Artificial Intelligence: Promoting Investigative Skills In University Students In Ecuador

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Abstract

The problem of research skills in university students in Ecuador lies in a lack of early focus on the development of research skills during basic and secondary education. The objective: Apply artificial intelligence to boost research skills in university students in Ecuador. The methodology is Applied, Quantitative and Descriptive, its design is pre-experimental, the population is made up of 40 students belonging to the 8th level of university studies at the UTB. The results show that the current state of the investigative skills in the students under study, with respect to the Observable, a weakness is noted when carrying out this activity, since it is not specific or planned and even less registered, with regard to the Analytical, it presents little capacity. objective, weak relationship between the variables studied and limited evidence to make comparisons and with respect to the Interpretative point, it is almost null in assertiveness, since the ideas are not clear, they are also very extensive and their arguments are directed. concluding that there is a significant effect when applying artificial intelligence with the purpose of promoting the necessary research skills in the university students of the UTB, given that a p-value of less than 0.05 was found in the Wilcoxon test, which shows that the use of artificial intelligence boosts investigative skills; notable differences were also found between the pre- and post-test evaluations.

Keywords: Pedagogical model, academic competencies, students, university.

INTRODUCTION

The problem of research skills in Ecuador's university students lies in a lack of early focus on the development of research competencies during basic and secondary education. Many students enter higher education [1]without having acquired strong research skills, hindering their ability to conduct quality research at the university level. In addition, the lack of resources and opportunities for research practice limits the development of these skills. This is exacerbated by an academic culture that often values memorization and reproduction of information more than critical thinking and independent research. As a result, students face difficulties in conducting meaningful research and contributing to the advancement of knowledge in their fields of study.

According to Rojas and Tasayco (2020), it is important to develop general and specific competencies to prepare professionals for the changing labor market. It is important to identify the research skills needed for college students to be able to represent scientific concepts. In summary, identifying research skills are key to the scientific production of university students through a systemic approach.

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Likewise, Llacsa-Puma and Guadalupe-Zevallos (2022) argued that it is important for human beings to learn research skills from an early age in order to be successful, which requires effective educational innovations. Several studies analyzed showed the impact of experimental activities on students' learning of research skills. These activities are an innovative and fun way of teaching science, where the student experiments as the main actor of their learning.

ARTIFICIAL INTELLIGENCE

Artificial intelligence (AI) is a field of computer science that focuses on creating systems that can perform tasks that normally require human intelligence, such as learning, reasoning, and perception. (PRTR, 2023). Valbuena (2021) also expressed that the creation of intelligent machines using bio-mathematical models to mimic human cognition is being explored. And finally, Costa (2023) expressed that artificial intelligence involves the creation of systems and machines that can perform human-like tasks.

Regarding its characteristics, Valbuena (2021) expressed that AI involves a unique exploratory investigation that uses various search methods to create a map of an unexplored territory, called problematic space. Pedagogical models direct teaching and learning based on institutional commitments. On the other hand, Costa (2023) expressed that machine learning is a key sector of Artificial Intelligence. This field involves the development of algorithms and models that learn from data to identify patterns and make decisions based on them.

AI performs this integration to enhance learning through engaging activities, improving cognitive skills, and promoting effective learning experiences (García, 2021). While Arango (2021) argued that the integration of AI presents prospects for the banana industry. Similarly, it depends on the specifics of the product you control. These areas are important, which is why systematic reviews of AI techniques in supply chains have been conducted.

According to Fajardo et al. (2022), they argued that AIs changed teaching in university education. The main goal is to understand how AIs are developed and implemented in university education. It is crucial to responsibly address ethical and societal concerns about the use of artificial intelligence in education. AI should be used ethically in education as a complement, not replacement, to human interaction.

Fernández and Esteves (2022) also argued that Artificial Intelligence has advanced significantly with new developments in the last decade due to digital transformation. AI impacts various domains and technologies, influencing informational behavior. Artificial intelligence impacts how people search, process, and share information, as well as their critical and cognitive ability. There is a need for constant research and reflection on the advances of AI and its effects on information skills and societal changes.

Finally, Zamora and Mendoza (2023) argued that clear guidelines are needed to use AI in education and define related ethical concepts. Generate mental processes using a computational metaphor, used in psychology and neuroscience. These systems use complex algorithms and mathematical models to learn from data, improve their ability, and perform specific tasks over time, similar to a human; One benefit is its ability to analyze multiple sources of information almost simultaneously.

Knowledge simulator: according to Vargas-Sierra (2020), AI technologies aim to replicate the functions of human intelligence using computer systems. It also has very relevant characteristics, according to Trejos (2021) he expressed that AI uses data to make decisions; Data science extracts information using math, statistics, and ML. Computer systems simulate human reasoning learned from data or information using mathematics and logic.

In the same vein, Obregó et al. (2023) argued that adaptive teaching systems based on AI make it possible to create personalized learning trajectories for greater efficiency in the acquisition of knowledge. Research confirms that artificial intelligence benefits education. Science supports that AI can transform education by personalizing learning.

Likewise, Carrazco et al. (2022) argued that developing a virtual simulator with AI using the ADDIE model. Where students can interact with real cases. Law professors should improve their skills using AI in real cases and in information and communication technologies. Develop a virtual simulator to help law students practice and improve their skills in MASC. Technological focus on software development, not legal.

On the other hand, Harris et al. (2022) expressed that the pandemic changed education. Plans were needed to take full advantage of the technological advantages in this field. This analysis examines how technological resources improve education and facilitate the construction of knowledge. A systematic review was conducted. Find empirical evidence to support "digital skills".

On the other hand, Rama (2023) expressed that artificial intelligence is driving digital disruption in a broad ecosystem. Artificial intelligence will change education with more automated processes and chatbots. The structural inequality between mass teaching and individual learning contributes to problems of educational quality.

Castillejos (2022) also expressed that AI has arrived in educational spaces to transform teaching. This essay reflects on how artificial intelligence impacts college student learning and the need for meaningful educational spaces. If solutions are proposed from the classroom, knowledge should not be fragmented. Critical and creative thinking are affected by applying tools in learning. A value problem is detected in the student.

Metadata : According to Soria (2022), metadata is a crucial part of AI and data management systems. Its use cannot be ruled out without impacting the operation of these systems. Data science is used to design services and plan for various aspects required for specific purposes. Berenguer (2021) stated that open data portal search engines rely primarily on metadata for search, but results may not always be optimal due to the manual definition of metadata and its ability to accurately represent the dataset.

Galindo (2023) argued that semantic technologies on the web use protocols to manage information with metadata and organize content on the Internet. Technologies have transformed university environments by using them to reorganize epistemic structures and social relations. Identify how semantic technologies benefit the organization of information in complex university environments. The results include consensual vocabularies, techno-social learning, and smart communities. The conclusions highlight that using semantic technologies in complex university environments helps to organize knowledge, scientific knowledge and social relations in an appropriate way.

García (2023) argued that the use of Artificial Intelligence in cultural heritage is analyzed, addressing the documentation, conservation, management and study of digital collections, as well as interdisciplinary research approaches using machine learning. Provide strategies to protect the site's collections. One strategy to address this challenge is to adopt standards that connect open data and metadata between institutions.

Maffei, Neil, and Battaglia (2023) argued that during the pandemic, education was only obtained online through LMS platforms. Identify each student's learning style to personalize teaching strategies. The Secretariat for University Policies and the University Information System Consortium have provided computer applications to University Institutions to improve data management and quality. Smart tutoring systems and an adaptive assessment system will be used to learn about students' strengths and weaknesses through online tests.

Villacreses et al. (2022) expressed that this research explores how artificial intelligence is used in the evaluation of software quality through genetic metrics and algorithms. This research is based on the systematic review. AI applications in software quality detect issues in quality specifications. "The challenges of artificial intelligence in software quality satisfy programmers who want to use or modify algorithms."

Arango and Mejía (2023) stated that the work focuses on improving the management of university rooms and laboratories through a web application. Create a web application in .NET Core with C# to manage rooms and laboratories, reducing waiting times and optimizing resources at the Pascual Bravo University Institution. The database includes

metadata that allows logical-physical independence of the data. A complementary technological solution is to implement a remote monitoring system to supervise the rooms and laboratories. This involves remote control of equipment and maintenance.

INVESTIGATIVE SKILLS
According to Barbachán (2021), they are defined as individual characteristics that contribute to the development of training for research, through the application of the scientific method to solve problems that affect humanity. On the other hand, Moreno (2012, cited in Tovar et al., 2021) states that it encompasses several skills that begin to be developed before formal research training begins. Yaques et al. (2023) also expressed that research skills are manifested in the activity through professional competencies, making it a crucial part of the subject's training.
These show specific characteristics, as reported by Rojas and Tasayco (2020), who argued that research skills are a priority in higher education to increase academic and scientific production. Likewise, Martínez and Márquez (2014, cited in Tovar et al., 2021) stated that research skills are essential for problem solving and are closely linked to the learning process in different areas and contexts according to the authors.

Observable, observation is a continuous process of directly obtaining information about events, facts, or phenomena (Fernández & Carcausto, 2022; Guamán et al., 2020) cited in Dávila et al. (2022). On the other hand, Lora-Loza et al. (2020) argued that among its main characteristics are observing and generating skills, helping advanced empirical thinking by making evaluative judgments, designing educational strategies, and investigating scientific knowledge to align it with reality.
Aranguiz (2023) argued that analyzing the development of research skills in a university degree proposes a method: Internal and evaluative case study. The methodology includes five skills for conducting research, constructing knowledge, creating observables, designing procedures and instruments for searching and analyzing information. Integrating research skills into the training of nursing students is important for them to become professionals capable of generating change. It is crucial to review and improve research skills training for nurses through targeted educational interventions.
Murcia (2022) argued that the main objective was to learn about the contributions of a program that fosters the development of skills to motivate research in students and promote a culture of research in the educational system. The professors observed that the students improved their skills in presentation and argumentation by participating in research projects, which led them to actively participate in actions to strengthen environmental and scientific issues.
Andreu et al. (2023) argued that they explored how the curricular management of Master's programs at a university in El Salvador affects the development of students' research skills for thesis elaboration. The management of master's degree programs should improve the integration of research skills at all curricular levels.

Analytical according to Fernández & Carcausto (2022); Guamán et al. (2020), cited in Dávila et al. (2022) argued that analysis involves examining the components of a whole and their attributes. On the other hand, Loayza (2021) argued that analyzing a situation, proposing a hypothesis, planning and analyzing a solution to the problem. Finally, specific research skills involve writing about the same idea in various ways using different theories and relating scientific methods to a problem.
Sierra (2022) expressed that improving reading skills to analyze, infer, and synthesize information needed for research projects. Students struggle to create preliminary projects, face challenges when conducting research papers, and may not graduate because they did not complete their degree project.
Navas et al. (2023) stated that the formation of research skills is key in professional training. The research has a non-experimental, cross-sectional, exploratory and descriptive design. Identify a framework for theoretical reflection on the current challenges and perspectives

in university Physical Education through the analysis of specialized literature. Students acquire new qualities by participating in their learning process. The student becomes the protagonist, builds their knowledge and applies it in the classroom with analytical and reflective thinking. Promotes effective and comprehensive learning.

Lora-Loza et al. (2020) stated that the study assessed the research skills of master's students. The study was descriptive and evaluative. According to the skills observed, 13.8% have a very high level of development in analytical empirical knowledge. There is no significant difference in the development of research skills according to the type of knowledge. Developing research skills is crucial for researchers as they enter scientific research.

Mármol et al. (2022) expressed that "Developing research skills in higher education is an urgent professional need." The phenomenological interpretative paradigm analyzes the formation of research skills in Business Administration students at the Salesian Polytechnic University. Developing skills during the tenure in college is essential.

Díaz and Cardoza (2021) argued that research skills and attitudes are important in higher education to access, manage, and generate knowledge. The study investigated the relationship between skills and attitudes towards research in master's degree students in education at a university. Students showed poor research skills and low attitude towards research. Research skills have a positive relationship with attitudes, but negatively influence certain attitudes. "Competencies have not been developed to master the research processes."

Interpretative according to Fernández & Carcausto (2022); Guamán et al. (2020), cited in Dávila et al. (2022) argued that interpreting involves elucidating facts or phenomena, assigning meaning to them. For his part, Chirino (2002, cited in Gonzales, 2021) argued that applying scientific knowledge to understand education and adopting an ethical stance. Galvan (2023) expressed that the research suggests a didactic strategy to improve the research skills of students at the public university of Trujillo. The research methodology employs a qualitative approach and a sociocritical and interpretative paradigm, being of the educational applied research type. The main findings of the fieldwork were the low use of didactic strategies, the lack of motivation of the students, and the lack of knowledge about the importance of formative research. Using this diagnosis, the proposal was modeled and a didactic strategy was designed that uses Mendeley as a tool to develop research skills in students. A didactic strategy to promote research skills in university students.

Asis, Monzón, and Hernández (2021) argued that defining formative research and its use in Higher Education as a systematic scientific method with observational techniques. It demonstrates how promoting skills such as critical thinking and collaboration will guide new teachers to act thoughtfully in various situations.

Álvarez et al. (2020) argued that research is fundamental in the university today. The study characterized the research skills of the teaching staff of the Catholic University of Cuenca - Azogues Campus. A descriptive and cross-sectional research was carried out, without experimentation. In summary, the most difficult investigative skills included data tabulation and statistical test selection, among other aspects. The university should promote research to improve research skills and achieve excellence.

These analyzed situations allow us to propose as a central objective: To apply artificial intelligence to develop research skills in university students in Ecuador.

METHODS

The research has a quantitative approach and a descriptive scope. The design of the study is experimental and cross-sectional in nature. The theoretical foundations are based on the dialectical method, incorporating both theoretical and empirical approaches to systematize the aspects of how artificial intelligence generates an influence on the development of the research skills of university students.

The body of the article differs from the theoretical sections, making it easier to understand the results presented. These degrees classify skills including Observational Ability, Analytical Ability, and Interpretive Ability, which are derived from theory. The study will

show the progress made by university students with respect to the study variable: Artificial Intelligence with its dimensions Information Integrator, Knowledge Simulator and Appropriate Use of Metadata.

The analysis allowed the articulation of the dimensions of Artificial Intelligence and its influence on the dimensions of research skills.

The population consisted of all the students of the eighth level of studies of the 20 careers of the Technical University of Babahoyo (UTB) and by the technique of non-probabilistic sampling and convenience criterion, 2 students per career of the eighth level of the UTB were taken, making a total of 40 students.

The technique used was Observation, which is a technique that consists of carefully observing the phenomenon, event or case, taking information and recording it for later analysis. Observation is a fundamental element of any research process; It is used by the researcher to obtain the greatest amount of data.

The instrument was the Checksheet which is an instrument that allows identifying and recording learning with respect to attitudes, skills and abilities. It contains a list of achievement indicators in which the presence or absence of them is verified at a single moment through the performance of the resident.

RESULTS AND DISCUSSION

We started from the reliability analysis of the instrument with a Cronbach's alpha = 0.962 and corroborated it, which according to the literature of many authors, this value is highly reliable.

Table 1 Reliability Test Two-Half Test

Reliability Statistics			
Cronbach's Alpha	Part 1	Value	0,944
		N of Elements	9a
	Part 2	Value	0,952
		N of Elements	9b
	Total Number of Items		18
Correlation Between Forms			0,948
Spearman-Brown coefficient	Equal Length		0,938
	Uneven length		0,938
Guttman's coefficient of two halves			0,949

Note: Result obtained from the SPSS program

Likewise, the analysis was carried out regarding the conditions in which **the Research Skills** are perceived by the university students of the Technical University of Babahoyo.

Figure 1: Situational Status of the Research Skills of University Students in Ecuador. In original language: Spanish

Figure 1 describes the weaknesses found in the development of students' research skills. They stand out in the Observable dimension, it was detected that the observed facts are not described clearly, it is very general and creates confusion, in addition each fact or action to be observed must be part of a planning, which is not evidenced in many cases and also the observed facts must be recorded in order to verify their veracity, there is no record. Regarding the Analytical dimension, it is evident that the events that are observed do not respond to a specific objective to be analyzed, likewise, the analyses on observed facts are not in relation to what is sought to be achieved and also the analyses on observed facts cannot be compared with other related investigations. Regarding the interpretative dimension, it is evident that the interpretation of the observed facts does not express clarity about the results, also many sentences about the interpretation of the observed facts are not concise, they are very extensive and finally the interpretation of the observed facts evidences directed argumentation.

Application of statistical tests for pre-experimental design (Pre and Post)
Presentation of the results obtained in the tests of the development of research skills at the beginning of the program and at the end. It is important to highlight that the application of artificial intelligence was carried out with 40 eighth-level students from the 20 careers of the Technical University of Babahoyo (UTB), which was developed in 12 sessions to strengthen the development of research skills.

Figure 2. The Relationship of Artificial Intelligence to Research Skills. In original language: Spanish

As seen in Figure 2, artificial intelligence (AI) integrates information in a variety of ways, leveraging techniques and algorithms designed to process data and extract meaningful knowledge, simulates knowledge in various ways, using techniques that allow machines to represent, store, and manipulate information in a way that resembles human knowledge, and also uses metadata in various ways to improve data processing and decision-making decision-making. Metadata is data that provides information about other data.

Such a development leads to artificial intelligence being a powerful tool for developing research skills by facilitating data analysis, information search, hypothesis generation, experimental design, and knowledge discovery in a variety of scientific and academic fields

Table 2. Social Skills Development Assessment Scores

N°	DESCRIPTION	SESSIONS		N°	DESCRIPTION	SESSIONS	
		S-1Pre	S-12Post			S-1Pre	S-12Post
1	Student 01	1,30	3,70	21	Student 01	1,30	3,70
2	Student 02	1,10	3,80	22	Student 02	1,10	3,80
3	Student 03	1,60	3,60	23	Student 03	1,60	3,60
4	Student 04	1,10	3,60	24	Student 04	1,10	3,60
5	Student 05	1,80	3,40	25	Student 05	1,80	3,40
6	Student 06	1,80	3,40	26	Student 06	1,80	3,40
7	Student 07	1,50	3,40	27	Student 07	1,50	3,40
8	Student 08	1,70	3,90	28	Student 08	1,70	3,90
9	Student 09	1,10	4,00	29	Student 09	1,10	4,00
10	Student 10	1,30	3,40	30	Student 10	1,30	3,40
11	Student 11	1,30	3,40	31	Student 11	1,30	3,40
12	Student 12	1,50	3,50	32	Student 12	1,50	3,50
13	Student 13	1,40	3,30	33	Student 13	1,40	3,30
14	Student 14	1,50	3,50	34	Student 14	1,50	3,50
15	Student 15	1,30	3,40	35	Student 15	1,30	3,40
16	Student 16	1,60	3,70	36	Student 16	1,60	3,70
17	Student 17	1,50	3,80	37	Student 17	1,50	3,80
18	Student 18	1,80	3,30	38	Student 18	1,80	3,30
19	Student 19	1,10	3,40	39	Student 19	1,10	3,40
20	Student 20	1,30	3,50	40	Student 20	1,30	3,50

Note: Report Cards.
Prepared by: The Authors

Establish the mean and standard deviation differences of the grades in the Pre and Post text comprehension assessments

Table 3. Descriptive Statistics of Pre and Post Tests

Descriptive Statistics

	N	Stocking	Desv. Deviation	Minimal	Maximum
Pre Test Score	40	1,46	0,25	1,10	1,90
Post Test Score	40	3,64	0,22	3,30	4,00

The initial mean was 1.46 points, an average of 1.46 points in the development of research skills, which is considered deficient, and then the final mean was 3.64 points, which is considered optimal, while the average distance in the values (standard deviation) with respect to the central value was initially 0.25 and in the end it was 0.22

These values show that statistically there are significant differences and that they show the relevance of the application of artificial intelligence on the development of research skills, since the qualifying average increases and the differences in deviation decrease.

Apply the Normality Test
This applicability with respect to the normality test allowed us to evidence the internal constitution of the dataset.

Hypothesis Formulation
Ho: The sample follows a normal distribution. $X = N (\mu, \sigma^2)$
H1: The sample does not follow a normal distribution. $X = N (\mu, \sigma^2)$
Decision Rule:
If p-value > 0.05, Ho is accepted; but if p-value <= 0.05 then Ho is rejected and H1 is accepted

Table 4. Normality Test

	Shapiro-Wilk		
	Statistical	Gl	Gis.
Research Skills Assessment - Pre	0,929	40	0,015
Investigative Skills Assessment - Post	0,917	40	0,006

The results of Table 4 show that because the p-value is < to 0.05, the null hypothesis that the samples follow a normal distribution is rejected, and on the other hand, the alternative hypothesis that the samples do not follow a normal distribution is accepted, with which it is established that the data collected from the experiment will be analyzed with the Wilcoxon test.

Applying the Wilcoxon Test
This test posits the following research hypothesis:

The use of playful strategies improves the development of social skills in students.

Hypothesis Formulation
Ho: The use of artificial intelligence does not improve investigative skills. Ho: $\mu1 = \mu2$
H1: The use of artificial intelligence improves investigative skills. H1: $\mu1 < \mu2$

Decision Rule
If p-value > 0.05, Ho is accepted; but if p-value <= 0.05 then Ho is rejected and H1 is accepted

Table 5. Wilcoxon's Signed Rank Test

		N	Average Range	Sum of Ranks
Post Test Score - Pre Test Score	Negative Ranges	0a	0,00	0,00
	Positive Ranges	40b	20,50	820,00
	Draws	0c		
	Total	40		

to. Post Test Score < Pre Test Score
b. Post Test Score > Pre Test Score
c. Post Test Score = Pre Test Score

Table 5 shows that, when evaluating the related samples, it is evident that the established ranges show that all students achieved higher scores in the Post Test than in the Pre-Test, both on the development of investigative skills.

Table 6. Wilcoxon Test

Test Statisticians	
	Post Test Score - Pre Test Score
Z	-5,520B
Asymptotic sig. (bilateral)	0,000

to. Wilcoxon Sign Range Test
b. It is based on negative ranges.

Table 6 shows that when evaluating the related samples, it is evident that the p-value is less than 0.05, so we reject the null hypothesis that the use of artificial intelligence does not improve the development of research skills and accept the alternative hypothesis that statistically shows the relationship that the use of artificial intelligence improves the development of research skills.

CONCLUSIONS.
There is a significant effect when applying artificial intelligence in order to develop the necessary research skills in UTB university students, given that a p-value of less than 0.05 was found in the Wilcoxon test in which it is evidenced that the use of artificial intelligence improves research skills, and notable differences were found between the pre- and post-test evaluations.

It was possible to diagnose the current state of the research skills in the students of the 8th level of university education of the UTB, in relation to the Observable there is a weakness when carrying out this activity, since it is not specific or planned and less registered, in

what concerns the Analytical it presents little objective capacity, There is a weak relationship between the variables studied and limited evidence to make comparisons and with respect to the interpretative point, it is almost null in assertiveness, since the ideas are not clear, in addition the interpretations are very extensive and also evidence directed arguments.

An artificial intelligence design was developed to improve the development of research skills at the UTB, which contributed to strengthening these capacities, it was possible to activate the analytical capacity that makes them sensitive to their context, evidencing clear ideas and generating academic interaction.

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