Exploring the Role of Generative AI Tools in Shaping Learning Behaviors in Engineering Education

Mr. Tanzeel Rahman, University of South Florida

Tanzeel Rahman is an undergraduate Computer Science student at the University of South Florida and a Research Fellow in the NSF RED Participatory Action Research (PAR) program. His work focuses on understanding how generative AI tools influence student learning behaviors and help-seeking practices in engineering education. His broader interests include artificial intelligence, engineering education, and human–AI interaction.

Dr. Dhinesh Balaji Radhakrishnan, Purdue University – West Lafayette (College of Engineering)

Dr. Dhinesh Radhakrishnan is a Research Scientist at Purdue University's School of Engineering Education. His research focuses on participatory and community-driven approaches to engineering education, particularly in displacement and marginalized contexts. He has led research and educational initiatives in Kenya, Uganda, Jordan, Zimbabwe, Senegal, and the U.S., co-developing the Localized Engineering in Displacement (LED) program. His doctoral dissertation explored how a Community of Practice (CoP) approach can engage informal educators in Kenya to co-design and teach community-centered engineering education. Currently, he co-leads a reciprocal innovation initiative that bridges CoPs across diverse countries and contexts. His work examines how local engineering knowledge is recognized, revitalized, and integrated into technical education and workforce development, fostering more inclusive and culturally responsive learning models.

Dr. Chris S Ferekides, University of South Florida

Dr. Chris Ferekides has a Ph.D. in Electrical Engineering. He is a Professor and Chair of the Electrical and Computer Engineering Department at the University of South Florida. His research focuses on electronic materials for photovoltaics and other opto-electronic applications, with emphasis on chalcogenide compounds and devices for thin-film solar cells.

WIP: Engineering Students' Use of AI Tools: Qualitative Study of Learning and Help-Seeking Behaviors

Abstract

This Work-in-Progress study examines how engineering students use generative AI tools such as ChatGPT, Claude, and Gemini in undergraduate engineering coursework, including concept-heavy and programming-intensive courses, with a focus on learning behaviors and help-seeking practices. As these tools become widely accessible, students increasingly rely on them to clarify complex concepts, debug code, and support academic tasks. While prior research has examined AI use primarily through surveys and performance outcomes, less is known about how students and instructors describe everyday behavioral changes associated with AI use in authentic learning contexts.

This study adopts a qualitative interview approach using semi-structured interviews with undergraduate engineering students and an engineering instructor. Thematic analysis identified patterns in AI use, perceived benefits and risks, and shifts in study habits and help-seeking behavior. Preliminary findings suggest that students frequently use AI as an on-demand, nonjudgmental source of support that increases efficiency, reduces stress, and builds confidence, while also reducing engagement with traditional resources such as office hours. Instructor perspectives highlight concerns related to over-reliance, shallow learning, and assessment challenges, alongside recognition of AI's potential as a supportive learning tool when used intentionally.

Our study was undertaken to facilitate student-led educational research in engineering and inform insights to supporting departmental changes at a large R1 southeastern university, and through this particular study we contribute early qualitative insights into how generative AI is reshaping learning behaviors and support-seeking practices in engineering education, informing ongoing discussions about the role of AI in teaching, learning, and assessment.

INTRODUCTION

Artificial intelligence (AI) tools such as ChatGPT, Claude, and Gemini are increasingly used by engineering students for academic support [1]. Engineering coursework often involves complex problem-solving, programming, and abstract reasoning [2], and AI tools provide on-demand explanations and guidance outside of class. As these tools become more capable and accessible, students are adopting them for tasks such as understanding difficult concepts, debugging code, and preparing assignments [1]. This growing use presents both opportunities and challenges for engineering education, particularly as instructors navigate changing learning behaviors, help-seeking practices, and concerns related to academic integrity.

We examine how engineering students describe their use of AI tools for academic support and how this use relates to learning behaviors and help-seeking patterns. In addition, we incorporate an instructor perspective on how AI use affects student engagement, skill development, and assessment practices. Rather than focusing on performance outcomes, this study centers on

students' and instructors' descriptions of everyday learning experiences, including how AI influences decisions such as attending office hours, asking questions in class, and studying independently.

This work is informed by self-regulated learning (SRL) theory [3], which conceptualizes learning as an active process involving monitoring, understanding, managing effort, and adjusting strategies in response to feedback. SRL is used as an interpretive lens to examine how students describe using AI tools to regulate learning and seek help during coursework.

Existing research on AI in engineering education has largely relied on surveys and experimental designs, offering valuable insight into general trends but limited understanding of how AI reshapes learning behaviors in authentic contexts. To address this gap, this paper presents a qualitative interview study that provides preliminary insight into how AI tools are being integrated into engineering learning practices. The study addresses the following research questions:

1. How do engineering students describe their use of AI tools in their coursework and studying?
2. How do students' descriptions of AI tools demonstrate their influence on engineering students' learning behaviors and help-seeking practices?
3. How do instructors perceive the role of AI tools in student learning, engagement, and academic integrity?

LITERATURE REVIEW

Recent research suggests that AI tools can support student learning in engineering and higher education by providing explanations, feedback, and study assistance. Bernabei et al. [1] found that engineering students frequently use large language models to clarify concepts and support coursework. Similarly, Bravo et al. [2] reported that AI chatbots can help students understand material more efficiently, though they cautioned that over-reliance may encourage shallow learning. Broader reviews indicate that AI use is often associated with improved engagement and performance, but outcomes depend on how tools are used and structured within courses [4], [5].

At the same time, scholars have highlighted significant risks associated with generative AI in education. AI tools can produce inaccurate or misleading information and may reduce effort, critical thinking, and independent problem-solving when used uncritically [4], [6], [8]. In engineering contexts, where reasoning accuracy and skill development are central, these risks raise concerns about learning quality and long-term competency.

Instructor perspectives further emphasize the need for careful integration of AI into engineering education. Liu [7] noted that effective use of AI requires clear instructional guidelines, thoughtful assignment design, and institutional support. While AI tools offer potential benefits for tutoring and adaptive feedback, their impact depends on how they are introduced and regulated in classroom settings. Despite this growing body of research, less is known about how students and instructors describe the everyday behavioral changes associated with AI use.

RESEARCH METHODS

This study is a student-led project situated within an NSF-funded departmental change initiative at the Department of Electrical Engineering at the University of South Florida. As part of that initiative, a Participatory Action Research (PAR) program supports undergraduate engineering

students in leading, designing, and conducting studies on engineering education topics they identify as important. The intent is for these student-led inquiries to surface student perspectives and inform critical aspects of departmental change. This study employed a qualitative interview design to explore how engineering students and an instructor describe the use of generative AI tools in coursework and learning. A qualitative approach was selected to capture participants' perspectives, experiences, and decision-making processes related to AI use in authentic educational contexts. Ethical approval was obtained from the university's Institutional Review Board for the PAR program, and the university's review board determined that this specific study was a quality improvement project.

Participants and Data Collection

Five participants from the university participated in the study: four undergraduate electrical engineering students and one engineering instructor. Student participants were electrical engineering majors at different academic levels, including one sophomore, two juniors, and one senior. Participants described their frequency of AI tool use as ranging from daily to weekly. All students had experience using generative AI tools such as ChatGPT, Claude, or Gemini for academic tasks including studying, homework, and coding-related activities.

The instructor had seven years of teaching experience in engineering and computing courses, including Python, C, Rust, and COBOL. The instructor reported limited but intentional use of AI tools for instructional support, such as generating assessment questions, and shared observations related to student engagement, assignment quality, and classroom dynamics following the widespread adoption of generative AI tools.

Data were collected through semi-structured, in-person interviews lasting approximately 20–30 minutes. Student interviews focused on familiarity with AI tools, contexts of use, perceived benefits and risks, and changes in study habits and help-seeking behavior. The instructor interview centered on classroom observations, student engagement, assessment practices, and instructional concerns related to AI use. Interviews were not audio recorded; instead, the researcher took written notes during each session and reviewed them immediately afterward to ensure clarity and accuracy.

Participants were selected using purposive sampling to capture perspectives from both students and an instructor. Student participants were recruited through informal outreach within undergraduate engineering courses, while the instructor was selected based on their teaching experience in engineering and computing courses. The inclusion of both students and an instructor was intentional to provide both learner and instructional perspectives on AI use. Participants were not directly supervised by the researcher, which helped reduce potential bias in responses.

Ethical Considerations and Researcher Positionality

Participants were informed of the study's purpose and provided verbal consent prior to participation. No identifying information was collected, and all interview notes were stored securely and used solely for research purposes.

The researcher is an undergraduate engineering student with personal experience using AI tools for coursework. This shared academic context supported rapport and open discussion during interviews. To mitigate potential bias, analysis was grounded in participants' recorded statements, and interview notes were reviewed after each session to support accuracy and consistency. The student researcher, before the start of the research, participated in a month-long engineering

education research training facilitated by an engineering education researcher (the lead for the PAR initiative) from Purdue University, and was also supported by the PAR initiative lead and the department chair during monthly program meetings.

Data Analysis

Interview notes were analyzed using thematic analysis following the approach outlined by Braun and Clarke [8]. The researcher engaged in iterative reading of the data to identify patterns across participant responses. Themes were developed based on relevance to the research questions, recurrence across participants, and interpretive significance related to learning behaviors, help-seeking practices, and instructional perspectives. The analysis is at an early-to-intermediate stage, where broader themes from the data are being triangulated, but future work will identify and use relevant theoretical framing for further interpretation.

FINDINGS

Findings are organized into student and instructor perspectives. Direct participant quotes are used to illustrate themes, followed by brief interpretive descriptions that explain how AI tools shape learning behaviors, help-seeking practices, and perceptions of academic work.

Student Findings

AI as on-demand support for conceptual understanding and coding

All students described using AI tools to support understanding of difficult concepts and assist with coding-related tasks. AI was most commonly used when coursework involved abstract reasoning, multi-step problem solving, or technical errors that were difficult to diagnose independently. Students emphasized that AI helped break problems into manageable steps and enabled iterative questioning without time pressure.

One electrical engineering sophomore described AI as an interactive learning aid, noting that *"I treat it like a study partner. I'll ask it to walk me through a problem step-by-step, and if I don't get it, I'll ask again in a different way."* Similarly, a computer science student described using AI to overcome conceptual barriers in programming, explaining that *"I use it like a rubber duck that talks back. I'll paste a logic error I've been staring at for two hours, and it usually spots the off-by-one error in seconds."* Several students also reported using AI to diagnose low-level programming issues and interpret confusing error messages, reducing time spent troubleshooting.

Across participants, AI functioned as a form of on-demand scaffolding that supported both conceptual understanding and technical problem-solving, particularly when traditional instructional materials felt dense or difficult to navigate.

Shifts in study habits and help-seeking behavior

Students consistently reported changes in how they studied after adopting AI tools, describing fewer interruptions in workflow and less time spent stuck on minor hurdles. One student explained that *"I don't spend as much time hitting the wall anymore. If I'm stuck on a small thing, I just ask the AI and keep going."*

AI use also influenced help-seeking behavior. Most students reported reduced reliance on office hours and fewer in-class questions, often because AI was perceived as more immediate and accessible. As one student noted, *"If I can get a clear explanation at 11 PM from an AI, I'm not going to wait until Thursday for a TA."* Students further described AI as a nonjudgmental resource

that lowered emotional barriers to asking questions. As one student explained, "*It feels easier to ask AI because it doesn't judge you or make you feel like your question is dumb."*

At the same time, some students recognized that relying on AI reduced opportunities for discussion and instructor feedback, particularly the ability to ask follow-up questions, receive clarification tailored to their reasoning, and engage in dialogue that surfaces misunderstandings. As one student reflected, *"You lose that back-and-forth discussion you get with a professor."* These findings suggest that AI has become a first point of support for many students, reshaping traditional help-seeking pathways and altering when and how students engage with instructors.

Perceived benefits and risks of AI use

Students identified several benefits associated with AI use, particularly reduced stress and increased confidence. One student described AI as "*a 24/7 tutor that never gets frustrated*," while others noted that using AI to verify understanding helped them feel more capable in technical coursework.

At the same time, students expressed awareness of risks. Several reported encountering incorrect or misleading information generated by AI, including fabricated resources. As one student recalled, "*It gave me a hallucinated Python library that didn't exist. I spent 30 minutes trying to install it.*" Students also articulated clear boundaries between acceptable explanatory use of AI and inappropriate substitution of effort, indicating active negotiation of ethical limits.

For example, one student noted, "*I use AI to understand concepts, but I don't just copy answers into my assignments.*" Another student similarly explained, "*It helps me figure things out, but if I rely on it too much, I know I'm not actually learning*." These responses suggest that students are actively negotiating how to use AI in ways they perceive as supportive rather than substitutive.

Instructor Findings

Instructor use of AI and changes in student engagement

The instructor interviewed had seven years of experience teaching engineering and computing courses, including Python, C, Rust, and COBOL. They reported using AI tools primarily for instructional preparation rather than direct content delivery. In particular, AI was used to generate and diversify assessment questions within the learning management system, noting that *"Canvas only supports five types of questions. I load the AI with the course materials and ask it to give me ten multiple-choice questions. Doing it multiple times gives me fifty."*

The instructor also observed noticeable changes in student engagement since the widespread availability of AI tools. They reported a sharp decline in student questions and office hour attendance, explaining that *"the number of questions has reduced. No one comes to office hours now."* This reduction limited opportunities to identify and address student misunderstandings during the learning process.

Assignment quality, depth, and assessment challenges

The instructor described changes in student work that raised concerns about depth of understanding. While assignments were consistently submitted and often well-written, they

frequently lacked evidence of underlying reasoning. As the instructor noted, *"their assignments look polished but shallow. Sometimes the writing looks almost too perfect."* This polish made it increasingly difficult to determine whether students could independently explain their work, complicating assessment of conceptual understanding and originality.

Context-dependent encouragement of AI use

The instructor emphasized that their approach to AI varied by course context. In a COBOL course with limited modern learning resources, they explicitly encouraged students to use AI as a learning aid, explaining that *"there isn't a lot of information online for COBOL, so I encouraged them to use AI."* This decision was informed by conversations with industry professionals, who advised that *"if you use AI, you should say yes in interviews. They want people to be honest about it."* At the same time, the instructor stressed that AI should support learning rather than replace it, stating that *"I want students to use it as a tool, not as a replacement."* This example illustrates how instructional context shapes whether AI is framed as a productive support or a potential risk.

Over-reliance, integrity, and future concerns

Despite recognizing potential benefits, the instructor expressed concern about student over-reliance on AI, noting that *"students become over-reliant. They trust the answer even if it is wrong."* The instructor further observed that AI complicates authorship and assessment of originality in student work.

Reflecting on the future of engineering education, the instructor emphasized that AI is unlikely to disappear, stating that *"it's here and it's not going away."* They concluded with a warning to students: *"AI is a tool, not a replacement. If you use it as a replacement, you will be replaced."*

DISCUSSION

This Work-in-Progress study examined how engineering students and an instructor describe the use of generative AI tools in coursework, with a focus on learning regulation and help-seeking behaviors. Interpreted through a self-regulated learning (SRL) lens, the findings suggest that AI tools are increasingly embedded in how students monitor understanding, manage effort, and progress through academic tasks.

From an SRL perspective, students primarily used AI as an on-demand resource to clarify confusion and maintain momentum when encountering conceptual or technical obstacles. This aligns with prior research highlighting AI's role in providing timely feedback and reducing cognitive barriers [2]. Reports of increased confidence and reduced stress further suggest that AI may support motivational components of SRL, including self-efficacy.

At the same time, the findings reveal important tradeoffs. Students frequently described relying on AI explanations to work more efficiently, sometimes at the expense of extended independent problem-solving or reflection. Within an SRL framework, this reflects a shift toward efficiency-oriented strategies that prioritize task completion over deeper cognitive engagement. Prior work similarly cautions that unreflective AI use may encourage surface-level learning [4].

Changes in help-seeking behavior further illustrate this tension. Students reported reduced use of office hours and in-class questions, often because AI was perceived as more immediate and

nonjudgmental. While this lowered emotional barriers to asking questions, it also displaced forms of help-seeking that provide richer instructional feedback and guided reflection. The instructor's perspective reinforced these concerns. Observations of polished but shallow assignments suggest that AI-assisted work can obscure students' underlying reasoning, complicating assessment of conceptual understanding and skill development. Reduced classroom interaction and challenges related to authorship and academic integrity echo existing concerns regarding AI-mediated assessment practices [6], [7].

Importantly, the instructor emphasized that AI use is context dependent. In courses with limited learning resources, such as COBOL, AI was intentionally encouraged as a learning aid rather than restricted. This highlights that instructional context, resource availability, and explicit guidance shape whether AI functions as a productive learning support or a substitute for learning.

Beyond these findings, this study suggests a broader shift in how engineering students engage with learning support systems. Generative AI tools are not simply supplementary resources, but are increasingly becoming primary points of interaction for problem-solving and conceptual clarification. This represents a structural change in how students navigate learning challenges, where immediate, on-demand assistance may replace more effort-intensive or delayed forms of help-seeking such as peer discussion or instructor interaction.

This shift introduces a critical tension between efficiency and depth in engineering learning. While AI tools enable students to overcome immediate barriers and maintain workflow, they may also reduce opportunities for productive struggle, reflection, and iterative reasoning; processes that are central to developing deep conceptual understanding in engineering contexts. The displacement of traditional help-seeking behaviors further raises concerns about the loss of dialogic learning environments where misconceptions can be surfaced and addressed through interaction.

For engineering educators, these findings point to the need to move beyond viewing AI as either a tool to restrict or a tool to adopt uncritically. Instead, there is a need to reconsider how instructional design, assessment practices, and support structures evolve in response to AI-mediated learning. This may include designing assessments that emphasize reasoning and process over final answers, creating structured opportunities for reflection on AI use, and explicitly guiding students on how to engage with AI as a learning support rather than a substitute for thinking.

Finally, the findings raise important questions about how students and instructors negotiate the boundaries between acceptable AI-supported learning and inappropriate substitution of effort. While students demonstrated awareness of these boundaries, the instructor's concerns highlight potential misalignment in how these limits are understood and enacted. Future work should explore these dynamics more deeply, including comparative analysis of student and instructor perspectives, to better understand how ethical and effective AI use can be supported within engineering education.

LIMITATIONS AND NEXT STEPS

This study has a few limitations. The small number of participants from a single institution limits generalizability, and the use of written interview notes rather than audio recordings may have constrained the depth of captured responses. Additionally, the researcher's positionality as an

undergraduate engineering student may have influenced interpretation, though efforts were made to ground analysis in participants' statements.

Future work will expand this investigation to include a larger and more diverse sample across institution and engineering disciplines. Longitudinal data and additional instructor perspectives will further support examination of how AI use evolves over time. Subsequent phases of this research will also explore instructional strategies and institutional frameworks that support reflective, ethical AI use while preserving independent problem-solving and meaningful learning.

ACKNOWLEDGMENTS

This material is based upon work supported by the National Science Foundation under Grant No. 2022299. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.

This study involved the use of generative AI tools for editing and refinement of language. All intellectual contributions, analysis, and interpretations were conducted by the authors.

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