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Attention to Diversity from Artificial Intelligence

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Abstract: Artificial intelligence (AI) is influencing various sectors of society, including the educational field. The use of AI can have great potential in education; however, it is necessary to know both its performance and its limitations. The main objective of this study is to analyze the prompts made by teachers in initial training in relation to the topic of specific educational support needs, classifying them according to Bloom's Taxonomy. For this, 63 students from the first year of the Primary Education Degree in the subject Information and Communication Technology applied to Education participated. The results show that the highest frequency of prompts made by students correspond to the highest levels of Bloom's taxonomy (apply and create), which suggests that students are capable of using the knowledge acquired in the subject to create new learning situations with their future students. This confirms that the implementation of this methodology is beneficial for the development of cognitive and pedagogical skills of future teachers.

Keywords: *Artificial intelligence; higher education; Bloom's Taxonomy; special education.*

Introduction

Bloom's Taxonomy

Since its introduction in 1956, Bloom's Taxonomy has been an indispensable tool for teachers to both design and assess student learning. However, with the entry into the 21st century, the need for a revision became evident (Oaks, 2017). Thus, Anderson et al. (2001), conducted the first significant revision. The importance of the revised Bloom's Taxonomy for education centers on its focus on cognitive skills beyond memorizing and comprehension. By placing "creating" at the top of the hierarchy, it recognizes the value of creativity, problem solving, and the ability to generate new ideas (Larsen et al., 2022). With the incorporation of metacognition, students are active participants in their own learning process, promoting self-reflection and self-evaluation (Hattie, 2016). Likewise, with the digital transformation of education, the revised Bloom's Taxonomy has also proven to be useful for the effective integration of technology in the classroom, as it has enabled teachers to teach and assess digital skills (Green, 2019).

The revised Bloom's Taxonomy provides a clearer and more structured framework for assessing student learning progression. It allows teachers to assess and document learning progress, as well as identify areas for improvement (Daniel & Darragh, 2018). At the same time, it facilitates personalization and differentiation of learning, and promotes a more student-centered approach and skill development for the 21st century (Fisher & Frey, 2018). By using this taxonomy, teachers can design lessons and tasks aimed at different levels of thinking, ensuring that students not only memorize facts, but also learn to understand, apply, analyze, evaluate, and create based on what they have learned. This promotes an education that goes beyond the acquisition of knowledge and goes into the formation of individuals capable of thinking critically and creatively. Students become more effective learners, able to approach problems from multiple angles, judge the validity of information sources and generate innovative solutions to problems.

Artificial intelligence in education

Text Artificial intelligence (AI) is changing the teaching-learning process and reshaping the educational landscape (Naidu, & Sevnarayan, 2023; Shrivastava, 2023; Nipun et al., 2023). For Jamal (2023) "The potential of AI in teacher education is significant, but its application requires careful consideration of ethical, social, technical, and cultural factors. While AI has the potential to improve the quality of teacher education, potenuate teacher skills, and facilitate personalized learning, it also raises issues related to data privacy, bias, and cultural acceptability (p.144)." Perhaps Chat Generative Pre-Trained Transformer (ChatGPT) is the technological development that is having the most impact; it has been trained by deep learning algorithms to generate conversational interactions to user prompts (Fergus et al., 2023; Lopezosa et al., 2023). The trained model can answer followup questions, admit its mistakes, question incorrect premises, and reject inappropriate requests (ChatGPT). As Naudi & Sevnarayan (2023) tell us "the limitations of ChatGPT are that the quality of the answer provided by ChatGPT (output) will depend on the quality of the question or input. Clear questions and input will generate better responses from ChatGPT" (p.12).

In addition, it has allowed the personalization of learning on a scale that was unimaginable in the past. Thus, it is possible to adapt the content and pace of learning to the individual needs of each student, favoring more effective learning, promoting diversity in the classroom (Biswas et al., 2023). However, the future of AI in education poses significant challenges (Naudi & Sevnarayan, 2023). There is concern that AI may dehumanize education, reducing teacher roles and human interactions in the learning process. Another challenge is that the implementation of AI in education must be done in an ethical manner, avoiding discrimination and ensuring privacy of student data (Kerrigan et al., 2022).

Working in Special Education

Inclusive education is an approach that seeks to transform and adapt the educational system so that all students, regardless of their abilities, origins or individual characteristics, can participate fully in the educational system (Valdés et al., 2022). This concept is based on the fundamental principle that education is a human right, and that all students should have the opportunity to learn and grow together, promoting respect and appreciation of diversity (Ortiz González, 2023). Effective inclusive education requires that teaching-learning strategies be flexible and adapted to the needs of each student (Fuentes Gutiérrez, et al., 2021). This means that teachers must be able to adjust their teaching methods to accommodate individual differences and ensure that all students have equal opportunities to learn and participate in the classroom. Specific Educational Support Needs (SEN) refer to the individual needs that some students have, which are related to physical or intellectual disabilities, learning disorders, emotional or behavioral difficulties, or social or cultural circumstances (Lorente, 2023). These students need additional accommodations or supports in order to fully participate in the classroom and reach their academic potential. Accommodations for students with SEN include a variety of strategies, such as curriculum modifications, adaptations in teaching methods, the use of assistive technology, or the provision of additional supports, such as speech therapy or psychological support. It is important that these adaptations are made on an individualized basis, based on the specific needs of each student (Tomlinson, 2014).

Students with SEN present challenges in any of the levels of cognitive skills: remembering, comprehending, applying, analyzing, evaluating and creating, but the adaptation of teaching strategies according to Bloom's taxonomy is of great help to their learning by providing a clear and progressive sequence of cognitive skills that can be supported and developed through adapted teaching strategies. The effectiveness of these strategies may vary depending on the individual needs of each student. As Friend (2014) argues, there are no one-size-fits-all strategies for all special education students, as what works for one student may not work for another. Therefore, it is crucial that teaching strategies be personalized and continuously adapted based on the student's needs and progress. Therefore, the role of the teacher is crucial in implementing these strategies and creating an inclusive learning environment. As mentioned by Tomlinson (2014) differentiated instruction is a teaching philosophy that involves recognizing individual differences in students and adapting instruction to meet these differences.

According to Prince (2004) prompts, also known as guides or hints, play a crucial role in active learning, as they act as a catalyst that prompts students to think, reflect and actively participate in their learning process. Prompts can be defined as text that is entered into ChatGPT for the purpose of generating a response (Xiao & Zhi, 2023).
They are an effective tool for active and meaningful learning, and when designed and implemented effectively, they greatly enhance students' motivation and engagement, as well as the development of their cognitive skills. Therefore, prompts are designed to address different levels of cognitive complexity (Prince, 2004). Prompts should be appropriate to the level of cognitive development of the learner and the learning objectives set by the teacher (López Galisteo et al., 2023). Each prompt is designed to address one or more levels of Bloom's taxonomy. For example, a prompt that asks to recall a list of facts will address the first level of the taxonomy, while one that requires designing an experiment to test a hypothesis involves the higher levels of analysis, evaluation, and creation.

An effective strategy for assessing prompts is to classify them according to Bloom's taxonomy. By aligning prompts with Bloom's taxonomy, teachers design activities that correspond to different levels of thinking and thus promote deeper and more meaningful learning. It is crucial to evaluate and classify the effectiveness of prompts by identifying which level of the Bloom taxonomy the prompt addresses (recall, comprehend, apply, analyze, evaluate, create) and whether it meets the intended pedagogical objective. Thus a prompt that simply asks students to recall a fact would be classified at the lowest level of the taxonomy (recall), while a prompt that asks students to generate a new idea or concept based on what they have learned would be classified at the highest level (create). This form of assessment helps teachers ensure that they are providing a range of learning opportunities that span all levels of Bloom's taxonomy (Anderson & Krathwohl, 2001).

When evaluating a prompt, teachers judge its effectiveness in terms of engaging students, promoting higher order cognitive level thinking, and fostering meaningful learning. The implementation of prompts based on Bloom's taxonomy in initial teacher education is beneficial for the development of cognitive and pedagogical skills of future teachers.

Methods

Objectives

The main objective of this research is to analyze the prompts made by teachers in initial training of the primary education degree in relation to the topic of specific educational support needs. The specific objectives are:

a. To identify the frequency of use of each level of Bloom's taxonomy in the prompts.

b. To evaluate the level of complexity of the prompts made by the students.

c. Identify patterns or trends in prompts that may be relevant to teacher education.

We have used a descriptive approach with an ex post facto methodology, understood as one that can be applied once the event has occurred without the need to modify variables (Hernández et al., 2014). Subsequently, a qualitative analysis of the results has been carried out.

Participants

The participants in this study are 63 students enrolled in the academic year 2022-23 in the subject of Information and Communication Technology applied to Education, in the first course of the Degree in Primary Education, in the Faculty of Educational Sciences (University of Seville). For the selection of the sample we opted for incidental or convenience criteria, according to their availability to carry out the research (Hernández-Sampieri et al., 2014).

Procedure

The students were asked to write a prompt individually before starting the four AI training sessions, and once the sessions were concluded. The prompts were classified according to the six levels of Bloom's taxonomy, evaluating the level of complexity of each prompt, and patterns and tendencies were identified in the distribution of prompts according to the different levels of Bloom's taxonomy, the categories being: remembering, understanding, applying, analyzing, evaluating and creating. Specifically, the activity requested to the students was the following: "Write a prompt (individually) to work with students with Specific Educational Support Needs in Primary Education. The subject matter is free choice".

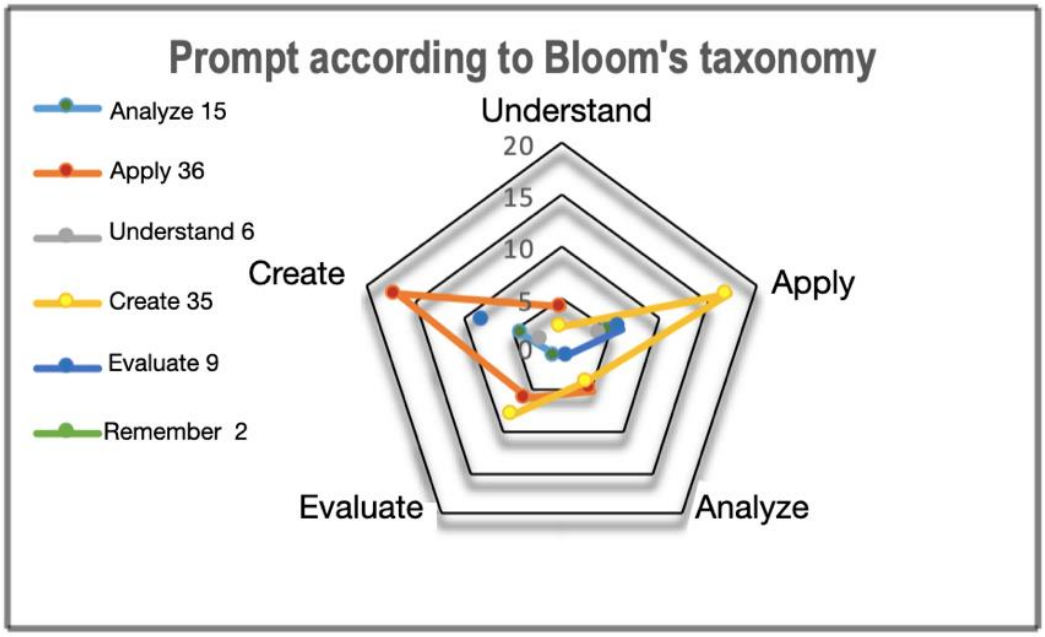
Results

Objetive A. Analysis according to Bloom's taxonomy

To carry out the analysis of the prompts, they were categorized according to the different levels of Bloom's taxonomy, the categories being: remember, understand, apply, analyze, evaluate, and create. Thus, in a first analysis we can say that they have an average of 108 words and 665 characters, and in general terms they are placed in the higher levels of the taxonomy: analyze, evaluate, and create (Figure 1).

Figure 1

Prompt according to each of the categories of Bloom's taxonomy



If we focus on the co-occurrence analysis of each of the categories of Bloom's taxonomy using ATLAS. ti (Figure 2), we find that the highest co-occurrence is found in Create-Apply with 17 (26.9%); followed by Create-Evaluate with 8 (12.6%); Evaluate-Apply with 6 (9.5%); then we find the co-occurrence Analyze-Apply with 5 (7.9%); Apply-Comprehend with 4 (6.3%); Create-Comprehend with 2 (3.1%); and finally the co-occurrence Evaluate-Analyze with 1 (1.5%). Therefore, there is a tendency towards higher order cognitive levels in the elaboration of Prompt by future primary education teachers.

Figure 2

Co-occurrence analysis of each of the Bloom's taxonomy categories using ATLAS.ti

	1 Remember 2	2 Understand 6	3 Apply 36	4 Analyze 15	5 Evaluate 9	6 Create 35
1 Remember 2		0	0	0	0	0
2 Understand 6	0		4	0	0	2
3 Apply 36	0	4		5	6	17
4 Analyze 15	0	0	5		1	4
5 Evaluate 9	0	0	6	1		8
6 Create 35	0	2	17	4	8	

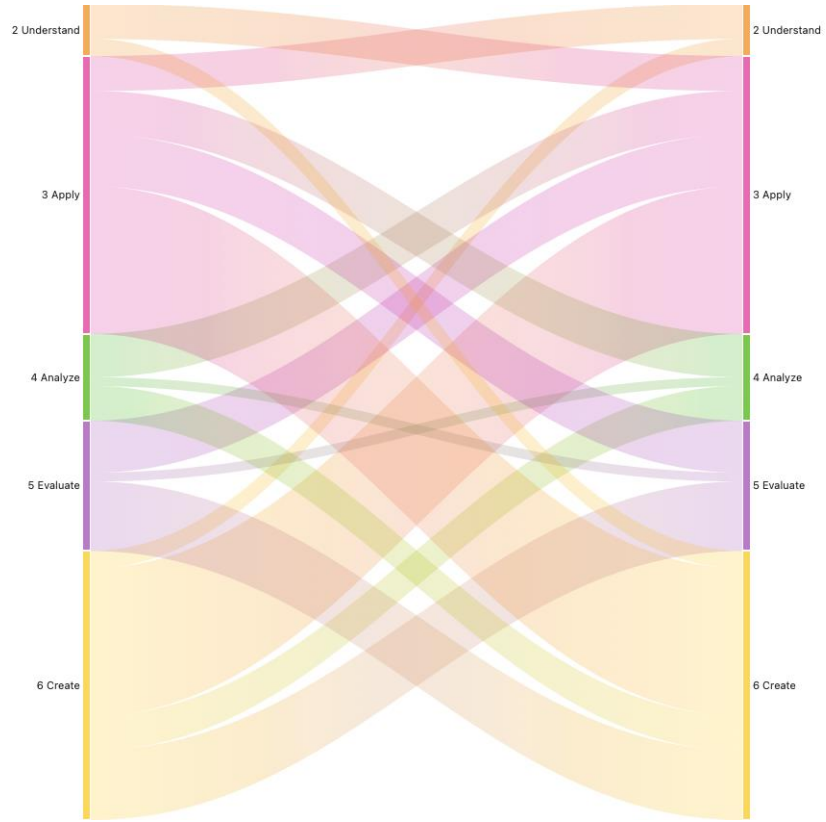
Sankey Diagram

The Sankey diagram (Figure 3) visualizes the relationships between the codes, each of the categories of Bloom's taxonomy. These are flow diagrams where the width of the flow indicates the number or frequency of codes; however, the length has no meaning and can be represented with flexibility. Sankey diagrams are useful for visualizing complex contexts such as the social environment, which is why they are becoming increasingly prominent in research (Vos & Frejd, 2022).

This Sankey diagram shows the different flows of the Bloom's taxonomy levels (Remember, Understand, Apply, Analyze, Evaluate and Create) of the students of the Primary Education grade. Thus we have an important flow which is Apply with value of 36 which is divided in the output into: Understand with value of 4, Analyze with value of 5, Evaluate with value of 6 and Create with value of 17. Another important input stream is Create with value of 35 which is divided in the output into Understand with value of 2, Apply with value of 17, Analyze with value of 4 and Evaluate with value of 8. Another input stream is Analyze with value of 15 which is divided in the output into: Apply with value of 5, Evaluate with value of 1 and Create with value of 4. Another flow is Evaluate with value of 9, which splits on the output into Apply with value of 6, Analyze with value of 1 and Create with value of 8. And the last flow is Understand with value of 6 which splits on the output into Apply with value of 4 and Create with value of 2.

Figure 3

Sankey diagram showing the different flows of Bloom's taxonomy levels



Based on the above (Figure 3) and performing a more detailed analysis, we can say from the Sankey diagram that:

1. Apply (36): this is the highest level of taxonomy entry in the data set. This indicates that a large number of students focused on tasks that involve applying what they have learned to new or practical situations when developing prompts. Thus, the majority of these students (17) moved on to higher level tasks related to creating new content or solutions to problems. This is a positive sign as it demonstrates the students' ability to not only learn and understand the content of the ICT subject, but also to apply it and create with it in new ways new and meaningful ways to serve students with specific educational support needs. The rest of the flow is distributed among Evaluate (6), Analyze (5) and Understand (4), suggesting that many students also focus on evaluating and analyzing their work, although to a lesser extent than creating.
2. Create (35): this is the second highest level of taxonomy entry in the dataset, indicating that many students are actively engaged in creating new content or solutions when making prompts. This suggests that students are reaching the highest level of Bloom's taxonomy, a positive sign of deep and effective learning acquired with the content of the Information and Communication Technologies course. Most of these students (17) return to the applying level, which may indicate an iterative learning process where students alternate between applying what they know and creating something new. Students who go to Evaluate (8), Analyze (4), and Comprehend (2) indicate a focus on reviewing and analyzing their work and improving their understanding.
3. Analyze (15): a smaller number of students start at the Analyze level, suggesting that this level of taxonomy may not be the primary focus of students' activity in developing the prompt. Most of this flow (5) is directed to Apply, indicating that students are using their analytical skills to inform their application of the material. The flows to Evaluate (1) and Create (4) suggest that some students are using their analysis to inform both their judgment of the quality of the work (evaluate) and the creation of new content (create).
4. Evaluate (9): few students start at the Evaluate level, which may indicate that evaluating their work is not the students' primary focus. Most of this flow is split between Apply (6) and Create (8), suggesting that students are using their assessment to inform both their application of the material and the creation of new content when developing the prompt.
5. Understand (6): this is the lowest level of taxonomy entry in the data set, which could indicate that students already have a good understanding of the content of the Information and Communication Technologies subject or that comprehension tasks are not the primary focus when students create the prompt. The flow from "Understand" is toward "Apply" (4) and "Create" (2), suggesting that students are using their understanding to inform their application of the material and creation of new content in the prompt.

From our perspective, it is interesting and encouraging to see that the highest levels of Bloom's taxonomy, i.e., "Apply" and "Create," are the most important input streams. This suggests that the students in the class group are not

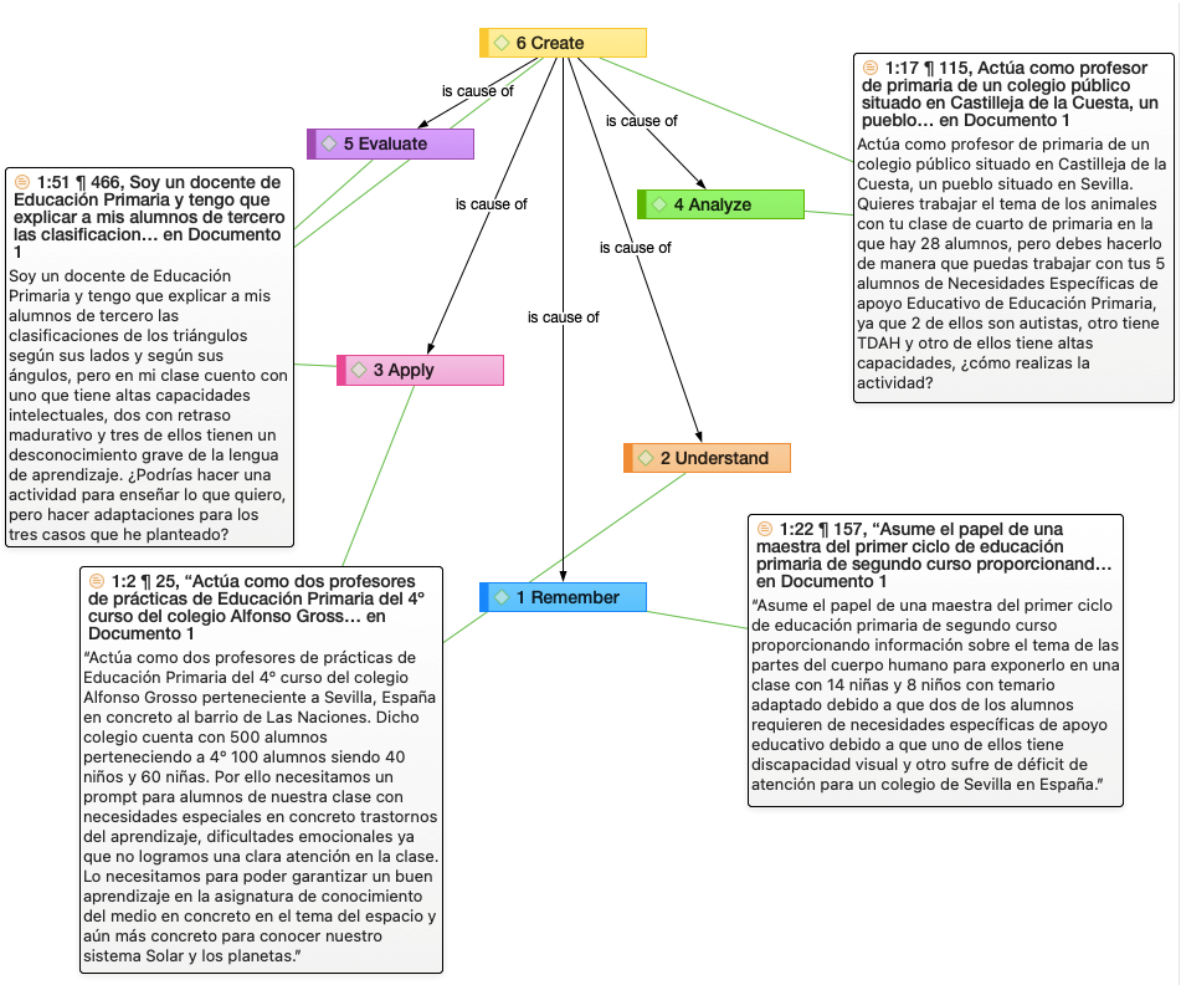
only absorbing and remembering the subject information, but are also managing to use it in new learning situations and in creative ways, which is a fundamental objective of the teaching-learning process of the teachers involved in the subject (one teacher with no experience, as she is in her first year of teaching; and one teacher with 26 years of teaching). Looking at this Sankey diagram, it would be desirable to see more input flows in the categories of "Understand", "Analyze" and "Evaluate". These levels of taxonomy are critical for deeper understanding and for the development of critical thinking skills. Low participation in these categories tells us that more emphasis needs to be placed on these areas in an attempt to promote deeper and more effective learning.

Objectives B and C: Examples of prompts

We cannot forget that the data in the Sankey diagram are a snapshot of a moment in time and that learning is a continuous process that can vary according to the content of the subject, the students and the situation, among other factors. Although the prompts focused on the topic of specific educational support needs with a freechoice theme, the different students gave it their own distinctive nuance. Thus, in Figure 4 we find examples of the same.

Figure 4

Examples of prompts according to the dimensions of Bloom's taxonomy



As an example, we focus on the analysis of some of the prompts written by the students. Thus, in prompt no. 22: "Assume the role of a teacher of the first cycle of primary education of second year providing information on the topic of the parts of the human body to expose it in a class with 14 girls and 8 boys with adapted syllabus because two of the students require specific educational support needs because one of them has visual impairment and another suffers from attention deficit for a school in Seville in Spain" (prompt nº 22).

In this prompt the proposed scenario includes several levels of Bloom's taxonomy: remembering, applying, and creating. Here is the breakdown:

- "Assume the role of a second grade early elementary school teacher." This is the scenario and role you are asked to assume, and it does not directly relate to Bloom's Taxonomy.
- "Providing information on the topic of human body parts." This is the topic and would fall under the category of Recall, as you would have to recall information about the parts of the human body in order to share it.
- "To exhibit in a class with 14 girls and 8 boys." Here you are asked to apply the information about the parts of the human body in a way that is accessible to lower elementary students. Therefore, it falls into the Apply category of Bloom's Taxonomy.
- With adapted curriculum because two of the students require specific educational support needs due to the fact that one of them is visually impaired and the other one suffers from attention deficit disorder". Here you are asked to create or adapt mathematics to be accessible for students with specific educational support needs, which would imply the level of Creation in Bloom's Taxonomy.

The prompt (nº 17) reads:

"You act as a primary school teacher in a public school located in Castilleja de la Cuesta, a town located in Seville. You want to work on the topic of animals with your fourth grade class of 28 students, but you must do it in a way that you can work with your 5 students with Specific Educational Support Needs of Primary Education, since 2 of them are autistic, another one has ADHD and another one has high abilities, how do you carry out the activity?" (prompt nº 17).

- This prompt sets a very specific context: "being a primary school teacher in a public school in Castilleja de la Cuesta, a town located in Seville". This encourages us to keep in mind geographical and cultural factors are taken into account in the response. Knowledge of the Spanish educational environment and the characteristics of a public school in a small town may be important factors in constructing an appropriate response.
- Pedagogical challenge: The prompt presents a multifaceted educational challenge. The teacher is tasked with teaching the topic of animals to a diverse fourth grade classroom, including several students with special educational needs. The diversity of learning needs (including students with autism, ADHD and high abilities) means that the teacher must consider inclusive teaching and learning strategies to meet the needs of all students.

- Competencies required: To address this prompt, participants must demonstrate an understanding of several competencies. These include lesson planning, adapting instruction for students with special educational needs, inclusive education, and classroom management. They will also need specific knowledge about the topic of animals and how to make it accessible and engaging for fourth grade students.
- Purpose of the prompt: This prompt appears designed to evaluate both pedagogical knowledge and the participant's creativity and critical thinking. There is no single "right answer," which means that participants must generate and justify their own solutions. They may also need to research or reflect on their own experience to effectively address the scenario.
- Bloom's Taxonomy: This prompt seems to align more closely with the higher levels of Bloom's taxonomy: Apply, Analyze, Evaluate, and Create. Participants must apply their pedagogical knowledge in a new context, analyze student needs, evaluate different teaching and learning strategies, and create a lesson plan or series of learning activities.

Prompt nº 50:

"I am a teacher of 3rd grade of primary school in a school in Sevilla and I need you to help me to work on the Solar System in a playful and dynamic way. I need 5 activities taking into account that in the class there are 2 children with ADHD, 3 children with dyslexia and 1 with intellectual disability, adapting these 5 activities to the characteristics of these students. I also want you to tell me how to facilitate relationships among the students and, thus, create a climate of empathy and respect for others" (prompt nº 50).

- "I am a 3rd grade teacher at a school in Sevilla and I need you to help me work on the Solar System in a playful and dynamic way." This section involves the "Apply" dimension, as you are looking for effective ways to implement your teaching plan.
- "I need 5 activities taking into account that in the class there are 2 children with ADHD, 3 children with dyslexia and 1 with intellectual disability, adapting these 5 activities to the ca-racteristics of these students." This falls under the "Create" dimension, as you are looking to design specific activities tailored to the needs of the students.
- "I also want you to tell me how to facilitate relationships among the student body and thus create a climate of empathy, collaboration, and respect for others." This implies "Evaluate," as you need to make a judgment about how to improve relationships among students, and also "Create," as you seek to generate an atmosphere of empathy and respect.

Another example is prompt nº 40:

"I am a primary school teacher in a school located in Sevilla, Spain, called Maestro Enrique Diaz Ferreras and in the 4th grade of primary school. There are 30 students in the classroom and one of them is deaf. I want to do an activity related to animal classification that adapts to the needs of the student with this

problem. Make me 2 activities related to this topic and that one of them uses an educational robot" (prompt nº 40).

- In this case, the requests for activities fall mainly on the levels of applying, analyzing, and creating.
- "I am a primary school teacher in a school located in Sevilla, Spain, called Maestro Enrique Díaz Ferreras and in the 4th grade of primary school". This is the role and context.
- "In the classroom there are 30 students and one of them is deaf. I want to do an activity related to animal classification that adapts to the needs of the student with this problem". This is the learning challenge to be solved. This task can involve the Understand (you understand the learner's learning challenge), Apply (you will apply your memories and skills to create a solution), and Create (you will create an activity for the learner) levels of Bloom's Taxonomy.
- "Make me 2 activities related to this topic and have one of them use an educational robot". Here we are at the highest level of Bloom's taxonomy: create. You will need to create two activities that allow the student to learn about animal classification. One of the activities should involve the use of an educational robot, which could involve even more creativity.

And finally, we present another very meaningful prompt (prompt nº 37):

"Imagine that you are a Primary Education teacher at the CEIP Federico García Lorca Educational Center, located in San Jerónimo (Seville) in a class of 28 students (13 girls and 15 boys) in which there are children with different specific educational support needs; Special Educational Needs (SEN), high intellectual abilities (ALCAIN).... Specifically, you have the case of 3 SEN students, one with a significant visual impairment (total blindness), the other with great hearing problems and finally another with a complicated social role because he does not have a great family support. In the Social Science class you are working on the Solar System. Elaborate a teaching material (videos, activities...) that will allow these 3 students to overcome the learning difficulties of each one and allow them to acquire the teaching-learning contents in an optimal way, that is to say, to know the celestial bodies of the Solar System and all the planets that form it" (prompt nº 37).

In this situation, you are being asked to Create instructional materials, the highest level of Bloom's Taxonomy. Here is the breakdown:

- "Imagine you are a Primary Education teacher at CEIP Federico García Lorca Educational Center." This is the scenario and the role you are asked to assume.
- "In the Social Sciences class you are working on the Solar System". This is the content you need to "understand" (Bloom's taxonomy "Understand" level) in order to create didactic materials.
- "Create a didactic material (videos, activities...) that will allow these 3 students to overcome the learning difficulties of each one and allow them to acquire the teaching-learning contents in an optimal way, that is, to know the celestial bodies of the Solar System and all the planets that make it up". Here you are asked to create a set of teaching materials, which is at the highest level of Bloom's taxonomy. You need to use your

"Recording" and "Understanding" of the Solar System, and then apply that "Understanding" to design appropriate learning materials for students with special needs.

Discussions and Conclusion

When evaluating a prompt, teachers judge its effectiveness in terms of engaging students, promoting higher order cognitive level thinking, and fostering meaningful learning (Larsen et al., 2022). The implementation of prompts based on Bloom's taxonomy in initial teacher education is beneficial to the development of cognitive and pedagogical skills of prospective teachers (Hattie, 2016). Although in general terms they are situated at the higher levels of the taxonomy: analyze, evaluate, and create. The patterns and trends identified in the prompts indicated that university education students are more focused on "apply" and "create". The "apply" level indicates that a large number of students focused on tasks that involved applying what they had learned to new or practical situations when developing prompts. And the "create" level indicates that many students are actively participating in the creation of the prompts of new content or solutions when developing prompts. This suggests that students are reaching the highest level of Bloom's taxonomy, a positive sign of deep and effective learning acquired with the content of the ICT subject (Naudi & Sevnarayan, 2023).

Consequently, the highest levels of Bloom's taxonomy, i.e., "Apply" and "Create," are the most important input streams. This suggests that the students in the class group are not only absorbing and remembering the subject information, but are also managing to use it in new learning situations and in creative ways, which is a fundamental objective of the teaching-learning process of the teachers involved in the subject (Fisher & Frey, 2018).

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