THE USE OF LLMS IN ACADEMIC WRITING INSTRUCTION FOR FIRST-YEAR STUDENTS IN THE ENGINEERING BACHELOR PROGRAMMES

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ABSTRACT
The introduction of Open AIs Chat GPT in November 2022 changed the game on academic writing instruction. Questions on how the use of large language models (LLMs) will affect students' writing skills were discussed among educators and in academia. This article aims to obtain understanding on how to adapt course content in academic writing in the engineering studies to the use of LLMs. It also aims to evaluate how students may use LLMs effectively in their academic writing. A survey was conducted to research students' experiences with LLMs as part of academic writing instruction, and how staff's instruction can be improved. The academic writing instruction was prepared in collaboration between academic staff in the discipline, the university library and the writing centre. Survey findings and experiences from a project given to first year engineering students reveal that students want and need academic writing instruction, but that it needs to also embed instruction on the use of LLMs. The problem areas in academic writing are the higher order skills, such as critical thinking and information literacy. When asked where students seek help to improve academic work, the LLMs appear as the lead supervisor. This calls for a need for educators to engage critically with the LLMs and how students use them. Academic writing instruction may need to include responsible use of LLMs into the course content.

Keywords: Large language models, academic writing instruction, engineering sciences, higher order writing elements

1 INTRODUCTION
The introduction of Open AIs Chat GPT in November 2022 changed the game on academic writing instruction. It raised questions both on how to use the new tools wisely and how to adapt the writing courses to work alongside with the tools. This article evaluates how the use of large language models (LLMs) may contribute to the writing instruction courses in academia in general, but specifically in the engineering education.

1.1 Background
Even though the engineering sciences evaluate practical tasks in the bachelor and master's programmes, the written report is still the core of assessment. Academic writing instruction has in recent decades been two-pronged; The genre-oriented approach has emphasised instruction on how to use formats, templates and language conventions within the discipline [1], [2]. The other approach to writing instruction emphasises 'the higher order elements' such as critical thinking, source competency, language awareness and rhetorical skills [3], [4], [5].
It is argued [3], [4], [5] that templates and disciplinary requirements, such as style and fixed structures may stand in the way of text flow and argumentation flow, and that students find it difficult to write according to these formal requirements. However, on surveys [1] that question what the engineering students find the most difficult in academic writing, three challenges appear:
1. Information literacy
2. Genre orientation and text structure
3. Creating good research questions

These challenges show that students struggle both with form as well as the higher order writing elements, such as critical thinking. Academic writing instruction has attempted to cater for these needs prior to the introduction to LLMs in academia. The question remains on what changes in writing instruction will be required now that the students have AI to help them write.

The LLMs have shown capability to aid students in at least two of these problem areas [6]. They can generate seemingly flawless well-structured text as well as demonstrating critical thinking in terms of asking topical questions for the students to reflect upon. This begs the question of what it is that our engineering students need to develop language skills for, when they no longer need to produce their own text. When grammar, spelling, text structure and maybe even the art of analytic thinking, can be handed over to the LLMs, the question of purpose rattles the core of language instruction.

One of the fundamental issues of language and knowledge acquisition in academia is critical thinking. A major part of that entails information competency. The ability to think critically and make balanced judgement about information students find and use is pivotal. Therefore, language skills, and by extension, critical thinking, is important for the development of information literacy. The question of overreliance on LLMs in students' academic writing exercises raises issues both on bias in the LLMs' training data and the problem of skill degradation among students, both in which 'the higher order' writing skills may suffer loss [7], [8], [9].

The Sapir-Whorf hypothesis [10] suggests that a person's language will shape her world view and may even determine her thoughts. Language is thus an active component in the ability to reflect upon and to create new meaning in our surroundings [11]. Developing writing skills therefore becomes an act of developing thinking skills, as Johansen puts it; "Writing is the technology used for thinking" [12]. The LLMs, on the other hand, are only form. They do not have access to meaning. They cannot create anything new, that is factually reliable. They can only copy what they have been trained on or hallucinate [13]. In the article 'On the Dangers of Stochastic Parrots' [14], Bender and Gebru warn us about the dangers of bias connected to the LLMs' training data. In a time where social views are rapidly changing, the use of static training data, and the hegemonic voices they represent, may pose a threat to the increasing diversity in academia. The challenges we see in the use of LLMs in academic writing training [15], [16] call for a closer look into the content of courses in academic writing in the engineering education.

1.2 Research question

How may students' use of LLMs change how we conduct academic writing instruction?

2 CASES

2.1 Information about the course

Students from all engineering programmes at UiA must take the course "Technology, Environment and Sustainability [17] in their first year. This includes students from the programmes Civil and Structural Engineering, Computer Engineering, Electronics and Electrical engineering, Renewable Energy and Mechatronics. The course is divided into two parts. This article covers the section on academic skills, with focus on information literacy, writing and the use of LLMS. Three two-hour lectures were given during two weeks in the beginning of September 2023, and the exam question was made available for the students at the same time. The lectures were optional. Each week the rest of the semester, a changing group of students had mandatory guidance on their exam paper. There were also optional guidance sessions based on drop-in for all interested students in the course. The students were evaluated on two papers. One was an article, about a chosen technology, written by the student in collaboration with one or more chosen LLMs. The second was a report written without LLMs. The report was about their experience with writing together with an LLM, and their evaluation of the results. This was the main assignment for evaluation.

2.2 Planning the course

The educator team for academic skills consisted of three teachers with different fields of expertise, each providing one lecture. Academic writing was covered by a writing- and language lecturer with engineering students as their speciality. Source literacy was covered by a research librarian for computer science and engineering research. Introduction to LLMs was covered by a researcher in the field of AI.

All work at the University of Agder, Norway (UiA). In addition, there was a group of other lecturers in the course who were available for guidance, both the mandatory and optional sessions.
While planning the content of the three lectures in academic skills, the educator team also prepared the exam paper, so they were always aware of what the students were supposed to gain from the lectures.
UiA also has a writing centre that was informed of the paper, so that students in this course could have easy access to other sources of support for academic writing. In addition, there is a well-functioning mentorship programme (FYSE) for all these students, who were also available for support, though not with the same capacity and knowledge of the taught subject.

3 METHODOLOGIES

A survey, made in SurveyXact, was distributed to all 332 students in the course. It was distributed in our learning management system Canvas in November and December 2023. 90 students enrolled in the course responded, equalling a response rate of 28%. The entire survey included 55 questions, where 25 were relevant to this article. The survey consisted of both qualitative and quantitative questions. This provided the students with the opportunity to give feedback and input both with fixed answers, and on what they felt important to share to the educator team. This paper also draws on the first-hand experiences of the educators, as well as some observations from the final exams in the course and the educators' reflections on the lectures and learning outcomes.

4 RESULTS AND DISCUSSION

The selected variables for the question of how LLMs may change the way we teach academic writing are as follows:

- Students' satisfaction with the given lectures
- Students' challenges regarding academic writing
- Where do students seek help to improve their texts?

4.1 Lectures in academic writing

91% of the respondents in the survey answered that they will use the lectures in academic writing, and the following training, to improve written work in other courses in their engineering education. It seems that most of the respondents are aware that training the 'writing- and thinking' muscles' [12] is a crucial part of being able to analyse, synthesise and to reflect, both theoretically and practically. *Figure 1* shows the perceived usefulness of the lectures in academic writing. A large majority of the respondents found the lectures useful, especially for understanding the importance of good writing skills.

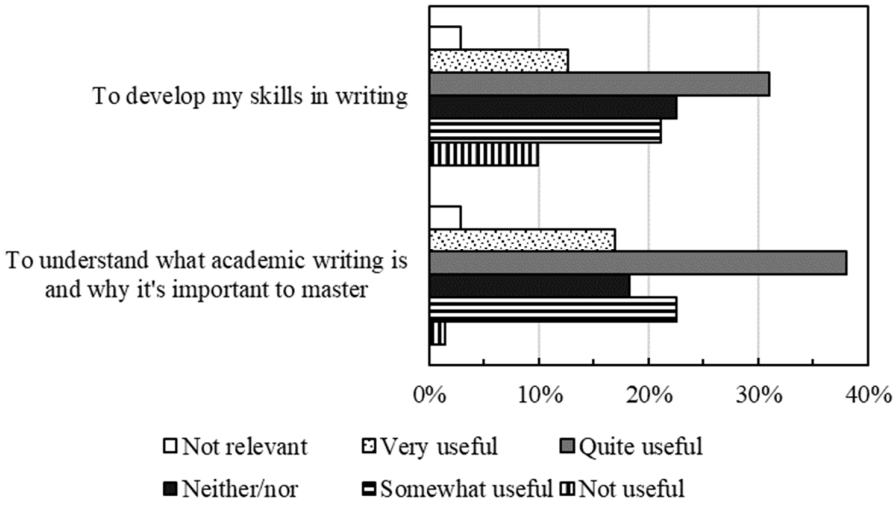

Figure 1. How useful were the lectures in academic writing?

Still, the survey shows that only 42% of the respondents were actually present at all three lectures. It is reasonable to assume that their interest in lectures on academic writing is low [18]. Generally,

students in the professional studies find academic writing very difficult [1], [4] and tedious work, and the temptation to outsource writing tasks to the LLMs may be all too difficult to resist.

4.2 Students' challenges in academic writing

Findings shown in *Figure 2* reveal that many of the higher-order writing elements, such as developing a research question, understanding the task, and information competency are difficult for students. These elements are important to continue to incorporate into academic writing instruction.

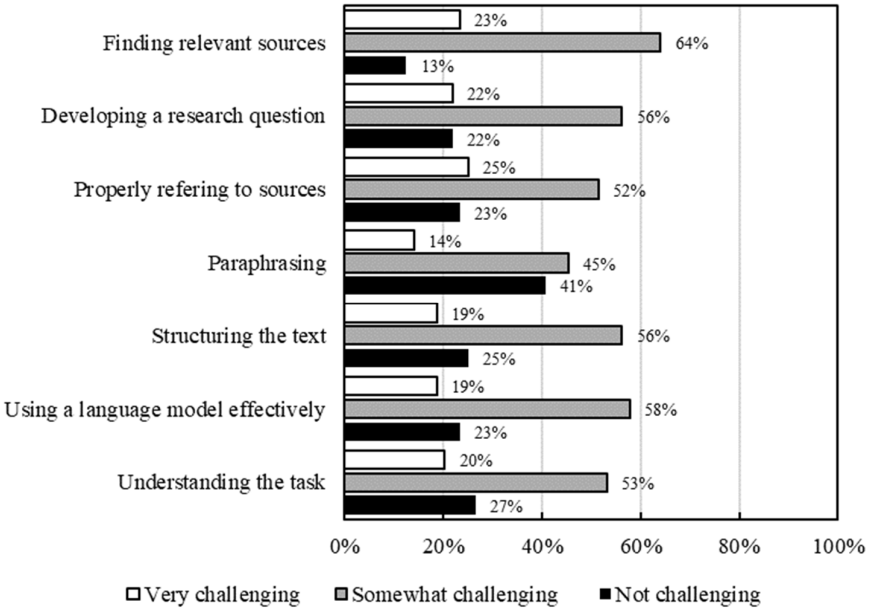

Figure 2. Academic writing: Evaluate the level of difficulty for the following

The students also, not surprisingly, struggled with using the LLMs. Open comments from students, as well as supervision sessions, confirm that the difficulties the students faced were related to both that the tools are new to the students, but also that they introduced a very different way of producing text. Students commented that prompting became a skill they needed to learn in addition to learning general academic writing. Training in how to prompt is an element that may have to be included in academic writing instruction [14], [15]. On questions of which language model was used, all respondents replied they had used ChatGPT 3.5. Only five respondents had tested other LLMs in addition to Chat GPT 3.5. These were Bing, BARD, Chat GPT 4, Perplexity, Phind and Assistant by Scite. From the exams we saw at least one student using the SnapChat AI.

Results from the survey also show that a majority of students found the lecture on searching, critical thinking and reference management to be very useful. However, as shown by *Figure 2*, many students find the various information literacy skills somewhat or very hard. An observation made while reviewing the exam papers was that several students struggled with the importance of knowing where they find their information. Several papers had an LLM cited as the source of information about how LLMs work, and what issues they can represent. There were also several cases where the owner of the LLM was cited as the only source of the same information. Very few papers had credible sources outside of encyclopaedias. It poses the question on how we in higher education can expect future engineers to use and develop advanced models in their speciality, when they do not prioritise learning how to find and use quality information, as Lievens points out [19].

With the exception of paraphrasing, under 27% found information skills not challenging, even if they found the lecture useful. The issue of information literacy is increasingly important when university students use LLMs as their writing and sparring partner. Biases in LLMs are discussed in [7], [14], [16] and the overarching issue is that in our world where the narrative in public discourse is rapidly changing from hegemonic narratives to a broader diversity, the LLMs are still stuck in a narrative of static data fed into the LLMs training materials [14]. This issue must be regarded differently from training the

students in being critical to which website they obtain their information from. It brings aspects of source criticism to a whole different level.

4.3 Where do students seek help to improve their writing?

Table 1 shows that a slightly higher number of students had help from LLMs than from academic staff to improve their written assignment. These are numbers that instructors in academic writing are disappointed, but not surprised by. On further questions of what the LLMs were used for, four categories can be obtained:

1. Text generation, translation, and proof reading
2. LLM as a learning partner: language training and text feedback
3. Plain outsourcing/plagiarism
4. Finding information

Table 1. In what degree did the following contribute to improving your written assignment?

Question	Not challenging	Somewhat challenging	Very challenging
Understanding the task	27%	53%	20%
Using a language model effectively	23%	58%	19%
Structuring the text	25%	56%	19%
Paraphrasing	41%	45%	14%
Properly referring to sources	23%	52%	25%
Developing a research question	22%	56%	22%
Finding relevant sources	13%	64%	23%

The numbers in *Table 1* indicate that the introduction of LLMs into academia calls for a change in how we teach. Students' discussion in their lab reports show that more training and instruction in the use of LLMs may help them reflect upon how to use LLMs wisely in their academic writing training. To incorporate this into academic writing instruction seems to be in order, in addition to showing students what people can do that machines cannot do [13].

One of the responses in the survey was that "it is difficult to know how to use language models without training". Other students gave the same feedback in various phrasing. This response needs to be seen in light of the attendance in the course, where 58% responded that they did not attend all lectures. From observation, most students in the course did not attend the optional guidance sessions either. This finding highlights an issue we can see in all parts of academia, where we face the question of combining student responsibility for their own learning with the attendance necessary for the relevant learning outcomes.

5 CONCLUSIONS

It is necessary for student success with academic writing, and critical thinking in general, that we as educators at universities and colleges take responsibility for engaging critically with LLMs.

Even when we engage in cross-disciplinary discussions during both planning and follow-through stages, there are still no guarantees that the students learn the necessary skills without more thorough guidance during the work phases of student academic writing.

On the introduction of LLMs into the engineering education and students' work on academic writing, we see that the higher order elements seem more important to teach than ever. Critical thinking as well as text production-training will be a part of that. Another issue that may need to be included in academic writing instruction is appropriate and responsible use of the LLMs [16], including how to prompt, as well as awareness of bias in the various models.

A third issue concerning academic writing and the use of LLMs, that needs further investigation, is how the written work of students is assessed. It is clear that even though students may submit better texts, they may not have become better writers [8]. Assessing the end product therefore seems futile, and a need for process-based assessment is emerging.

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