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# Uses and Impacts of LLMs on the Learning Experience of Future Engineers: Case Studies in the Context of a French Engineering School

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## ABSTRACT

In November 2022, the release of ChatGPT to the public challenged the established order of our educational systems. Faced with this disruptive innovation, traditional educational structures were unprepared to handle this complexity and manage its uses. Consequently, the burden of social regulation became the responsibility of individuals and collectives. In this context, students' and teachers' practices adapted and evolved to both take advantage of the opportunities offered by this new tool,

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and/or to establish a regime of "new normal" that would appease tensions and improve learning. This article aims to empirically detail the mechanisms of social reconfiguration deployed to integrate ChatGPT more harmoniously in classrooms. It focuses on initiatives within a French engineering school, on both institutional and individual levels. Firstly, it outlines strategy and actions settled by the "*pedagogical and digital innovation*" team to support and guide teachers in this transition. Secondly, through three case studies, it describes the activities set up by teachers to make ChatGPT an effective resource for diversifying pedagogical practices and questioning students' learning processes. The first case concerns the design of a course aimed at creating a charter for the responsible use of ChatGPT for and by students. The second case covers the adoption of a problem-based learning approach so students can overcome their problematic use of ChatGPT. The last case reports an experiment to help students use ChatGPT more effectively in learning English. With this contribution, the authors hope to inspire similar initiatives and strengthen the existing teaching communities of practice.

## **1 INTRODUCTION**

The introduction of new technologies in society has almost always been followed by waves of "moral panic" (Cohen 1972) in the educational system (Reich 2020). The emergence of Wikipedia and the vast amount of knowledge it shared with everyone (Reagle and Koerner 2020), and the arrival of calculators in mathematics (Ellington 2003), are concrete examples of such a phenomenon. In many cases, these sensationalistic discourses have faded with time, leaving place for a normalization of their uses in teaching practices. The same scenario occurred again after the release of ChatGPT in November 2022 (Fütterer et al. 2023). While the use of ChatGPT is still controversial in education, initiatives are multiplying to make generative AI a useful learning resource. Aiming to nurture this growing "community of practice" (Lave and Wenger 1991) through feedback, this article presents the actions taken within a French engineering school by three teachers and a pedagogical coordinator.

## **2 GUIDING TEACHERS TO BETTER INTEGRATE CHATGPT: PDI TEAM ACTIONS AND STRATEGY**

Several institutional reports have been published on the impacts and potential uses of ChatGPT in education since its release (Romero and Heiser 2023, Sabzalieva and Valentini 2023), but teachers don't always have time to familiarize themselves with this literature. Within our engineering school, teachers' concerns about the use of ChatGPT in classrooms were addressed by the Pedagogical and Digital Innovation team (PDI). The PDI's main mission is to support teachers in the pedagogical innovation process. Through its local coordinators, the PDI team can offer guidance and recommendations across multiple campuses (7 in France, and 2 in Africa).

As part of a proactive approach, an educational half-day was organized by the PDI team in May 2023 to present the possibilities of using LLMs to help design teaching programs. The aim of this initiative was to raise teachers' awareness of the potential of these technologies to enhance their teaching practices. Concrete examples of the use of LLMs in the creation of course materials and the running of practical workshops enable teachers to test and experiment with these tools. The main objective was to provide teachers with the skills they need to: integrate LLMs into their teaching practices in a thoughtful and effective way, design innovative learning situations adapted to students' needs, and support students in the responsible use of

these technologies. This first step offered an opportunity for discussion and reflection on the implications of these tools for the various courses.

At the same time, teachers questioned the local PDI coordinator about the challenges posed by the use of LLMs by students in the context of assessments. They particularly shared their fears on three issues. 1) **Cheating**: students use LLMs to produce non-personal content without bothering about their learning. 2) **Unequal access**: not all students have the same skills or the same level of access to these technologies. 3) **Loss of meaning**: assessment would no longer focus on students' actual skills but on their ability to use LLMs.

Aware of the importance of this topic, a workshop was organized in February 2024 to gather their views and proposals (several workshops were held in parallel, combining fields and courses). Feedback from the 24 participants (teachers and researchers) highlighted the need to train students in the ethical and responsible use of LLMs, as well as the relevance of identifying options to guarantee the integrity and validity of assessments. Discussions also focused on the need to rethink assessment formats to make them more resilient to students cheating using ChatGPT.

To address these concerns, several initiatives have been implemented. One of the first actions taken was to set up a working group with some of the volunteers present at the workshop. Among other missions, the group will monitor the opportunities offered by LLMs for teachers. A second action currently underway consists of testing the various existing AI-generated text detection software to limit fraudulent use of ChatGPT in exams and reassure teachers. These tools will be used in conjunction with preventive measures such as the introduction of a clear policy on the use of LLMs in assessments. Thirdly, a series of new workshops and training courses have already been scheduled to meet the needs of teachers and students. More globally, the PDI team will continue to follow the development of LLMs, support teachers in their use of these technologies, and stimulate a collective reflection on the appropriate solutions to guarantee the integrity and quality of training.

### **3 ADAPTING TEACHING PRACTICES TO BETTER INTEGRATE CHATGPT: THREE CASE STUDIES**

#### **3.1 ChatGPT and Ethics: a charter for and by students to guide their uses**

The following case study reports the implementation of a teaching initiative focused on elaborating a charter for a socially responsible use of ChatGPT by and for students. The main inspiration for designing this teaching was the early feedback from teachers like Ethan and Lilach Mollick. Sharing the principles for successful integration of ChatGPT in education (Mollick and Mollick 2023) they emphasized the crucial role of providing students with a document defining clear guidelines for the use of AI in class. Seeking to reverse this top-down pedagogical approach, this course invited students to build their own AI usage charter.

This course took place in the context of a teaching module entitled "Adopting a Position". In this module, teachers must conceive a series of workshops that immerse students in a project-based teaching approach and seek to actively engage them in a creative process, leading to a production that expresses a real standpoint. After reading a booklet presenting the proposed workshops<sup>2</sup>, students chose the project

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<sup>2</sup> The presentation of the Chatgpt charter workshop is available at the following link:  
[https://drive.google.com/file/d/1eCbgH-li1LDfUP32T0nG3pg\\_JEDus7N0/view?usp=sharing](https://drive.google.com/file/d/1eCbgH-li1LDfUP32T0nG3pg_JEDus7N0/view?usp=sharing)

they would like to contribute to. Project groups were then set up by teachers. The first 8 sessions were devoted to the group production process, the 9<sup>th</sup> session was a whole-class presentation of each group's productions, and the last session was a written exam inviting students to individually review their own experience<sup>3</sup>.

GANTT CHART		FEBRUARY				MARCH					APRIL				MAY	
		2 <sup>nd</sup>	9 <sup>th</sup>	16 <sup>th</sup>	23 <sup>rd</sup>	2 <sup>nd</sup>	9 <sup>th</sup>	16 <sup>th</sup>	23 <sup>rd</sup>	30 <sup>th</sup>	6 <sup>th</sup>	13 <sup>th</sup>	20 <sup>th</sup>	27 <sup>th</sup>	4 <sup>th</sup>	11 <sup>th</sup>
INTRO	From AI to generative AI	█														
	AI and ethics		█													
	Charter writing principles			█												
WRITING	Design of the charter plan					█	█									
	Charter writing					█	█	█	█	█						
	Review, discussion, correction						█	█	█	█						
	Preparation for restitution									█	█					
EXAM	Charter presentation											█				
	Written exam															█
	No class				█	█	█	█	█			█	█	█	█	

Fig. 1. Gantt chart of the ChatGPT charter creation project.

In the case depicted here, 5 teachers proposed 6 workshops to a class of 84 students in their second year of preparatory studies for engineering schools. The class was divided into 9 groups of 6 to 12 students. Workshops exceeding 12 students were split into two groups working on the same project. Thus, two parallel projects on ChatGPT were directed. They were managed similarly, resulting in two different but close charters. The class ran from February to May 2023 (Fig. 1).

The first 8 sessions were organized into weekly two-hour classes. They were split into 2 phases. The first phase, from session 1 to session 3, consisted in a series of 3 introductory courses on AI, generative AI, ethics and the basics of charter writing. The purpose of these sessions was to provide a common base from which students could build these charters. Although students had benefited from computer science courses, notably in their first year via a programming project for a low-complexity symbolic AI system, their "digital culture" (Crepel et al. 2018) was strongly disparate and relied mainly on watching YouTube videos.

To address these gaps, the first session traced the history of AI from its founding fathers (McCarthy et al. 2006) to ChatGPT, covering topics such as AI systems functioning and their applications, the paradigmatic separation between symbolic and connectionist AI (Cardon et al. 2018), an overview of language models and chatbots, the Transformer model revolution (Vaswani et al. 2017), and the social actors and stakes behind the release of ChatGPT. To help them self-diagnose their knowledge, students were invited, after the class, to answer a consultation led in Occitania (France) to assess citizens' level of awareness and acceptability of AI<sup>4</sup>.

The second session addressed the ethical stakes raised by AI, avoiding speculative debates on the consequences of the emergence of a strong AI (Ganascia 2017). To nurture a reflexive perspective on ChatGPT, chatbots with controversial applications, uses or developments were presented to students, such as HereAfter AI (2022), Xiaoice (Zhou et al. 2020), Tay (Suárez-Gonzalo et al. 2019), Koko (Germain 2023), precarious workers training AI systems (Perrigo 2023), or the prohibition of ChatGPT in school (Yang 2023) or workplace (Ray 2023). Several questions from the public

<sup>3</sup> The standard exam subject proposed to students for this module is available at the following link: [https://drive.google.com/file/d/1M-eLJLDaUyPQ4RQMq7H84wPH31st\\_zPd/view?usp=sharing](https://drive.google.com/file/d/1M-eLJLDaUyPQ4RQMq7H84wPH31st_zPd/view?usp=sharing)

<sup>4</sup> More informations about this consultation are available at the following link: <https://aniti.univ-toulouse.fr/en/2023/11/23/consultation-citoyenne-sur-lia-les-resultats-sont-disponibles/>

consultation presented in CNPEN (French national digital ethics pilot committee) opinion on chatbots were collectively discussed (Devillers et al. 2021).

The third session was split into two parts. During the first hour, students were set in pairs, and each group had to analyze one of the 5 proposed charters: OpenAI charter (2018), Montreal Declaration for a responsible development of AI (Dilhac et al. 2018), guidelines for AI in class (Mollick and Mollick 2023), the Responsible engineer and scientist charter of the association of French Engineers and Scientists (Anstett et al. 2022) and the values charter of our school. To analyze these documents, students were allowed to mobilize all the resources at their disposal: including ChatGPT to translate, summarize, vulgarize, criticize, etc. the text. During the second hour: students presented their text in 5 minutes, followed by a 5-minute discussion with the class on the resources they used to study the text and how they used them, on the relevant points to remember that could provide inspiration for their ChatGPT charter, or bringing further explanations from the teacher on this document.

The second phase, from sessions 4 to 8, consisted in the creation of the charter by students. For this, students could mobilize all possible resources. After discussing the plan of the charter as a group, students divided into pairs to write a first draft of each part for which they were responsible. The writing was done in a shared document on the cloud, from which they were able to exchange ideas in real time. To adopt an iterative logic, encourage debates and make the process more dynamic, several techniques were employed. Firstly, a system of rotating pairs so that each participant could collaborate with different colleagues and bring a fresh perspective to the various written parts. Secondly, close supervision by the teacher to guide them towards questions or resources they might not have considered. Finally, encouraging discussions within the group on best practices for using ChatGPT.

These discussions led to several observations. Firstly, the students' use of ChatGPT remained poor, usually limited to a single iteration, which didn't allow them to meet the requirements of the charter-writing exercise. Secondly, like any other tool, skills development were necessary (notably in prompting) to maximize the effectiveness of ChatGPT's use. Finally, they realized that to really perform in this exercise, the essential points were to understand the methodological expectations, to multiply the confrontations of various points of view (colleagues, ChatGPT, articles, etc.), and to be able to converge all these views in a coherent way in a single document. A long and complex task which cannot be substituted by a superficial use of ChatGPT.

This process led to the production of two 4-page charters<sup>5</sup>, both containing: 1) a preamble, providing background information on the implications of these charters and the conditions under which they were produced; 2) definitions, to ensure that these charters are accessible to everyone; 3) a series of articles setting out recommendations and warnings on the use of ChatGPT. These articles include critical analysis on the use of ChatGPT by students to cheat, advice on how to improve the effectiveness of prompts for learning purposes, and the potential "hallucinations" (Alkaissi and McFarlane 2023) of ChatGPT. Are also included the responsibility that students must have when using erroneous information, the importance of critical thinking and comparing different sources without becoming dependent on ChatGPT, the data collection done by OpenAI, or ChatGPT's environmental impact and the importance of considering the relevance of its usage. This work was then presented

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<sup>5</sup> These two charters can be consulted at the following link:

<https://drive.google.com/file/d/15nWJQeVxaeByheMq1oTOcer8gGY-LY0T/view?usp=sharing>

to the rest of the class during session 9, in a 15-minute presentation, followed by a discussion with the audience.

Throughout this workshop, using ChatGPT as a starting point and through the creation of a charter, students were able to think critically on innovation, which is essential for any engineer. Beyond nurturing a reflection on the uses of chatgpt, this charter acted as an intermediary for students, to inform, debate, argue and defend their opinions, but also to listen and make concessions, to produce a document that could reach a consensus within the group. This workshop was repeated from February to May 2024, with a single group this time, assigned to synthesize these two charters into a single one and focus solely on the recommendations section in order to simplify the document and encourage its appropriation and discussion in the school. Students will be recontacted, in a few years, in order to evaluate any lasting impacts of this course on their use of ChatGPT.

### **3.2 ChatGPT and coding: problem-based learning to empower students**

Programming is an ever-present subject when learning engineering, be it for specialized fields or generalized tracks (like in our school). Students must and need to learn one or several programming languages. Tools like ChatGPT have become commonplace as they can quite easily, and with very basic prompts, generate functional snippets of code. Positive impacts of using ChatGPT in a classroom setting, when learning to code, have been observed (Yilmaz and Yilmaz 2023). In this study the authors demonstrated that students who used ChatGPT when learning had increased levels of computational thinking and programming skills, as well as programming self-efficacy and motivation. However, AI coding bots do struggle with more complex problems, especially when using badly constructed prompts. We thus must address questions like, how can the students subdivide the problem at hand? How can they plan to reach a useful solution? And most importantly, what process pushes them to learn? In this setting, AI can be a source for co-creation (Jonsson and Tholander 2022) and an agent aiding the students to learn.

To showcase our approach, and attempt to answer these questions, we detail a use case pertaining to two PBL activities (Problem Based Learning) conducted with first year engineering students. Generally speaking, a PBL is any activity centered around a given problem situation where students learn and work in groups in order to find a possible solution. The aim of these two PBLs was to teach students the basics of algorithmic thinking and its applications using Python. In the first PBL, their task was to find a way of converting text into an image containing an encrypted message generated using a simple substitution cipher. In the second, students had to improve a program with a user interface using the tkinter Python library.

The format of PBLs adopted in our institution is as follows: the activity stretches out over two to three weeks and the class is divided into groups of 6 to 8 students (called PBL groups). The PBL is composed of five main phases (Fig. 2). Starting with the “Go Phase” where the problem situation is introduced to students, followed by the “Self-Study” phase where students discover resources (textbooks, technical reports, online articles, etc.). In these two phases, interactions between the tutor and students are limited. Next comes the “Practical Session” which is more classical and can consist of guided exercises and practical work. The activity ends with the “Group Return” phase where each PBL group presents its results. This can be done under a variety of formats depending on the main topic of the PBL. Then comes the “Common Return” phase with the whole class where direct feedback is given to the students. It is also

important to highlight that the adopted evaluation method is based on competencies and not grades. This means that the metric used to assess success or failure in learning is the ability of a student to demonstrate specific skills.

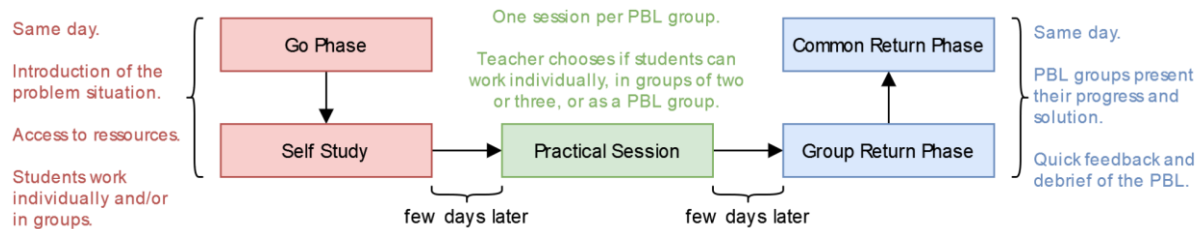


Fig. 2. Diagram representing a typical organisation of a PBL.

In the first PBL, after introducing the problem situation, students were asked to work collaboratively in groups. However, and as anticipated, a good deal of them directly sought refuge in ChatGPT, which started outputting answers that students simply could not comprehend as they lacked the basics that they are supposed to learn throughout this PBL. The more the students went back and forth with ChatGPT, trying to inefficiently modify the increasingly complex generated code, the more they struggled to comprehend it.

This situation should be treated as any other engineering problem. First, the main issue has to be clearly identified. When discussing this topic with students, it became clear that their rush to use ChatGPT was due to three main reasons. First, a lack of confidence in their abilities to tackle new topics. Second, a lack of patience and sometimes, an inability to deal with their frustrations when their solutions “do not work”. Third, the importance they give to obtaining results over the learning process. Student self-efficacy (Zimmerman 2000) is key when studying the implication of students. As they leave high-school and enter higher education, the paradigm shift can be brutal. Not only are the subjects of their courses more complex, but their autonomy becomes crucial for their progress. In this context, ChatGPT became an easy way to face their lack of confidence and patience. Thus, the path towards autonomy and critical thinking is slowed by a growing dependence on ChatGPT.

It has become abundantly clear that ChatGPT is influencing learning both positively and negatively (Bai et al. 2023). Such tools can on the one hand introduce bias, superficial and false information, while on the other hand offer a flexible and creative environment to learn. This is why during the PBL, and in parallel to the technical skills, one of the main goals was to show students how to properly divide and conquer a problem. Instead of jumping steps and expecting to arrive at a solution in one go using ChatGPT, students needed to be explicitly guided through this fundamental approach, which is necessary no matter what tools they might use to find information. However, a new question arises: How can they identify steps to solve a given problem if they haven't faced it before? To solve this issue, the students' sense of curiosity and desire to understand must be nurtured. Without this, it will become quite impossible to converge towards an impactful and long-lasting solution. Even if the students use tools to generate answers, their new posture will automatically push them to strive to comprehend what they have in hand and to go and seek information at its source, and not only through the filters of AI.

Throughout the practical sessions of the PBL, a plan to solve the main problem situation was iteratively co-constructed with the students (Fig. 3). For each new step, the main objective was recalled, as well as all the steps taken thus far, and the global plan readjusted due to newfound information. A rhythm was imposed where for each

new arising question, students had to either go through technical documents, or use AI to help zoom into the issue so they could tune their search. This tempo was heavy on the students, and by the end of the four-hour session most of them felt like they just went through a rigorous class of mental gymnastics. The impact of this approach became quite apparent in the second PBL, as during the practical sessions, students were presented with basic building blocks for adapting a functioning user interface, and were free to explore other existing methods on their own, and they were of course allowed to use AI. However, some wanted to go through the same hard process as the previous PBL. Surprisingly, students seemed more patient and rather eager to show what they are capable of.

Research has shown that students benefiting from using AI to learn can indeed be more creative and propose more original solutions (Urban et al. 2024). Yet, awakening the students' desires to learn is intimately coupled to their confidence and patience. Once the students witnessed that they are indeed capable, they became bolder and more structured in their approach, and their willingness to construct unique solutions to a given problem became much more apparent. Of course, this approach will not totally solve all ChatGPT related issues, but it can certainly nourish reflections that can push students towards becoming responsible future engineers.

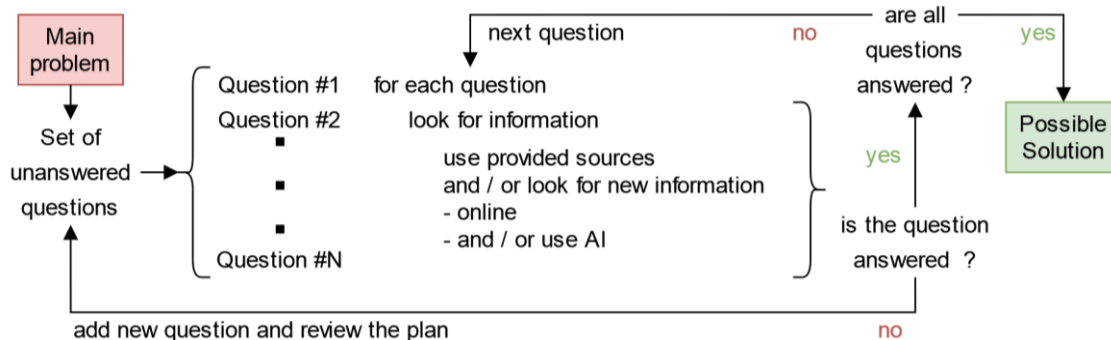


Fig. 3. Flow diagram showing the problem-solving approach shared with students.

### 3.3 ChatGPT and language courses: AI tutor to improve learning efficiency

The following case study reports an experimentation to help students use ChatGPT more efficiently in learning English. In a very traditional way, we regularly ask our students to read a text and answer comprehension questions. Digital tools are usually forbidden during these courses, in order to particularly avoid the use of automatic translators. But, several considerations led us to make the use of ChatGPT compulsory during one particular course. Firstly, the fact that multiple studies have shown the benefits of chatbots for language learning (Haristiani 2019, Jeon 2021, Godwin-Jones 2022). Secondly, inspired by a questionnaire conducted among students by Czech-Norwegian researchers to assess ChatGPT usefulness and effectiveness for English learning (Shaikh et al. 2023), we decided to conduct our own experiment to analyze student practices and see how ChatGPT could help them improve their English language learning.

As usual, students had a text to read and comprehension questions to answer. They had 10 minutes to read and understand the text, then they could use ChatGPT for 10 minutes. The only instruction was to use ChatGPT to help them understand the text. They were then asked to send their conversations with ChatGPT to the teacher, and we analyzed them. The analysis showed that they mainly used ChatGPT to translate words or sentences, to ask for explanations on specific words, and to summarize the text. One student asked ChatGPT to generate questions on the text and to give the

answers to these questions. Another one asked ChatGPT to ask him questions, and give feedback on his answers. Most of the students considered their use of ChatGPT very basic. Then, they were asked to use this prompt:

*“Assist a French student with an A2 level in English in text comprehension. Begin by asking 10 easy questions, then gradually increase the difficulty of the comprehension questions. Continue this process until the student says 'Now, move on to questions focusing on vocabulary'. Present one question at a time, each with three possible answers, concerning the meaning of the text and its vocabulary. After the student answers, provide feedback on correctness, offer a brief debriefing, and then present the next question. This is the text: [...]”*

They had 10 minutes to chat with ChatGPT, then sent their conversations to the teacher. All students said that this conversation was more interesting than their traditional use of ChatGPT. To get a more objective view of this experience, the 11 present students were asked to complete a questionnaire<sup>6</sup> structured around 4 questions, to which they could respond via a 5-level Likert scale (1=more negative, 5=more positive), with indications to better situate themselves towards each level. Those questions concerned: 1) relevance of comprehension; 2) relevance of vocabulary; 3) clarity of feedback; 4) activity efficiency for learning. Figure 4 shows the results of this survey. They could finally answer the usual comprehension questions. The success rate was the same as usual, but students felt more confident and said they would use this prompt again. They even asked if we could create another prompt to help them during the other technical project-based courses, as they often feel alone and confused.

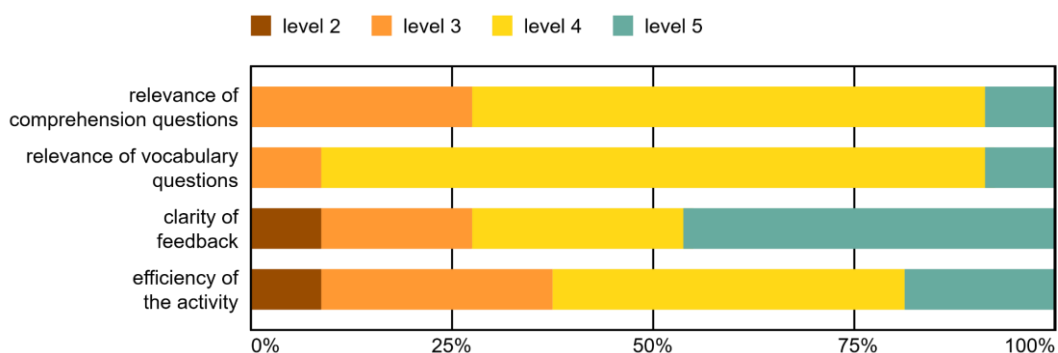


Fig. 4. Chart depicting student satisfaction levels.

Although the small sample size makes it impossible to generalize results, this short experiment has strengthened the trust relationship between teacher and students, and helped students to identify more efficient ways of using ChatGPT for learning. As predicted, their initial use was really basic. They were convinced of the usefulness of writing more complex prompts to help them reflect and check their understanding. This experiment reinforced our belief that students should be taught to use ChatGPT, and that they are willing to use it more as a tutor (Mollick and Mollick 2023) than a simple tool that gives them the correct answer that just has to be copied and pasted. Using ChatGPT in this way, can improve the students' autonomy and learning experience by giving them personalized feedback, something a teacher cannot easily achieve in large classrooms.

<sup>6</sup> The questionnaire addressed to students is available at the following link: <https://drive.google.com/file/d/15atk4Vaak3G5zX8eLprR54hXVKFxZoL/view?usp=sharing>

#### 4 SUMMARY AND ACKNOWLEDGEMENTS

This article explores the potential impacts and uses of LLMs in higher education, by sharing initiatives conducted at institutional and individual levels in a French engineering school. It illustrates the conditions under which students and teachers can appropriate LLMs by sharing the actions led by a pedagogical advisor within the "*Pedagogical and Digital Innovation*" team, and by three teachers through various case studies: 1) the creation of a ChatGPT charter for and by students in an ethics course to help them develop sociotechnical reflexivity on this tool, 2) the adoption of problem-based learning approach in a programming course to emancipate students from ChatGPT dependency, 3) a prompt experiment turning ChatGPT into a tutor to help students become more autonomous and efficient in language learning courses. Far from speculative debates and moral panics, these case studies demonstrate that when ChatGPT is used with creativity while keeping the educational objectives at the heart of the process, it can be a versatile and useful tool for students and teachers. Moreover, enriching the growing corpus of pedagogical experiments conducted since the arrival of ChatGPT, such feedback contributes to paving the way towards a more responsible use of ChatGPT in the learning experience of future engineers.

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