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First Year Engineering Students Artificial Intelligence Use

Dr. Elizabeth Flanagan, Clemson University

Libby Flanagan is a Lecturer in General Engineering at Clemson University. She received her B.S. in Biosystems Engineering from the Clemson University Honors Program in 2017, along with a minor in Spanish Language Studies. She completed a two-year teaching appointment with Teach for America in 2019, where she taught 6th-grade math and computer science in Tulsa, Oklahoma. She earned her M.S. in Biosystems Engineering at Clemson University in 2021, during which she was an NRT Resilient Infrastructure and Environmental Systems Fellow. Libby holds a PhD in Engineering and Science Education with a research focus on empathy in engineering.

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Abstract

This **complete research paper** investigates the early patterns of artificial intelligence (AI) engagement among first-year engineering students prior to formal instruction or policy intervention. A survey administered near the end of the Fall 2025 semester collected self-reported data on frequency and purpose of AI use, trust in AI-generated outputs, verification behaviors, perceived benefits and risks, and engineering identity. A total of 818 students consented to participate. Results show that AI use is nearly ubiquitous among first-year engineering students and is frequently embedded in core academic tasks, including studying concepts, brainstorming, and problem solving. Participants report moderate trust in AI accuracy, lower confidence in its ethicality and potential for bias, and varied verification practices, while a smaller subgroup rejects AI as a learning tool and exhibits significantly lower trust, suggesting principled resistance rather than lack of exposure. At the same time, all participants express strong concern about over-reliance on AI, and high agreement that AI should be used responsibly by professional engineers. These findings suggest that first-year students are already navigating complex relationships with AI, balancing perceived learning benefits with concerns about independence and professional responsibility. The study establishes an important baseline for AI use in engineering education and highlights the need for instructional approaches that emphasize verification, ethical judgment, and reflective AI use as components of professional formation. This work provides a foundation for longitudinal research examining how structured AI literacy instruction influences student practices, trust, and identity over time.

Introduction

Generative artificial intelligence (AI) tools have rapidly become embedded in higher education, reshaping how students access information, generate solutions, and engage with learning tasks. Tools such as ChatGPT, Copilot, Claude, and Gemini are now widely available to students, often at no cost and with minimal barriers to entry. In engineering education, where problem solving, design thinking, and professional judgment are central learning outcomes, the emergence of these tools has sparked both enthusiasm and concern. Faculty and institutions are actively debating how AI should be incorporated into coursework, how its use should be regulated, and what competencies students should develop to use these tools responsibly.

First-year engineering students occupy a particularly critical position in this evolving landscape. These students are simultaneously acquiring foundational technical knowledge and beginning to form their identities as engineers. Early coursework often emphasizes learning how to approach problems, evaluate solutions, and develop confidence in one's own reasoning. The introduction of AI tools into this formative period raises important questions about how students interact with external sources of authority, how they evaluate correctness and credibility, and how they conceptualize their own competence when AI is readily available to generate answers or explanations.

This study aims to establish students' baseline AI engagement, which is essential for several reasons. First, assumptions about student behavior may be inaccurate or incomplete, leading to policies or instructional interventions that do not align with actual student practices. Second, early patterns of trust and reliance on AI may shape long-term learning habits, influencing whether students develop critical evaluation skills or adopt AI outputs uncritically. Finally, without baseline data, it is difficult to assess the impact of AI literacy instruction or to evaluate whether educational interventions meaningfully shift students toward more intentional and ethical use of AI tools.

This study addresses the following research questions:

1. How are first-year engineering students currently using AI tools to support coursework and problem-solving?
2. To what extent do students trust AI-generated outputs, and what factors influence this trust?
3. How do students perceive the role of AI in their learning, identity development, and sense of engineering competence?

Literature Review

The integration of AI in higher education has accelerated rapidly, prompting a growing body of empirical research on how students interact with these tools and the implications for learning, trust, and academic integrity. While rates of first year engineering students in the United States (US) are yet to be published, we can examine the broader context of use in the US, use in higher education, and use among STEM students.

Trust, Ethical Perspectives, and Academic Integrity

Recent work by Lund et al. examined student perceptions of AI-assisted writing and academic integrity across U.S. universities [1]. Their survey of 401 students revealed that ethical beliefs about AI use, more than institutional policy awareness, predicted whether students viewed AI use as misconduct or engaged with AI tools for writing tasks. This illustrates the complexity of trust and ethical decision-making that students navigate in relation to generative AI, with implications for how trust and academic integrity are conceptualized in educational settings. “Interestingly, a student’s broader stance on academic dishonesty—whether they believe cheating is wrong—did not significantly predict how they viewed AI use ($p = 0.333$). This suggests that students may treat AI writing as a distinct category, not merely as an extension of conventional cheating. It may require its own ethical vocabulary” [1, p. 7].

AI Use in the United States

Understanding the broader landscape of AI adoption in the U.S. sets context for student behavior. National surveys reveal that AI use has become widespread across the adult population. A recent nationally representative survey found that “usage peaks among 30–44 year-olds (31%) and remains high for those aged 45–59 (26%) and 18–29 (25%) but then plummets to 8% for adults aged 60 and above. AI use also varies across income levels, rising from 9% usage among earners below $30,000 to 34% among those making $100,000 or more. Men’s overall professional use (25%) slightly exceeds women’s (17%).” [2]. The PEW Center surveyed 5,023 adults from June 9 to 15, 2025, and found 62% of U.S. adults say they interact with AI at least several times a week [3]. Concern around AI use is up from 37% in 2021 to 50% and “younger Americans are also somewhat more likely than older Americans to say it is extremely important for people to understand what AI is” [3, p. 20]. The younger age groups are also more concerned about humans losing the ability to do things with “roughly six-in-ten adults under 30 (57%) say they are extremely or very concerned about this, compared with 46% of adults ages 65 and older” [3,

p. 21]. Although peer-reviewed literature on national AI adoption is still emerging, these large-scale population surveys consistently illustrate rapid integration of AI into everyday life, suggesting that incoming college students bring diverse and substantial prior exposure to AI technologies.

AI Use in Higher Education

A survey of 1,001 U.S. college students found that students' academic disciplines and the type of institution they attended were strong predictors of how often and for what purposes they used AI tools for both writing and coding tasks, underscoring the role of background and context in shaping AI engagement. Older students, particularly those in their 30s and 40s, reported more frequent ChatGPT use than their younger peers. Additionally, non-native English speakers were more likely than native speakers to rely on ChatGPT for writing, highlighting its usefulness as a language support resource. Consistent with expectations, institutions that permitted ChatGPT use saw significantly higher levels of student adoption [4].

Additional research highlights distinctions between academic levels: first-year university students tend to be more cautious or anxious about AI use than their more senior peers, while upper-level students may use AI tools more frequently for complex study tasks [5]. These findings suggest that university students are not a monolithic group and that academic stage plays a role in how AI is used academically and the meanings students attach to that use. In this study, 35% of undergraduate students were STEM students, and 15% were in their first year. An analysis that overlaps these two populations of interest is absent [5].

AI Use in Engineering Students

In one study, first and second-year engineering students (n = 403) were given unrestricted access to a GPT-4.0-based chatbot and could choose whether to incorporate it into their design projects. Results showed that 59.80% of students made substantial use of GenAI, while 40.20% reported minimal or no use. Students who adopted GenAI employed it for activities such as generating and refining ideas, facilitating communication with instructors and teaching assistants, compensating for gaps in non-technical knowledge, and improving design outcomes. In contrast, non-users cited concerns including perceived shortcomings in GenAI-generated content, a mismatch between the tool's capabilities and project requirements, limited experience with effective prompting, and uncertainty about the value of GenAI for their own learning and development. These findings challenge the assumption that university students naturally and uniformly embrace GenAI technologies [6].

Delcker et al. investigated the relationships between first-year students' AI competence (knowledge, skills, and attitudes) and their intended and actual use of AI tools to support learning processes [7]. Through a survey of 638 first-year students across disciplines, the authors found that students' attitudes toward AI significantly predict their intention to use of AI tools. This work highlights that baseline attitudes and competencies shape early engagement with AI technologies, and shows the need for instructional support that builds critical AI skills rather than assuming naive or uninformed usage [7].

Some work has explored first-year engineering students' perceptions of AI-generated performance feedback, summarizing peer feedback in a project-based learning course, suggesting opportunities for using AI to build feedback literacy [8]. An additional exploratory qualitative study examines first-year students' perceptions and use of AI tools, such as ChatGPT, in a freshman design thinking course at a large public university. The study analyzes 179 open-ended survey responses to better understand how students view AI as a collaborative learning tool. The findings highlight the importance of incorporating student perspectives into discussions about AI policy. Students pointed out the weakness in math and programming [9].

Despite increasing attention to the topic, there remain notable gaps in isolating novice engineering learners' baseline behaviors prior to instructional intervention. Most peer-reviewed work to date has either focused on broad undergraduate populations or on specific competencies (e.g., writing, programming) without centering the first-year transition experience or the engineering discipline. The literature also points to the need for longitudinal work that tracks how AI literacy instruction alters use patterns, trust, and professional identity.

Methodology

Data for this study was collected from the entire cohort of the first-year general engineering course at a large R1 institution in the southeast of the United States from November 20 to December 10, 2025. The institution of study is a large land-grant university that accepted 42% of first-year applicants in 2025. The incoming class in 2025 included 5,084 students, of which 680 were first-generation students. Survey items asked about self-reported frequency and purpose of AI use, levels of trust, and perceived benefits and risks of AI. The survey was offered as a completion grade for the course, in which students did not have to participate in the research to receive full credit for the assignment (IRB approval #2025-1243).

A total of 818 general engineering students, representing 68.7% of the 1,190 incoming cohort, consented to participate in the study and were over the age of 18. Self-reported race is shown in Table 1 below.

Table 1. Responses to "Choose one or more races that you consider yourself to be"

Options	Count
White or Caucasian	666
Asian	69
Other	46
Black or African American	44
Prefer not to say	22
American Indian/Native American or Alaska Native	9
Native Hawaiian or Other Pacific Islander	6

Of participants who reported demographic information, 782 were between 18 and 24 years old, and 8 were between 25 and 34 years old, with 554 male, 221 female, and 13 in other categories, including non-binary, prefer to self-describe, or not to say. Students' intended engineering disciplines are shown in Figure 1.

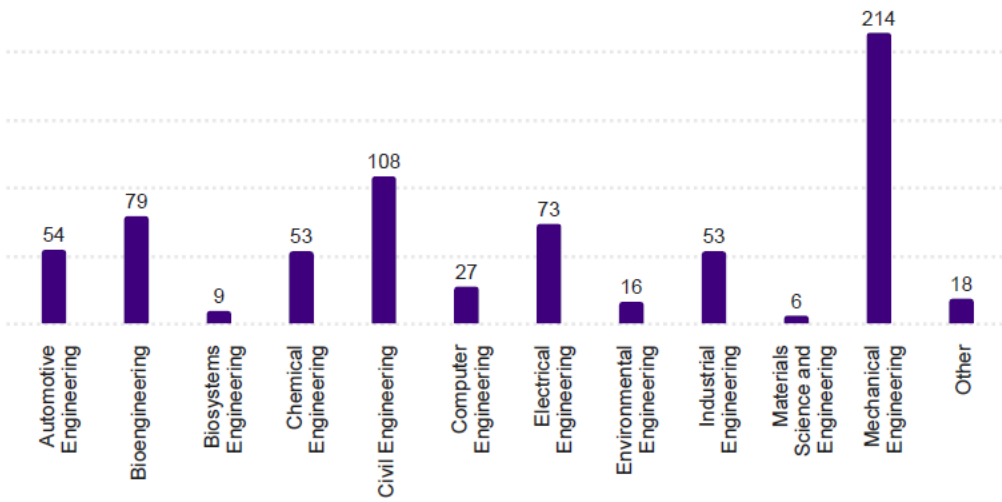

Figure 1. Intended Engineering Major

The demographic information and rates of intended majors of those who consented to participate is aligned with the overall first year cohort.

Results

Prevalence and Frequency of AI Use

AI tool use was nearly ubiquitous among first-year engineering students surveyed. Prior to the start of the semester, 89% of respondents (720 students) reported having used an AI tool such as ChatGPT, Copilot, or Gemini. By the time of survey administration during the semester, reported AI use increased to 94% (757 students), indicating that exposure and adoption expanded rapidly once students entered the course environment.

Frequency data, shown in Figure 2, further demonstrate that AI use was not occasional. A substantial portion of students reported using AI tools multiple times per week or more frequently. Specifically, 161 students reported daily use, while 150 students used AI tools 4–6 times per week, and 266 students used them 2–3 times per week. Fewer students reported infrequent engagement, with 112 students using AI once a week, 16 once a month, 81 rarely, and 23 never. Together, these results suggest that for many first-year engineering students, AI tools are already embedded into regular academic and personal workflows.

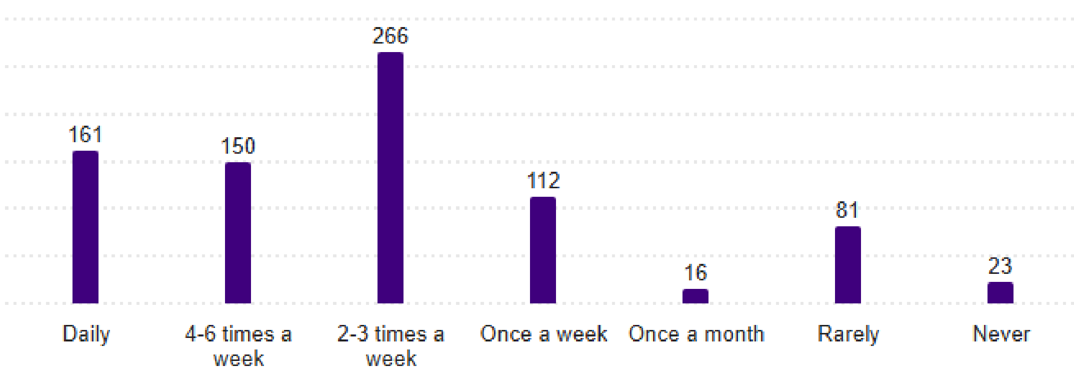

Figure 2. Responses to “About how often do you currently use AI tools for academic or personal purposes?”

Academic Tasks Supported by AI

Students reported using AI tools across a wide range of academic tasks, Figure 3, with particularly high engagement for conceptual support and problem solving. The most frequently selected task was studying or explaining concepts, reported by 715 students, followed by brainstorming ideas or problem-solving, selected by 538 students. AI was also commonly used for solving problems (410 students) and writing new problems (317 students), indicating use beyond surface-level assistance and into core cognitive tasks.

More traditional academic support uses were also reported, including writing or editing text (205 students) and coding or debugging programs (130 students). Less common but still notable uses included completing assignments (119 students), creating graphics or figures (89 students), modifying existing problems (96 students), and other uses (40 students). These patterns highlight the breadth of AI integration in students' academic work, spanning explanatory, generative, and evaluative functions.

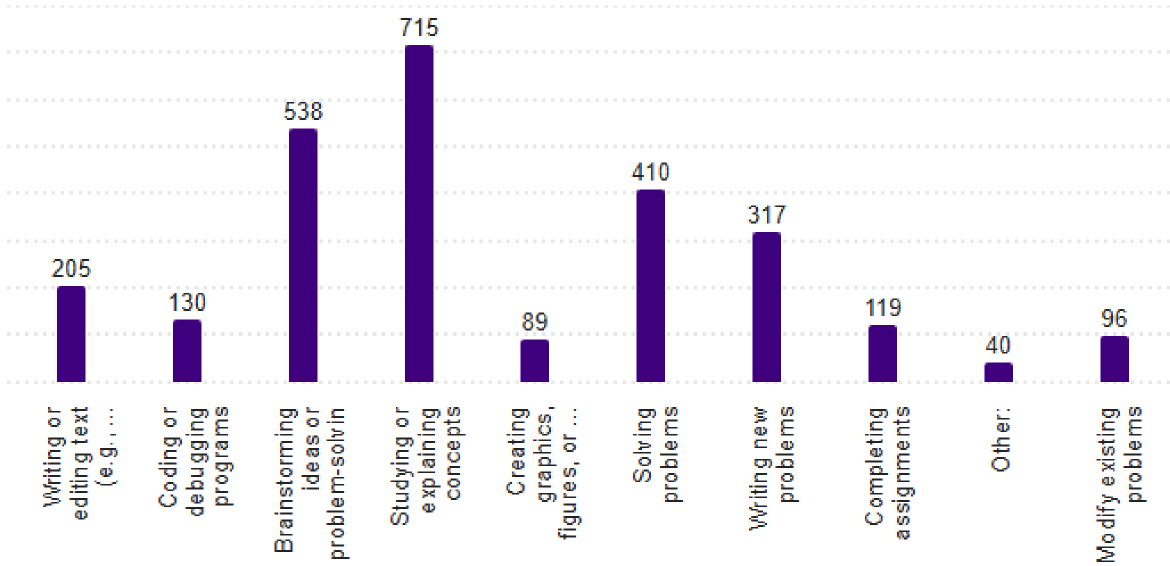

Figure 3. Responses to "What types of academic tasks have you used AI tools for? [Select all]"

Confidence in AI Outputs

When asked about their confidence in AI-generated responses, students expressed moderate trust, with notable distinctions between perceived accuracy, ethics, and bias as shown in Table 2. On a five-point scale, students reported a mean confidence of 3.19 that AI responses are accurate. Confidence was lower for ethical considerations, with a mean of 2.96 for ethicality and 2.97 for unbiased responses. These results suggest that while students are moderately confident in AI correctness, they are more uncertain about the ethical and impartial nature of AI outputs.

Table 2. Response to "When using AI for coursework, how confident are you that the AI's response is …." on a Likert-like 5-point scale

Field	Mean	Standard Deviation	Variance	Responses
accurate?	3.19	0.79	0.63	791
ethical?	2.96	1.08	1.17	746
unbiased?	2.97	1.16	1.34	748

Tools Used Most Frequently

Among AI tools, ChatGPT (free version) dominated student use, reported by 472 students as their most frequently used tool. Smaller but notable groups reported using ChatGPT (paid) (94 students), Copilot (91 students), Gemini (92 students), Claude (6 students), and other tools (53 students). This distribution reflects both accessibility and brand familiarity, shaping early AI adoption.

Understanding, Judgment, and Verification Practices

Students generally expressed confidence in their ability to make judgments about AI use, even when their understanding of AI mechanisms was more moderate, as shown in Table 3. Students reported a mean agreement of 3.30 that they understand how AI tools generate responses, and 3.41 that they know the limits of what AI can do well. Higher agreement was observed for evaluative judgment, with a mean of 3.78 for recognizing inaccurate or biased AI answers.

Notably, students expressed strong confidence in knowing when it is appropriate to use AI in coursework. Students also reported feeling comfortable explaining their AI use to instructors.

Table 3. Response to "How much do you agree with the following statements" on a Likert-like 5-point scale

Field	Mean	Standard Deviation	Variance	Responses
I understand how AI tools generate their responses.	3.30	1.06	1.13	780
I know the limits of what AI can do well.	3.41	1.06	1.13	787
I can recognize when an AI answer seems inaccurate or biased.	3.78	0.88	0.77	791
I know when it is appropriate to use AI in my coursework.	4.54	0.73	0.53	796
I feel comfortable explaining my AI use to an instructor.	3.95	1.10	1.20	788

Verification behaviors varied as shown in Figure 4. While 130 students reported always verifying AI outputs and 333 reported often verifying, a sizable number reported sometimes (201) or rarely (110) verifying, and 33 students reported never verifying AI-generated responses.

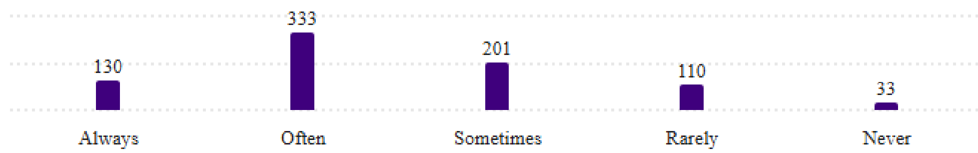

Figure 4. Response to “How often do you verify AI-generated responses using another source (textbook, code execution, instructor feedback, reference checking, etc.)?”

Perceived Impact on Learning, Identity, and Independence

Students’ perceptions of AI’s role in their learning and identity reveal a nuanced relationship, as shown in Table 4. Agreement that using AI makes them feel more capable as engineering students was moderate (mean = 3.05), while agreement that AI helps them understand engineering concepts more deeply was higher (mean = 3.61).

At the same time, students expressed strong concern about over-reliance: agreement with the statement that relying on AI too much could harm independent thinking was high (mean = 4.44). Students overwhelmingly agreed that AI is a tool professional engineers should know how to use responsibly, and most reported a strong engineering identity, agreeing with “I see myself as an engineer.”

Table 4. Response to “To what extent do you agree with the following statements?” on a Likert-like 5-point scale

Field	Mean	Standard Deviation	Variance	Responses
Using AI makes me feel more capable as an engineering student.	3.05	1.09	1.19	756
Using AI helps me understand engineering concepts more deeply.	3.61	1.11	1.24	773
Relying on AI too much could harm my ability to think independently.	4.44	0.93	0.86	797
AI is a tool that professional engineers should know how to use responsibly.	4.29	0.89	0.78	790
I see myself as an engineer.	4.21	0.99	0.98	795

Students who reported not using AI tools (52) exhibited a distinct pattern of responses (*t-test, $p < 0.05$), shown in Table 5. These students reported low agreement that AI enhances capability or supports deeper understanding, alongside strong agreement that over-reliance could harm independent thinking and that AI is a tool professional engineers should use responsibly. Taken together, these findings suggest that non-users may be actively resisting AI integration based on concerns about learning and professional integrity, rather than a lack of awareness or access.

Table 5. Response to "To what extent do you agree with the following statements?" on a Likert-like 5-point scale for students who reported not using AI

Field	Mean	Standard Deviation	Variance	Responses
Using AI makes me feel more capable as an engineering student.	1.82*	1.09	1.19	44
Using AI helps me understand engineering concepts more deeply.	2.18*	1.19	1.42	44
Relying on AI too much could harm my ability to think independently.	4.25	1.22	1.48	51
AI is a tool that professional engineers should know how to use responsibly.	3.48	1.16	1.34	46
I see myself as an engineer.	3.90	1.19	1.41	50

Students who reported not using AI tools expressed generally low confidence in the quality of AI-generated outputs, as shown in Table 6. These values are lower (*t-test, $p < 0.05$), than those observed in the full sample (shown in Table 2), indicating a more skeptical orientation toward AI systems. The relatively consistent ratings across accuracy, ethics, and bias suggest that non-users do not differentiate strongly between technical and ethical concerns, instead viewing AI outputs as broadly unreliable. This pattern reinforces the interpretation that non-use may be driven, at least in part, by low trust in AI performance and credibility, rather than simply a lack of exposure or opportunity to engage with these tools.

Table 6. Response to "When using AI for coursework, how confident are you that the AI's response is …." on a Likert-like 5-point scale for students who reported not using AI

Field	Mean	Standard Deviation	Variance	Responses
accurate?	2.08*	0.88	0.77	40
ethical?	2.02*	0.95	0.90	41
unbiased?	2.26*	1.09	1.19	38

Skill, Trust, and Responsibility

When asked to self-assess their prompt-writing skill, most students rated themselves as moderately skilled (294 students), with fewer reporting being skilled (167) or very skilled (50). Lower self-ratings were also common, with 116 students reporting not skilled and 175 slightly skilled.

Trust in AI to support learning was most frequently described as moderate. 343 students reported trusting AI a moderate amount, while 250 trusted it a little, 118 a lot, and 22 a great deal. In contrast, 66 students reported no trust at all.

Responsibility for verification was rated relatively high. A majority reported feeling responsible (336 students) or very responsible (170 students) for verifying AI-generated content, compared to 190 somewhat responsible, 78 slightly responsible, and 22 not responsible.

Discussion

This study provides an early snapshot of how first-year engineering students are already engaging with generative AI tools prior to formal instruction or explicit policy guidance. The findings reveal a student population that is not experimenting tentatively with AI, but rather integrating it deeply into academic workflows while simultaneously expressing caution, ethical awareness, and concern about over-reliance. Interpreted through the lenses of AI literacy and identity formation, these patterns suggest both opportunities and risks for engineering education.

AI Use as a Normative Academic Practice

Given that this was self-reported data, use may even be higher than the percentage reported here. The near-universal use of AI tools among first-year engineering students suggests that AI engagement is already normalized by the time students enter required introductory courses. The rate of use among this population is higher than that reported in years past or by national survey data, suggesting larger adoption as time has gone on and within first year engineering students [2], [3], [4]. Rather than viewing AI as an external or optional technology, many students appear to treat it as a routine support for studying, explaining concepts, brainstorming, and solving problems. This normalization has important implications for AI literacy instruction: students are not beginning from a position of unfamiliarity, but rather from established habits, assumptions, and expectations about AI's role in learning.

Importantly, the breadth of reported academic uses, particularly for conceptual understanding and problem solving, indicates that students are not limiting AI to surface-level tasks such as editing or formatting. Instead, AI is being positioned as a cognitive partner in tasks that traditionally play a central role in the development of engineering thinking, as echoed by [6]. This raises critical questions about how students differentiate between productive support and the substitution of their own reasoning, reinforcing the need for AI literacy frameworks that emphasize intentionality rather than prohibition.

Trust, Skepticism, and Emerging Critical Judgment

Students' moderate confidence in AI's accuracy, combined with lower confidence in its ethicality and bias, points to an emerging yet incomplete form of critical AI literacy. On one hand, students express confidence in their ability to recognize when AI responses are inaccurate or biased and report strong agreement that they know when AI use is appropriate. On the other hand, verification behaviors are inconsistent, with a meaningful subset of students reporting infrequent or nonexistent checking of AI outputs.

This tension suggests that students may believe they possess evaluative skill without consistently enacting it in practice. Such a gap between perceived competence and behavior is particularly important in first-year contexts, where students are still calibrating their confidence and developing workflows. AI literacy instruction that makes verification strategies explicit and ties them to disciplinary norms of engineering practice may help align students' self-perceptions with more reliable evaluative behaviors.

Non-Users as a Distinct Subpopulation

A closer examination of students who reported not using AI tools reveals a distinct subpopulation whose perceptions differ meaningfully from those of the broader cohort, similar to other previous results [6]. Non-users reported significantly lower agreement that AI enhances their capability or supports deeper conceptual understanding. These findings stand in sharp contrast to the full sample, where students generally viewed AI as a beneficial support for learning. At the same time, non-users expressed strong agreement that over-reliance on AI could harm independent thinking, a concern shared across the full sample. Non-users reported lower agreement that AI is a tool professional engineers should use responsibly, indicating a weaker alignment between AI use and their conception of engineering professionalism. Their relatively high agreement with "I see myself as an engineer" suggests that this skepticism is not due to disengagement from the field, but rather reflects a different interpretation of what it means to think and act like an engineer. This skeptical orientation is further reinforced by non-users' significantly lower confidence in AI outputs across accuracy, ethicality, and lack of bias.

Taken together, these findings indicate that non-users represent a coherent and meaningful subgroup characterized by low perceived value, low trust, and partial misalignment with prevailing views of AI in engineering practice. Rather than viewing them as lagging adopters, it may be more appropriate to interpret this group as expressing principled resistance grounded in concerns about learning, credibility, and professional integrity. For educators, this highlights the importance of addressing not only how to use AI responsibly, but also why AI might be considered a legitimate and valuable tool within engineering, while still engaging seriously with the concerns raised by students who remain skeptical.

AI Literacy as Professional Formation

One of the most striking patterns in the data is students' strong agreement that AI is a tool professional engineers should know how to use responsibly, paired with concern that excessive reliance on AI could undermine independent thinking. This dual perspective reflects an early professional orientation: students are not rejecting AI, nor are they embracing it uncritically. Instead, they are beginning to situate AI within a broader understanding of engineering responsibility, judgment, and ethical practice.

From an identity formation perspective, this suggests that AI literacy is already intertwined with how students imagine themselves as future engineers. Students largely report seeing themselves as engineers, and their views of AI reflect professional values such as responsibility, competence, and accountability. This alignment presents an opportunity for educators to frame AI literacy not as compliance with rules, but as part of becoming an engineer who can collaborate effectively and ethically with powerful computational tools.

First-Year Identity Development and Confidence

Students' moderate agreement that AI makes them feel more capable as engineering students, alongside stronger agreement that it helps them understand concepts more deeply, suggests that AI may function as a confidence scaffold during the first year. For novice learners navigating challenging material, AI tools may reduce cognitive load or provide reassurance, supporting persistence and engagement. However, this same scaffolding may become problematic if it substitutes for productive struggle, inhibits the development of independent problem-solving skills, or provides false information. The fact that students simultaneously express concern about over-reliance indicates awareness of this risk, even if they have not yet developed effective strategies to manage it. AI literacy instruction that explicitly addresses this balance, helping students decide when and how to use AI, may support healthier identity trajectories.

Implications for AI Literacy Instruction

Taken together, these findings suggest that effective AI literacy instruction for first-year engineering students should move beyond tool demonstration or policy explanation. Students already use AI extensively and hold nuanced beliefs about its benefits and risks. What they appear to need is structured guidance that helps them:

- Translate ethical awareness into consistent verification practices
- Distinguish between AI use that supports learning and use that undermines skill development
- Connect AI use to professional engineering norms rather than short-term academic performance

By grounding AI literacy in identity formation, framing responsible AI use as part of "thinking like an engineer" educators may better support students in developing reflective, intentional relationships with AI tools.

Establishing a Baseline for Longitudinal Change

Finally, this study establishes an essential baseline for understanding how AI engagement evolves over time. As institutions implement AI policies and instructors introduce explicit AI literacy instruction, future research can examine how students' trust, behaviors, and identity alignment shift. Longitudinal comparisons will be particularly valuable for determining whether structured instruction strengthens critical evaluation, reduces unreflective reliance, and supports professional identity development.

Limitations

Several limitations should be considered when interpreting the findings of this study. First, the data are based entirely on self-reported student responses, which are subject to recall bias, social desirability bias, and potential inaccuracies in students' perceptions of their own behaviors. For example, students may overestimate their ability to detect inaccurate or biased AI outputs or underreport behaviors that they perceive as academically questionable. Similarly, reported frequencies of AI use and verification practices may not fully reflect actual behavior in real time.

The study was conducted at a single large R1 institution in the southeastern United States within one first-year engineering program. While the demographic alignment between participants and the broader cohort supports internal validity, the findings may not generalize to other institutional contexts, such as smaller colleges, community colleges, or institutions with different student populations, levels of AI access, or instructional policies. Differences in discipline, course structure, and faculty guidance may also shape AI use in ways not captured here.

Participation was voluntary, and although the response rate was relatively high (68.7%), there remains the possibility of nonresponse bias. Students who chose to consent to the study may differ systematically from those who did not, particularly in their attitudes toward AI, their level of engagement, or their comfort with disclosing their practices.

The cross-sectional design captures a single snapshot of student behavior near the end of the Fall 2025 semester. As such, it cannot account for how students' AI use, trust, and perceptions evolve over time, nor can it establish causal relationships between AI use and outcomes such as learning, confidence, or identity development. Given the rapid pace of AI tool development and changing institutional policies, student behaviors observed in this study may shift quickly, limiting the temporal generalizability of the findings.

Finally, the survey instrument simplifies complex constructs such as engineering identity, ethical reasoning, and AI literacy into Likert-scale responses. While useful for identifying broad patterns, these measures may not fully capture the nuances of students' experiences or the contextual factors that influence their decisions. Future work incorporating qualitative methods, behavioral data, and longitudinal designs would provide a more comprehensive understanding of how students engage with AI and how those practices develop over time, particularly in response to the rapidly evolving capabilities of AI tools and the introduction of structured instructional interventions.

Conclusions

This study provides an early empirical snapshot of how first-year engineering students engage with generative AI tools prior to formal instruction or explicit policy intervention. The findings demonstrate that AI use is already widespread, frequent, and deeply embedded in students' academic practices. Students are using AI not only for peripheral tasks, but for core learning activities such as studying concepts, brainstorming solutions, and solving engineering problems. At the same time, students express nuanced perspectives: moderate trust in AI outputs, awareness of ethical and bias-related concerns, and strong agreement that AI should be used responsibly within professional engineering practice.

Taken together, these results highlight a critical reality for engineering educators: first-year students are not waiting for permission or guidance to use AI. Instead, they arrive with established habits, assumptions, and emerging beliefs about AI's role in learning and competence. Ignoring or attempting to prohibit AI use risks disconnecting instruction from students' lived experiences. Conversely, treating AI as an unquestioned solution risks undermining the development of independent thinking and professional judgment that are central to engineering education. The results of this study establish a foundational baseline for longitudinal analysis. As structured AI literacy instruction is introduced in subsequent semesters, future work will examine how students' trust, behaviors, and professional identities evolve over time. Such longitudinal insights will be essential for determining which instructional strategies most effectively support responsible, reflective, and competence-building AI use.

Implications for Instructional Practice

1. Shift from prohibition to intentional integration.
Given the prevalence of AI use, blanket restrictions are unlikely to be effective. Instead, instructors should design assignments that explicitly acknowledge AI as a possible tool and require students to articulate how and why they used it. This approach aligns with students' existing behaviors while encouraging reflective, transparent, and ethical engagement.

2. Teach verification as an engineering skill.
While many students report confidence in recognizing inaccurate or biased AI outputs, verification practices are inconsistent. Instruction should frame verification not as an academic integrity requirement, but as a core engineering competency. Activities that require students to test AI-generated solutions, compare them with analytical methods, or validate outputs against physical constraints or known principles can reinforce disciplined skepticism.

3. Address AI skepticism.
A subset of students demonstrates low trust in AI and rejects its value for learning, suggesting principled resistance rather than lack of exposure. Instructional approaches should engage these students by critically examining both the limitations and legitimate applications of AI in engineering practice. Rather than assuming universal adoption, educators should create space for evaluating when AI use is appropriate, when it is not, and how professional engineers balance tool use with independent judgment.

4. Connect AI literacy to professional identity.
Students strongly agree that professional engineers should know how to use AI responsibly, suggesting an opportunity to embed AI literacy within identity formation. Instructors can emphasize that responsible AI use reflects professional values such as accountability, judgment, and ethical reasoning, positioning AI literacy as part of becoming an engineer rather than merely completing coursework.

5. Support productive struggle and independence.
Students recognize the risk that over-reliance on AI may harm independent thinking. Instructional scaffolds, such as staged problem-solving, partial AI use restrictions, or reflection prompts can help students learn when AI support is beneficial and when it interferes with learning. These strategies support confidence development without eliminating necessary cognitive challenge.

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