

## **Student Use of ChatGPT to Write an Engineering Report**

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## **Abstract**

Artificial intelligence (AI) tools, like ChatGPT, are increasingly being used by engineering students to help write reports submitted for academic credit. This paper presents a concise overview of findings from a writing assignment in a mechanical engineering thermodynamics course. The assignment requires students to research and summarize findings on a contemporary topic associated with energy and its use. With ChatGPT, improvements are observed in grammar, organization, and conclusions. Areas with little or no improvement are visuals, equations, and references. AI assistance in engineering education is anticipated to continue to expand, especially as AI tools improve and become integrated with other tools already used by students. It is important for faculty to have a firm understanding of how AI tools are being used by students to write reports. Faculty perspectives differ on how AI assistance can benefit engineering students while avoiding academic dishonesty issues. Faculty will need to communicate the permissible and prohibited usage of AI tools in future assignments.

## **Introduction**

ChatGPT, introduced in the fall of 2022, has swiftly emerged as a prominent Artificial Intelligence (AI) chatbot, finding widespread use, including in higher education [1], [2]. Engineering educators have taken notice and discussed how it is impacting a freshman engineering course [3] and throughout engineering programs [4]. Within a few months of the release of ChatGPT, it was being reported to be used to produce essays, poems, prompts, contracts, notes, computer code, and reports [5]. Many concerns are being raised, especially as it can be used to commit plagiarism [6]. Faculty members have encountered instances of suspicious writing and, in response, have issued warnings of academic consequences for submitting work predominantly sourced from ChatGPT [7]. An author admitted using AI to help write parts of a book that won a prestigious writing award [8]. ChatGPT is being used to write product reviews and social media posts, which are inundating the internet [9]. Detecting AI-generated writings can be challenging, unless someone mindlessly duplicates specific phrases like “As an AI language model ...” or “I’m sorry, but I cannot fulfill this request ...” [9]. Other than these obvious phrases, it is challenging to detect AI authorship in programming, laboratory, and/or design projects, so faculty are concerned about it being difficult to uphold academic standards [10]. At our University, the percentage of referrals for academic sanctions involving student use of AI is almost 40% in the first half of the academic year 2023-2024 where no referrals for academic sanctions involving AI occurred in the academic years 2021-2022 or 2022-2023. Faculty do not want to read and grade AI-generated reports purported to be authored by students.

This paper evaluates the impact of ChatGPT on a mechanical engineering thermodynamics course, focusing on a writing assignment that required students to explore a contemporary energy-related topic. This paper describes the writing assignment and student reports received. The paper summarizes distinctive characteristics of AI assistance and the challenges arising from the use of AI tools in the academic setting. This work underscores the significance of educators

comprehending the potential applications of AI in report writing, enabling them to clearly state the permissible and forbidden uses of AI to students.

## Assignment

One major writing assignment is often given in a mechanical engineering thermodynamics course. The assignment requires small teams of students to research and summarize a contemporary topic associated with energy and its use. Since the introduction of ChatGPT, the instructor clarified that the use of AI tools was permissible, provided that it was recognized in the report's acknowledgement section. Nearly all student reports acknowledged using ChatGPT, and a few also acknowledging the use of QuillBot [11] and Grammarly [12]. The students were allowed to work in teams of up to three members, yet many students opted to work independently. Each report was to have a section describing economic, environmental, and societal considerations, as well as a section summarizing the ethical obligations of professional engineers. Students were given a suggested outline for the report, description of required report formatting, and a detailed grading rubric.

## Reports

Reports from two semesters are compared. Reports collected in the Spring 2022 are considered pre-ChatGPT since ChatGPT was released in November 2022. Reports collected in the Spring 2024 are considered post-ChatGPT. Table 1 summarizes the reports from both semesters.

**Table 1. Thermodynamics reports collected in Spring 2022 and Spring 2024.**

	Spring 2022 Pre-ChatGPT	Spring 2024 Post-ChatGPT
<b>Number of Students</b>	95	59
<b>Number of Reports</b>	28	31
<b>Pages</b>	169	140
<b>Words</b>	88,389	75,582
<b>Students/Report</b>	3.4	1.9
<b>Pages/Report</b>	6.0	4.5

In the Spring 2024 semester, a total of 59 students in the class submitted 31 reports. These reports had a combined length of over 140 pages and a total word count over 75,000 when merged into a single file. The number of students per report was 1.9 with 4.5 pages per report. Table 1 also shows the same data from the Spring 2022 semester. Overall the overall number of pages and word count are similar between semester.

The Spring 2024 semester had fewer late submissions, fewer incomplete reports, and fewer spelling and grammar problems. It is difficult to quantify ChatGPT's contributions to improvements in reports. The sentences were typically longer in length and more coherent with

ChatGPT. Some sentences were rambling and repetitive, but this is true of student reports without AI assistance.

The reports were found to contain words that can be described as “uncommon,” or “unfamiliar,” or “non-natural.” These words were rarely used by students in prior semesters but are now excessively used in post-ChatGPT reports. Table 2 provides a comparison of these words. These non-natural words are believed to have been initially authored in ChatGPT and then copied and pasted into the report.

**Table 2. Words found to be more frequently used in post-ChatGPT reports.**

	Spring 2022 Pre-ChatGPT	Spring 2024 Post-ChatGPT
<b>nuance, nuances nuanced</b>	0 + 0 = 0	24 + 7 + 29 = 36
<b>incur, incurs, incurring, incurred</b>	0 + 0 + 0 + 0 = 0	6 + 1 + 3 + 4 = 14
<b>underscore, underscores, underscored</b>	0 + 0 + 0 = 0	10 + 17 + 4 = 31
<b>delve, delves, delved, delving</b>	1 + 1 + 0 + 1 = 3	6 + 17 + 1 + 10 = 34
<b>diverse</b>	0	17
<b>encompass, encompasses, encompassing</b>	1 + 0 + 1 = 2	16 + 19 + 17 = 54
<b>align, aligning, aligns</b>	1 + 0 + 1 = 2	19 + 23 + 20 = 75
<b>holistic</b>	1	26
<b>paramount</b>	5	22
<b>intricate, intricately</b>	0 + 0 = 0	21 + 3 = 24
<b>realm, realms</b>	2 + 0 = 2	19 + 1 = 20
<b>multifaceted</b>	0	14
<b>crucial</b>	18	93
<b>perspective</b>	12	33
<b>comprehensive</b>	2	76
<b>meticulous</b>	0	13

After reading many student reports over many years before ChatGPT, faculty can often identify suspicious wording that indicates the use of AI-assistance in the first sentence of the abstract. Typically, non-natural words are characterized by being exaggerations or more fanciful forms of expression. Here are three examples of the first sentences with the unique words flagged in bold.

This study explores the **nuanced** considerations surrounding the choice ...

This abstract **delves** into the thermodynamic distinctions between ...

This paper ..., with the overarching objective of raising consumer awareness about the **multifaceted** impacts ...

Some reports contained fewer non-natural words, indicating that the student probably made a greater contribution to the substance of the report or modified ChatGPT's suggestions to make the words more meaningful to the student.

Table 3 shows words that were found to be used more often in pre-ChatGPT student reports. It was observed that simpler words like *large*, *larger*, or *important* are more likely to appear in student-authored and less likely in AI-authored reports. These words appear straightforward and uncolorful compared to alternative expressions.

**Table 3. Words found to be more frequently used in pre-ChatGPT reports.**

	Spring 2022 Pre-ChatGPT	Spring 2024 Post-ChatGPT
large, larger, largest, largely	102 +21 +43 +9 = 175	20 +5 + 0 + 9 = 34
important, importantly	101 + 3 = 104	46 +1 = 47
issue, issues	51 + 32 = 83	6 + 32 = 38
slow, slower, slowing, slowly	17 + 0 + 7 + 7 = 31	0 +5 +0 +0 = 5

Some AI-assisted writing tools allow the user to select the style of writing and suggests alternative words that better match the style [11]. As AI tools improve it will be more difficult to identify AI-authored writings by the frequency of non-natural or fanciful words. If a student were given Table 2, they could easily ask ChatGPT to rewrite their report without using words like: nuance, incur, underscore, delve, etc.

Current versions of ChatGPT used by students are not helpful with visuals, equations, and references. In most reports, the student located a pertinent visual and then copied and pasted it into the report. If AI is used to generate a visual, it is often accomplished in a multi-step process where the student instructs ChatGPT to write Matlab (or python, etc.) code that will generate a plot or bar/pie chart with specific attributes specified by the student. The code is then copied and pasted into Matlab, where the graphic is generated, and subsequently copied back into the report. Only a few students generated unique visuals using this method, while the majority opted to locate preexisting graphics through online searches.

AI-generated equations and mathematical manipulations can be incorrect. Many students are aware of this, so they avoid having AI introduce equations and opt to introduce equations themselves. An incorrect equation that is suspected of being generated by ChatGPT and then submitted in a student's report is included here:

$$\text{Energy Efficiency (EE)} = \frac{\text{Total Energy Input}}{\text{Total Energy Input}}$$

References provided by early versions of ChatGPT are often incorrect, and many students are aware of this. Here is an incorrect reference submitted in a student's report:

#### REFERENCES

- [1] Smith, J. A., and Brown, M. R. 2022. "Comparative Life-Cycle Assessment of Gas and Electric Water Heaters." \*Journal of Sustainable Energy\* 45(2): 123-145.

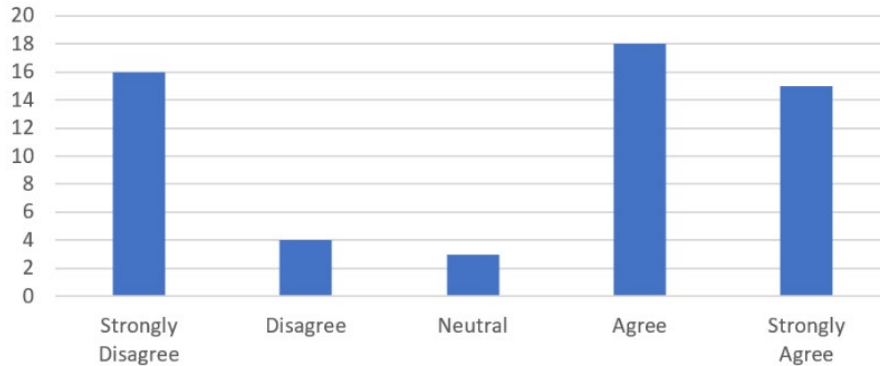
The citation lists Smith and Brown as authors, names that are among the most prevalent in the United States. While the "International Journal of Sustainable Energy" is a legitimate publication, the current volume is 42 as of January 2024, indicating that volume 45 has not yet been published. Interestingly, the title of the paper aptly corresponds to the theme of the student's report. However, upon searching, the cited journal article could not be located. This discrepancy is a common occurrence in earlier versions of ChatGPT, where references may appear accurate but do not necessarily correspond to existing papers.

#### Survey

A survey was conducted in the Spring 2024, with a total of 64 students responding. Some students chose not to respond to some survey questions. The majority of the survey provided a statement, and students indicated their responses using the following scale: SD=strongly disagree, D=disagree, N=neutral, A=agree, and SA=strongly agree.

Figure 1 shows that more than 60% of the students have already used AI assistance on a report submitted for academic credit. These findings demonstrate the widespread use of AI among engineering students and it can be expected to continue to increase next year. The majority of students only use ChatGPT. Since the release of ChatGPT, other companies have been introducing similar tools or enhancing existing tools with AI.

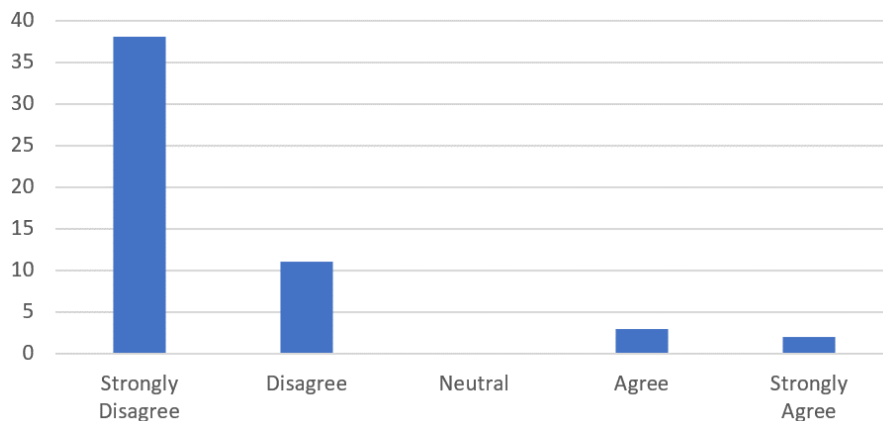
Before this class, you used an Artificial Intelligence (AI) tool, like ChatGPT, to help complete a writing assignment or report that was submitted for academic credit.



**Figure 1. Majority of students have used AI assistance before this assignment.**

Figure 2 shows that a few students used AI assistance other than ChatGPT. In follow-up comments, about five students reported using QuillBot [11] or Grammarly [12]. Surprisingly, no student reported using Microsoft CoPilot [13] or Google Gemini [14]. There are numerous writing tools available that offer varying degrees of AI assistance, and companies are rapidly developing new AI tools.

For this report, you used an AI-tool that is not ChatGPT.



**Figure 2. Number of students indicate that ChatGPT is the only AI tool used.**

Table 4 summarizes student responses on specific report sections that AI improved. A mean response was computed numerically using a 5-point scale with SD (strongly disagree)=1 and SA (strongly agree)=5. The highest “agree” response was that AI assistance helped with the Life-Cycle Assessment (LCA), with an average response of 4.28. The instructor's explanation of LCA was concise, leaving students with the task of acquiring the necessary skills to do a basic LCA. Several students commented that AI greatly facilitated their understanding of LCA for the

purpose of successfully completing the assignment. The high mean response indicates that students believe that AI is effective in helping them learn.

Table 4 shows that AI was least helpful with the “references,” which are well known to not be trusted from current AI tools. A few students commented that AI was helpful in putting a reference into the format required for the report but not in finding the reference.

**Table 4. Students responses to “AI assistance helped you improve the report’s”.**  
SD=Strongly Disagree, D=Disagree, N=Neutral, A=Agree, SA=Strongly Agree.

	SD	D	N	A	SA	Avg
<b>Abstract</b>	<b>2</b>	<b>2</b>	<b>4</b>	<b>17</b>	<b>25</b>	<b>4.22</b>
<b>1. Introduction</b>	<b>3</b>	<b>1</b>	<b>5</b>	<b>22</b>	<b>22</b>	<b>4.11</b>
<b>2. Life-Cycle Assessment</b>	<b>1</b>	<b>2</b>	<b>4</b>	<b>18</b>	<b>25</b>	<b>4.28</b>
<b>3. Evaluations</b>	<b>1</b>	<b>2</b>	<b>10</b>	<b>19</b>	<b>20</b>	<b>4.06</b>
<b>4. Role of Engineer</b>	<b>3</b>	<b>1</b>	<b>6</b>	<b>20</b>	<b>22</b>	<b>4.10</b>
<b>5. Conclusions</b>	<b>3</b>	<b>3</b>	<b>7</b>	<b>19</b>	<b>20</b>	<b>3.96</b>
<b>References</b>	<b>21</b>	<b>6</b>	<b>7</b>	<b>6</b>	<b>12</b>	<b>2.65</b>

Table 5 summarizes survey results about student learning. Students self-assessed their learning in different areas of the report as well as an overall assessment. The last question shows the students believe they learned “something meaningful from the assignment.” Since about 40% had never used AI assistance before, many left comments about how powerful and useful AI was in quickly completing the assignment. Another area highly rated was “about life cycle analysis” required in the report. The instructor was initially concerned about student feedback because students had received little guidance in this area prior to the assignment. Student feedback suggests AI helped them learn enough about life-cycle analysis in order to complete the assignment.

**Table 5. Students responses to “AI assistance helped you learn:”.** SD=Strongly Disagree, D=Disagree, N=Neutral, A=Agree, SA=Strongly Agree.

	SD	D	N	A	SA	Avg
about gas/electric appliances	4	2	5	21	22	4.02
about life cycle analysis	2	2	7	18	22	4.10
about economic, environmental, and social considerations	2	3	9	19	19	3.96
about ethical and professional responsibilities of a professional engineer	4	3	14	18	15	3.69
something meaningful from the assignment	0	1	11	19	20	4.14

The following student comments collected from the survey support the observation that AI was helpful in this area:



“I’ve used AI to define concepts and procedures when the textbook was unclear, the language when explaining concepts is much easier to follow.”

“AI gives exact answers to questions where a search engine provides plenty of different pages.”

“When YouTube and books fail, it can sometimes help with comprehension of difficult concepts.”

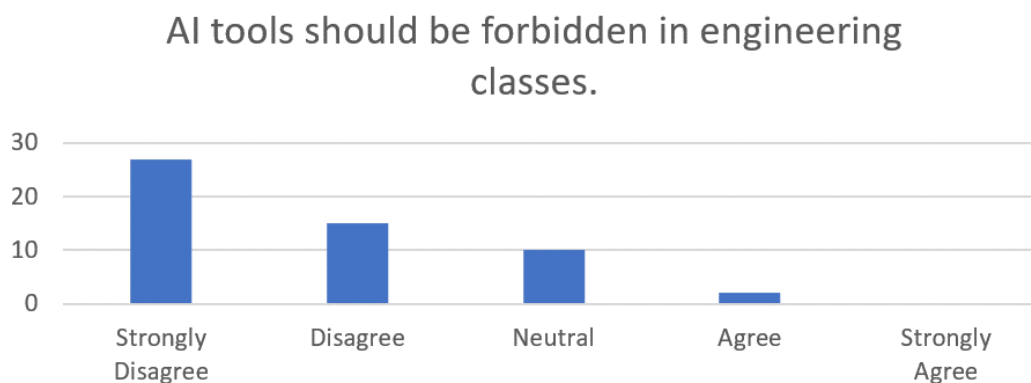
“It helps by getting to the point faster rather than searching for hours.”

“I think AI can be HUGE in getting started with ideas. You don’t know what you don’t know, and AI can help get you started ...”

“If asked the right questions, AI can be very beneficial to research and knowledge growth.

“AI saved time with the fluff, but it was not very helpful with getting and analyzing the actual data.”

Figure 3 summarizes student responses about prohibiting the use of AI tools in engineering classes. The students overwhelmingly believe that AI tools should not be forbidden.



**Figure 3. Number of students responding that AI should be forbidden in engineering.**

A few student comments from the survey reinforce the responses shown in Figure 3:

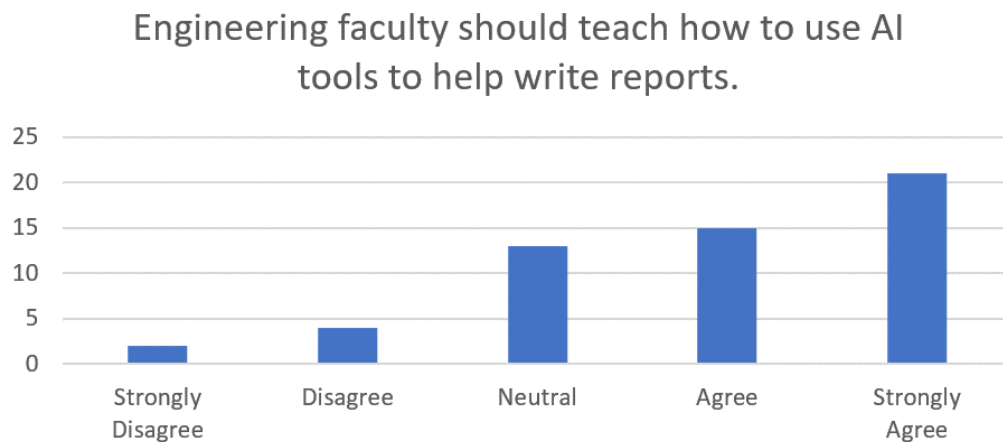
“AI is the future, ... and should be understood and utilized properly”

“Forbidding tools that will very likely be used in our future professions would put us at a major disadvantage.”

“AI will become a larger part of everyone’s lives and it would be beneficial to have a better understanding of which it is and how to use it properly”

“Just like calculators, CAD, or any other technological advancement in engineering, AI tools are officially a part of our world, and we should be focused on learning how to use & optimize this tool at our disposal. It would be ignorant to neglect this valuable tool. It’s only going to become more prevalent, so we might as well get used to it.”

Figure 4 shows the responses for the final survey question about teaching AI. The responses are surprising because it was expected that students can learn the mechanics of using AI tools without the assistance of faculty. Most AI tools have an intuitive, well-designed interface.



**Figure 4. Number of students responding that faculty should teach how to use AI tools.**

There appears to be two main reasons explaining Figure 4 results. Students commented that they want to either (a) learn the mechanics of AI better or (b) learn the responsible use of AI. A few suggested a technical elective course teaching AI. Many more students want to avoid the possibility of getting into academic trouble using AI. Students want faculty to help clarify the ethical use of AI, explaining what is acceptable and what is not acceptable on future assignments. Below are student comments concerning engineering faculty teaching AI tools:

“AI can be self-taught outside of class”

“there should be an elective course for it.”

“want to become more effective using AI and want to know restrictions on its use”

“teach at least how to be careful with it, as to not misguide us.”

## Conclusions

This paper presents insights gleaned from a writing assignment in an engineering thermodynamics course, where students were permitted to utilize AI tools. Feedback from students indicates a widespread use of AI tools such as ChatGPT for such assignments. Approximately 60% of students reported prior use of AI assistance in writing assignments for credit before the Spring 2024 semester. Notably, the quality of AI-assisted reports surpassed that of previous semesters before AI assistance was available. Enhancements were noted in report organization, grammar, abstracts, and conclusions. Other areas such as graphics, equations, and references displayed less improvement.

Presently, generating graphics with AI entails a multi-step process involving MATLAB code generation, graphic creation in MATLAB, and subsequent inclusion in the report. Graphics generated with AI assistance were infrequent in the reports received in the Spring 2024 semester, yet this trend is anticipated to evolve as AI assistance improves.

AI assistance often yields erroneous references and equations, though students are generally aware of this and correct errors before submission. Instances where errors persist suggest potential scholastic dishonesty, as students appear to have simply copied the AI-generated content.

According to survey responses, students overwhelmingly advocate for the integration of AI tools in engineering classes, believing it enhances report quality and facilitates meaningful learning experiences. Noteworthy benefits include assistance with initiating tasks, organizing content, and drawing conclusions. Students assert that instructors should educate them on AI usage, emphasizing acceptable versus forbidden practices.

The integration of AI assistance in engineering education is expected to rise, especially with AI tools becoming integrated into existing tools such as word processors and programming software. Faculty perspectives vary regarding the appropriate implementation of AI support without raising academic dishonesty concerns. Clear communication of expectations and restrictions regarding AI usage is recommended. It is proposed that faculty require an acknowledgments section in reports and require students to disclose any AI tools used and describe how the tool(s) was used to help complete the assignment.

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[12] Grammarly, <https://www.grammarly.com>

[13] Microsoft CoPilot, <https://copilot.microsoft.com>

[14] Google Gemini (formerly Bard), <https://gemini.google.com/>