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Thinking with and Beyond the Tool: High School Students' Use of GenAI During STEM Research Internships

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Abstract: This study explored how high school students engaged with Generative AI (GenAI) tools during a summer STEM research internship program, and how their perceptions and responsible use of GenAI for research evolved. The study is grounded in constructivist learning theory and cognitive apprenticeship to understand student perceptions of GenAI for learning and STEM research. Using qualitative open-ended survey questions and semi-structured student interviews, it showcased how students used GenAI tools like ChatGPT and Gemini across research phases, from summarizing literature, clarifying concepts, coding, and data analysis. Students remained mindful of GenAI's limitations, like hallucinations, while also expressing concerns about being overly reliant. As a preliminary study, this highlights the importance of developing AI literacy in high school students in an authentic, inquiry-based context. The paper also discusses the importance of designing research-based learning environments that strengthen the STEM pipeline while integrating GenAI as a collaborator and thought partner, while encouraging responsible use.

Introduction

The increased integration of Generative AI (GenAI) tools like ChatGPT, Gemini, and Claude in K-12 education continues to underscore the need to study how learners engage and learn with them in different contexts (Mintz et al., 2023). Some studies indicated how students are curious and cautious about using GenAI, primarily using it for brainstorming, problem solving, writing essays, and coding, while also being concerned about misinformation and over-reliance (Bueie et al., 2025). GenAI tools are seen as thought partners and collaborators, and student use is shaped by their instructors, peers, tasks, and learning environments (e.g., Klarin et al., 2024). Not a lot is known about how they engage with these tools in authentic, inquiry-based learning environments, or their understanding of responsible use in contexts beyond their classrooms.

We examine high school students' perceptions and use of GenAI tools in the context of a STEM research internship program where students conducted interdisciplinary research with mentors, while integrating GenAI tools into their activities. The internship program was developed within a research institute at a large midwestern university, in partnership with a public STEM school in the state. The 10-week summer research internship program was designed to provide students from underrepresented backgrounds with opportunities to conduct real-world, interdisciplinary research and mentorship with scientists at the institute.

In this study, we investigated how 13 high school students participated in the summer internship program and used GenAI for their research tasks during the internship. The study focused on how their perceptions and use of GenAI evolved, and how mentorship and collaboration supported their responsible use of GenAI. With the discussion around the use of GenAI in research, understanding how students adopt, reflect, and learn with them is essential to develop future learning systems and strengthen STEM and research career pipelines from a high school level. We address the following research questions with a constructivist and cognitive apprenticeship theory lens.

1. What are high school students' perceptions of using Generative AI tools for STEM research?
2. How did high school students engage with Generative AI tools during the internship to complete various research tasks?
3. What are students' perspectives on ethical and responsible use of GenAI in real-world STEM research?

Theoretical framework

This study is grounded in constructivism and cognitive apprenticeship theory to understand how students perceived and used GenAI in an informal, inquiry-based learning environment, a summer research internship program. Constructivist learning theories posited that learners actively construct knowledge through inquiry, discourse, experience, and reflection (Kalina & Powell, 2009). As active participants, they make meaning through interaction and participation with mentors, peers, and technologies. In the context of the STEM research internship, it is essential to understand their perceptions and processes in a research context. This gap strongly aligns with recent studies that discussed that student use of GenAI is shifting from getting answers towards testing, comparing, and reflecting on them, indicative of developing AI literacy (e.g. Bueie et al., 2025). Drawing from

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constructivist theory, this study explores how students use GenAI in ethical and strategical ways to support their learning.

This study and the research internship draw from cognitive apprenticeship theory (Dennen et al., 2008), which posited that learning happens through guided participation in authentic tasks, as students engage in real-world problems with research mentors. Alongside the guidance and scaffolding from mentors, GenAI tools also provided support when research mentors were unavailable, or in addition to them. Students going to GenAI to seek help to complete research tasks and activities also aided their thinking and learning processes, as they understood the process of providing effective prompts to GenAI, evaluating and checking outputs for misinformation or bias, integrating or contextualizing them to their research project (e.g. Arora et al., 2023; Hmelo-Silver et al., 2007). This study explores how students worked around these processes, while making choices about when and how to use GenAI in the context of academic integrity and responsible use. These two theories support our exploration of the role of GenAI as students engaged with inquiry, problem solving, academic integrity, and responsible usage within an informal, real-world learning context.

Methods

Program background

This study was conducted within the context of a 10-week summer research internship program for high school students, implemented within a large midwestern public university. The program was designed to strengthen experiential and inquiry-based learning opportunities for high school students from underrepresented backgrounds in partnership with their schools. The research institute partnered with a public residential school that developed an "Introduction to STEM research" course to their juniors and seniors. Researchers provided their mentorship availability, project requirements, prerequisite skills and they were matched with the students who applied for the internship through the school. Most research projects were interdisciplinary, applied STEM focused on topics related to climate change, public health, cybersecurity, with AI and machine learning being prominent in developing tools and solutions. Students participated in tasks like data collection, coding, webscraping, literature review, and data analysis with guidance and mentorship from the researchers, provided through weekly task roadmaps, discussions with their research cohort, individual meetings, and progress checks. They showcased their work at the end of the internship as a presentation/poster.

Participants

Thirteen high school students (rising juniors and rising seniors) participated in the 2025 cohort of the internship. Students were selected from applicants who completed the research course and expressed interest in the research projects shared by mentors/researchers.

Research design and data collection procedures

This qualitative research study uses pre-and post-program surveys with open-ended questions and in-depth, sem-structured interviews. All the research procedures were completed after the approval from the university's IRB. Parent/guardian consent and participant assent were obtained for all students. Eleven students completed the pre- and post-surveys, and six students participated in the interviews, all of which were administered online. Survey questions included "What concerns do you have while using Generative AI for your research tasks?", "Describe some research tasks you completed using GenAI during your internship". Interview questions included, "Walk me through your process of approaching a GenAI tool with a question or a task you had to work on during the internship." "What does responsible use of GenAI in your research project mean to you?"

Data analysis

Data from open-ended survey questions and semi-structured interviews was done using thematic analysis (Braun & Clarke, 2006). The first round included open-coding the excerpts from the data sources, followed by cross-comparison of the codes, merging them into categories and themes to answer the research questions. Table 1 provides an example of the coding process.

Table 1

Coding Process

Excerpt	Open Code	Category	Theme/RQ
Coding was the big thing. I knew a bit of Python but not what my mentor asked me to do. I tried doing it on my own, but if it had an error, I give it to the AI and asked for help to fix it.	AI can help parse code.	Student use of GenAI for research tasks.	Using GenAI across research process

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Findings

This section presents the overarching themes that emerged from open-ended survey questions and student interviews, and how they address each research question. The findings indicate how students perceived the role of Generative AI tools in their learning, how they used them to complete various research tasks, and how their use evolved in different ways during the internship period.

RQ1. GenAI as a source of default support

Students shared that Generative AI tools like ChatGPT, Gemini, and CoPilot were very useful and convenient in helping them learn various topics related to the interdisciplinary research they conducted. Most of them have been using GenAI to seek help with schoolwork, and it has encouraged them to learn about new things in a short period of time. Student A said, "Generative *AI tools can certainly impact my motivation to learn by simplifying concepts for me, especially those that might not have been well-taught in class, and therefore bring about a sense of mild dread in students*." GenAI tools were time-saving and efficient in ways that made STEM research more accessible and relevant for them. Most of them perceived GenAI as a collaborator, a thought partner that they reached out to when their research mentor was unavailable or would not respond immediately. "*If I went to my mentor for every question that I had, it would be crazy, I would have so many questions*", said student E.

On the other hand, students also discussed how they often found themselves "Defaulting to AI" or relying too much on it for every task. While they acknowledged the importance of having access to a lot of information and learning opportunities, they were concerned that GenAI is "kind *of like a crutch for me. I never have actually to figure out how to do anything on my own, I can always ask the chatbot*", student C shared. Most students elaborated on how they are becoming too reliant on GenAI, and the need to work through the problem or the task by themselves before seeking help. Student F mentioned,

> If I am getting frustrated with something, I will start to think, oh this would be so easy with ChatGPT, and I could have been done with this by now. It goes back and forth. Sometimes it can be good, but a lot of times it starts to have a negative effect if I just default on to that. I think a lot of students fall into this trap where our first instinct is to go to a GenAI and it can get scary after a while. Once you[I] realize it, I have to take a step back and try to do more work myself.

RQ2. Using GenAI across research phases

Students engaged actively with GenAI tools over the course of their 10-week internship, for various research tasks from literature reviews to data analysis. They mentioned that GenAI was very helpful in filling knowledge gaps, providing foundational knowledge about a research topic they are working on with their mentors.

> I had to get familiar with [topic and tool] because we were creating the graphs. It helped me assimilate things that I would typically find online by searching through somebody's Github or Stack Overflow. It [ChatGPT] was pulling them for me and it made it more efficient with the amount of time it took for me to click through links and find what pertained to my problem.

Almost all students shared that they used GenAI tools primarily to seek help with coding, as using Python for data analysis or building a model or a prototype was central to all the research projects. All the students had a foundational knowledge in Python, which was also a prerequisite skill required for most research projects, and students used GenAI to seek help with writing long codes, parsing, and identifying errors.

> I tried to do it [coding] on my own. I would go through and debug a few things, but after a while, the APIs get messy and the libraries get messy. It [ChatGPT] would help explain what was going on and how to fix the errors and where they were, especially when some of those API errors are not super comprehensive.

Students also discussed that GenAI helped provide them with a structure to solve their problem, a roadmap for the tasks they are working on, and guidance through data analysis. When student A shared a short overview of the tasks for the week and how they envisioned the output, " *it gave me a skeletal structure and simplified things for me because I had never done this before. It helped me work backwards*". Students also shared that they were cautious of not asking GenAI to do any statistical analysis for them or provide them with direct answers. Student F shared, "When *I was doing the data analysis, I did not know how to specifically do the analysis my mentor wanted me to do. I would ask [Chat]GPT, how do I do this? Give me a few examples. And then I would try it myself to get the experience of actually doing it*."

RQ3. The responsible use conundrum

Students viewed responsible use of GenAI in STEM research as being mindful, reflective, and cautious of when and how to use it. Almost all students shared that they would not plagiarize or use AI-generated work as their own. "[*I could] summarize topics for my own understanding and use it for application, but when it is doing your work for you, then that would be an integrity issue.*" They discussed being careful of hallucinations and accuracy in outputs, and noted the importance of verifying information, checking codes, and verifying the resources it provides. Student C shared, "For *research, I felt it was important to double-check because we are doing important work, and I do not want to be wrong. I would check almost all the information it gives.*" Students also talked about the importance of working with GenAI through the process of understanding a topic or solving a problem, rather than merely requesting information and using it to complete the tasks.

Students reiterated the importance of guidance and support from their research mentors. While all of them encouraged students to use GenAI for tasks like summaries, finding sources, or coding, they often provided feedback on how to navigate the tools. "*She said it is good to use ChatGPT, but you should also make sure you understand everything it is doing to generate the graphs [you need].*" Students also mentioned that while they did not reach out to their mentors for every question they had during the internship, they prioritized and valued their time and when and what to seek their advice on.

> I do not think AI should replace going to teachers and mentors. I think the whole point of mentoring is to learn from them. However, for some smaller questions I had, I thought it was something I could research on my own. However, if it is a big question, going to the mentor is nice. It is sort of a balance between: do I want to waste their time or is it a meaningful learning experience for me to be able to talk to the mentor?

Students often felt conflicted about where the line is drawn for using AI responsibly for STEM research. Nearly all of them said that it is responsible use of AI as long as the idea comes from humans, but they also shared concerns about their work "coming off as AI." Student F shared, "*The line is definitely blurry. There are times when I feel that using it makes me seem a little cheap. Because people have succeeded in academia before without ever needing these tools*." However, they also indicated that, taking the time to reflect on the process, learn about new interdisciplinary areas through opportunities like these internships helps them engage with these tools better. "*Through the experience of doing the internship, it definitely changed and applied over to my school life and home life as well, in how I use GenAI tools and what I use them for*", student D said.

Discussion and conclusion

This paper explored how students engaged with GenAI tools during a structured, mentored STEM research internship. Students viewed GenAI tools as collaborative partners that supported their learning and aided the completion of research tasks efficiently. They also discussed being conflicted about being over reliant and the need to reflect on how and what they are using GenAI for, in a research context. Students' use of GenAI as an interactive, collaborative partner to support their understanding of the topics, building on prior knowledge, and their strategic use of the tools aligns with constructivist theory and recent studies (Bueie et al., 2025), which described the role of student epistemic agency in engaging with GenAI. Students also shared that GenAI supplemented, but did not replace, human mentorship. They used GenAI to expand their knowledge about the research topic, get a roadmap to complete their tasks, check errors in their codes or analysis, while also reaching out to mentors to provide updates, seek specific task-related guidance, and share their project progress, while also indicating how they are using GenAI. This informs how students tried to constantly learn responsible use of GenAI, independently and through their mentors (Arora et al., 2023). Even as students reflected on over-reliance and being conflicted in blurred boundaries of ethical AI use, they voiced caution and exercised practices like code verification, seeking sources, and citations.

In conclusion, students saw GenAI as a partner that they need to work with awareness and strategy. This preliminary study speaks directly to the ISLS theme of "Partnering with Purpose" by highlighting how students engage with GenAI tools and research mentors as they actively learn in an authentic research environment. This shows how students learn through inquiry, problem solving, and critical thinking, while partnering with GenAI responsibly. The study underscores the need to design research environments that encourage young students to explore technologies like GenAI while also providing guidance and mentorship to construct their STEM identities.

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