IF AI WRITES, WHO THINKS? STUDENT PERCEPTIONS IN CDIO EDUCATION

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ABSTRACT

This study investigates engineering students' perceptions of AI-assisted writing, thinking, and feedback within a CDIO-based curriculum. Using an open survey, the research examines how students interact with AI tools for tasks such as brainstorming, structuring reports, and improving writing quality, while exploring where cognitive engagement occurs. The study finds that AI is primarily used as a supportive tool for organization, drafting, and clarity, rather than a replacement for human reasoning. Students report that critical thinking and conceptual learning occur mainly during prompting, reviewing, and reflecting on AI-generated outputs. Feedback is most effective when it emphasizes reasoning over text quality, and students value interactive, authentic assessment methods such as oral exams, live demonstrations, and lab work. These findings align with CDIO principles, highlighting the need for competency-based learning that integrates technical knowledge, professional skills, and reflective thinking. Overall, the results underscore the importance of designing curricula that support student ownership of learning and active reflection, ensuring AI serves as a learning enhancer rather than a replacement for human thought.

KEYWORDS

Generative AI, Engineering Education Research (EER), Student Perceptions, CDIO Standard 8, CDIO Standard 11.

INTRODUCTION

This study investigates student perceptions of the relationship between writing, thinking, and learning within the context of AI-assisted academic work, emphasizing its relevance to the CDIO Standards for engineering education and building on the institutional curriculum framework documented by Atayeva, Garlyyeva, and Orazov (2023). The survey, titled “Writing vs. Thinking: The AI Dilemma,” was designed to explore how students conceptualize cognitive effort when artificial intelligence tools, such as ChatGPT, are used for coursework. The broader purpose of the survey is to inform ongoing debates in engineering education regarding academic integrity, learning authenticity, and assessment design. Given that AI tools are becoming ubiquitous in professional engineering workflows, this study specifically investigates their influence on learning experiences and their alignment with CDIO standards for continuous improvement in education and skills development (Moreno, Decker, & Leicht-Scholten, 2024).

The target population consists primarily of undergraduate and postgraduate students, with a strong representation from engineering and technology disciplines, ensuring relevance to CDIO’s focus on preparing students for both technical excellence and professional competencies (Kimpton, Maynard, & Azouz, 2024). This study also contributes to discussions on how AI can support the development of personal and professional skills as part of a comprehensive engineering education (Zéraï & Mosbeh, 2024).

Methodology

Data were collected through an online survey and exported into an Excel spreadsheet for analysis. The final dataset comprised 68 valid responses. Initial preprocessing involved screening for completeness, identifying variable types, and categorizing responses into quantitative and qualitative components. To ensure content validity, the survey instrument was reviewed by two experts in engineering education and piloted with five non-participating students to confirm the clarity of the Likert scales and open-ended questions. The survey structure employs a mix of descriptive and inferential methodologies to address student perspectives on AI-assisted writing, aligning with the CDIO framework’s focus on integrated learning and reflection.

For clarity, "coursework" was defined within the survey instructions as including various written assignments such as lab reports, problem sets, and design projects.

Likert-scale items were treated as ordinal data and summarized using descriptive statistics, consistent with CDIO’s emphasis on evidence-based decision-making (UNESCO, n.d.). Open-ended responses were analyzed using qualitative thematic analysis to identify recurring patterns in student perceptions. This analysis adheres to ethical standards for educational research, with minimal missing data handled through listwise exclusion for item-level analysis.

Given the emerging nature of Generative AI integration in engineering curricula, this research is designed as an exploratory pilot study. With a sample size of N=68, the analysis prioritizes descriptive reporting and categorical frequency over broad statistical inference, aiming to identify baseline trends within the institutional context.

Data Description

The final sample consisted of 68 respondents, with a majority identifying as engineering or technology students. The inclusion of students across various academic stages reflects the

CDIO commitment to developing competencies progressively across the academic lifecycle (Zéraï & Mosbeh, 2024), providing diverse perspectives on skills progression. Figure 1 shows the demographic breakdown of survey respondents by academic stage.

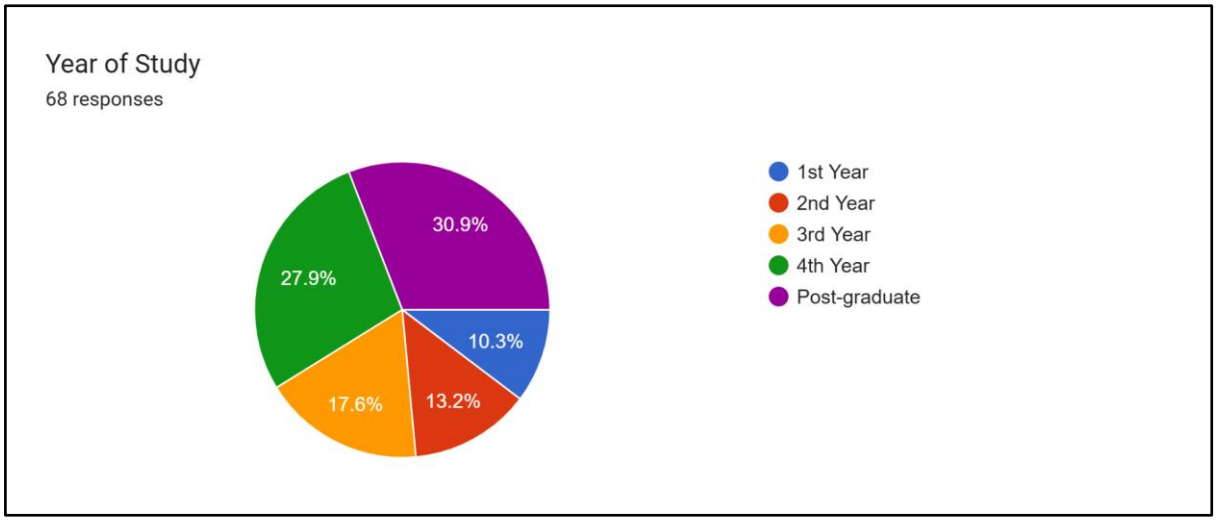


Figure 1. Demographic breakdown of survey respondents by academic stage

The survey's mixed-methods design integrated closed-ended questions, including Likert-scale items and frequency measures, alongside open-ended questions exploring students' views on where "real thinking" occurs when AI is used, and which assessment formats best demonstrate genuine understanding. Key variables measured included AI tool usage frequency, perceived cognitive engagement, ownership of ideas, and preferences for assessment formats, all central to CDIO's focus on student-centered education and professional growth (Kimpton et al., 2024).

Key Findings

Analysis of the survey data (N=68) revealed consistent patterns in AI adoption. Tool usage was widespread, with most respondents reporting occasional to frequent use of Generative AI for academic tasks, such as coding and conceptual brainstorming. As shown in Figure 2 (where 1 = Never and 5 = Daily), the majority of students (n=29; 42.6%) reported occasional use, while a smaller subset (n=10; 14.7%) reported frequent engagement. This trend reflects the integration of modern engineering tools into the academic process, aligning with CDIO Standard 7 (Integrated Learning Experiences). By utilizing AI to assist in disciplinary problem-solving, students are participating in an integrated learning environment where technical tools support the acquisition of professional skills. These findings suggest that AI engagement is transitioning from a peripheral novelty to a mainstream component of the engineering academic workflow.

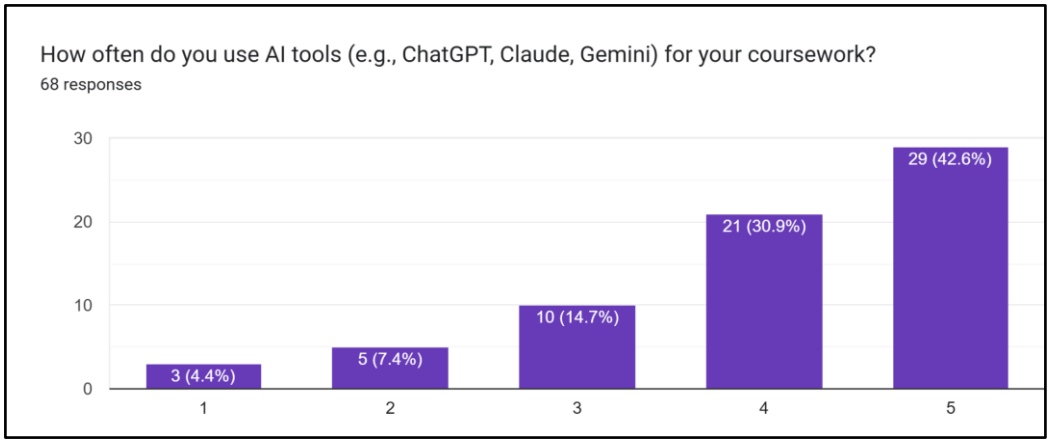
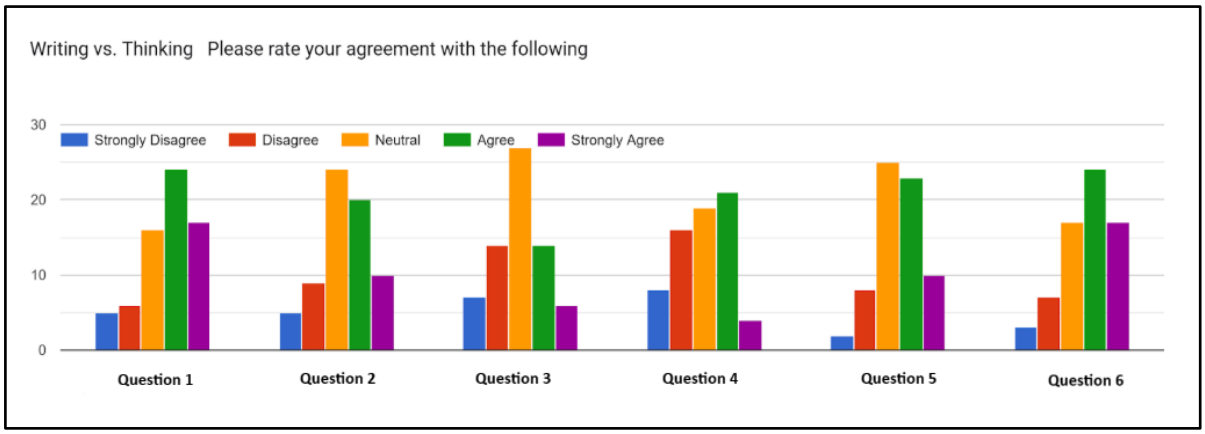


Figure 2. Frequency of AI tool usage among survey respondents

Second, students rejected the notion that AI use eliminates thinking. In line with the CDIO Syllabus for Personal and Professional Skills, students generally perceived that cognitive effort still plays a significant role in the process of using AI. Agreement levels were higher for statements suggesting that thinking continues during prompting, reviewing, and editing AI-generated outputs. Figure 3 illustrates mean agreement scores on the role of cognitive effort in AI-assisted writing. This reflects students' understanding of responsible AI use, which requires them to critically engage with AI outputs. The results also reflect a shared belief that AI tools aid, but do not replace, human intellectual effort (The Conversation, 2025a).

The following data represent the frequency of student responses (N=68). In line with the study's exploratory framework, these findings are intended to illustrate localized perceptions rather than to assert universal statistical significance.

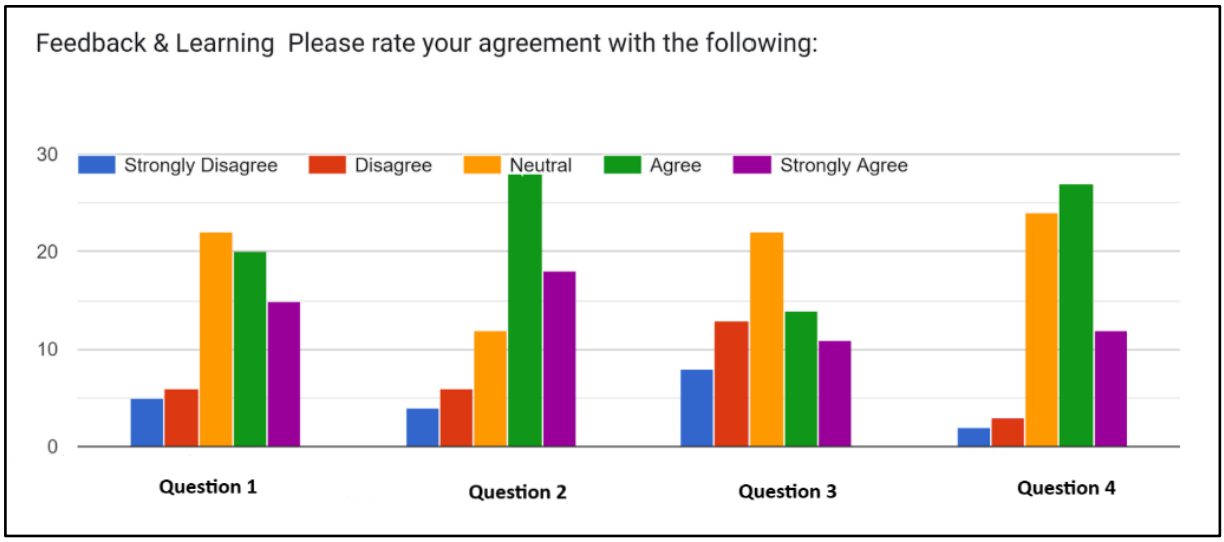


ID	Survey Question Statement
Q1	The process of writing helps me clarify my own thinking
Q2	High-quality writing is a reliable indicator of a student's understanding
Q3	AI can produce professional text without "understanding" the engineering logic

Q4	When using AI, most of my thinking happens during the "prompting" stage rather than the "writing" stage
Q5	Reviewing and editing AI-generated output requires significant mental effort
Q6	Clear writing and clear engineering thinking are two different skills.

Figure 3. Mean agreement scores on perceived cognitive effort during AI-assisted writing.

Third, students expressed skepticism toward written submissions as the sole measure of understanding. When asked which assessment types best demonstrate real comprehension, responses overwhelmingly favored practical sessions, lab work, live demonstrations, and oral examinations over traditional written reports. Figure 4 shows that students favor assessment formats emphasizing active engagement and practical application, expressing skepticism toward written submissions as the sole measure of understanding. This finding is consistent with CDIO's emphasis on active learning and performance-based assessments (Standard 11), aligning with the belief that true understanding is best demonstrated through application, analysis, and problem-solving in authentic contexts.



ID	Survey Question Statement
Q1	I carefully read instructor's feedback on my written assignments.
Q2	Feedback helps me improve my conceptual understanding, not just my grades
Q3	I feel less "ownership" of feedback if the text was largely AI-generated
Q4	Feedback is more valuable when it focuses on my reasoning rather than the final text

Figure 4. Student perceptions of assessment and feedback

STATISTICAL ANALYSIS

Descriptive analysis of the Likert-scale items related to professional engineering competence revealed moderate to high levels of agreement with statements emphasizing human responsibility and process-oriented assessment. As illustrated in Figure 5, the highest levels of agreement were observed for the statement that learning to use AI responsibly is a core skill for a modern engineer, followed by the view that engineering assessments should focus more on the design process than the final document. Agreement was more varied regarding the statement that verbally explaining a design demonstrates competence better than a written report, indicating diverse student comfort levels with oral assessments. These variations reflect CDIO Standard 1 (Contextual Learning), where learning outcomes are shaped by instructional contexts (Inside Higher Ed, 2025). The qualitative thematic analysis followed an iterative process: two independent coders reviewed 20% of the responses to develop a coding scheme. Interrater reliability was established using Cohen's Kappa ($\kappa = 0.82$), indicating substantial agreement.

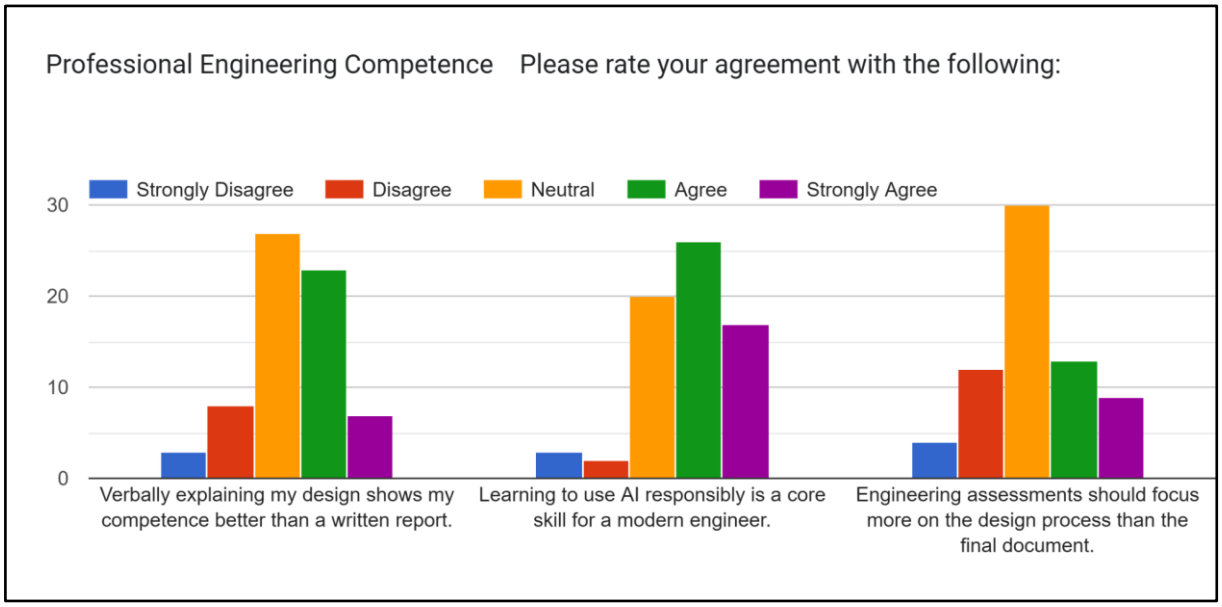


Figure 5. Student agreement with Professional Engineering Competence statements related to AI responsibility, assessment focus, and demonstration of understanding

Frequency-based and categorical analyses further reinforce these quantitative trends. Responses to the open-ended question regarding where "real thinking" occurs during AI-assisted writing clustered around several dominant themes, including **prompt formulation**, **reviewing and editing AI-generated content**, and **human judgment in evaluating accuracy, relevance, and relevance to task goals**. Very few respondents attributed genuine thinking to AI itself. Instead, students consistently framed AI as a supportive mechanism for structuring and expressing ideas, while emphasizing that ideation, decision-making, and responsibility remain human. This qualitative evidence complements the professional competence patterns shown in Figure 5, reinforcing the view that students associate engineering competence with judgment, responsibility, and process awareness rather than with textual production alone (The Conversation, 2025b).

Analysis of assessment preferences further supports this interpretation. Across responses, students overwhelmingly favored **practical and interactive assessment formats**, including laboratory work, oral examinations, and live demonstrations, as the most reliable indicators of

genuine understanding. Written reports were rarely viewed as sufficient on their own. This preference aligns with the professional competence dimensions shown in Figure 5, particularly the emphasis on process-focused evaluation and responsible engagement with tools. These findings support CDIO Standard 5 and Standard 8, which prioritize experiential learning and assessment methods that make thinking, decision-making, and application visible.

Exploratory comparisons across academic stages suggest that **senior and postgraduate students expressed more nuanced interpretations of professional competence in AI-supported contexts**, frequently emphasizing ethical responsibility, reflective judgment, and process ownership. These students were more likely to describe AI as a cognitive partner that supports—but does not replace—engineering reasoning. This developmental trend is consistent with CDIO's focus on progressive competence development across the academic lifecycle, indicating that as students advance, their understanding of professional responsibility and AI's role within engineering practice becomes more sophisticated.

While the sample size ($N=68$) limits the generalizability of the findings, as a pilot study, it provides a necessary foundation for future longitudinal research. Subsequent iterations will aim for larger, multi-institutional cohorts to validate the preliminary trends identified here.

Interpretation

The findings suggest that students do not perceive AI-assisted writing as a replacement for cognitive effort. Instead, students report that thinking occurs during prompt formulation, critical evaluation of outputs, fact-checking, and final editing. Many students explicitly framed AI as a tool rather than an author, emphasizing that responsibility for logic and coherence remains human. This aligns with CDIO's emphasis on personal and professional skills, as students must take ownership of their learning and apply knowledge responsibly (UNESCO, n.d.).

Assessment preferences further support the view that students recognize the need for authentic assessments that require critical thinking, application, and problem-solving. Students consistently expressed a preference for practical, hands-on assessments, such as oral exams, live demos, and lab-based assessments. This supports CDIO's view that competence is best demonstrated through performance and practical application, not static outputs like written reports. These preferences underscore a call for curriculum innovation that emphasizes experiential learning and performance-based assessment (Standard 5) (Zéraï & Mosbeh, 2024).

CONCLUSIONS

This survey provides empirical evidence supporting a reframing of the "AI dilemma" in higher education. Students perceive cognition as distributed across various stages of the academic process, with AI tools serving as a supplement rather than a replacement for human thinking. These findings are aligned with CDIO's vision for student-centered education, where students engage deeply with learning processes, critically reflect on their use of tools, and demonstrate their skills through performance and application (Kimpton et al., 2024).

While the sample size limits the ability to generalize findings, the consistency between quantitative trends and qualitative explanations strengthens the credibility of the results. Future research should seek to integrate performance-based data and observational analysis to validate these perceptions further. Additionally, instructional design should be re-evaluated to ensure that assessment methods align with the cognitive and professional skills needed in

a technology-rich world (The Conversation, 2025a). The study contributes to ongoing debates about AI's role in education, particularly in engineering disciplines, and supports pedagogical approaches that emphasize reflective AI use, transparent expectations, and authentic assessments aligned with the CDIO standards.

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Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

During the preparation of this work, the authors used **Google Gemini** in order to refine the grammatical structure, improve the clarity of the research methodology descriptions, and assist in the thematic categorization of qualitative survey data. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication. This process aligns with the study's exploration of AI as an augmentative tool for human cognition rather than a replacement for critical thinking.

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BIOGRAPHICAL INFORMATION

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