Implementing the LSEESC Methodology With AI-guided support for Active Learning in Engineering Physics Courses

Erika Cervantes Juáres
Instituto Politécnico Nacional - UPIIG.
Silao de la Victoria, México
ecervantesj@ipn.mx

Daniel Sánchez Guzmán
Instituto Politécnico Nacional - UPIIG.
Silao de la Victoria, México
dsanchez@ipn.mx

***Abstract*— In this research-to-practice full work, we will explore how innovative educational strategies can improve students' learning experiences. Specifically, we will focus on the early development of skills in engineering students, such as numerical manipulation for problem-solving, proficient spreadsheet management, experimental implementation, and mastery of mathematical modeling complemented by informed decision-making with graphics understanding and interpretation. The effective utilization of available technological resources helps to enhance the student learning experience and prepare them for the challenges in their engineering professional practice. Physics courses often present high rates of low academic performance, but these innovative approaches can enhance active student engagement and help nurture essential skills. However, integrating technology into innovative teaching methods can have implications; one seen recently is the use of Generative Artificial Intelligence (G-AI) in many instruction courses; as a technology of easy access and manipulation, it can result in a confused tool if students don't have the appropriate instruction in its use. Therefore, educating students on the ethical and proper use of AI technology is crucial, guiding them in formulating relevant questions and accurately interpreting the results. To achieve this, we used the Learning Science and Engineering with Electronic Spreadsheets Cycle (LSEESC) methodology, which has been rigorously tested across various contexts over the last four years and has shown promising results. We will support its implementation with comprehensive guidance and use Artificial Intelligence as a prompt/chat tool (e.g., Chat GPT) as a supplementary tool. This strategy aimed to help students develop effective study habits for independent study sessions and promote autonomous learning. We examine how students ask for help from AI, including their choice of words and language. We will also investigate the effects of using casual or informal language and suggest guidelines for constructing practical questions. Our goal was to assist students in obtaining a better understanding and explanations of physics concepts and problem-solving exercises with the help of AI combined with a well-defined methodology, like the LSEESC, which promotes the development of skills like numerical manipulation, mathematical modeling, variables understanding, graphics generation, interpretation, and understanding. The learning intervention considers *N = 140* students for working on the LSEESC methodology and using G-AI in physics courses during spring *2024*, with students in the first year of academic engineering programs. The topics to evidence the learning process are kinematics and electrics. The results were analyzed with the Normalized Conceptual Gain (NCG) given a value of $\langle g \rangle = 0.75$ and *0.67*, the Concentration Factor (CF), Rasch's index, and qualitative students' question formulation. This is particularly important because, in some instances, the results provided by G-AI were incorrect owing to the system's inability to detect specific implications that a human can easily recognize; the teacher explained the confused results presented by G-AI and student received the corresponding feedback about these issues with artificial intelligence.**

Keywords*— *Learning Physics in Engineering Courses, LSEESC Methodology, Artificial Intelligence in the autonomous learning process, Engineering Students, Active learning strategies.

I. Introduction

Integrating technology into engineering education enhances the understanding of some physical concepts, fosters active student engagement, facilitates access to educational resources, and prepares students for an increasingly digitalized and technological world by providing relevant skills, such as simulation tools and data analysis; these are necessary for an Education 4.0 approach. It is also important to mention that it enriches the teaching and learning process by offering multiple perspectives and points of view to the concepts learned, allowing for the visualization of abstract concepts and the simulation of phenomena. Electronic spreadsheets have proven to be an efficient tool in this process for several decades [1-8].

Hence, this research presents the results of implementing the Learning Science and Engineering with Electronic Spreadsheets Cycle (LSEESC) methodology [1] assisted by integrating Generative Artificial Intelligence (G-AI) to support students learning various topics in physics for science courses in engineering academic programs. This approach in Physics Education offers many possibilities for enhancing students' learning experience. G-AI can adapt resources and activities according to necessities and available materials, offering a more effective and student-centered approach.

Additionally, G-AI can be seen as an intelligent tutoring system that provides personalized real-time assistance, answer questions, and offer additional explanations. G-AI can enrich Physics Education and offer more interactive, personalized, and practical educational experiences. The present research work reports the preliminary activities for integrating G-AI in first-semester Physics courses for engineering academic programs; these are calculus-based courses, the proposal was implemented in classroom modality and assessed using the Force Motion Concept Evaluation (FMCE) [9], Force Concept Inventory (FCI) [10], and the Test of Understanding Graphics in Kinematics (TUG-K) [11] test for kinematics and the Conceptual Survey of Electricity and Magnetism (CSEM) [12] test for electromagnetics, evaluating the conceptual gains, concentration factor, and the Rasch index to discern patterns and trends in student learning for a pre-and post-implementation.

It has been demonstrated that the LSEESC methodology facilitates a more efficient teaching-learning process, expedites result analysis, and cultivates students' abilities to research information and discern between credible and unreliable sources. In addition, students develop self-directed learning skills that can be applied to other areas of life, such as ease of use.

A. *Generative Artificial Intelligence implemented in science and engineering instruction.*

We start by describing what Generative Artificial Intelligence is and how it has been implemented in some learning scenarios; to define it, we can explain that: *"Generative artificial intelligence (AI) refers to a type of AI capable of producing human-like language. It is a technology that uses machine learning algorithms to process large amounts of text data and generate relevant and meaningful content in response to user requests. Generative AI models, such as ChatGPT, are trained on vast amounts of text, including books, news articles, websites, and Wikipedia, to acquire the patterns and structure of language."* [13]

We can describe the ChatGPT software as a variant of the Generative Pre-training Transformer (GPT) model developed by OpenAI[1]. It can be used for various natural language processing tasks, such as language translation, text summarization, question answering, and chatbot applications. ChatGPT can understand and respond to human inputs conversationally, making it suitable for interactive applications. However, it is essential to note that ChatGPT has limitations. The given material highlights ethical concerns associated with AI, including potential biases in the generated content and the risk of copyright infringement. ChatGPT's output may perpetuate biases present in the data it was trained on, leading to unequal and unfair outcomes, particularly related to factors like race, gender, or socio-economic status. Additionally, the environmental impact of AI, content moderation issues, and the responsibility of educators to model responsible use of ChatGPT are essential considerations.

Educators can potentially utilize ChatGPT in their science pedagogy by designing science units, rubrics, and quizzes. However, it is crucial for educators to critically evaluate any AI-generated resource and adapt it to their specific teaching contexts. They should prioritize critical thinking, model responsible use of AI, and be clear about their expectations. Finally, generative AI, such as ChatGPT, offers transformative potential in the field of education. While it can be a helpful tool for educators, it is essential to be aware of its limitations and ethical concerns. Educators should critically evaluate and adapt AI-generated resources to their specific teaching contexts while prioritizing critical thinking and responsible use of AI. Also, policymakers and administrators must help teachers be involved in using G-AI or any other kind of AI because it can present a new gap in the correct use and manipulation of AI.

Generative artificial intelligence has been implemented in learning science and engineering. In [14], the work discusses generative artificial intelligence (AI) in science education. It explores the potential of ChatGPT in answering questions related to science education and its utilization in science pedagogy. The article highlights the alignment between ChatGPT's output and key themes in the research, such as active and inquiry-based learning, real-world connections, differentiation, and collaboration in science teaching. However, it also raises concerns about ChatGPT's lack of evidence-based responses and potential biases in its output. Regarding utilizing ChatGPT in science pedagogy, the article suggests that educators can use it to design science units, rubrics, and quizzes. In conclusion, this research [14] highlights the transformative potential of generative AI in science education while raising critical ethical concerns. It suggests that ChatGPT can be a valuable tool for educators but emphasizes the need for critical evaluation, responsible use, and adaptation to specific teaching contexts. The article also discusses the potential use of ChatGPT as a research tool and the importance of transparency in AI-related research [14].

In another study [15], the researchers investigated whether the freely available version of ChatGPT can produce a quality conference abstract. They used a fictitious but accurately calculated data table and found that the resulting abstract was well-written without obvious errors. They also noted that one of the references in the abstract was fictitious, which they called a "hallucination." The researchers concluded that ChatGPT, or similar programs, with careful review by authors, may become valuable scientific writing tools. However, they also acknowledged that using generative artificial intelligence in science and medicine raises many questions.

Generative artificial intelligence, such as ChatGPT, has the potential to revolutionize various aspects of medicine and scientific writing. It can assist researchers in writing papers and grants, summarize complex information, and streamline existing documents [15]. For researchers with limited English skills, AI tools like ChatGPT can be particularly helpful in improving the quality of their written work. In conclusion, while generative AI like ChatGPT can be a valuable tool in scientific writing, its use should be accompanied by careful review and consideration of ethical implications [15].

Finally, we can see that as much research work has been reported but has not been done on the use of G-AI in the guidance for students that work with textbooks like Physics, Mathematics, or Engineering, where the exercises for solving numerical, mathematical, and graphical problems. We try with this research to integrate a well-defined methodology like the LSEESC with a G-AI supporting tool, mainly to pave the learning process in more autonomous learning by the student.

B. *The LSEESC Methodology an Active Learning Approach in Engineering and Science courses*

In 2023, the methodology Learning Science and Engineering with Electronic Spreadsheets Cycle (LSEESC) was published to improve the learning of physics, science, and engineering concepts was published [1]. It's a methodological proposal that promotes the use of electronic spreadsheets as a learning digital tool to promote understanding, critical thinking, and reasoning in students. It includes programming dynamical systems, generating and analyzing graphics, and explaining physical phenomena [1]. The LSEESC methodology can be implemented in different

[1] https://chatgpt.com/

learning scenarios, whether the class uses computational devices or if the teacher exposes a specific topic in the classroom. The methodology allows for feedback from students in a comprehensible manner and can be adapted based on previous results to different learning scenarios [1].

The authors describe applying the LSEESC methodology using the example of the rigid body concept, a fundamental concept in science and engineering. They explain how to program the solution of the rigid body system in an electronic spreadsheet, generate data series, manipulate mathematical models, and plot 2D graphs. They also suggest using a robotic arm simulation or real-life examples to reinforce the concept and show its application in a professional context [1].

The LSEESC methodology aims to enhance students' learning experience by integrating electronic spreadsheets, programming, and graphical visualization. It provides a structured approach to teaching physics, science, and engineering concepts and encourages students to develop computational thinking and digital skills [1, 3, 8].

In the present section, we described what Generative Artificial Intelligence (G-AI) is, how it has been implemented in different learning scenarios, and its potential to improve learning activities. Also, the Learning Science Engineering with Electronic Spreadsheets Cycle (LSEESC) methodology was described as an active learning methodology that promotes the development of different skills in the learning process like numerical manipulation, mathematical model programming, graphical generating, and interpreting in a well-defined cycle for learning abstract and complex concepts in many subjects of engineering and science. In the next sections, we will describe how combining these two approaches can enhance students' learning concepts in science and engineering.

II. THE LSEESC METHODOLOGY COMPLEMENTED WITH GENERATIVE ARTIFICIAL INTELLIGENCE

The Learning Science and Engineering with Electronic Spreadsheets Cycle (LSEESC) methodology proposes the using electronic spreadsheets (ESs) as a digital learning tool to improve the learning of concepts in physics, science, and engineering [1]. The methodology focuses on activities such as programming dynamical systems, generating and analyzing graphics, and explaining physical phenomena using real-life examples or simulations. It can be implemented in different learning scenarios, whether the class uses computational devices or if the teacher exposes a specific topic in the classroom.

The LSEESC methodology has demonstrated that the effectiveness of its activities is independent of the learning scenario; it has been tested in the three modalities of learning: virtual classroom, hybrid classroom, and personal classroom; the versatility of the methodology also has been evidenced by the high rates in students' academic scores, presenting high values in the normalized concentration gains, evolution and retention with concentration factor scores and the Rash' model presents a conceptual domain of knowledge in students according to their age and mental maturities [3,8].

Integrating generative AI into the LSEESC methodology could have potential benefits. Generative AI models, such as generative adversarial networks (GANs), can generate realistic data or simulate physical phenomena. This could enhance the learning experience by providing students with more diverse and interactive simulations. For example, AI-generated simulations could allow students to explore complex systems or conduct virtual experiments that may not be feasible in a traditional classroom setting. Additionally, generative AI models can assist in automating specific tasks, such as data analysis or graph generation, which are integral to the LSEESC methodology. This could save time for both students and teachers, allowing them to focus on higher-level conceptual understanding and interpretation of the results.

In the present research to practice work, we complemented the LSEESC methodology with G-AI; not all steps include G-AI, only those where the interaction of the students with the concepts are necessary; this consists of a self-students or a group of students activities, in both cases, students must perform the task and share the results with their colleagues and present the evidence to the teacher. As we have described the potential of using G-AI in a learning scenario, we decided to start with the confrontation of G-AI with the Physics problems described in basic text-books defined in the course; some examples are: *"Physics for Scientists & Engineers with Modern Physics, Global Edition"* from Giancoli [16], *"Physics for Scientists and Engineers"* [17], from Serway and Jewett and *"Fundamentals of Physics, Vol. 1"* from Halliday, Resnick, Walker [18], our goal was to determine if the basic text-books can be complemented with the G-AI with the idea in mind that G-AI only will describe in a more detailed way the problems that students must perform during the course.

A. *Describe the LSEESC Methodology with G-AI additional activities.*

The actualized steps of the LSEESC methodology are now described; in each one, we define if the step keeps as the original proposal, and we add the use of G-AI. Based on the methodology, we describe five steps and point out that, like the methodology is a Cycle, we must consider the future cycle after the new design of activities.

a) ***First step. Group of students characterization.*** *First, we must characterize the students who will work with the methodology. For this step, the measurement instruments will be applied to the students, conceptually and in terms of managing electronic spreadsheets. One session was allocated 90 minutes to gather all the possible information through the tests the students solved. Once the activity is finished, a visual map can be generated by analyzing the concentration factor. With the results obtained through the FC, the mental models that the students have can be characterized, and the actions to be taken for the next step can be considered.*

b) ***Second step. Introduction to the topic and the concepts with LSEESC.*** *Once the first step has been carried out, the teacher will present the basic ideas of the topic or concept to be learned by the students. In this stage, the students will work alongside the teacher and be presented with examples related to numerical manipulation, mathematical models, and graphs describing the physical phenomenon's variables. At this stage, students must be clear about how the potential of spreadsheets can serve the students' understanding* *of the concepts and their relationship when programming the activities entrusted to them in electronic spreadsheets by the teacher.*

c) ***Third step. LSEESC with self- and group students working with the concepts and G-AI support.*** *For this step, the participation of the students is essential since they will carry out the activities assigned by the teacher autonomously. For this stage, we can divide them into four small activities to be developed by the students: i) Carry out individually the problems assigned by the teacher and solve the problems found in the subject's textbook with the support of the G-AI. In this activity, the student is asked to capture the steps generated by the G-AI, as well as an individual description by the student if the understanding of the concept was carried out, all activities with the support of AI must be carried out with the support of electronic spreadsheets, to reaffirm the use of the digital tool, in accordance to the methodology and involve the student in the development of the skills necessary for problem-solving; ii) In groups of 4 or 5 students, the same problem-solving activities assigned by the teacher and with the support of the G-AI will be carried out. For this sub-activity, what is sought is for the students to develop the ability to socialize and peer instruction so that in small groups, they can understand what the G-AI describes in problem-solving or they can propose a new strategy in problem-solving; iii) The student teams that worked on the activities must develop a video of the five problems that were most difficult for them. Each problem must be described, including how the solution was proposed and its description. With the use of electronic spreadsheets, the video should be available online so that your colleagues can review and study the solved problems; iv) Finally, students present the results to the teacher in the form of reports and must include examples from professional life or that are of interest to them that they consider can be resolved with the LSEESC methodology and with the support of the G-AI, this allows students to identify problems similar to those they may encounter in their professional life, but they know how to combine them with the use of the new digital tools that they already use, for example, they can describe how to build a new engine with the support of artificial intelligence in the selection of materials that are sufficiently resistant and highly durable, generating the mathematical model of resistance and torque capacity with electronic spreadsheets.*

d) ***Fourth step. LSEESC is used to extrapolate the learning concepts and G-AI feedback.*** *With the previous activities developed, students can consider problems they have not solved in class but can identify them for their professional training since they have the disciplinary skills to formulate solutions to problems. For this penultimate stage, students are asked to present a proposal for a solution in the field of professional training. They must search on the Internet or in specialized magazines for topics that interest them and handle some basic principles of the issues seen in class. The proposal must include the simulation of the basic mathematical model, the use of G-AI to support understanding a topic, the search and description of information related to the topic, and how it was used to base the project. With this stage, we reinforce the student's understanding of concepts and their extrapolation in their training topics as engineers, evidencing the development of complementary digital skills under the Education 4.0 approach to participate in Industry 4.0.*

e) ***Fifth step. They are analyzing the results of the learning process of LSEESC with G-AI and ethical considerations.*** *For this last step, the teacher must confirm that the students have developed the skills that the LSEESC methodology requires for their professional training and that the G-AI can complement the development of academic activities. Also, the teacher supports students in formulating criteria and new points of view regarding the ethical use and benefit of the development of science and technology; he does not leave the student alone in understanding the latest tools developed; they must produce. Along with technical training, the reflection and impact that this type of methodologies can have on the development of society and its impact as accelerators of technological solutions.*

B. *Implementing the LSEESC Methodology with G-AI additional activities.*

The LSEESC methodology combined with the G-AI was carried out with the participation of $N = 140$ students, of which $N_1 = 105$ studied kinematics topics, addressing the issues of position, velocity, and acceleration, and $N_2 = 35$ studied electricity topics, specifically Coulomb's Law, the sessions to carry out the methodological implementation were *5*, each session has a duration of *90* minutes. Still, in both subjects, various topics were covered without affecting the development of other issues to be considered. The courses were held in April *2024*, within the semester from February to June of the same year. Figure 1 describes a session describing the kinematics concepts.

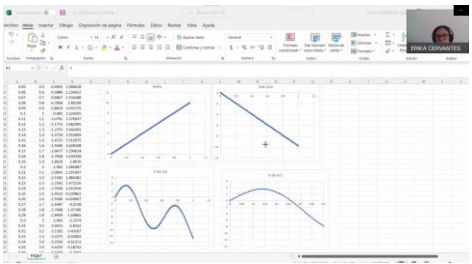

Figure 1. Kinematics' concepts explanation [3].

The LSEESC methodology has been verified in the last *four* years, which allowed the stages and activities to be identified where the implementation of the G-AI could support the students. The authors did Preliminary work on the use of artificial intelligence technology to make a more detailed identification of the stages where it could be implemented as additional support in the students' learning process. Figure 2 is an example of how students use G-AI to solve problems in a Physics textbook.

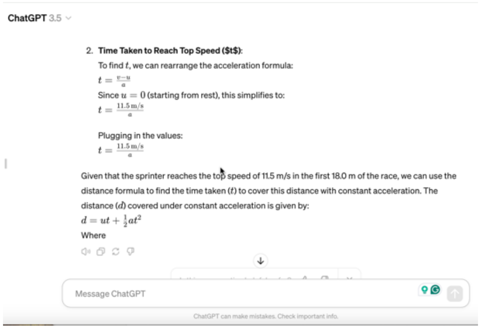

Figure 2. Results presented by chat GPT for solving and explaining an acceleration problem [13].

The tests that were used for collecting misconceptions and based on the concepts viewed are standardized; as mentioned at the beginning of the work, the FCME, FCI, and TUG-K tests were used to understand kinematics and the CSEM test to understand Coulomb's Law. It is important to mention that these data collection instruments have been used to demonstrate conceptual learning in students who must learn the concepts mentioned before. All questions of the tests consider the abstract level knowledge of the students, as they are in the first or second semester of an academic engineering program, the mental concepts are concrete ideas with low abstract understanding, and in most cases, no previous calculus or linear algebra courses were taken.

III. Results and Discussion

To describe the results quantitatively, the values obtained in the normalized conceptual gain, the concentration factor, the Rasch index, a comparative table of the problems described in the textbooks are presented, and the percentage of correct resolution. and explanation of exercises by the G-AI, it is important to mention that for this last analysis, the students were asked to capture the problems from the textbook, in the same way in which they are presented in the book, and request the G-AI to solve the exercises and the explanation for a student with the maturity of 15 years, for the present case and with these conditions the G-AI had an effectiveness of 42% of problems solved correctly and with an acceptable description for students.

A. Normalized Conceptual Gain (NCG)

The Normalized Conceptual Gain (NCG) [19] presented a positive effectiveness of the proposed methodology with the use of LSEESC combined with the G-AI, being in a range of *<g> = 0.75* for the concepts of Kinematics, for the case of Electromagnetism the gain value was *<g> = 0.67*, which shows a high GCN compared to the literature and following the proposal (see TABLE I).

TABLE I. Normalized Conceptual Gain (NCG)

Kinematics (NCG) is [a]		
N	Pre-Test	Post-Test
105	*0.32*	*0.83*
NCG <g>	***0.75***	
Ohm's Law (NCG) [a]		
35	*0.23*	*0.75*
NCG <g>	***0.67***	

a. Source: Pre-test and Post-test.

Although the result is positive in both cases, the isolated LSEESC methodology presents similar values of conceptual gain. So, a new experiment is proposed that compares both implementations: LSEESC without G-AI support and the same methodology with artificial intelligence support.

B. Concentration Factor (CF)

In the case of the concentration factor (CF) [20], the implemented methodology favored learning, more significantly in the case of the topics in Kinematics than in the case of learning Ohm's Law, but in both cases, it confirmed that the methodology positively favors learning and the development of skills that have been described in previous works.

In both cases, the graphs obtained show that questions significantly favor understanding concepts and go from the entire group being those who did not know the concepts to understand the concept uniformly. Thus, questions 3, 7, 10, 12, and 14 are for learning kinematics, and questions 5, 8, 9, and 10 are for learning Ohm's Law (see Figures 3 and 4).

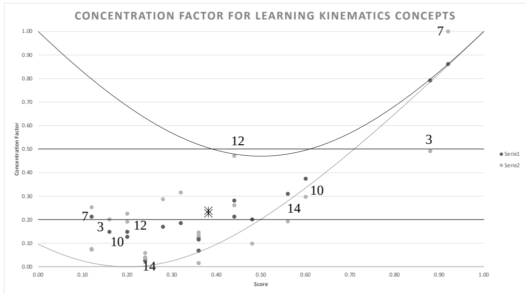

Figure 3. Concentration factor for learning the kinematics concepts. Serie 1. Pre-test. Serie 2. Post-test.

In Figure 3, the post-test results for the evaluation concepts increased. As described before, the methodology implemented helped learn kinematics concepts. The learning intervention favored most of the items, and for Coulomb's Law, the questions were fewer than the kinematics concepts (see Figure 4).

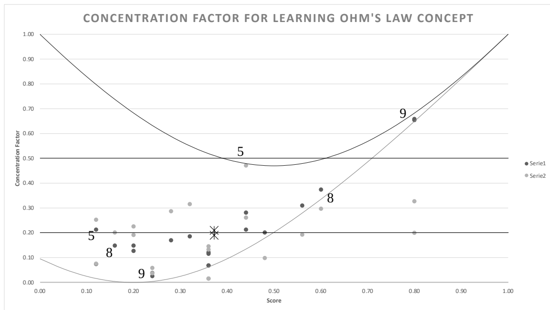

Figure 4. Concentration factor for learning the kinematics concepts. Serie 1. Pre-test. Serie 2. Post-test.

For learning Ohm's Law, the Concentration Factor graphic shows a significant increase in the results but less effectiveness relative to the kinematics concepts learned. This can be presented because of the abstract idea to be learned and the students' difficulties understanding this concept, as it is not evident and physically complicated to see in a classroom or laboratory. However, the results remain positive in both cases.

C. Rasch's Index

The Rasch index [21] presented a significant result since the tool did not identify a negative trend. The values obtained correspond to the updated literature, which can be identified in the following graph (Figure 5).

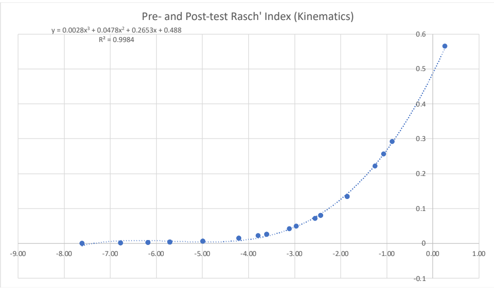

Figure 5. Pre- and Post-test Rasch's index for Kinematics groups.

For the pre- and Post-Test analysis of the Rasch index, we observe that the objective results did not influence the methodology, the evaluation kept the corresponding levels of the index, and we can consider the results fair in terms of the activities realized, not presenting an influence by the test in both cases.

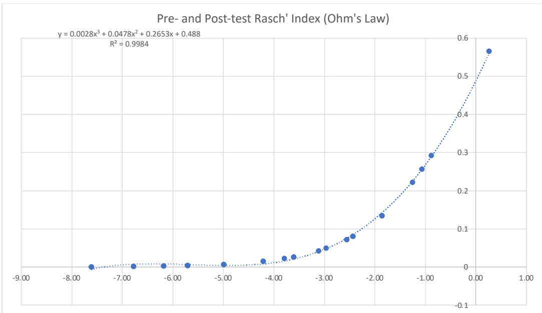

Figure 6. Pre- and Post-test Rasch's index for Ohm´s law group.

D. G-AI Efficiency with respect to the textbook problems

Finally, a comparative and support study was carried out to identify the impact of the use of G-AI for students of Physics courses in academic engineering programs. The students were instructed to capture the Physics problems from the textbooks, and the G-AI was asked to explain the solutions to the problems posed in detail. The objective is to analyze how artificial intelligence proposes the solution to a classic Physics problem and the descriptive scope so that a student can understand in detail what happens in the problem.

Table II shows that the efficiency of the G-AI is less than 50% of the total problems posed. For this example, the ChatGPT system was used. In the case of the textbook problems related to the concepts of Kinematics, there was a correct rate of 47%; in the case of the concept of Ohm's Law, the G-AI had a proper percentage of 39%.

TABLE II. G-AI EFFICIENCY RELATED TO TEXT-BOOK PROBLEMS

Kinematics = 32 problems		
Correct problems	**Incorrect problems**	**Efficiency**
15	*17*	*47 %*
Ohm's Law = 27 problems[b]		
11	*16*	*39 %*

b. Source: Pre-test and Post-test.

In the case of problem-solving by G-AI, it was observed that the solution proposals depend greatly on the level of abstraction of the problem and how the data is connected to be able to solve a problem; it was detected by artificial intelligence that nested data did exist to solve the general problem, there was a tendency to invent data or use data that was already available, presenting a mental model, in solving problems, similar to those reported in students between age ranges from *13* to *17* years.

It can also be observed that the exercises solved for the concept of Ohm's Law are more complex to respond to by the G-AI; the above can be attributed to how abstract these types of problems are since the quantities, artificial intelligence tends to answer without the physical and theoretical foundation that knowledge on the subject implies. It is important to identify this situation since most problems tend to increase the complexity and abstraction needed to be solved, and the same thing occurs when requesting demonstrations on certain physical principles.

IV. CONCLUSION

The present research results are consistent with the learning instruction design and implementation. Using an active learning methodology combined with artificial intelligence can improve the students' learning concepts in Physics topics. In conclusion, we have different aspects identified in the present research, which are described as follows:

a) ***Active methodologies such as the LSEESC promote content-oriented and student-centered learning.*** *The methodology has been documented in different scenarios. Complementing this methodology using G-AI can further improve academic performance, but teachers' participation is essential so that incorrect information or approaches are not generated. Instead of supporting learning, inaccurate information or approaches create more confusion and a certain fear of using technology when this is just another tool to develop educational activities.*

b) ***Generative Artificial Intelligence partially helps in the learning and comprehension process.*** *While working with Generative Artificial Intelligence, we identified that for fundamental concepts and support in problem-solving as exercises proposed in the textbooks, the G-AI really can help students learn and comprehend the topics studied. Still, when the abstraction level and reasoning goes to more complex and abstract ideas, the G-AI presents failed information and difficulties in reasoning more complicated problems; these results are essential to point out because the G-AI will present a risk in the confidence for the students to continue their learning, get confused results and frustration, similar that the absence of the G-AI support, produce a low academic performance.*

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