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The Use of Generative AI Tools and Their Role in Science Learning amongSenior High School Students

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Abstract

This qualitative study examines the interactions of senior high school STEM students in the Philippines with generative artificial intelligence (GAI) tools, particularly in the context of science learning. Against the backdrop of post-pandemic educational recovery and the country's persistent challenges in international science assessments, the research aims to explore students' perceived benefits, limitations, and ethical concerns regarding GAI technologies such as ChatGPT. Sixteen participants were purposively selected and engaged in individual in-depth interviews. Thematic analysis revealed that students primarily use GAI tools as virtual tutors, research aids, and academic support systems. While participants acknowledged the advantages of GAI in enhancing learning efficiency and providing personalized support, issues such as overreliance, reduced critical thinking, and potential misuse were also highlighted. These findings underscore the need for a balanced and guided integration of GAI in educational settings. The study provides valuable insights for educators and policymakers in developing informed strategies for the responsible adoption of generative AI in science education.

Keywords: Generative AI, Science Process Skills, STEM Education, Student Perceptions, Educational Technology.

Introduction

Filipino students still struggle to master the most important aspect of scientific inquiry and competency, which is science process skills (SPS). Thus, the learning gaps such as skills gaps have been manifested in post-pandemic educational setup (Alejo et al., 2023). This aligns with the claims of the Congressional Policy and Budget Research Department: House of Representatives (2024), highlighting the poor performance in international assessments like the Programme for International Student Assessment (PISA) and the Trends in International Mathematics and Science Study (TIMSS).

The rise of generative AI (GAI) tools, such as ChatGPT, presents new opportunities to address these gaps. This idea is supported by Gonçalves Leonel da Silva (2024), who describes how these tools can enhance learning through personalized instruction, quick access to information, and instant feedback. However, these potentials also pose several issues in the educational field. According to Akgun and Greenhow (2022), concerns about academic dishonesty, bias, and the reliability of AI-generated content raise questions about their potential drawbacks. There are also fears that overreliance



on AI could diminish critical thinking, creativity, and the educator-student relationship (Antony & Ramnath, 2023; Estrellado & Miranda, 2023).

In the Philippine context, students struggle to develop science process skills (SPS) due to several systemic factors, including large class sizes, low funding, inconsistent teacher quality, and limited laboratory resources (Cabrales & Pacala, 2023; Noroña & Abuda, 2021; Zabala & Dayaganon, 2023). Meanwhile, opinions on generative AI in education vary—some highlight its interactive benefits (Lei et al., 2025), while others raise concerns about academic integrity, teacher autonomy, and student skill development (Estrellado & Miranda, 2023; Ghamrawi et al., 2024; Obenza et al., 2023), including AI over-reliance affecting critical thinking (Gocen & Aydemir, 2020), necessitating a balanced integration approach (Asio, 2021).

Understanding student engagement with GAI is timely and relevant for educators, as studies link GAI interaction to academic performance, self-efficacy, and cognitive engagement (Bommasani et al., 2021; Chan & Hu, 2023; Obenza et al., 2023). However, limited research has explored the experiences of senior high school students using GAI tools, particularly in local contexts. This gap underscores the need for a comprehensive analysis of both the advantages and potential risks of GAI in science education, particularly its role in science learning. Providing insights valuable to educators and policymakers.

Further, this study will investigate senior high school STEM students' perceptions, interactions, and utilization of generative AI tools, focusing on their influence on SPS development. Using qualitative approach allows for deeper insights into real-world experiences, values, and concerns, helping inform policies, teaching strategies, and ethical guidelines that ensure the responsible and inclusive integration of generative AI in education.

The findings will be particularly valuable for the Department of Education and science educators, offering new insights into the role of AI in teaching and learning. The main objective of this study is to investigate the perceptions, interaction patterns, and utilization of generative AI tools among senior high school STEM students. Specifically, this study seeks to answer the following questions:

- how do senior high school STEM students in the Philippines perceive and use generative AI tools in their science learning?;
- what are the perceived roles of Generative AI tools in science learning?; and
- what are the perceived benefits and challenges of using GAI tools in science education?

Methods

Design

This study employed a qualitative research design to examine the experiences of Senior High School STEM students with generative AI tools. Qualitative research methods offered valuable insights into complex social phenomena, providing depth and context to the research questions (Lim, 2024). This approach was particularly useful in studying students' experiences with emerging technologies such as generative AI tools (Acheampong & Nyaaba, 2024). Qualitative methods enhanced creativity and reflexivity while helping to mitigate power dynamics in research involving young people (Sanders, 2018). In the context of Design and Technology education, qualitative approaches were used to explore the integration of generative AI and social-emotional learning, revealing potential benefits for fostering



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creativity and problem-solving skills (Chigora, 2024). However, challenges such as ethical considerations and potential researcher bias needed to be addressed (Lim, 2024).

This design enhanced credibility and validity (Noble & Heale, 2019) and enriched the data with meaningful context (Greene, 2006). Its flexibility allowed the study to address diverse research questions (Jagosh et al., 2012). Further, qualitative research provided a robust framework for understanding complex phenomena (Creswell & Piano Clark, 2007).

Furthermore, qualitative data offered deeper insights into students' experiences and perceptions of generative AI tools and their influence on science learning (Fawaz et al., 2025). Using thematic analysis and individual in-depth interviews (IDIs), the study captured students' lived experiences, focusing on their perspectives regarding the role of generative AI in improving specific science process skills (SPS), the challenges they faced, and the alignment of these tools with their academic and personal learning goals. This qualitative approach also uncovered nuanced views, perceived benefits and limitations, and interaction patterns, offering a detailed understanding of how generative AI influenced learning and SPS development.

Research Locale

The study was conducted in the City of Mati, located in the southeastern part of Davao Oriental. The City of Mati Division consists of five school districts, encompassing 49 public elementary schools, 23 public secondary schools, and seven private schools.



Figure 1: Map of the Study Sites

Participants and Sampling Design

Purposive sampling was used to select Senior High School STEM students who could provide detailed insights into their experiences with generative AI tools. This approach aimed to capture a broad



range of perspectives, ensuring that the data reflected diverse usage patterns and experiences with these technologies (Creswell & Piano Clark, 2007).

To ensure diversity, participants were selected from both public and private schools and from varied socioeconomic backgrounds. The selection process focused on students who had prior experience using or interacting with generative AI tools, as their familiarity allowed them to provide informed and reflective responses aligned with the study's objectives.

Since the study utilized In-Depth Interviews (IDIs), a manageable and focused sample size was appropriate. A total of 16 participants were selected: four students each from the three schools with larger populations (two per grade level), and two students from each of the two schools with smaller populations (one per grade level). This sampling structure ensured representation across different school contexts and student levels. The final number was determined based on the principle of data saturation—where no new or relevant information emerged from additional interviews (Guest et al., 2006). This sample size allowed for rich, meaningful data without overwhelming the analytical process.

Participants were invited based on their background and experience with generative AI tools. Each invitation included information about the study's purpose, their expected contribution, and the voluntary nature of their participation. Confidentiality was assured, and pseudonyms were used during the transcription and analysis stages to protect participant identities.

Data gathering procedures

Individual in-depth interviews (IDIs) were conducted by the researcher to gain qualitative insights into participants' experiences and perceptions. These interviews used semi-structured questions developed by the researcher, allowing for a deeper exploration of themes identified in the data. This approach provided flexibility for follow-up questions while ensuring that key topics were consistently covered across participants.

Coding

The first step in the analysis process was to code the qualitative data by identifying key words, phrases, or ideas that emerged from the interview responses. This involved reviewing the interview transcripts and highlighting recurring concepts related to the perceived benefits, limitations, usability, impact on science process skills, and emotional responses to using generative AI tools. The goal was to organize the data into manageable categories that captured the essence of the students' experiences and perspectives.

Theme Identification

Once the data was coded, the next step was to group similar codes into broader themes. This process involved identifying patterns and clustering related codes to form themes that represented key aspects of students' experiences. Possible themes included perceived benefits (e.g., improved understanding and personalized feedback), limitations (e.g., technical issues or concerns about dependency), usability (e.g., ease of use or interface issues), impact on science process skills (e.g., critical thinking or data analysis), and emotional responses (e.g., confidence or frustration).



Theme Analysis

After the themes were identified, the analysis moved to examining how each theme reflected students' experiences with generative AI tools. This involved interpreting how the themes explained students' perceptions and behaviors in relation to their science process skills. For instance, the analysis explored whether students felt that AI tools enhanced their scientific reasoning and problem-solving abilities or whether issues like technical difficulties hindered their learning process.

Synthesis and Reporting

The final step involved synthesizing the findings from the thematic analysis into a table, showing the summary and supporting it with a cohesive narrative. The results were used to provide an overall understanding of how generative AI tools impacted students' science process skills, highlighting key themes, benefits, challenges, and emotional responses. The synthesis offered insights into the practical implications of using AI tools in science education, contributing to a deeper understanding of their role in enhancing or limiting students' learning outcomes.

Ethical Considerations

Ethical considerations are critical to ensuring the integrity of the research process, safeguarding participants' rights, and fostering trust between researchers and participants. This study integrates ethical guidelines emphasizing informed consent, voluntary participation, data security, and confidentiality. Informed consent will be obtained from all participants, ensuring they fully understand the purpose, procedures, and potential risks of the study. Additionally, all collected data will be securely stored and anonymized to maintain participants' privacy, with access restricted to authorized personnel only.

Participants were fully informed about the study's objectives, methodology, potential risks, and benefits before agreeing to take part. They received detailed information about the research procedures, the nature of their involvement, and their rights as participants. Written consent was obtained, explicitly outlining their understanding of how their data would be used, including the recording of interviews and its potential for dissemination in academic and public forums. They were also informed of their right to withdraw at any time without penalty.

The study emphasized that participation was entirely voluntary, with participants having the right to withdraw at any stage without any negative consequences. Clear procedures were in place to facilitate withdrawal, ensuring that participants felt comfortable exercising this right if they chose to do so. No participant faced any retribution for opting out of the study.

Data security was a primary concern for protecting participant privacy and confidentiality. All data collected (including interview transcripts, recordings, and other relevant materials.) was securely stored using encrypted digital files. Access was restricted to the research team, and personal identifiers were removed to ensure anonymity. A clear data retention and disposal plan was established, specifying how long data would be kept and the methods for securely destroying it once the study was completed. Additionally, all research activities complied with applicable laws and institutional guidelines on data protection.

Participants' identities were kept confidential throughout the research process, with any identifying information omitted from public reports or publications. Pseudonyms were used when



presenting data to ensure that no participant could be linked to specific statements or responses. This fostered an environment of trust and encouraged participants to share their honest opinions and experiences.

Legal Compliance

All research procedures underwent ethical review by the University Research Ethics Board of Davao Oriental State University. An ethics clearance was obtained to support the study's legal compliance and alignment with institutional ethics policies. The study adhered to the ethical guidelines outlined by the relevant research ethics committees and regulatory bodies, ensuring that participants' rights and privacy were respected at all times.

Conflict of Interest

RESULTS AND DISCUSSION

The researchers affirmed that there were no conflicts of interest that could have influenced the conduct or outcomes of the study. The research was conducted solely for academic purposes, and the findings were reported objectively, free from any bias or external influence. All funding was provided by the researcher alone, without any external sponsorship. Any conflicts that arose during the study were disclosed transparently.

Themes	Core ideas
Research Assistance Tool	Used as a tool for research assistance — for methods, tools, materials.
	Assists in statistical decision-making and research processes.
	Facilitates faster research through access to relevant sources
Learning Guide, Tutor, and	Used for learning difficult concepts and serves as a guide.
Validator of Answers	Perceived as a tutor for independent learning.
	Used to validate answers, especially in math.
	Used to generate practice questions for studying.
	Personal tutor for unfamiliar activities or topics.
	Supplements teacher explanations and gives additional insights.
Convenient Tool for Academic	AI is used out of necessity for academic survival and managing time
Survival and Time	constraints.
Management	AI provides quick solutions when students are time-pressed.
Personalized Learning Partner	AI is perceived as a personalized learning partner and source of everyday
and Friend	information.
	Peer influence and social motivation to use AI.
	AI helps efficiently gather information for assignments.

Table 1: Themes and Core Ideas of STEM Students' Generative AI Utilization.

Research Assistance Tool

Thematic analysis showed that many students use ChatGPT and GitHub Copilot to streamline their academic work, especially research. These tools help students find research methodologies, tools, and resources, according to sample replies. As one said, "AI was somewhat beneficial in enhancing my



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research capabilities... identifying optimal methods, tools, and materials..." (IDI-School A-11.1). Another student said, "We seek assistance from ChatGPT to determine whether to use ANOVA or means" (IDI-School A-11.2). AI improved research efficiency by offering quick access to relevant material and saving time, as one commented, "AI helps by showing the materials I need and summarizing them easily" (IDI-School A-12.1

These claims are aligned to Sasikala and Ravichandran (2024) found that AI systems help students generate research ideas, improve academic text structure and language, and create content. The students' accounts show that AI as a research helper improves academic efficiency and decision-making. Recent studies highlight ethical problems about AI use, even as students tout its benefits. Lee et al. (2024)showed that roughly one-third of students used chatbots during examinations without considering it academic dishonesty. This contradicts students' positive views of AI use, suggesting a gap between technological utility and ethical consciousness. Espartinez (2024) found that only 5% of students knew institutional AI norms, supporting this worry.

Learning Guide, Tutor, and Validator of Answers

AI becomes a learning guide, tutor, and answer validator, promoting students' academic growth and independent study. Several students said AI helps them understand hard concepts and complete academic work. One participant said, "*Not only is AI very useful for understanding concepts that are hard, but it also serves as a guide*" (*School B-11.1*), while another said, "*It's like a tutor*" (*School B-11.2*).(Bommasani et al. (2021) found that AI's individualized learning support improves students' academic performance and learning experiences.

AI tools were used for explanation and verification by pupils. One student said, "I don't use it permanently, but I use it to validate or see my math answers" (School B-11.2). Kanont et al. (2024) found that AI techniques help identify student deficiencies and meet educational demands. A student said, "Sometimes I use AI to input the biology, input the documents here in AI, and then it will generate the questions and answers for me" (School B-11.2).

Students compared AI to a personalized tutor, especially for novel tasks. *I treat AI as my private tutor, sir. School D-12.1*). AI enhances classroom learning by providing deeper perspectives and clarity, as another student stated, "*ChatGPT gives me more insights about that topic*" (*School E-12.1*).

These experiences support Wirzal et al. (2024) findings that AI engages students and personalizes learning. The benefits are clear, but literature raises concerns. According to Zhai et al. (2024), over-reliance on AI may hamper the development of autonomous problem-solving skills. They suggest that while AI increases academic performance and task efficiency, balancing conventional learning methods protects critical thinking and cognitive maturation.

Convenient Tool for Academic Survival and Time Management

Qualitative evidence also shows that AI helps academic survival and time management. With increased academic obligations and limited schedules, students turn to AI tools for practical and timesaving solutions. One student said, "The one that influenced my willingness to use [AI] is... surviving in school, especially with the lack of schedules" (School B-11.1). Another participant said, "If you're in a hurry, you can just use AI" (School B-12.1), emphasizing AI's speed.

Recent research show that AI tools improve students' academic achievement and time management. Walter (2024), pointed out that personalized material, adaptive support, and motivation



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from AI improve learning. Additionally, Jin (2024) also found out that AI integration improved students' comprehension, creativity, and production. And, Eden et al. (2024) found that AI-powered instructional tools reduced study hours and improved GPAs.

The research highlights constraints such AI overuse and difficulty integrating AI into traditional education approaches (Ben Ward et al., 2024). Similarly, results reveal that students who rely on AI for survival rather than skill-building which in turn increase complexity of proper integration.

Students' qualitative perspectives confirm existing material, showing how AI has become a learning aid and survival mechanism in fast-paced academic situations.

Personalized Learning Partner and Friend

Lastly, Students viewed AI as a friend and individualized educational partner, not just a tool. This are in-lined with current research findings, emphasizing the role of artificial intelligence in speeding, democratizing, and engaging education.

A participant observed, "It is more like a friend to me since I would somehow seek information from it—what I would do for daily things." School E-11.1. Similarly, Namjoo et al. (2023) found that AI increases academic performance and provides individualized, adaptive learning experiences outside the classroom. Additionally, Wang et al. (2024) noted that artificial intelligence boosts motivation and creativity, which somehow explains why the participants perceived it as a constant friend in school and life.

"Friends would show me this AI tool, and I'd use it," said another. School E-11.1 According to Ladd and Fiske (2003), peer pressure influences technology adoption, which means that the social context facilitates the integration and regular use of artificial intelligence products. In addition, shared student experiences can boost the perceived usefulness of artificial intelligence, increasing its use and student involvement.

The student added, "I often use them during assignments here... It helps me gather information that easily." School E-11 this remark indicates how AI accelerates student work, since Al Naqbi et al. (2024) found that students who use AI products efficiently reduce study hours and increase GPA. This efficiency drives students back to AI, as Asio (2021) found that AI integration improved time management and task completion.

Conclusion

This study reveals that senior high school STEM students are not merely passive users of generative AI tools—they engage with them in highly meaningful, multifaceted ways. The most striking finding is the perception of AI as a personalized tutor and companion, blending academic utility with emotional and social relevance. Students relied on AI not just for academic assistance but also described it as a "friend," underscoring a deeper level of integration into daily life and learning routines. Additionally, AI is widely valued for boosting research capabilities, especially in navigating methods and statistical decisions, and for providing on-demand tutoring that enhances conceptual understanding and independent study. Finally, AI has become a lifeline for academic survival, helping students manage time pressures and meet academic demands efficiently. These findings collectively point to a paradigm shift in student learning behaviors, where generative AI serves as both a cognitive tool and a personalized partner in education.



Recommendations

Based on the results of the study, the following recommendations are proposed to guide educators, policymakers, and future researchers in thoughtfully integrating generative AI tools into science education while addressing ethical, pedagogical, and practical considerations.

- **Curricular Integration Considerations:** Schools and educators may consider exploring structured ways to integrate generative AI tools into science curricula, potentially enhancing students' learning experiences while maintaining the value of traditional methods of instruction and inquiry.
- **Capacity Building and Support:** Developing training opportunities for teachers and students could support the ethical, critical, and responsible use of AI tools. Such initiatives might help foster digital fluency and encourage meaningful engagement with AI technologies in academic settings.
- **Policy and Equity Discussions:** It may be valuable for the Department of Education and other stakeholders to explore the development of policies or guidelines that address AI integration, focusing on areas such as data privacy, academic integrity, and equitable access across public and private educational institutions.
- **Promoting Critical Engagement:** Encouraging classroom discussions around digital citizenship and critical literacy might help students navigate and assess AI-generated content more thoughtfully, supporting their growth as discerning and responsible users of emerging technologies
- **Directions for Future Research:** Researchers may consider conducting further studies involving larger and more diverse samples to better understand the long-term impacts of generative AI on student learning. Such research could help inform evidence-based practices and guide context-specific implementations of AI tools in education.

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