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Evaluating ChatGPT Impact on the Programming Learning Outcomes of Students in a Big Data Course*

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Recent advances in Generative Artificial Intelligence are leading to major changes in education, both in the way educators teach and in the way students learn. For example, Generative Artificial Intelligence (GenAI) chatbots, such as ChatGPT, can help students by assisting them in problem solving or supporting them in code development tasks. This article aims precisely to explore the effect of ChatGPT in supporting students with different levels of programming experience in a course on Big Data. A Big Data challenge was carried out during one of the sessions with 31 students from different backgrounds. Overall, the students were able to solve the challenge, and the results of the pre- and post-tests indicate that the students improved their grades, i.e. they learned to solve the programming exercise. This quasi-experimental study shows that ChatGPT can be a valuable tool as an assistant in the field of data science and programming for students learning to program (even for the first time), whether they come from engineering programs or other completely different disciplines. It is important not to forget the role of the professor in guiding the students towards the correct use of these GenAI tools.

Keywords: Generative Artificial Intelligence; ChatGPT; Programming; Python; PySpark; Big Data

1. Introduction

Education has witnessed a significant change thanks to technological advances and the way knowledge is accessed and delivered. For instance, the possibility of accessing online resources on a wide range of topics, the availability of open online courses at any time (typically referred to as MOOCs – Massive Open Online Courses [1]), or the use of chatbots capable of answering questions [2], has modified traditional ways of teaching and learning.

These rapid technological advances also require students to develop digital skills, regardless of their chosen field of study, and this fact was reinforced by COVID-19 where all students were forced to learn at home through the computer, confirming the gap within existing technology in some cases ([3, 4]). Due to technological advances in this sector, there are some key digital skills students should learn to successfully complete their degrees and improve their employability [5], such as: computer skills, information search techniques, information management, data analysis and/or advanced digital skills (e.g., programming knowledge). Teachers also need these same skills to effectively instruct their classes. As current teaching methods rely on technology, educators must stay up-to-date and learn about the use of advanced technologies.

In this context, Artificial Intelligence (AI), particularly Generative AI [6], entails new challenges in education. Generative AI (GenAI) can assist with various educational tasks such as content generation, student support, and student assessment. GenAI has the capability to convert different input formats into multiple output formats, making it a valuable technology for teaching and learning. Notably, it can transform text written in natural language into several output formats, including text, images, or videos. Another possible application of Generative AI tools is the conversion of text written in natural language into code, enabling teachers and students to explore the application of programming concepts in a simpler way. In fact, GenAI models have demonstrated to perform well in programming and coding tasks, even specific models trained for coding have been released [7].

However, the widespread use of Generative AI causes an alert reaction as this technology could potentially be used for cheating. Educational institutions are not prepared to address this issue. Some universities directly block or restrict access to this type of tools to prevent their use [8, 9]. Other universities choose to observe and decide carefully [10]. At this point, the debate about what to do with GenAI tools in education is still open. Several researchers in education have and publish their ideas and opinions about the adoption of GenAI in the classroom [11, 12]. However, to the best of the authors' knowledge at the time of writing, few researchers have empirically measured whether GenAI tools, like ChatGPT, can facilitate students' learning processes in the field of ICT and programming. This paper aims to fill this gap by empirically measuring the effect of ChatGPT in the IT educational sector, by answering the following research question:

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RQ: How can ChatGPT impact the learning outcomes of students enrolled in a university Big Data course?

This research question is addressed through a quasi-experimental study in the context of a Big Data course within a special cross-curricular program called Digital Backpack launched at the host university (Universidad Carlos III de Madrid). This university program is optional for the students. Its goal is to train students in digital skills that they will need in their future work, through a series of courses that add up to 20 extra ECTS to their degrees. One of these courses is on Big Data, equivalent to 3 ECTS. This course lasts for two weeks, with a total of 20 hours, during which students learn the basic concepts of Big Data and solve their first Big Data related problems. There are two levels of the course, one called Entry level, for students enrolled in less technical degrees, such as Law, Economics or Journalism, who, in principle, lack any programming skills, and one called In-depth level, for students enrolled in engineering degrees, who have some previous knowledge in at least one programming language.

The objective of conducting this experiment in this transversal university course is based on the current demand for students of all disciplines to develop digital skills, which are no longer exclusive to the field of engineering. Therefore, assessing these skills in a diverse sample, including not only engineers but also students from other disciplines, provides a comprehensive understanding of the skills that can be acquired through GenAI tools.

2. Background

The development of technologies such as artificial intelligence (AI) and natural language processing (NLP) in education has given rise to tools that enable the evolution of teaching and learning processes, such as for course design, content creation, student support, or assessment, among others.

2.1 Generative AI Definition

Generative AI is a type of artificial intelligence that can create new content, such as text, images, video, audio, code, or synthetic data. It can do this by learning the patterns and structure of its input training data and then generating new data that have similar characteristics [6]. Generative AI models are often trained on large datasets of existing content. For example, a Generative AI for text might be trained on a dataset of books and articles, or a Generative AI for images might be trained on a dataset of photos and paintings. Once the model is trained, it can be used to generate new content that is like the content on which it was trained. It has a vast number of applications, such as content creation, image and art creation, text improvement or summarization, code review, and more [14].

Among the most well-known Generative AI tools are: ChatGPT [15], created by OpenAI and launched in November 2022, is the best known and most widely used tool; Bard (now rebranded as Gemini) [16], created by Google, first activated in January 2023; and Meta's Llama model, announced its first version in 2022, the open-source solution, currently in its version LLaMA3 [17].

Due to the success of these tools, platforms for more specific purposes have emerged, for example, to process PDFs [18], create videos [19-20], or generate images and artwork [21]. In the field of programming and coding in different languages, GenAI tools can be quite useful in providing explanations and generating code examples, functioning effectively as a programming assistant. While versatile tools like ChatGPT and Gemini can serve as programming assistants, there are also specialized platforms developed specifically for this purpose. Some examples are: CodeGPT [22], Tabnine [23], or GitHub Copilot [24]. All these tools serve as code assistants that can be seamlessly integrated into different Integrated Development Environments (IDEs); the software applications used for programmers to code easily.

This paper focuses on ChatGPT as it is the most widespread Generative AI tool that most of the students know and use on their daily basis [25], specifically the current free version, GPT-3.5.

2.2 Applications of Generative AI in Education

Researchers have explored the role of GenAI tools in education and its application in the university context, with most of them focusing on ChatGPT. With a special focus on the works done into the field of computer science and engineering education, many of these studies consider the advent of ChatGPT as positive. Qureshi et al. [26] analyzed the use of ChatGPT as a learning and assessment tool in a computer science undergraduate course, listing its opportunities and challenges. Bernabei et al. [27] examined the usage of ChatGPT in engineering education, focusing on essay generation quality and the existing identification systems for its detection, concluding to advocate for a balanced AI integration fostering critical thinking. Sarsa et al. [28] explored the automatic generation of programming exercises and code explanations using OpenAI codex, demonstrating its satisfactory capabilities, mostly. Cooper [29] studied the ChatGPT conversations used in the field of science education. Ellis et al. [30] provide examples of how to interact with ChatGPT in statistics and data science classes to

take advantage of its benefits. Nikolic et al. [31] analyze ChatGPT responses in exercises of engineering programs at Australian universities, indicating the need to develop critical thinking when using these tools, as the correct answer is not always given. Rahman and Watanobe [32] explored the capabilities of ChatGPT in coding-related tasks, validating a good accuracy in this type of tasks. Ibrahim et al. [33] measured the performance of ChatGPT solving exercises in 32 existing university courses of multiple disciplines, including programming, mathematics, engineering, and the results were positive; however, they also found that it is difficult to detect when this tool has been used, which could be a potential problem for teaching. More authors [34–38] offered reflections on whether ChatGPT should be banned or allowed in the university and education, analyzing the opportunities and threats of these tools in all the disciplines. However, many doubts have arisen about the integration of AI in engineering courses [39], as it could negatively affect students' learning. Besides all the work done by researchers in this field, OpenAI has provided guidelines for teachers, emphasizing the need for ethical and responsible integration of AI into educational environments [40].

A different point of view is in favor of embracing these new solutions into education, Rudolph et al. [41] argue that ChatGPT could lead to a shift away from traditional assessments towards more authentic assessments that measure students' ability to think critically and solve problems. Qadir [42] remarks the importance for engineering educators to understand the implications of ChatGPT and the need of adapting the ecosystem to benefit from GenAI capabilities. Sánchez-Ruiz et al. [43] run a survey over their students in a Mathematics course to explore the impact of ChatGPT and its adoption highlighting the need for adjusted teaching methods for future engineers. In favor of leveraging AI opportunities, some engineering professors have already taken steps to include Generative AI tools in their courses, such as CS50 [44] or DeepLTK [45], both teaching tools for engineering and programming courses.

To the best of the authors' knowledge, there are very few empirical studies that have quantitatively measured whether a Generative AI tool such as ChatGPT can help students on computer science, engineering, and data science tasks or not [25, 26]. For this reason, the authors of this paper will answer the research question through real and empirical measurements with undergraduate students.

3. Methodology

This paper conducts a quasi-experimental study within a cross-curricular program called *Digital Backpack* offered by the host university of the authors. This program was promoted by the local government with the goal of teaching university students the necessary digital skills to enhance their academic performance and future careers. The program comprised three distinct blocks: (1) courses on *Digital Literacy*, including Information Management, and Cybersecurity and Distributed Trust, (2) courses on *Digital Numeracy*, formed by Data Management and Big Data, and (3) courses on *Computer Literacy*, covering Programming and Machine Learning. Each course is equivalent to 3 ECTS and has two groups: one referred to as the *Entry level* for students pursuing less technical degrees from social sciences and humanities; and another one called *In-depth level* for students with more technical backgrounds, with students from engineering degrees.

Under the context of this cross-curricular program, the authors run the study in the Big Data course that took place in the first 2 weeks of July 2023, with a total of 20 hours. A new course in the field of Big Data, implicitly includes the concept of Artificial Intelligence and programming, which makes this course the perfect scenario to implement a challenge that includes programming with the assistance of ChatGPT.

The remainder of the section describes the details of the experimental design, the participants involved in this study, and the data collected.

3.1 Experimental Design

The main objective is to evaluate the impact of using Generative AI tools on the students' learning process. Both groups had to solve a challenge in one of the sessions using ChatGPT. The challenge consisted of solving a typical Big Data processing exercise, programming using PySpark, a Python API for Apache Spark [13]. The challenge itself was very simple, it was the first contact with this programming language for the students, and it involved many new terms and concepts, so the environment was already complex. Since it is impossible to learn a programming language in a single class, the students were given a sample code to learn the basic concepts in practice, and then they had to solve a similar exercise.

In this scenario, the objective was to evaluate the impact on student learning outcomes during the session and measure the improvement achieved thanks to the assistance of ChatGPT. Pre- and post-tests were carried out to assess students' knowledge before and after the exercise (Note: To carry out the tests, the authors used Google Forms where they first collected the informed consent of the participants to use the data for the analysis

Pre-test sample questions

1. If you were asked what PySpark is, what would you say?
   (a) A statistical analysis program
   (b) **A Python library for data processing in Spark**
   (c) A framework for designing web pages for Data Science
   (d) A programming language for real-time data analysis
2. Why is it necessary to create a session in PySpark?
   (a) To establish a connection with an external database
   (b) **To configure properties and settings of the Spark execution environment**
   (c) To import the necessary libraries for data processing
   (d) It is not necessary to create a session in PySpark
3. What data structure is commonly used to read a file in PySpark?
   (a) Stack
   (b) Json
   (c) **DataFrame**
   (d) Array
4. The `sep=","` option within `spark.read.csv` is used for:
   (a) **Specifying the field delimiter in a CSV file when reading it in Spark**
   (b) Setting the maximum number of partitions when loading a CSV file in Spark
   (c) Activating fast reading mode for large CSV files in Spark
   (d) Filtering rows based on a specific condition when reading a CSV file in Spark
5. Which library is used to read a file into a DataFrame in PySpark?
   (a) pandas
   (b) numpy
   (c) **spark.sql**
   (d) spark.read

Fig. 1. Pre-test sample questions.

presented in this paper). This challenge was designed for the two levels Entry level and In-depth level, with small modifications at the more advanced level, since it is expected that they had programming knowledge. In total, the challenge lasted 110 minutes, which is the typical length of a class at the host university.

The three key steps that were taken in class to conduct the challenge and measure the impact of ChatGPT on the students are detailed below:

1. **Pre-Test (10 minutes):** At the beginning of the class, each student had to complete a pre-test. The pre-test was designed to measure students' background knowledge and skills in data science and programming. This pre-test was done before explaining anything about the exercise to make it unbiased. An example of the technical questions asked can be seen in the Fig. 1. With this initial assessment, it would be possible to measure the individual learning outcome of each student throughout the challenge. In addition to technical questions, a couple of questions were asked to know the profile of the students, one of them was: *How often do you use ChatGPT?* and another one about the use they give to ChatGPT for university tasks.
2. **In-Class Exercise (90 minutes):** During the class session, students were presented with a data science exercise in which they had to solve a basic data processing task using PySpark, one of the fundamental Big Data tools. When the exercise was designed, it was assumed that the students had never worked with PySpark before (confirmed later in Section 4 by the pre-test results). For this reason, they were provided with an exercise solved with a code like the one they would have to solve. The example code can be found in Fig. 2. The first step of the experiment was that they had to understand the example code with the assistance of ChatGPT, instead of with that of the teacher, as it would traditionally be. To help them understand the code, they were instructed to use ChatGPT, along with the example exercise and the prompts. They were given example prompts to maximize the benefits of using ChatGPT.

Below is an example of the guidelines provided to students in the exercise on how to use ChatGPT, which was also explained during class to ensure that they had no doubts about using ChatGPT:

> *In order to perform the exercise maximizing the capabilities of ChatGPT, it is important to follow the following steps:*
>
> (a) *Open a chat and ask ChatGPT to act as a Data Science programmer.*
> (b) *Identify yourself and say what you know about the exercise.*

```
spark = SparkSession.builder.master('local[*]').getOrCreate()
df = spark.read.csv(pdataset.csv', header=True, sep=',',
    inferSchema=True)
df.printSchema()
df.show(10)

df.select(df['col1']).show(truncate=False)
total_count = df.count()
print('TOTAL ENTRIES COUNT: ' + str(total_count))
filtered_count = df.filter(col('col1')=='value').count()
print('FILTERED ENTRIES COUNT: ' + str(filtered_count))
df.filter(col('col1')=='value').show(truncate=False)
df.orderBy('Electric Utility').show(truncate=False)
```

Fig. 2. Example code provided to the Entry-level group.

(c) *Specify what objective you want to solve.*
(d) *Ask ChatGPT to explain the sample code provided line by line.*
(e) *Ask ChatGPT to explain each action you are taking.*
(f) *Interact with the chat and insist on what you don't understand.*

In addition to the guidelines provided to maximize the use of ChatGPT, screenshots of examples of ChatGPT prompts were also given applying the indicated guidelines, so they were clear on how to interact with the chat. Subsequently, students were free to use the chat as they wanted, following the indicated guidelines or not. The objective was to understand the example code and then solve a very similar exercise. Next is the exercise required for the Entry level group, after reading, executing, and understanding the sample code provided:

In a Jupyter Notebook, using the provided file, write the code to solve the following steps:

(a) *Read dataset2.csv file into a PySpark DataFrame.*
(b) *Show the content of the first 4 rows of the DataFrame.*
(c) *Print a text with the length of the table, saying "There are a total of X lines." Where X is the length of the table.*
(d) *Now take the Sample variable and print the values of the variables without truncating them.*
(e) *Last, order the Sample2 variable descendant order and show the DataFrame on the screen.*

3. **Post-Test (10 minutes):** The students took the post-test after completing the in-class exercise. The post-test was identical to the pre-test in terms of content and difficulty, allowing the knowledge and skills acquired during the exercise to be measured with the help of ChatGPT. An open-ended question was also included to find out their opinion at the end of the task and if it had changed compared to the beginning. The question was: *Do you think you could use ChatGPT for your learning? What do you think it brings you as a student?.*

3.2 Participants

The designed experiment was carried out for the two different levels, Entry level and In-depth Level. This subsection describes the profile of the participants at each level.

- **Entry Level:** The *Entry level* included 22 students whose programming level is considered practically zero given that they come from the following degrees: Political Science, Journalism, Labor Relations, Sociology, International Studies, Finance, Business and Technology, Law, Business Administration, and Economics. These students had differing levels of prior experience and knowledge in digital skills. However, as we will see in the results, some of the finance and economics students did have some prior knowledge in the world of programming, but on their own. Regarding their experience with ChatGPT, in the pre-test they were asked how often they used this tool. Table 1 shows that 2 of the students had never used ChatGPT, although the majority say that they use this tool from time to time.
- **In-depth Level:** The *In-depth level* included 9 students with experience in engineering disciplines, specifically, Mechanical Engineering, Industrial Technologies Engineering, Industrial and Automatic Electronics Engineering, Telematics Engineering, Telecommunications Technologies Engineering and Biomedical Engineering. These students are expected to have a more advanced

Table 1. Responses about how often the students in the experiment use ChatGPT daily

How often do you use ChatGPT?	Entry level	In-depth level
A lot	2	5
From time to time	14	3
A little	4	1
Never	2	0

knowledge of programming concepts and data analysis techniques. In this case, the exercise they had to solve included some additional tasks that were not explained previously in the example code. Regarding their use of ChatGPT, Table 1 indicates that almost everyone used the tool frequently.

3.3 Data Gathering

The final step of the experiment is to analyze the data collected in the pre- and post-tests to evaluate the impact of ChatGPT as a teaching assistant in the learning outcome of the students. This analysis focuses on comparing students' performance and improvements between the two assessments. It assesses whether there are significant differences in test scores before and after the exercise. The results obtained from this experiment shed light on the impact of ChatGPT on students' learning outcomes at different proficiency levels in the field of data science, which can have potential relevance to other subjects. The details of these results are explained and shown in detail in the next section.

4. Results

This section discusses the results of the experiment conducted in this article, which involved students with different technical backgrounds. The authors analyzed the changes in performance from the pre-test to the post-test. For this analysis, the authors measured what is called the learning effect by comparing the scores of the post-tests and the pre-tests taken by the students. This is a typical practice to measure learning gain on a specific task, since knowing the knowledge before and after the task makes it possible to compare both scores.

Table 2 provides an overview of the results of the experiment. The table presents data related to the pre-test scores and the post-test scores, as well as the learning effect for the different levels. The results obtained for each level and the comparison of both levels in terms of learning effect are discussed below:

- **Entry Level:** For students at the *Entry level*, the pre-test and post-test assessments clearly indicate a significant improvement in their knowledge. The minimum increase observed was 2 points, while the maximum improvement reached up to 8 points. These results provide strong evidence of the effectiveness of ChatGPT as a resource for helping students understand and apply concepts in the data science and programming field.
- **In-depth Level:** Likewise, students at the *In-depth level* also demonstrated positive progress in terms of the learning effect. The minimum gain observed in this group was 3 points, and the maximum reached 7.66 points. These findings suggest that even students with a more advanced background in engineering and programming benefited from the guidance and support provided by ChatGPT, in this case working with PySpark.
- **Learning effect:** Overall, the results indicate that ChatGPT has a significant positive impact on student learning outcomes, regardless of their initial level of knowledge. Students at the beginning and advanced levels experienced substantial improvements in their understanding of programming and data science concepts. These results underscore the effectiveness of ChatGPT as an educational assistant, capable of enhancing the learning experience and facilitating the acquisition of knowledge in these areas. In summary, all the students passed the post-test after using ChatGPT as assistant, while the pre-test most of the students had failed. All grades improved, more than five points on average, meaning that the students actually learned during the exercise. However, an interesting observation is that the pre-test grades were lower at the *In-depth Level*. This could be attributed to a potential effect of the sample size, where the limited amount of data might have influenced the outliers from the *Entry level*, thereby affecting the final grades. Further investigation is needed to explore this phenomenon in detail.

Takeaway: *All the students participating in the challenge improved their knowledge of the subject. They successfully completed the exercise, and their grades improved by an average of 50%.*

5. Discussion

The overall results of this experiment are promising. They suggest that ChatGPT can serve as a valuable educational tool for students with different levels of proficiency in data science and programming. However, it is important to note that none of the students achieved the highest grade.

Table 2. Summary of the results for both tests and levels. Tests can grade from 0 to 10

Level	# students	Pre-test			Post-test			Learning effect		
		Mean	Std	Max	Mean	Std	Max	Mean	Std	Max
Entry level	22	2.227	1.71	6.33	7.11	1.88	9	4.88	1.88	8
In-depth level	9	1.55	1.88	4.67	7.04	1.29	8.67	5.48	1.66	7.66

Table 3. Sample of responses on the students' opinion about ChatGPT, before performing the in-class exercise. (*Translated from the original language)

Before doing the exercise: How do you use ChatGPT for university assignments? Do you think that the way you currently use it teaches you something?	**Level**
"Normally **as a filter for large documents and files**, to then have a lighter search when doing some work, or similar. Considering how far the databases go (2021), and also that it is not always reliable when it comes to providing information, since its information sources cannot be traced." "The main use is to begin writing a text, as a starting point, or as a **tool to summarize or rewrite a text**. That is, I use it to generate texts without data because I am aware of its limitations when searching for data, explaining its answers or using references." "I don't use it at all. I prefer to push myself and use my abilities."	Entry level
"I use it mainly **to relate concepts and define concepts**. It is a way to better understand things in different areas and contexts. I think it helps me understand things faster. It is true that sooner or later I was going to understand them but by using ChatGPT I feel that I finished sooner because it is quite precise in what I ask of it." "I do not use GPT chat for university tasks, I only use it for personal matters like daily questions or leisure." "In research work, it has **helped me to better structure ideas,** and, above all, it has helped me make better use of language in scientific environments. Currently, it has taught me to improve the way I express ideas and look for new tools to express them better."	In-depth level

Table 4. Sample of responses on the students' opinion about ChatGPT, after performing the in-class exercise. (*Translated from the original language)

After doing the exercise: Do you think you could use ChatGPT for your learning? What do you think it brings you as a student?	**Level**
"Like any new and powerful tool, it depends on how it is used. On the one hand, it can be a **great learning tool**, in which instead of having to get lost in search engines or similar, you gain speed and fluidity, of course, as long as you keep in mind that it is not 100% reliable, given its dubious reliability in the traceability of its information, and that it only lasts until 2021." "I have **discovered its role as a programmer** because it helps students and professionals without knowledge of technology to make simple programs or understand code." "It has been quite useful. I had never used it before, and it explained quite well. Although I felt that it gave me the answers directly, it would be better to improve the prompts so that it explained everything better before giving the result."	Entry level
"I think that chatGPT helps a lot in the programming environment if the queries are made cautiously and little by little. ChatGPT is capable of providing adequate lines of code as long as large amounts of code are not required. I believe that it can **provide knowledge quickly and accurately** as long as the consultations are carried out properly. I do believe that chatGPT can be used for learning." "Yes, I could use it, thanks to having used it during this activity I have managed to **speed up the learning process** and understand the concepts more clearly. With correct use of it, students could learn faster and better, but not with misuse." "Of course. I would use ChatGPT as a great tool to support learning unknown topics, if there is no expert who can guide me. As a student, in the absence of an expert who can guide me in a personalized way in learning an unknown topic as is the case with this activity, ChatGPT is a great assistant for self-taught learning."	In-depth level

This could be because the students only completed the task with the help of ChatGPT, without receiving the traditional explanations from the teacher, although this is only an assumption. It will be necessary to conduct a study with a control and an experimental group to validate this statement.

Another important finding of this experiment is that the students in the advanced group were able to follow the exercise with complete autonomy, without needing help to learn how to use ChatGPT and generate prompts appropriately, while those in the intermediate group needed help.

While these initial findings are optimistic, the authors acknowledge the limitations of the study due to the small number of participants. The results presented in this paper are preliminary conclusions that offer a small slice of reality. Further experiments with a larger number of students and a control group would help to validate the effectiveness of ChatGPT as an educational tool.

Finally, as part of the empirical experiment presented in this paper, students were asked for their opinions about a tool like ChatGPT in the context of the university. A similar question was asked both before and after the exercise to determine if their views changed. In the pre-test, they were asked: *How do you use ChatGPT for university assignments? Do you think that the way you currently use it teaches you something?*, where, for example, someone answered: "Sometimes I ask to the chat about certain information and ideas. Yes, it teaches me, sometimes by offering me several answers to the same question, it opens a new path of thinking for me.". More examples of the answers provided of the pre-test can be found in Table 3.

In the post-test, they were asked: *Do you think you could use ChatGPT for your learning? What do you think it brings you as a student?*, where for

example someone answered: "Yes, and I think it contributes a lot to me, giving me more precise solutions than I would sometimes not be able to obtain through a normal Google search, in addition to the fact that when more specific questions are asked, the vast majority of the time it solves them.". More examples of the responses of the post-test are presented in Table 4.

The overall opinions of the students were positive; while some were more critical than others, all believed that a tool like ChatGPT can be useful for their learning process in the university. Some students believe that it is not reliable for all types of tasks, such as gathering bibliographic data, but found it very useful in programming and Big Data tasks. In the *Entry level* group, everyone found it more useful when they had less technical knowledge, this conclusion can be directly related to students in the first course of engineering, learning for the first time in a programming subject.

In summary, the test results and the students' opinions concur that ChatGPT is a valuable tool for learning as an assistant in tasks related to data science and programming, which is important for the future of engineering educators. However, educators should review their teaching methods, incorporating the advantages of GenAI tools, guiding students toward the proper use of these tools, to develop critical thinking over its usage.

Although these initial findings are promising, the authors acknowledge the limitations of the study due to the small number of participants. Further experiments with a larger number of students should be conducted to measure the effectiveness of ChatGPT as an educational assistant on programming tasks.

6. Conclusions

This study measured the impact of ChatGPT in supporting students with different levels of programming skills in a Big Data course. The findings demonstrate that the integration of ChatGPT as an educational tool in the field of engineering brings promising results. An exercise was conducted during one of the classes of the course. This exercise involved two groups: one group formed of students pursuing less technical degrees and another group consisting of students pursuing engineering degrees, with a total of 31 participating students with differing levels of technical and programming knowledge. This exercise revealed that students successfully completed the task with the support of ChatGPT, and not only completed it but also gained a better understanding through its explanations. Specifically, the pre- and post-test grades indicated an improvement in all grades, implying an impact on their learning progress on programming skills. These results represent a new paradigm for programming students, regardless of the discipline they choose, as digital skills are now required in many more disciplines than just engineering and computer science programs.

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