

Navigating AI in Engineering Education: Impact of Chat GPT on International Student's Learning and Academic Integrity

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Abstract

This study examines the impact of AI tools like ChatGPT on graduate engineering students, particularly international students, focusing on misuse for plagiarism and its effect on learning. Two Engineering Organizational Development (EOD) classes were analyzed: one with 60% international students (60IS) and another with 100% international students (100IS). In 100IS, around half of the students relied heavily on ChatGPT, showing little interest in traditional learning, while 60IS retained more conventional study patterns. The research also evaluated two Graduate Academic Research (GAR) courses before and after a redesign aimed at reducing plagiarism and improving learning outcomes. In redesigned GAR, students performed better on smaller, skills-based assignments incorporating ChatGPT. However, patterns of plagiarism in major assignments persisted across both GAR courses. The findings highlight the ongoing challenge of AI misuse in education despite course redesigns and suggest a need for continued efforts to integrate AI tools responsibly in academic settings.

Keywords: ChatGPT; Engineering Education; AI Plagiarism; International Students; Course Redesign

1. Introduction

Historically, AI tools are not the first computer software to have arrived at engineering schools. For decades, engineering faculty have developed student skills across various software platforms such as Microsoft Office, specialized applications like Python and MATLAB programming languages [1, 2], online distance learning [3, 4], and computer-supported collaborative learning [5, 6]. If the past is any indicator, AI tools like ChatGPT will eventually be integrated effectively into Engineering programs. ChatGPT should generally inspire optimism for classroom use, offering both students and professors access to vast, organized information. Unlike the Internet, which requires extensive reading, thinking, and analysis to produce engineering work, ChatGPT synthesizes information into various formats based on prompts, potentially bypassing much of the hard work involved. Menekse (2023, p. 578) views ChatGPT as enhancing "instructional resources," creating "new technology-enhanced learning environments," reducing "instructors' workloads," and allowing "students to design and develop their learning experiences" [7]. However, it remains to be seen if this optimistic view aligns with actual classroom practices and the goals of writing-intensive engineering courses, particularly as AI tools are newly integrated.

There is a general consensus that instructors must adopt tools that promote student-centered instruction. This approach emphasizes a process that recognizes the inherent complexity of learning, and designs "tools and social support structures that are responsive to this complexity." By addressing this complexity, the distinction between adoption and adaptation is reconciled as the tools adapt and instructors respond to educational contexts [8]. However, research shows that the engineering discipline traditionally comprises students who do not write well [8]. Writing anxiety and lack of confidence in academic writing skills are common among engineering students, which teachers must address [9, 10]. To study the effects of AI on student commitment to processes that teach excellence in writing skills and promote critical thinking and logical reasoning, general observations can only go so far. In our view, during this pre- and post-ChatGPT transitional period in academics, the classroom offers the best laboratory to observe how both teachers and students deal with AI tools.

Moving beyond traditional generalizations, Baidoo-Anu and Owusu Ansah (2023, p. 52) asked ChatGPT to explain how it benefits students. Based on ChatGPT's response, they concluded that ChatGPT promotes beneficial teaching and learning in the

form of “personalized and interactive learning” [11]. They also highlight inherent limitations of the tool, such as “generating wrong information, biases in data training which may augment existing biases, [and] privacy issues.” In this article we also seek to move beyond generalizations and demonstrate that actual classroom observations provide a richer and more accurate view of the degree and the mode of existence of “potential benefits.” Tu (2024, p. 198), in reviewing Baidoo-Anu and Owusu Ansah’s work, adds that in addition to personalized learning, ChatGPT also promotes “higher-order thinking” [12]. Based on our actual classroom observations, we will demonstrate that such statements are inaccurate. None of the behaviors we observed in actual classrooms can be generalized to correspond to promotion of personalized learning or higher-order thinking.

Regardless of general or specific observations, with ChatGPT’s release in November 2022, engineering education faces a transitional challenge regarding how engineers will be taught to write. ChatGPT has amplified the question of what tools engineering students need to learn in order to write well. Current research into this question has followed two paths: first, general and conceptual (theoretical), and second, practical and classroom-specific. On the theoretical side, we find general and conceptual aspects of how ChatGPT will be embedded in engineering in the near future [13-15]. The practical approach seeks pragmatic and specific examples of how real classroom instruction evolves within this transition period into a post-ChatGPT world [16].

This article focuses on ChatGPT integration in classrooms with international students, who are particularly vulnerable to ChatGPT use—and misuse. We use the classroom as a laboratory during this transitional period in academia, examining two practical applications: first, the integration of ChatGPT in classrooms with international engineering students, who face challenges in both language proficiency and skills learned in undergraduate education [17-19]; and second, the redesign of an engineering course to better serve these students’ needs. By comparing student behavior before and after the redesign, we aim to gain deeper insights into digital plagiarism.

We specifically focus on engineering classrooms that teach writing and idea synthesis, requiring critical thinking in assignments that relate the engineering mindset to assessments of given situations. After observing and analyzing behavior and outcomes in specific classes, we believe that AI tools like ChatGPT will eventually be integrated into engineering in the same way the slide rule was, before being replaced by computers. The slide rule approach to writing may eventually give way to the ChatGPT approach. Thus, the questions we raise are not about the final outcomes of using ChatGPT as an engineering tool but about student behavior during this transitional period.

2. ChatGPT and Multifaceted Engineering

Our analysis of writing assignments and ChatGPT-related behavior begins with graduate students in an Engineering Organizational Development (EOD) course. In the pre-ChatGPT history of this

course, most students have consistently received A grades as they learned to apply a variety of models to case studies and two projects. In one project, the students focused on improving the individual and organizational behavior in an organization with which they were personally familiar. In the other project, they picked and studied an exceptional individual whose behavior they wanted to understand. The choices included notable figures like Jesus, Nelson Mandela, Malala Yousafzai, Xiaoping Deng, Henry Ford, and Bill Gates. In both projects, students had complete control over their choices, enabling them to apply various models and analytical skills to situations that piqued their interest.

In fall 2023, two EOD classes were taught: one with 60% international students (60IS), and the other with 100% international students (100IS). Generally, the 60IS class followed the traditional learning pattern and refrained from using ChatGPT. In contrast, about half of the 100IS class heavily relied on ChatGPT for their weekly case study assignments. They would instruct ChatGPT to say something about a model like “knowledge management” and place the ChatGPT response under that heading. They would compile and submit the composite of such paragraphs as their assignment report. Within the first few weeks, it became clear that 6 or 7 were working together, presenting identical model headings in the same sequence with slightly modified paragraphs—a few words changed here and there—to create the illusion of individual work.

In past EOD courses spanning two decades, most students quickly grasped the relevance of the models to both professional and personal interactions. The course covered a wide range of subjects, with assessments focused on students’ ability to synthesize model applications in various real-world management scenarios. The diversity of models familiarized students with the need to manage different organizational dimensions, each with its own competing theories. For example, they studied leadership models like Trait Theory, Behavioral Theory, and Contingency Theory. They learned that Trait Theory emphasizes traits such as extraversion and openness, while Behavioral Theory argues that leaders can be trained to exhibit specific behaviors. Contingency Theory, on the other hand, suggests that successful leadership depends on the match between leaders and followers. Students had to determine the most relevant leadership model for their case studies or projects.

Similarly, students explored multiple models of power, incorporating them into their writing assignments to demonstrate critical thinking. They examined personal power, formal power, and their components, identifying key factors and dominant power types in their analyses. Other topics covered in class included managing force, resources, knowledge, direction setting, communication, groups and teams, conflict and negotiation, emotions and moods, personality, perception and decision-making, organizational culture, motivation, and justice.

The models were introduced and applied at a controlled pace to prevent overwhelming the students. The main application was through case studies addressing key issues of both individual

and organizational interest. The case studies were one-page descriptions of specific situations with intriguing titles like “Should women have more power?” and “You want me to do what!”—(focusing on manager asking the employee to perform a seemingly inappropriate task). Other titles included “There is a drone in your soup,” “When the going gets boring,” “Cheating is a decision,” “Laziness is contagious,” “Voiding the license to discriminate,” and “Culture of deceit.” This deliberate design aimed to keep students engaged and enable them to apply the models for a deeper, multi-faceted understanding of human behavior in situations relevant to organizational development.

In this application-driven instructional process, developing and applying multiple models to case studies and projects intended to establish a robust knowledge base, equipping students with tools to address various workplace situations. While this approach worked well in the class where 60% were international students (60IS), it did not in the 100% international students’ class (100IS). There, nearly half the class delivered ChatGPT-generated content using only model names and assumed the instructor would not detect it. Despite instructor feedback, their learning revolved around improving their use of ChatGPT. The group that submitted similar model headings with slightly modified ChatGPT content started rearranging paragraphs to appear different. This behavior's inevitable outcome became apparent in the first exam, which included a writing element requiring students to synthesize, apply, and analyze organizational behavior models in a closed book, closed notes, closed computer setting.

3. ChatGPTers Taking an Exam

In week 5, a closed book, closed notes, closed computer exam provided the first opportunity to assess student performance independent of ChatGPT. The core of this first Engineering Organizational Development (EOD) exam consisted of five essay questions on models learned in class. Before the exam, students were informed that the essay questions would include topics such as: Can you describe the formal power model? Can you describe the behavioral leadership model? Can you compare three leadership models and explain which one you think is better?

In the 100% international students class (100IS), 12 students failed the exam. The instructor set up a meeting to hear student explanations for the failure and suggestions for potential remedies. Almost all causal factors identified by students fell into the category of “I did not study well, and it is my fault.” As a remedy, they collectively asked for another chance to retake the exam, assuring the instructor that they would study and not fail the retake. In the next class the instructor told the students that all those who had failed the exam will be allowed to retake it. The instructor had already reviewed the exam solution in class and provided them with the solution file. The instructor emphasized the importance of carefully reviewing the solution because the retake exam would only be slightly different from the original. The retake exam was scheduled for the following week, giving them a full week to study and prepare.

One student who had passed the original exam objected, reflecting the sentiment of others. He argued that allowing only the failing students to retake the exam might result in them all getting A's, which he deemed unfair. The retake exam yielded a surprising result. Only two of the graduate engineering students improved their grade from F to A. Ten students received an F again, even though the exam was exactly the same as the previous one, had been reviewed in class, and they had the solution file. Another meeting was set up with the students. One student, recognized as the leader of the group of 6-7 ChatGPT users, summarized their reason for failure. “You did not say it would be the same exam. You said, it will be slightly changed, so we didn’t study the previous one.” This raises questions: What did they study? Did they study? Did they even care? The only plausible conclusion from the retake exam is that the students who, for five weeks, had entered model names into ChatGPT and submitted it as their analysis, lacked the experience of studying and understanding models. Consequently, they most probably could not comprehend the exam solutions, which were expressed in terms of model descriptions and comparisons. Their behavior had remained unchanged. Their proficiency lay in entering model names into ChatGPT, but neither the exam nor the retake exam allowed that type of ChatGPT-assisted behavior. This result, observed in an actual classroom setting, contrasts sharply with other analyses of how students relate to ChatGPT.

While our observations imply ChatGPT-addicted behavior, other explanations are possible. One study of ChatGPT-related behavior uses a draw-a-picture technique to explore undergraduate viewpoints on ChatGPT use. The study concluded that students with different growth mindsets had different learning achievements and critical thinking tendencies in relation to the roles and functionalities they assigned to ChatGPT [12]. This viewpoint suggests that the ChatGPT users in the 100% international students class (100IS) might have low growth mindsets, incapable of relating to the roles and functionalities of ChatGPT through critical thinking. Embedded in this view is also the implied instructor’s low growth mindset, indicating an inability to understand and teach the course in relation to proper use of ChatGPT.

4. Redesigning to Counter ChatGPT Plagiarism

Engineering graduate students are expected to engage in critical thinking and produce writing that meets the needs of various audiences. Berdanier and Alley (2023) argue that ChatGPT is a tool, not a substitute for teaching writing [13]. However, this view overlooks the teacher-student dynamic, where either party can decide whether ChatGPT should replace the writing process. This creates tension if a teacher sees ChatGPT as a tool, but a student views it as a replacement. As a parallel, Berdanier and Alley note that while students use tools like MATLAB for engineering problems, this is contingent on a solid understanding of engineering theories and concepts. MATLAB is ineffective without foundational knowledge, but ChatGPT doesn’t require such a background. If used as an “editing consultant,” ChatGPT could be beneficial, especially for international students, provided they already have a firm grasp of engineering writing.

Beyond editing, ChatGPT offers additional functions valuable to international students, such as translating articles, summarizing main points, and organizing citations. The key question is what can be outsourced to ChatGPT and what cannot. For example, would it be acceptable for ChatGPT to conduct a comparative cost-benefit analysis of different manufacturing alternatives, considering supply, demand, and regulatory processes? While ChatGPT has many potential applications in engineering, classroom observations show that some international students use it as a shortcut, bypassing the effort required to interpret and validate its output. These students often submit ChatGPT-generated content without turning it into their own thoughts or refining and editing the output to reflect their abilities, even though ChatGPT, like earlier grammar checkers, offers an opportunity to improve writing skills. So, how should a course teach students to develop their own writing, use ChatGPT to enhance it, and then edit the ChatGPT-enhanced version to reflect their writing style? One approach we considered focuses on minimizing plagiarism.

Our research analyzed ChatGPT-related plagiarism through a course redesign aimed at minimizing plagiarism motivation. The redesigned course, Graduate Academic Research (GAR), provided an opportunity to study the effect of ChatGPT on the performance of international graduate engineering students. The course's two primary goals were to teach research methods and writing skills and reduce plagiarism motivation. The sources of plagiarism motivation were identified as [19]:

- pressure to succeed,
- difficulty adjusting to American academic culture, and
- lack of familiarity with academic research.

The redesign aimed to restructure assignments to reduce pressure while enhancing academic skills in a low-risk, high-reward environment. With hands-on support from teachers and peers, students were expected to develop skills needed for future engineering courses, such as writing lab reports, creating data visuals, and conducting research. The goal was to increase student engagement and reduce plagiarism, monitored through rates of missing and late assignments.

In both the “pre-redesign” and “redesigned” GAR courses, the first assignment was a short response paper followed by a group discussion on “plagiarism,” based on Sowell's (2018) article [19]. Unexpectedly, many students in the redesigned course used ChatGPT to generate lengthy, impersonal responses about plagiarism in their home countries, deviating from the personal and reflective answers previously they provided in small group discussions. Despite their ability to engage thoughtfully on plagiarism, students continued to rely on AI tools for assignments rather than completing them independently.

To cater to the needs and interests of students, mostly Engineering Management majors, the research component of the redesigned course was structured to guide them through a step-by-step process similar to the final research project in the Engineering Organizational Development (EOD) course. This connection

aimed to motivate students by aligning the final GAR assignment with the work in EOD. However, a key difference was that the GAR course incorporated ChatGPT as a research assistant throughout the process—from brainstorming to research to writing—whereas the EOD course strictly prohibited AI tools.

To increase success and reduce the likelihood of cheating, the final research assignment in the redesigned GAR course was made a group project. This group format aligned with the incremental, skills-based research methodology adopted based on student feedback during discussions on plagiarism. It also supported students who were culturally hesitant to ask questions or voice concerns in class, as they were more likely to seek help from the instructor through a peer in a group setting. This approach also addressed concerns about differing growth mindsets, which might prevent some students from having a constructive view of ChatGPT's role in critical thinking [12].

5. Motivating Engineering Students out of Plagiarism

From the outset, the redesign of the Graduate Academic Research (GAR) course adopted a dynamic, interactive approach. A notable point emerging from student discussions was their preference for a learning method that broke down the research process into a series of simple steps. Specifically, students emphasized the need for more help with finding and reading sources, note-taking and note organization techniques, summarizing and paraphrasing, and properly citing sources to avoid accidental plagiarism. Essentially, students were requesting more "scaffolding support" for research skills to help them avoid plagiarism and reduce reliance on ChatGPT when completing assignments [20].

Initially, the GAR redesign overlooked that most students were from the Engineering Management discipline, a field not typically requiring extensive lab reports or scientific papers. Realizing this, the instructor restructured the GAR research assignments to align with those in the Engineering Organizational Development (EOD) course, which also had a large population of Engineering Management students. The EOD course featured a final research project that was specific enough to prevent plagiarism but strongly student-centered to avoid overwhelming students with complex theses. This integrated approach aimed to reduce plagiarism in both courses by focusing students on applying their research skills and achieving excellence in research writing.

These dynamic adjustments aimed to improve students' analytical and writing skills, reducing their reliance on plagiarism or ChatGPT. The redesign favored small, skills-based, group assignments completed in a writing-lab environment during class meetings. This approach was expected to lower the pressure to succeed and ease the adaptation to American university coursework, thereby reducing the motivation to engage in plagiarism or use ChatGPT. By working towards immediate, achievable goals, students would experience a sense of accomplishment and satisfaction by mastering skills learned in class. Each class meeting functioned as a research writing workshop, with brief, step-by-step instructions and visuals that students could consult within their groups, while the

instructor provided personalized support and feedback throughout the class. Throughout the GAR research process, brief activities were integrated to show students how to use ChatGPT as a tool. These activities included comparing their own topic brainstorming to the brainstorming results produced by ChatGPT, summarizing articles, and translating articles to help students decide whether or not they were worth reading for their research.

Was student performance in the redesigned GAR course measurable compared to the pre-redesign class? As a rough but plausible performance proxy, the number of missing or late assignments was compared between the two courses. Figure 1 summarizes the comparison, showing a range of 0 to 5 missing or late assignments. This comparison demonstrates a relative improvement in performance.

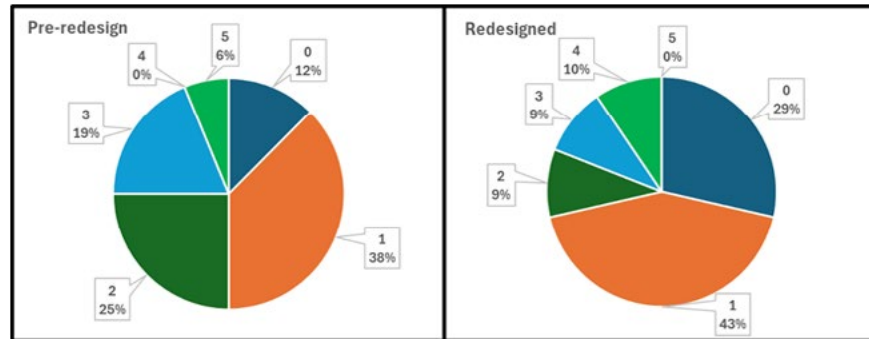


Figure 1: Comparison of Missing or Late Assignments as A Proxy for Performance Improvement in the Step-By-Step Skills Mastery Teaching Method.

In theory, the redesign would shift the focus from a few large, high-stakes graded assignments to a method of rewarding students with points for skills-mastery assignments submitted at the end of most class meetings. Figure 2 compares the two courses across two dimensions: grades and missed/late assignments. In this comparison, the grade distribution clearly shifts to higher grades

in the redesigned course. This supports the pedagogical move toward lab-like, step-by-step instructions for building engineering students' research and writing skills. However, the question remains whether students will maintain this behavior when faced with a large assignment like the final research project.

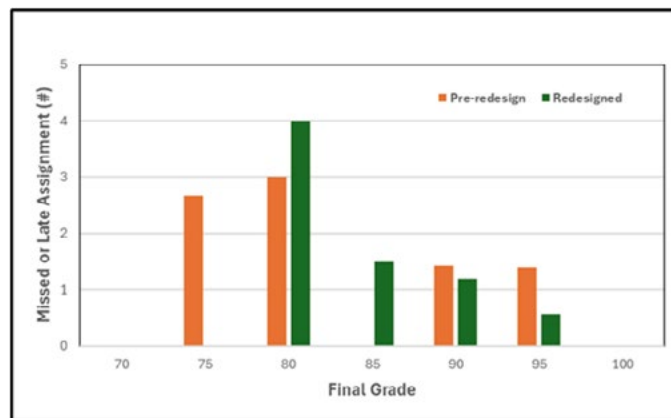


Figure 2: Grades and Missed/Late Assignments Between the Two GAR Courses as a Measure of Performance Improvement Achieved Through the Step-By-Step Skills Mastery Teaching Method

6. Changing the Organizational Dynamics

Over two decades of teaching Engineering Organizational Development (EOD), it became clear that analyzing a case study using models does not come naturally to engineering students. To address this, the first two case studies in Weeks 2 and 3 were designated as "practice" case studies. These assignments were thoroughly reviewed, commented upon, and graded, but the grades did not count towards the overall course grade. This approach aimed to help students understand the teacher's expectations, develop the skills necessary to identify the important aspects of a case, determine the relevant models to apply, and learn from their mistakes. The results from the Week 2 case study revealed

distinct differences between the 60% international students (60IS) and 100% international students (100IS) classes. To motivate the 100IS students, the instructor compared their grade distribution with that of the 60IS class, as shown in Figure 3. The instructor explained that the 60IS grade distribution suggested that those students were studying the models and learning the method of analysis. In contrast, the 100IS distribution indicated that many students were not studying and were instead relying on ChatGPT for learning. The instructor emphasized that this behavior could be seen as cheating, which would lead to serious grade and disciplinary issues in regular case studies.

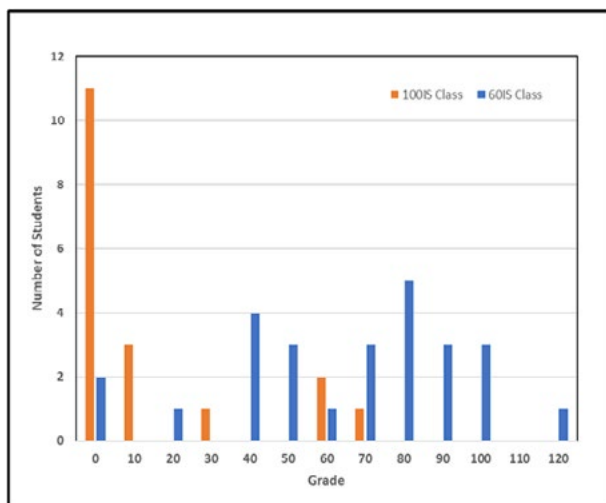


Figure 3: Comparative Grade Distribution in Week 2 Case Study—Should Women Have More Power.

After class, the last student remaining, who the instructor later identified as the leader of a group of 6-7 ChatGPT users, approached the instructor. He suggested that the international students in the other class were not studying either but were using more effective ChatGPT techniques that the instructor could not detect. He thought of contacting some students in that class to learn their techniques.

The instructor was surprised by the student's openness in promoting "not learning" and reliance on ChatGPT, and was also intrigued by student's honesty in expressing his thoughts. By connecting with others, the ChatGPT-dependent student might realize that those students were actually studying and not relying on ChatGPT. Through this experience, he and other ChatGPT-focused students might start studying and learning the models for their assignments. The instructor never found out if there was a contact, but observed no change in the performance behavior of the ChatGPT-using students. For these students, ChatGPT remained the easiest alternative to active participation in class. This behavior, ironically, finds support in some scholarly research.

Berdanier and Alley (2023) argue that teaching writing is akin to teaching thinking, whether or not an AI tool is used [13]. Teaching engineering students to write well and draw logical conclusions enables them to communicate effectively with those inside and outside of engineering disciplines. This view is challenged by the possibility that engineers might not need to become good writers if they can become "prompt writers" using AI tools to communicate effectively. In this scenario, engineers would only need to be skilled at writing prompts. This is not unlike engineers using Excel to create charts or analyze data.

Johri et al. (2023) argue that AI tools are no different from other digital tools already integrated into engineering education and applications [14]. In effect, they advocate for the creation of "clerkly engineers" by highlighting the view that, using a catalogue of prompts, better prompts lead to better and more specific AI-generated outputs [21]. In an extreme scenario, one

could simply request an AI to "build an airplane with the latest knowledge," and it would be built. This would render the term "engineer" obsolete, similar to the slide rule's irrelevance in modern engineering education. However, this raises the question of whether engineering schools will become centers for training "clerkly engineers," where professors teach students to ask the right AI-driven questions. What would this look like in a program of study? And how do we differentiate the importance of non-negotiable learning versus prompt-writing training?

In this prompt-driven view of AI tools in engineering, there is an expectation that engineers who know little beyond entering prompts can still change the output of the AI tool and verify the tasks it suggests. Johri et al. (2023) recognize that having an AI tool generate tasks is not the same as verifying their validity and completeness [14]. They emphasize the need for a "sensemaking component" to check the output for validity and completeness. They add that in the foreseeable future, AI tools might perform these functions or make appropriate corrections through user feedback. However, our observations indicate that a significant portion of students either lack the knowledge and ability to verify ChatGPT outputs or do not value this skill. This is alarming because, upon graduating, these students will become educators or managers, potentially creating an organization of clerkly engineers.

International students from high-power-distance cultures often perceive themselves at the bottom of the power hierarchy and are rarely allowed to ask challenging questions or express personal views. In an American academic setting, where critical thinking and skill development are expected, this cultural mindset can hinder their willingness to engage deeply with the material. Consequently, they might resort to using AI tools to avoid confronting the challenges and expectations of the coursework. Additionally, in an environment where students avoid questioning received knowledge or expressing opposing viewpoints, teaching them to question the validity of ChatGPT's output becomes a significant challenge.

7. The Final Exam

True to their orientation, the core members of the 100IS ChatGPTer group maintained their expected behavior during the final exam in the Engineering Organizational Development (EOD) course. The exam consisted of true/false and multiple-choice questions, extra credit multiple-choice questions, a single essay question, and a task requiring the use of Excel and simulation software to analyze group behavior in relation to a specific model. The essay required students to describe three motivation theories and compare and contrast them, while the Excel question involved analyzing data related to the personal power model.

The exam schedule introduced a logistical element to student behavior. The university had scheduled the 60IS exam on Monday and the 100IS exam on Friday. The instructor wondered if the 100IS ChatGPTer group, lacking knowledge of the models and faced with an exam structure that made ChatGPT irrelevant, might resort to cheating by asking a 60IS student for information, particularly on the essay question. Since the 60IS students were allowed to keep the Excel file from the exam, that could also be available to the 100IS ChatGPTers. The instructor considered changing the essay question and altering the model used in the Excel portion of the exam, but despite the potential for cheating, he decided to keep the exam unchanged to observe and analyze student behavior. What would the graduate students do when presented with opportunities to cheat? Would knowledge-deficient ChatGPTers succumb to cheating?

Although the instructor could not prove that students cheated, the exam results presented anomalies. Every member of the ChatGPTers performed exceptionally well—almost textbook perfect—in describing the three motivation theories. However, they struggled to compare and contrast them. Equally noticeable was their failure in the Excel part of the exam. Despite the class

material and multiple in-class exercises, they had not learned the method for analyzing a group responding to a model. On average, the ChatGPTers improved from their previous F level to a C level in the final exam.

At the end of the semester, four members of the group, including the leader, remained firm in their belief in ChatGPT as the only way to complete assignments, even if it meant failing the course. Only a few members adjusted midway through the semester and started learning, with one even achieving an A-. Figure 4 shows the final grade distribution for the two EOD classes. This raises the question: would the percentage of international students be a significant variable in these distributions? Would student behavior differ if both classes had 60% international students?

From the instructor's observations, the key factor in the 100IS class was the presence of an already-established group of academically weak students led by someone who advocated using ChatGPT to pass the course. Such a group was absent in the 60IS class. However, this does not mean that no one in the 60IS class attempted to use ChatGPT or resorted to cheating instead of learning.

Two 60IS students did try using ChatGPT in their early assignments but quickly realized that the instructor disapproved of that approach, and they changed their ways. One student cheated on the first graded assignment by submitting another student's report from a previous course—without bothering to learn from it or check its content for suitability. He had merely changed the name on the first page and the file name before submitting it. He failed to notice that the second page of the file contained teacher comments from the previous course. This incident is both comical and unbelievable unless directly experienced. The student received zero for the assignment and immediately changed his approach to learning.

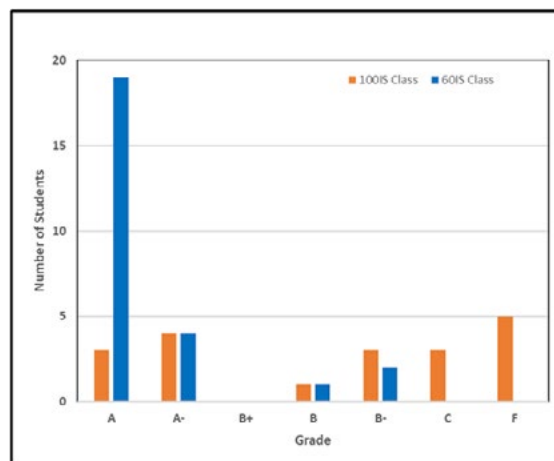


Figure 4: The Final Grade Distribution For 60is and 100IS Classes.

8. AI Incorporation vs Plagiarism

The redesigned Graduate Academic Research (GAR) course initially aimed to reduce plagiarism through a small group approach in a lab-classroom setting, with dynamic adjustments based on student capabilities. However, the introduction of AI tools

presented new challenges. Unlike the Engineering Organizational Development (EOD) courses, where AI tools were prohibited, the GAR course saw potential benefits in using AI for specific tasks, such as generating citations. ChatGPT offered a faster, more accurate alternative to tools like Citation Machine, which was

often bogged down by ads.

The use of AI tools like ChatGPT raises questions about the boundary between learning and "intelligent copying." For example, the GAR instructor conducted a class session to test whether ChatGPT could quickly translate research articles into students' native languages, helping them assess the articles' usefulness. This raises the issue of whether students should learn in English, as required by the American academic environment, or rely on AI tools to learn primarily in their own language, even at an American university. This touches on the broader debate about whether AI tools should replace the process of teaching and learning writing and reasoning in engineering research [13].

Using ChatGPT to summarize articles and simplify language could, in theory, allow nonnative students to replicate the academic research process in their own language without engaging deeply with English texts. However, the key issue is whether a ChatGPT-generated summary holds the same knowledge content or learning value as one created by a student after thoroughly reading the article. Pedagogically, the question is whether the course aims to teach students to seek knowledge by reading research articles themselves or if it is acceptable to rely on AI-generated summaries. In our view, high-quality knowledge content requires students to create their own summaries rather than rely on AI tools. This perspective is challenged by those who argue that AI tools are similar to other digital tools in engineering education and that better prompts could yield better summaries [13, 21]. More research is needed to understand what is lost when we bypass the slow process of reading and thinking within the context of our own ideas and experiences.

9. Some Foundational Observations

In the pre-redesign GAR course, AI tools were absent. However, some students used Internet searches and sought help from peers to complete assignments, driven by a desire to save time and effort. In the pre-ChatGPT GAR course, using Turnitin as an audit tool, the plagiarism rate in the final research project was 27.6%. In the redesigned GAR course, within the domain of ChatGPT, Turnitin reported a plagiarism rate of zero. This discrepancy highlighted that Turnitin, at the time, could detect plagiarism from Internet

sources and a database of student work but not AI-generated content. Consequently, Turnitin could not identify AI-assisted work submitted by students during the 2023 academic calendar.

In the redesigned course's final research project, an AI detector used by the instructor reported a plagiarism rate of 35.2%. Despite extensive efforts to redesign the course, focusing on small group work, lab-classroom settings, and step-by-step instructions for skill mastery, students still resorted to using AI tools or copying material from other sources to complete their final projects. Although students performed well in class assignments, they did not transmit these skills to their final research projects, displaying a dual behavior: adhering to in-class methodologies while continuing to plagiarize using AI tools for larger assignments.

The course redesign, aimed at improving student performance and plagiarism avoidance through class assignments, showed overall effectiveness. However, as illustrated in Figure 5, there was no significant reduction in plagiarism for the final research project, suggesting that coursework redesign alone was insufficient for larger assignments. The introduction of ChatGPT not only impacted plagiarism rates but also provided a new tool for it. Unlike Turnitin, which detects plagiarism from the Internet and peers, ChatGPT enables students to generate seemingly personalized content, shifting the nature of plagiarism.

This shift presents challenges but also offers potential benefits. If students use ChatGPT as a "consultant" rather than just copying its outputs, they might engage with more reliable sources compared to the less reliable Internet content or peer material used before. ChatGPT could enhance knowledge processing if used as an assistant rather than merely for easy assignment completion [7]. This consulting aspect of plagiarism behavior varies in effectiveness depending on the user. Further research is needed to explore how to redesign course instruction and assignments effectively, helping international graduate students improve their research and academic writing skills while minimizing plagiarism. This will likely require a combination of pedagogical strategies and socio-cultural training, which alone may not fully address students' attitudes towards assignments.

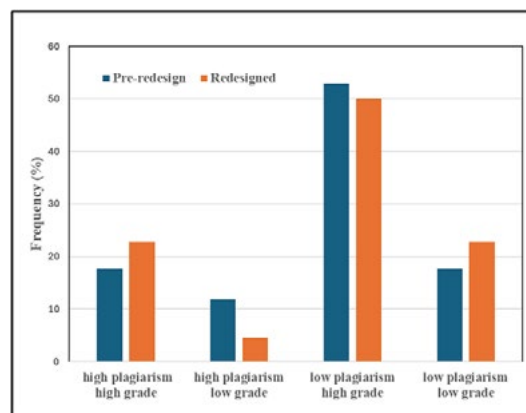


Figure 5: Comparison of Grade Distribution in Relation to AI-Driven Plagiarism Behavior.

10. The Classroom ChatGPT Policy

How should instructors handle students who prioritize using ChatGPT over traditional learning methods, such as studying books and applying models to engineering problems? There have been suggestions to create and adopt comprehensive AI policy frameworks for university teaching and learning [22]. During this transitional period, we recommend a "strategy of transparency" that includes:

- Effective communication on a clear policy regarding ChatGPT use in course assignments, and
- A comparative view of assignments before and after ChatGPT use.

This policy would help students understand the availability of tools and the course expectations. The comparative aspect is akin to using hand calculations to verify Excel calculations in the early days of Microsoft Excel adoption in engineering. However, this transparency policy is valuable only during the transition phase. It becomes obsolete when an AI tool like ChatGPT becomes an established tool, similar to Microsoft Office.

From our classroom-as-laboratory perspective, here is the transitional ChatGPT Policy included in the Engineering Organizational Development (EOD) course Syllabus in spring 2024.

EOD ChatGPT Policy

ChatGPT has recently emerged as a tool that offers new possibilities to students for creating course content. The following delineate the course's position on using ChatGPT:

- Any assignment—case study or Project—that uses ChatGPT in full to create the report of the assignment will receive the grade zero.
- Any assignment—case study or Project—that partially uses ChatGPT in creation of the report of the assignment will receive proportional grade deductions.
- Students who wish to use ChatGPT to improve the grammar and wording of their report must seek prior authorization from professor. When authorized, they will provide the professor with both the preGPT and postGPT reports. The purpose is to "improve" the writing and not just to copy a manuscript into ChatGPT and declare the result as student's work.

Implementing this policy is expected to bring pedagogical challenges. As students become proficient with ChatGPT, distinguishing between proper and improper use becomes difficult. Instructors may struggle to determine if students are genuinely engaged in knowledge-seeking or merely fabricating content that mimics understanding without truly grasping the course material.

The key question then becomes: Should instructors encourage students to use their own knowledge, with ChatGPT enhancing their writing skills, or should they train students to become "prompt specialists," relying on ChatGPT for analysis and writing? In the extreme, students might never attend class or engage in traditional learning. Instructors could provide a prompting manual and accept

ChatGPT-generated output as homework, effectively outsourcing analytical skills. This isn't entirely new, as online services already offer completed assignments for a fee. However, ChatGPT amplifies this behavior, allowing students to generate assignments for free with just a simple prompt.

A deeper question is whether students want to write their assignments, ChatGPT-amplified or not, or prefer ChatGPT to write for them. Observations from decades of EOD classes reveal that students often cheer when class is canceled, indicating a trend toward avoiding learning while maintaining the appearance of engagement. This raises concerns about academic institutions producing "prompt entry specialists" instead of engineers. The issue lies in the dependency on ChatGPT—if the power goes out, engineers reliant on ChatGPT may struggle to function. The shift from human-driven to ChatGPT-driven thinking could lead to radically different outcomes for engineering and human existence.

In the EOD course during spring 2024, how did students respond to the transitional ChatGPT policy? No one chose to submit pre-ChatGPT and post-ChatGPT reports to demonstrate writing improvement. Only two students attempted to pass off ChatGPT content as their completed assignments—these were the same students who had failed the 100IS EOD course and struggled to move away from relying on ChatGPT for analysis and writing.

11. Conclusion

If ChatGPT becomes a permanent tool in engineering and universities subscribe to its advanced version, how will engineering skills evolve? What training will enable students to use AI tools effectively, especially in "prompt engineering," which involves creating prompts for optimal outputs? Like any tool, proficiency in using ChatGPT is crucial for adding value. However, ChatGPT could diminish an engineer's learning as much of the knowledge-seeking and processing might shift to the AI. While AI may not fully replace engineering jobs, it could significantly substitute part of the work, especially if students follow trends observed in classrooms [23]. Johri et al. (2023) emphasize the importance of managing "safe and ethical use," including issues like "[b]ias, misinformation, and data-gathering malpractice," regardless of how AI is integrated into engineering [14].

Following Baidoo-Anu and Owusu Ansah (2023), we asked ChatGPT to discuss the issue of engineering students relying heavily on ChatGPT rather than doing the engineering assignments themselves based on the knowledge acquired in class [11]. Here is the prompt and ChatGPT's response:

- Prompt given to ChatGPT: Write one or two paragraphs about engineering students not studying, and instead, when doing assignments, only entering prompts into ChatGPT.
- ChatGPT Response: In a curious twist of academic behavior, a growing number of engineering students have been observed diverting from traditional study methods and, instead, relying heavily on artificial intelligence for assistance. Rather than delving into textbooks and grappling with complex equations, these

students are turning to ChatGPT for assignment guidance. This unconventional approach reflects a shift in learning patterns, where students are drawn to the efficiency and accessibility of AI models. By entering prompts related to their assignments, these engineering students leverage the expansive knowledge base of ChatGPT to generate solutions and explanations. While the integration of AI can undoubtedly enhance problem-solving capabilities, it raises questions about the depth of understanding gained through this unconventional study method and the potential long-term impact on the students' foundational knowledge in their engineering disciplines. The phenomenon underscores the evolving relationship between education and technology, prompting educators and institutions to reconsider their pedagogical approaches in the face of these emerging trends.

The above ChatGPT-generated paragraph is impressive in its “wisdom” on the subject of engineering students using ChatGPT in their studies. In the teaching experience of the 60IS and 100IS Engineering Organizational Development (EOD) classes, this type of wisdom seemed entirely absent in some international graduate engineering students captivated by ChatGPT. Instilling this type of wisdom in students is an instructor’s responsibility and, in our view, a daunting challenge.

Nonetheless, the reality remains that among international students, the pressure to succeed in a foreign environment coupled with linguistic and academic deficiencies can adversely affect the quality of learning and teaching. Facing such barriers, the path to learning might be burdened with anxieties that impede student participation and achievement in the classroom [18]. In such a setting, ChatGPT can be perceived as a performance savior and anxiety minimizer, as assignments that students cannot complete by themselves are now completed through ChatGPT. The anxiety of getting caught is lower than the anxiety of not succeeding, regardless of implications for learning and developing engineering skills.

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