used AI to simplify objectives and organize lesson plans, while ST3 emphasized that AI reduced the burden of manually creating materials. Teachers also used AI to clarify difficult scientific concepts, tailor lessons to different learning needs, create quizzes and activities, and improve the presentation and organization of science content. These experiences indicate that AI is becoming part of teachers' routine instructional practice. AI-assisted teaching has been associated with enhanced teaching and learning, personalized instruction, and responses to diverse learner needs (Fitria, 2021), while its applications can generate text, images, sound, and other forms of content from data (Kılınç & Keçecioglu, 2024). AI can also support personalized instruction and prediction of student outcomes (Kwid et al., 2024). The findings are consistent with Luckin and Holmes (2016), who emphasized the contribution of AI to lesson preparation, content presentation, and individualized instruction. UNESCO (2019) likewise recognized AI's potential to support personalized and student-focused education, while Nemani (2025) reported that AI can reduce administrative burdens and enable teachers to allocate more time to instructional activities. Thus, AI integration may improve instructional efficiency, differentiated learning, and teachers' capacity to provide meaningful science learning experiences.

3.1.2 Impact of AI on Classroom Interaction and Learning Environment

Teachers observed that AI-supported science lessons became more interactive, engaging, responsive, and student-centered. ST5 reported greater learner participation when AI-supported activities were introduced, while ST8 observed that AI helped simplify difficult concepts. ST3 described teacher-student interactions as more engaging and responsive and identified a more collaborative and interactive learning environment. Other participants observed increased participation, discussion, independent exploration of scientific concepts, and easier understanding of lessons. AI was therefore experienced not only as a content-generation tool but also as a means of modifying classroom interaction and encouraging learner participation. The findings demonstrate the potential of AI to support more personalized and interactive learning environments, consistent with the transformative role attributed to AI in K–12 education by Kashif et al. (2025) and Jiménez (2024). Its ability to support subject-specific knowledge also helps explain its usefulness in simplifying difficult concepts (Balta, 2025). The findings correspond with Chukwu et al. (2025), who emphasized AI-driven adaptive learning systems as tools for improving student achievement, and with Copur-Gencturk & Atabas (2024), who found that AI-supported instruction can promote connected learning and conceptual understanding. These experiences also reflect constructivist principles in which learning develops through interaction, collaboration, and active participation. Similarly, Chen et al (2020) suggested that AI-supported educational technologies can strengthen classroom involvement, engagement, and interaction. AI can therefore function as a mediator of learner-centered science instruction when teachers maintain appropriate pedagogical guidance.

3.1.3 Professional Growth and Pedagogical Development

Teachers reported that AI integration improved their confidence, technological competence, instructional flexibility, and willingness to explore new teaching strategies. ST1 and ST2 described becoming more confident and prepared in delivering lessons and attaining learning goals. ST4 associated AI use with student-centered instruction, problem-based and real-world activities, lifelong learning, and collaboration among teachers. ST6 reported greater confidence in technology and exploration of new methods, ST7 described becoming more innovative in using varied strategies, and ST8 reported acquiring new digital skills that improved teaching performance. Teachers consequently experienced AI as contributing both to immediate classroom practice and continuing professional development. These findings indicate that AI integration can strengthen professional growth by encouraging teachers to develop new technological and pedagogical competencies. Duan & Zhao (2024) emphasized that AI integration in instruction can support teachers' professional development and independent instructional practice. Kelly and Wenzel (2025) likewise explain that AI can improve educational efficiency, reduce administrative demands, and personalize educational experiences. Teachers' readiness to adopt AI is also important to successful classroom integration and professional satisfaction (Yang & Yanqiu, 2025). The findings are further consistent with the Technological Pedagogical Content Knowledge framework of Mishra &

Koehler (2006), which emphasizes the integration of technological, pedagogical, and content knowledge. AI use therefore appears to encourage greater confidence, innovation, reflective practice, and adaptability among science teachers.

3.2 Challenges Encountered in Utilizing AI in Science Teaching

Despite the perceived benefits of AI, teachers experienced barriers that limited its consistent and effective use. The analysis generated three major areas of concern: technical and practical challenges, institutional and systemic barriers, and student-related and ethical concerns. Such difficulties can constrain teachers' instructional use of AI (Tian, 2023), making their identification important in developing policy responses that balance the opportunities and risks associated with AI in education (Pedro et al., 2019).

3.2.1 Technical and Practical Challenges

Teachers identified unstable or limited internet connectivity as one of the most persistent barriers to AI integration, particularly among ST1, ST3, ST4, ST5, and ST6. They also reported inadequate computers and digital devices, lack of computer laboratory access, difficulties learning unfamiliar AI tools, limited knowledge of effective prompting, insufficient formal or hands-on training, time constraints, and heavy workloads. Some AI-generated suggestions were also considered unsuitable for the local classroom context or dependent on resources unavailable within the community. These conditions limited teachers' ability to consistently explore, practice, and apply AI-supported strategies. The findings demonstrate that effective AI integration depends on addressing both technological and practical conditions. The rapid adoption of AI makes careful examination of implementation challenges necessary (Owoc et al., 2021), particularly its technical requirements (Nesteverov, 2023) and practical limitations (Sijing & Lan, 2018). Addressing such barriers is necessary to align emerging technologies with teachers' preparedness and actual needs (Mehdaoui, 2024) and to balance potential benefits with possible educational harms (Dobrescu et al., 2025). Limited internet connectivity can particularly restrict access to AI-powered learning opportunities (Judijanto, 2025). The reported training difficulties also correspond with Chang & Choi (2025), who identified insufficient teacher expertise and limited professional development as barriers to AI literacy and integration. Cordero et al. (2025) similarly associate implementation difficulties with inadequate guidance and teacher knowledge. These findings indicate the need for stronger infrastructure and practical, sustained professional development rather than one-time exposure to AI applications.

3.2.2 Institutional and Systemic Barriers

Participants reported that AI integration was also constrained by insufficient school resources, limited administrative and technical support, inadequate institutional subscriptions to AI platforms, unclear guidelines, budget restrictions, and professional development opportunities that were either limited or too general. ST4 noted a lack of clear institutional prioritization and guidance, while ST1 and ST5 emphasized the need for continuing training and opportunities to practice. These findings show that individual teacher motivation alone is insufficient when the institutional environment does not consistently provide resources, policy direction, and professional support. AI integration can require substantial organizational change because external pressures such as regulations and financial constraints intersect with institutional culture, decision-making, and educators' professional roles (Labraña & Rodríguez Ponce (2026)). Institutional and instructional support can strengthen teachers' performance, motivation, and well-being (Purísima (2025)). Successful AI integration likewise depends on factors including cultural acceptance, adequate funding, infrastructure, and user readiness (Alhammadi & Alhazmi (2025)). Without adequate support systems, teachers may struggle to remain responsive to rapidly developing AI technologies, potentially widening the gap between technological advances and educational practice (Tomaskinova & Tomaskin (2024)). The results therefore emphasize that sustainable AI integration requires coordinated institutional investment in infrastructure, professional development, technical assistance, and clear policy frameworks.

3.2.3 Student-Related and Ethical Concerns

Teachers expressed concern about students becoming excessively dependent on AI-generated answers. ST1 identified student overreliance as an ethical concern, while ST4 observed that some learners copied AI-generated responses without fully reading or understanding the underlying concepts. ST7 reported difficulty determining whether submitted work represented students' original performance. Participants also identified unequal learner access to AI technologies, concerns involving student data and privacy, plagiarism, academic dishonesty, content authenticity, and the possibility that dependence on AI could weaken critical thinking and genuine scientific inquiry. These concerns demonstrate that AI integration involves ethical as well as pedagogical responsibilities. Remian (2019) emphasized that ethical issues surrounding AI must be clarified or mitigated to ensure that AI serves educators and learners appropriately. The participants' concerns correspond with Zhu et al. (2025), who identified risks involving academic misconduct, homogenized learning, changes in teacher-student relationships, and deviation from educational objectives. According to Nguyen et al. (2024), excessive reliance on AI may weaken independent learning and critical thinking and promote superficial engagement with academic concepts. Zhai et al. (2024) similarly identified plagiarism, algorithmic bias, AI hallucination, privacy risks, lack of transparency, and overreliance as concerns associated with AI dialogue systems. The findings therefore indicate

that schools need clear ethical parameters, content-verification practices, responsible-use guidance, and assessment strategies that protect authentic student learning while allowing appropriate use of AI.

3.3 Proposed Training Design for Effective AI Utilization in Science Teaching

The combined findings revealed that science teachers already use AI for lesson preparation, material development, assessment, conceptual explanation, student engagement, and instructional innovation, but continue to experience gaps in technical competence, training, infrastructure, institutional support, content evaluation, and ethical AI use. These identified needs became the basis for proposing a school-based training design for science teachers at Mobo National High School. The proposed training is designed to be hands-on, context-based, and practice-oriented so that teachers can directly apply AI tools within actual science classrooms. It focuses on strengthening foundational understanding of AI in education, AI-assisted lesson planning and instructional material development, interactive and learner-centered strategies, evaluation of the accuracy and reliability of AI-generated content, ethical and responsible AI use, reflective practice, and collaborative professional learning. It also responds to connectivity and resource limitations by recognizing the need for practical alternatives and institutional support. In this way, the training design directly reflects the teachers' lived experiences and identified challenges and is intended to develop more confident, competent, reflective, and ethically responsible users of AI in science education.

4. Conclusion & Recommendations

The study concludes that Artificial Intelligence can serve as an effective instructional support tool for public secondary science teachers rather than as a replacement for human teaching. Applications such as ChatGPT, Gemini, and Magic School AI contribute to greater efficiency in lesson preparation, instructional material development, assessment creation, and other routine academic tasks. By reducing the time required for these activities, teachers are able to devote greater attention to actual classroom instruction, learner engagement, individualized support, and other professional responsibilities that require human judgment and interaction. AI also facilitates the explanation and comprehension of complex scientific concepts by providing structured explanations, visual presentations, simulations, examples, and other learning resources that can make abstract or difficult topics more understandable to students. In this way, AI has the potential to strengthen conceptual clarity, enrich instructional delivery, and improve the overall quality of science teaching and learning. Nevertheless, the effective and sustainable integration of AI in science education depends on addressing existing technological limitations, ensuring adequate access to digital resources and reliable connectivity, strengthening teachers' AI-related competencies through continuous professional development, and providing clear institutional support and guidelines. Concerns regarding accuracy, data privacy, academic integrity, overdependence on AI-generated content, and ethical and responsible use must also be carefully considered. Therefore, the successful adoption of AI in public secondary science education requires a balanced and teacher-centered approach in which technology complements, rather than replaces, the professional expertise, pedagogical judgment, creativity, and interpersonal role of teachers.

Schools should institutionalize collaborative Learning Action Cell sessions on prompt engineering and AI-assisted lesson planning, adopt interactive and student-centered AI tools, and establish communities of practice and peer mentoring to strengthen teacher competence and collaboration. The Department of Education and school leaders should support low-resource, offline-capable, and blended approaches; provide clear AI policies, ICT technical assistance, adequate funding, and standardized content-vetting procedures aligned with DepEd policies and the Data Privacy Act; and encourage authentic, AI-resistant assessments that discourage plagiarism and overdependence while strengthening critical thinking and scientific inquiry. The proposed school-based AI training design should also be implemented to develop teachers' foundational AI knowledge, lesson-planning and instructional-material development skills, reflective and collaborative practices, strategies for student engagement, capacity to address technological limitations, competence in evaluating AI-generated content, and ethical and responsible AI use in science education.

The study was limited to eight (8) public secondary science teachers from Mobo National High School during School Year 2025–2026 who had exposure to AI tools in teaching. It excluded teachers from other subject areas and schools and did not measure students' academic performance. Consequently, the findings are specific to the experiences and conditions of Mobo National High School and may not be directly applicable to public or private secondary schools operating in different contexts.

5. Compliance with ethical standards

The study observed accepted ethical standards for human-participant research. Informed consent and voluntary participation were ensured, and participants were informed of their right to withdraw at any time without consequence. Confidentiality and anonymity were maintained through coded identities and secure handling of interview data, consistent with the Data Privacy Act of 2012. Necessary approvals were obtained from the concerned educational authorities and school administration before data collection.

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