

ARTIFICIAL INTELLIGENCE IN EDUCATION: LARGE MODEL (LLM) AS AN EDUCATIONAL RESOURCE

ARTIFICIAL INTELLIGENCE IN EDUCATION: LARGE LANGUAGE MODEL (LLM) AS AN EDUCATIONAL RESOURCE

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Abstract -- Artificial intelligence (AI) is revolutionizing education, and one of the most promising developments is the use of large language models (LLMs). LLMs are advanced AI systems that understand and generate human language by processing large amounts of data. These models use deep learning techniques enhance natural language processing.

In the educational context, LLMs are used to create chatbots and virtual assistants that can help students by answering questions, providing explanations, and facilitating personalized learning. These models can also generate new educational content, evaluate assignments, and adapt study to the individual needs of each student.

The impact of LLMs on education includes increased accessibility to knowledge, personalization of learning and continuous support for students, contributing to a more efficient and enriching educational experience.

Keywords: artificial intelligence, LLM, education, chatgpt.

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INTRODUCTION

Artificial intelligence has advanced significantly in recent years, especially in the field of Large Language Models (LLM). These models, such as GPT 3.5, GPT-4 have demonstrated impressive capabilities in text comprehension and generation, making them potentially revolutionary tools for education. It is important to explore the reasons why LLMs can be used in education, highlighting their benefits and applications.

LLMs are trained with massive amounts of text data that led them to demonstrate amazing capabilities in natural language comprehension and generation. Their ability to process and produce text in a coherent and contextually appropriate manner makes them tools with enormous potential in various fields, especially in education.

The education sector faces numerous challenges, from the need for personalization in learning to the scarcity of resources in certain regions. The integration of LLMs into education can address many of these issues by providing innovative solutions that facilitate learning and teaching. These models can offer personalized educational resources, act as virtual tutors, translate educational materials into multiple languages, and automate administrative tasks, among other functions. In addition, the flexibility of LLMs allows them to adapt to different educational contexts, from primary education to vocational training and higher education.

However, as we explore the applications of LLMs in education, it is also crucial to consider the challenges and ethical implications associated with their use. Aspects such as data privacy, equity of access, and potential biases in algorithms must be carefully addressed to ensure that the impact of this technology is positive and beneficial for all students.

Education is constantly evolving, and the integration of technology plays a crucial role in its development. Among the most recent and promising innovations are LLMs. These models, based on deep learning algorithms and trained with vast amounts of textual data, offer a range of benefits for improving teaching and learning, some of the benefits that can be achieved in education are listed below:

1. **Equitable Access to Learning:** LLMs have the capacity to provide equitable access to education. LLMs can democratize access to knowledge by offering high quality educational resources to students either locally or remotely, regardless of their socioeconomic circumstances. This can reduce the educational gap and offer personalized learning opportunities to a wider audience [3].
2. **Personalization of Learning:** LLMs enable personalization of learning.

Thanks to their ability to understand and generate natural language, these models can adapt educational content and methods to the individual needs of each learner. This not only improves comprehension and retention of the material, but also fosters a more engaging and effective learning experience [2].

3. **Time Management Efficiency:** These models can be used to automate repetitive tasks such as grading tests and generating progress reports. This allows them to devote more time to teaching and developing more effective pedagogical strategies. In addition, LLMs can help educators stay up-to-date with the latest research and trends in education, making it easier to incorporate new methodologies in the classroom [2].
4. **Fostering 21st Century Skills:** The use of LLMs in education fosters the development of 21st century skills such as critical thinking, creativity, and digital literacy. Students interacting with these technologies not only learn course content, but also acquire essential technology skills for their academic and professional futures [8].
5. **Learning Process :** LLMs can act as virtual tutors, providing detailed explanations and answering student questions in real time. This type of personalized assistance can help students better understand complex concepts and improve their academic performance. In addition, LLMs can be used to create interactive exercises and assessments that are tailored to each student's proficiency level, providing immediate feedback and directions for improvement [2].
6. **Translation and Multilingualism:** LLMs can also play a crucial role in language teaching and translation. These models are capable of translating texts between different languages with high precision, which

can be extremely useful in multicultural educational environments. Learners can access learning materials in their native language, which facilitates a deeper and more effective understanding of educational content [4].

LLM Models offer significant potential to transform education by providing equitable access to quality resources, personalized learning assistance, time savings for educators, and language teaching support. However, it is crucial to address ethical challenges and ensure responsible use of this technology. With proper implementation, LLMs can be a powerful tool for improving the quality and accessibility of education worldwide.

Despite the many benefits, the use of LLM in education also raises certain challenges and ethical considerations. Ensuring the privacy and security of student data is critical. In addition, it is important to address potential biases in the data on which these models are trained, as they may perpetuate existing inequalities. Transparency and human oversight are essential to mitigate these risks and ensure responsible use of technology in education [2].

DEVELOPMENT

The GPT-3.5 model developed by OpenAI was used to demonstrate the benefits of LLMs, as it has the potential to revolutionize how learners interact with knowledge and how educators facilitate learning based on their ability to understand and generate human language in a coherent and contextual manner. The integration of ChatGPT into education marks a significant milestone in the evolution of learning.

For this demonstration we will use the subject: Probability and Statistics with Subject Key: AEF-1052, of the Tecnológico nacional de México, the selected topic is "Topic 1 Descriptive Statistics." And the complete subtopics which are the following:

1. Basic concepts of statistics: Definition, Decision theory, Population, Random sample, Random parameters.
2. Data description: Grouped and ungrouped data, Class frequency, Relative frequency, Midpoint, Limits.
3. Measures of central tendency: Arithmetic, geometric and weighted mean, Median, Mode, Measures of dispersion, Variance, Deviation.

standard, Deviation mean, Median deviation, Range.

4. Parameters for grouped data.
5. Frequency distribution.
6. Data grouping techniques.
7. Sampling techniques.

Lines of action

The lines of action that we will follow to use LLM in education in an appropriate manner are shown below with the following steps:

1. Understand the purpose of the LLM:
 - a. Understand the purpose of the LLM, be it text generation, translation, summarization, etc.
 - b. Identify what specific task you wish to address with the LLM.
2. Select the appropriate LLM:
 - a. Research and choose the LLM best suited to your specific task and domain.
 - b. It considers factors such as model architecture, model size and training data set.
3. LLM training (optional):
 - a. If necessary, train the LLM using your own data to improve its performance on a specific task.
 - b. Adjust hyperparameters and make adjustments as needed during training.
4. Formulate the query or task:
 - a. Clearly define the question or task you wish to address with the LLM.
 - b. Specify any special requirements or context relevant to the query.
5. Encode the input:
 - a. Encodes the query or input data according to the format accepted by the LLM.
 - b. Make sure the input is in the correct format and understandable to the model.
6. Generate and evaluate the output:
 - a. Use the LLM to generate the desired output.
 - b. Evaluate the quality and relevance of the output based on your criteria and the standards of the task.
7. Refine and adjust:
 - a. Iterate as needed, refining the query, adjusting model parameters or collecting more data to improve LLM performance.

8. Review and validate:
 - a. Carefully review the output generated by the LLM for possible errors or inconsistencies.
 - b. Validate the results obtained by comparing them with other reliable sources or domain experts, if possible.

By following these steps, you will be able to use LLMs effectively in education and obtain satisfactory results.

DISCUSSION AND ANALYSIS OF RESULTS

A comprehensive review of previous research on the use of Large Language Models (LLM) in education was conducted. Below, we present a summary of the main ideas from each study, highlighting the implications for educational practice. These investigations reflect the variety of applications of LLMs, from personalization of learning to writing enhancement and language teaching support. Each of these studies offers valuable insight into how LLMs can transform education and optimize the learning experience for students, the main ideas are as follows:

1. Artificial intelligence can personalize instruction by analyzing individual student data, such as strengths, weaknesses and learning . This allows AI platforms to tailor materials and exercises to the specific needs of each student, optimizing their engagement and understanding. In addition, AI can provide real-time feedback and adjust the difficulty of assessments, ensuring that each student progresses at his or her own pace [16].
2. Artificial intelligence (AI) is revolutionizing education by enabling personalized learning, adapting content and methods to the needs of each student. Tools such as virtual tutors and chatbots provide instant feedback, improving academic performance. However, ethical concerns about data privacy and biases in algorithms arise, requiring further research on their integration into curriculum and educator training [17].
3. Artificial intelligence can personalize learning experiences by analyzing individual student data, such as learning styles and performance, to tailor content and task difficulty. It uses adaptive learning platforms that adjust educational resources in real time, providing targeted feedback and support. This

allows educators to implement differentiated instructional strategies that align with the unique needs of each student, thereby improving their academic engagement and performance [18].

During the development and discussion of this article on the use of llm in education we have become convinced that llm are robust tools that can be proposed for the personalization of learning, currently artificial intelligence (AI) has emerged as another tool in the educational arena, offering the possibility of personalizing instruction in a way that adapts to the unique characteristics of each student. From the summaries presented, several key themes can be identified that highlight both the opportunities and challenges associated with this technology.

One of the most significant advantages of AI in education is its ability to analyze individual data, such as students' strengths, weaknesses and learning . This allows AI platforms to customize educational materials and assessments in real time, thereby optimizing student engagement and understanding. This customization not only enhances the learning experience, but also makes it easier for each student to progress at his or her own pace, a crucial aspect in diverse educational environments.

In addition, the use of virtual tutors and chatbots, which provide instant feedback, has been shown to improve academic performance by allowing students to receive immediate support. This approach not only fosters a more interactive learning environment, but also empowers students by providing them with an additional resource that complements traditional instruction.

AI's ability to provide targeted feedback and support also allows educators to implement differentiated instructional strategies aligned to the individual needs of each student. This personalization not only improves academic engagement and performance, but also promotes more inclusive learning, where every student has the opportunity to reach their full potential.

At the Tecnológico Nacional de México campus Villahermosa, the subject Probability and Statistics is taught with subject code: AEF-1052 in the Computer Systems Engineering program. The content that was considered to address are some subtopics of topic 1 which is Descriptive Statistics.

The prompts for chatgpt were designed according to the learning activities considering the content of the subject, and the results are shown below.

In the following image ChatGPT provides an essay on the concept of descriptive statistics.

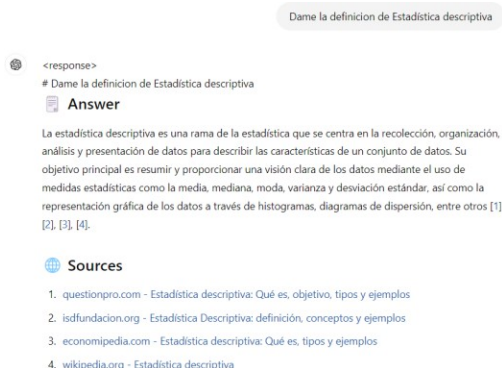


Figure 1. Definition of descriptive statistics.

In the following image ChatGPT provides an essay on the concept of statistics and decision theory.

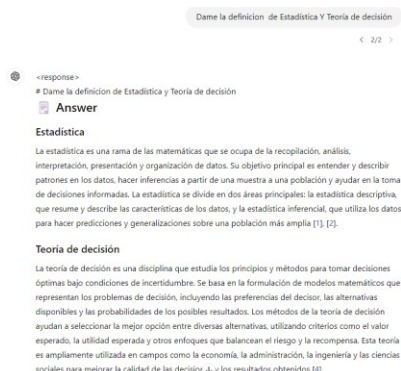


Figure 2. Basic definition of Statistics and Decision Theory.

In the following image ChatGPT provides an explanation of the concept of population, random sample and random parameters.

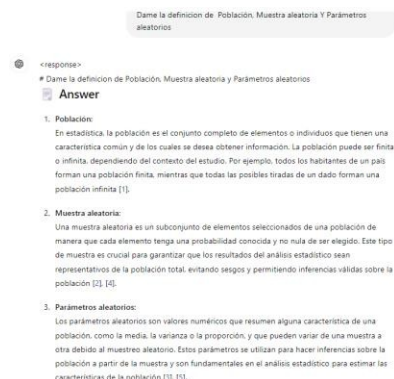


Figure 3. Definition of Population, Random Sample and Random Parameters.

In the following image ChatGPT provides an essay on the concept of clustered and non-clustered data.

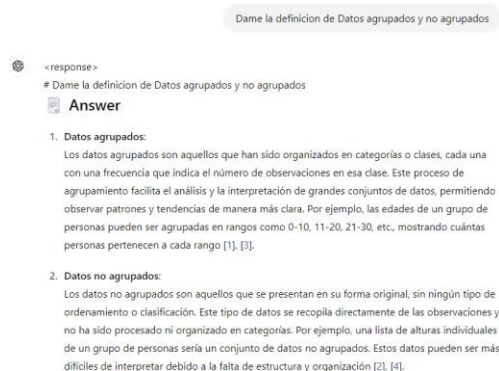


Figure 4. Definition of grouped and ungrouped data.

In the following image ChatGPT provides an essay on the concept of class frequency and relative frequency.

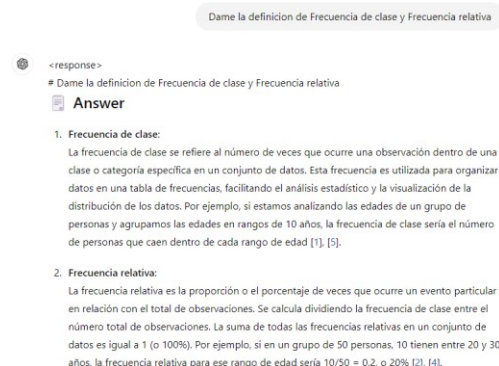


Figure 5. Definition of Class Frequency and Relative Frequency.

In the following image ChatGPT provides an essay on the concept of midpoint and limits.

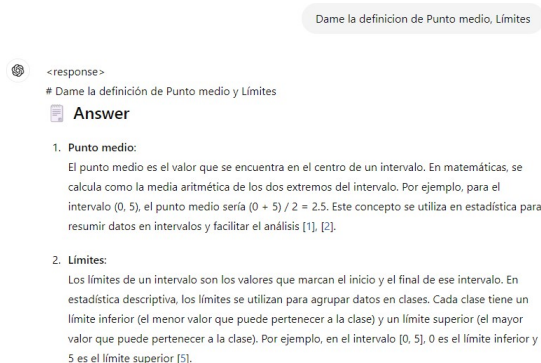


Figure 6. Definition of Midpoint and Limits.

In the following image ChatGPT provides an essay on the concept of random sample.

Dame la definición de Muestra aleatoria

<response>
Dame la definición de Muestra aleatoria
Answer
Una muestra aleatoria es un subconjunto de individuos seleccionados de una población mayor de tal manera que cada individuo tiene una probabilidad conocida y generalmente igual de ser elegido. Este tipo de muestreo se utiliza para asegurar que la muestra sea representativa de la población y para minimizar el sesgo en la selección de datos. Existen varios métodos de muestreo aleatorio, incluyendo el muestreo aleatorio simple, donde cada individuo de la población tiene la misma probabilidad de ser seleccionado [1], [2].

Figure 7. Definition of Random Sample

In the following image ChatGPT provides an essay on the concept of random parameters.

Dame la definición de Parámetros aleatorios

<response>
Dame la definición de Parámetros aleatorios
Answer
Los parámetros aleatorios son valores numéricos que se obtienen de una variable aleatoria, la cual puede tomar diferentes valores según las probabilidades asociadas a los resultados de un experimento aleatorio. Los parámetros aleatorios son utilizados en estadística y probabilidad para describir y analizar la variabilidad inherente a estos experimentos. Los parámetros más comunes incluyen la media, la varianza y la desviación estándar, que ayudan a resumir y entender la distribución de la variable aleatoria [1], [2], [4].

Figure 8. Definition of Random Parameters

In the following image ChatGPT provides a write-up on the concept of parameters for clustered data.

Dame la definición de Parámetros para datos agrupados

<response>
Dame la definición de Parámetros para datos agrupados
Answer
Los parámetros para datos agrupados son medidas estadísticas que se utilizan para describir y resumir un conjunto de datos que ha sido organizado en grupos o clases. Estos parámetros permiten obtener información relevante de manera más sencilla y clara. Los principales parámetros incluyen:
1. **Media aritmética:** Es el promedio de los datos en cada grupo ponderado por sus frecuencias.
2. **Mediana:** Es el valor que divide el conjunto de datos en dos partes iguales, considerando las frecuencias acumuladas.
3. **Moda:** Es el valor o intervalo con la mayor frecuencia dentro de los datos agrupados.
4. **Rango:** Es la diferencia entre el valor máximo y el mínimo de los datos agrupados.
5. **Varianza:** Es una medida de la dispersión de los datos respecto a la media.
6. **Desviación estándar:** Es la raíz cuadrada de la varianza y proporciona una medida de la dispersión en las mismas unidades que los datos originales.
Estos parámetros son esenciales para realizar análisis estadísticos, ya que ayudan a entender la distribución y la tendencia central de los datos agrupados [1], [2], [3], [4].

Figure 9. Definition of Parameters for grouped data

In the following image ChatGPT provides an essay on the concept of frequency distribution.

Dame la definición de Distribución de frecuencias

Dame la definición de Distribución de frecuencias
La distribución de frecuencias es un concepto estadístico que implica la organización y clasificación de un conjunto de datos en grupos o intervalos, conocidos como clases, para mostrar la cantidad de veces que ocurre cada valor o rango de valores en la muestra. Estas clases son mutuamente excluyentes y exhaustivas, lo que significa que cada dato pertenece a una clase y que todas las clases juntas cubren todos los posibles valores. La distribución de frecuencias se presenta generalmente en forma de una tabla que muestra las clases y sus correspondientes frecuencias absolutas o relativas. La frecuencia absoluta indica el número de observaciones en cada clase, mientras que la frecuencia relativa expresa esta cantidad como una proporción o porcentaje del total de observaciones.

Figure 10. Definition of Frequency Distribution

In the following image ChatGPT provides a write-up on the concept of data clustering techniques.

Dame la definición de Técnicas de agrupación de datos

Dame la definición de Técnicas de agrupación de datos

Las técnicas de agrupación de datos se refieren a métodos utilizados en estadística para organizar conjuntos de datos en grupos o categorías con el fin de facilitar su análisis y comprensión. Estas técnicas son fundamentales en la etapa de preprocesamiento de datos, donde se pueden aplicar diferentes criterios para dividir los datos en clases o intervalos, como límites de clase, rango de clase, fronteras de clase, entre otros. El objetivo principal de estas técnicas es simplificar la interpretación de los datos al resumir la información de manera más concisa y estructurada. La agrupación de datos permite identificar patrones, tendencias y características relevantes dentro de los conjuntos de datos, lo que ayuda a tomar decisiones informadas en diversos campos, desde la investigación científica hasta la toma de decisiones empresariales.

Figure 11. Definition of data grouping techniques

CONCLUSIONS

The integration of artificial intelligence (AI) in education, specifically through large language models (LLMs), offer significant benefits that transform the way teaching and learning takes place. These models have the ability to understand and generate human language responses with high accuracy, making them valuable educational resources

Implementing AI in LLM education opens up newly emerging opportunities for student-based personalization and tailoring of learning. AI can tailor educational content according to the individual needs of each student, providing a more student-centered approach and student-tailored academic progress. In addition, the ability to generate new and relevant educational content allows for greater flexibility in creating study materials tailored to various learning contexts and levels.

The use of AI in education has the ability to promote greater accessibility to knowledge by providing more interactive and accessible learning tools. LLMs can act as virtual assistants that answer student questions in real time, provide detailed explanations, and encourage autonomous learning. This continuous and personalized interaction contributes to a more dynamic and enriching educational environment.

The future research we have in mind is:

1. Effectiveness of Personalization of Learning through LLMs: Investigate the impact of large language models on the personalization of learning in various educational contexts. This would include comparative studies that analyze how LLMs can adapt to different learning styles and ability levels of students. Performance metrics could be assessed academic, motivation, and

student satisfaction, as well as the impact on knowledge retention.

2. Accessibility and Effect of Virtual Assistants on Inclusive Education: Conduct a study on how LLM-powered virtual assistants can improve educational accessibility for students with special needs. This research could evaluate how these tools can facilitate understanding of complex content, provide real-time support, and foster inclusion in the classroom, as well as measure their effectiveness in improving the academic performance and engagement of these students in learning environments.

Both investigations could contribute to a better understanding of how AI can transform education in an equitable and effective way.

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