THE IMPACT OF ARTIFICIAL INTELLIGENCE ON THE DIDACTICS OF DISCIPLINES.

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Abstract.

Artificial Intelligence (AI) has transformed numerous aspects of society, including education. Its application in the didactics of various disciplines has opened new possibilities for enhancing the teaching-learning process by providing advanced tools that can personalize education, heighten accessibility, and offer new ways to interact with knowledge.

It is essential to recognize that the ethical use of AI requires a restructuring of the communicative relationship between teacher and student. This process must establish a shared linguistic and pedagogical framework that enables education, as a dialogical and formative process, rather than merely a transmission of information. The ethical training of those who use it is crucial, making it important to analyze the impact of artificial intelligence on the didactics of disciplines. This will influence how students acquire knowledge and skills, achieving more personalized and effective learning tailored to each student's individual needs. It is vital to understand how artificial intelligence can transform educational processes by providing new teaching and learning opportunities, and to overcome any fear regarding its use by teachers, students, administrators, or parents.

This article aims to explore the impact of artificial intelligence on the teaching of various disciplines and to analyze the advantages and disadvantages of its implementation in the educational field. First, it provides a brief introduction to Artificial Intelligence and its relationship with education. Then, it explores the different approaches and applications of artificial intelligence in teaching specific disciplines. Next, it analyzes the benefits and challenges of its integration in the classrooms. Finally, it presents conclusions regarding the impact of artificial intelligence on the didactics of disciplines.

Keywords: Artificial intelligence, didactics, teaching, advantages, education.

Resumen.

La Inteligencia Artificial (IA) ha transformado numerosos aspectos de la sociedad, y la educación no es una excepción. Su aplicación en la didáctica de diversas disciplinas ha abierto nuevas posibilidades para mejorar el proceso de enseñanza-aprendizaje, proporcionando herramientas avanzadas que pueden personalizar la

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educación, mejorar la accesibilidad y ofrecer nuevas formas de interacción con el conocimiento.

Necesariamente, se debe reconocer que el uso ético de la IA, requiere de la reestructuración de la relación comunicativa entre el profesor y el estudiante, proceso en el cual, debe establecerse un código lingüístico en común, que permita educar, no transmitir información. La formación ética de quien la utiliza del tal manera que es importante analizar el impacto de la inteligencia artificial en la didáctica de las disciplinas, ya que esto influirá en la forma en que los estudiantes adquieren conocimientos y habilidades, para lograr un aprendizaje más personalizado y efectivo, adaptado a las necesidades individuales de cada estudiante, en el cual se reconozca la importancia de comprender cómo la inteligencia artificial puede transformar los procesos educativos, brindando nuevas oportunidades de enseñanza y aprendizaje y no tener mido a la utilización que se haga de ella por parte de profesores, estudiantes, directivos o padres de familia.

Este artículo tiene como propósito explorar el impacto de la inteligencia artificial en la enseñanza de diversas disciplinas, así como analizar las ventajas y desventajas de su implementación en el ámbito educativo, presentando inicialmente una breve introducción a la Inteligencia Artificial y su relación con la educación, para posteriormente abordar los diferentes enfoques y aplicaciones de la inteligencia artificial en la enseñanza de disciplinas específicas y así lograr un análisis de los beneficios y desafíos que conlleva su integración en las aulas y finalmente, se expondrán algunas conclusiones acerca del impacto de la inteligencia artificial en la didáctica de las disciplinas.

Palabras Clave: inteligencia Artificial, didacticas, enseñanza, ventajas, educación.

Didactics and its relation to Artificial Intelligence.

Artificial Intelligence (AI) refers to an activity within the field of Cognitive Sciences that focuses on the study of knowledge acquisition and how this knowledge relates to intelligence. Didactics, on the other hand, is the theoretical domain of Pedagogy that deals with the strategies and models used to make teaching and learning processes effective and productive.

It studies teaching systems from both an internal perspective (analysis of the processes that generate learning) and an external perspective (the social, cultural, and institutional factors surrounding educational institutions). It models comprehension and the ways in which we learn; it prescribes techniques, strategies, and instructional procedures that have positive effects on learning. Fundamentally, it constructs knowledge by means of the analysis, interpretation, and, where possible, generalization of ideas contributed by numerous sciences or diverse disciplines (Mieles Barrera, 2024).

If both fields are compared, their similarities and differences, their limits of application, their potentialities, and their specific contributions, as well as the limitations of their reciprocal contributions, become clear. AI focuses on modeling and creating intelligent artifacts without implementing a specific approach to the problem of teaching. In contrast, didactics is the discipline that focuses on the methods and techniques for teaching and learning in different educational contexts, which allows for the efficient integration of AI into the educational process (Reynosa et al., 2020).

Both fields have often been used inversely: There have been attempts to solve teaching problems by creating artificial subsystems with well-crafted cognitive processes, without understanding education, the theories that explain the educational process, or the didactics used in the communicative process that are consolidated through the practice of didactics. Nowadays, the integration of artificial intelligence into the didactics of disciplines represents a significant challenge for education.

Principles of didactics.

Didactics exist, in part, because people cannot be taught elements in a disorderly form. Besides, they not only need to know things but also how to use and apply them in practice. In other words, it is not only instructional training that is required but also formative training, as Comenius stated in the 17th century in his work Didactica Magna (1638) when he spoke of the need to holistically educate the future young citizen within the bosom of their family and community. In fact, one of the first great pedagogues and didacticists, Jean Pleynet (1499–1558), titled his work: "True and Clear Instruction for Educating Children and Beginners in Morality, No Less Beneficial for Teachers than for Students."

The goal of any discipline or subject is for individuals to learn and understand its complexities, engage in critical reasoning, and develop creativity. Achieving this requires more than the mere accumulation of information. It involves the integration of various dimensions of knowledge. In this context, Bloom's Taxonomy offers a valuable framework, it begins with knowing (the initial level), proceeds with various types of knowing how (observing, applying, analyzing, synthesizing, generating, and behaving in a certain way consistently), and finishes with knowing how to be (the highest level, where both knowing and knowing how have been successfully integrated). Additionally, we must consider the values that arise and act in accordance with them. Above all, we must manage our emotions to achieve this.

The Intersection of Didactics and Artificial Intelligence.

Didactics is defined as a scientific and pedagogical discipline applied in the classroom; thus, pedagogy and didactics maintain a close complementary relationship, although there are significant differences. According to C. Pérez, didactics is: "A distinct discipline with its own characteristics: it focuses on the education of individuals and is particularly concerned with the methods and processes through which learning occurs, and with how to organize teaching resources to achieve greater effectiveness in this co-education, taking into account the intellectual characteristics of the students, the content, and the instructional process as a whole".

From an active-participatory perspective of didactics, the teacher, derived from "docere" (to teach), is the one who teaches but also the one who learns the most in this process of continuous improvement through co-learning with colleagues and students. The term "dicere" refers to the learner, who can take advantage of quality teaching to understand themselves and respond to the ongoing challenges of a constantly changing world.

From this perspective, didactics is a discipline of a pedagogical nature, guided by educational purposes, committed to improving all human beings through the understanding and continuous transformation of socio-communicative processes, with the appropriate adaptation and development of the teaching-learning process.

Artificial Intelligence (AI), that is, the intelligence and techniques of cybernetics, is used to create entities capable of solving problems that require mental activity or manifest within the same paradigm as human beings (Salazar-Reyes et al., 2024). The best current applications of AI are expressed through its ability to support teachers

in planning and reorganizing their actions and facilitating personalized learning. Depending on the various approaches taken throughout the history of pedagogy, there exist different teaching methods, four of which include: responding to the formulation of educational objectives, the content to be taught, the procedures and teaching methods, and the conditions under which teaching will take place.

From the perspective of the contributions that artificial intelligence can make to didactics, the fact that new tutorial systems are intelligent enough to represent learning from an appropriate diegetic perspective will enable their use in a wide variety of learning situations (Niebles Carbonó, 2024).

Current Applications of Artificial Intelligence in Teaching.

The starting point is the following question: Is artificial intelligence useful in teaching? On the one hand, it could be affirmed that it is, as it "assists in the search and selection of information based on the user's actions with relevance and personalization, supports the process of knowledge inquiry, and diagnoses the technological and didactic situation, typically through the explicit representation of knowledge from various domains" (Lara, 2011).

Once a pattern is identified, AI can respond to situations by making decisions. Currently, a range of applications coexist across different educational levels. For example:

1.Puzzles. There are numerous websites such as "mathematical puzzles" (UNED) or "ACERTIJOSPARECEBONITOCOM" that stand out among others, like Antitesis, due to the variety of themes available (matchstick problems, logic problems, some involving ingenuity, some mathematical, interactive activities, easy puzzles, among others).

2. C-PAK (Computer-Based Program for Introduction to Acceleration and Kinematics). It was developed at Texas A&M University and is aimed at university students from various programs related to the scientific and technical branches of agri-food studies.

Ultimately, as will be discussed further later, tools like artificial intelligence pose, in the opinion of the authors of this work, exciting challenges to overcome in their application to the didactics of any discipline. However, on the other hand, the immediacy and personalization they must provide may cause them to "compete" with the true formative "spark" that must be guided by those who lead: the teachers.

3. Intelligent Tutoring Systems.

It has been demonstrated that one of the most effective learning methods with new technologies is the use of Intelligent Systems (I.S). For this to occur, opportunities must be provided through the S4 framework, which is based on the feedback provided by the S.I. Not all S.I. are suitable for generating learning opportunities; only those that utilize the theory of intelligent tutoring, known as Intelligent Tutoring Systems (ITS), are effective. ITS play the role of a human tutor and interact with the student to offer maximum pedagogical support for the development of the learning process within a specific system or environment, adapting to the student's needs and characteristics. Therefore, an ITS consists of two fundamental modules. First, there must be a pedagogical model that helps control the flow of learning, detect problems, and adapt the system to the student. Second, there must be a domain model (Task Model), which encompasses the knowledge about the content to be taught.

The system interprets the student's knowledge through prior experimental validation which determines the meaning attributed to the "signals" obtained through the techniques used in the interface (from verbalization to navigation patterns). Hence, ITS are based on theories such as the study of student models (profiling and monitoring), tutoring models (which organize interventions and thus directly influence the learning flow), and expert systems (due to their tutoring nature and other aspects involving the learner, the system and a shared plan of objectives).

Adaptive Learning Platforms.

Descriptive and predictive analyses from a learning perspective enable the analysis of data related to a specific educational context using various sources (PBL, self-assessment questionnaires, eye-tracking techniques, learning analytics), including both general demographic data (age, gender, score ranges in different disciplines) and highly specific procedural data from the learning process itself. The platform is responsible for conducting an initial descriptive and predictive analysis using different sources, considering two types of methodologies, as data mining techniques are limited if prior data is not available for the design of the hyper-object.

Once information is obtained through a methodology inverse to the traditional paradigm, such as Problem-

Based Learning (PBL), the platform automates and enriches it, analyzing users' procedural records and assisting the tutor in making meaningful inferences about the learning process that would not be feasible through mere observation of classroom behavior. This approach provides the tutor with a richer and deeper understanding of the activities and the learning process itself. Underestimating this approach would be equivalent to disregarding the potential of technology to collect and analyze large amounts of complex information, as well as neglecting the research aspect of learning science through a wide range of techniques associated with adaptive learning, which are abundant in this application.

Benefits and Challenges of Integrating Artificial Intelligence in Didactics.

A study published in the international journal Computers in Human Behavior has explored what teachers know about the pros and cons of this type of work and how their knowledge affects their decision-making regarding the importance of developing students' communicative competence. The data obtained show that 91% are aware of the benefits of implementing these exercises, although 63% are accustomed to using automated tools. However, 81.5% of teachers believe that non-face-to-face quality meetings do not influence students' transversal competencies, and only 10.6% disagree with this statement. In summary, 45.4% of teachers predominantly choose the online format (with a lower teaching load in the blended online modality), 33.6% select the blended online modality, and 21.0% represent teachers who choose only the face-to-face modality for delivering their subjects. No teacher selects the solely blended face-to-face modality.

Research. Instructors spent an average of 5 hours to planning and designing the practice ($M = 5.32$; $SD = 4.44$) and 4 hours to its execution. There was no evidence of a statistically significant effect between the hours dedicated to planning and the results of the evaluated indices. The variety of multimedia resources used had a significant impact ($t = 2.68$; $p = .008$) on the satisfaction shown by students. One of the main conclusions is that teachers rarely use the possibilities offered by AI to consider students' characteristics when designing learning materials, including different responses, recommendations, adaptations, and risk predictions. In this area, the use of information collection and processing techniques by teleodidactic environments for adaptation does not offer advantages beyond traditional study, nor, consequently, for the individualized adaptation of students with learning difficulties or slower learning paces.

Advantages for Students and Teachers.

Officially, a collaboration agreement was signed in 2006 between the Master's Degree in Teacher Training for Secondary Education, Baccalaureate, University, and Compulsory Secondary Education – Specialization in Technology and Computer Science – and the Didactics and Multimedia for Training research group at the University of Santiago de Compostela. These training courses, whether restricted to a specific area of knowledge, such as in this case the didactics of disciplines, or broader, such as the development of knowledge in ICT tools for pedagogical use in the classroom, or even oriented toward the development of research projects from practice, contribute to improving teachers' technological competence.

Out of responsibility, teachers must seek, from the resources available in their context, the tools and methodologies that best suit the specific characteristics of the learners, the subjects and content to be taught, and the family and social contexts. Failing to do so risks undermining the competence in their formative role for future sustainability: obtaining resources through production, adaptation, new uses, or transfer; or not supporting innovation through research jeopardizes the progress of teacher and social improvement. Carrying out activities that promote effective learning and authentic, competency-based assessments, and documenting the results obtained to compare, interpret, and justify the decisions made in planning, implementation, and evaluation for potential external reviewers or future self-assessment, are essential.

Ethical and Privacy Challenges.

Enhancing creativity, autonomy, and so on, as already mentioned in previous sections. In this regard, it is essential not to lose sight of the connection between technology, teaching practices, and shared ethical values. For instance, it presents an ethical challenge to address the longstanding dilemma of how intrusive profiling students' academic paths should be, while ensuring the right to privacy and the protection of personal information.

Under no circumstances should guiding students toward a particular discipline become an irrational obsession with knowledge. As the director of the Media Lab at the Massachusetts Institute of Technology points out, despite the proliferation of devices capable of recording and analyzing all kinds of data, it remains a pedagogical challenge to respect students' timing and learning pace. An excessive obsession with mapping a student's academic trajectory based solely on the quantitative aspects of their progress may lead to neglecting the importance of active learning—an activity carried out independently by the student, in which he or she decides not only when to undertake the task, but also how and with what resources to do so. Likewise, trying to exploit digital media for the sake of maximizing the planning, execution, and dissemination of knowledge without considering the necessary requirements can be counterproductive.

Models and Strategies for the Successful Implementation of Artificial Intelligence in Education.

Once the stakeholders involved in the process have been identified, a diagnostic has been conducted, and a theoretical model has been defined to guide the implementation of artificial intelligence in the teaching-learning process of a particular discipline, it becomes necessary to establish a series of strategies for AI development as proposed by Ray McAleer. These include automatically generating statements based on a set of axioms, rules, and facts; deducing results from those statements; and transforming the results in ways that can be directly or indirectly applied in building the Tutorial System. This involves domain modeling and selecting and implementing pedagogical and didactic decisions. The model is based on implementing a process of anticipation regarding each learner's knowledge and, at the same time, consists of three components:

Thus, the use of an Expert System (known as ES) enables the construction of knowledge repositories that have become the standard systems for developing expert applications across various technical domains. The exponential growth of mobile and portable devices in the educational field allows for the use of different types of devices that can utilize artificial intelligence in education. Allowing students to use the device they prefer helps them feel more "comfortable" when engaging in adaptive artificial intelligence processes. University selection systems, for instance, serve as a good example of current trends and types of applications. However, despite the development of AI applied to education, there are still very few projects that make use of this technology.

Legal and Political Framework.

The right of individuals to be educated encompasses two essential subjects: the individual and society. The freedom to teach and to learn (Art. 27, UNESCO) is preserved as a true guarantee of pluralism in both public and private education, while also ensuring respect and dignity for both teachers and students. UNESCO states that AI must be oriented toward empowering individuals and conscious groups, supporting a human-centered education.

Objectives, principles, and commitments of the academic community with the General Curricular Guidelines (CGU), the curriculum, and author programs. The CGU aim to ensure that the University Community is competent and aware of its social function. The university facilitates access to information and promotes critical reflection on the scientific, humanistic, political, social, and economic environment. AI is applied to the Community Commitment Charter (ACG), which is supported politically by the Governing Council and technically by the Rectorate. This includes the organized transition of the entire infrastructure to a selected teaching mode, chosen through informed decision-making. Theoretical foundations and a possible process design must be assessable, considering goals and, where applicable, principles for managing supervised practices, continuous assessments, reflections, and reports.

1. Background and research experiences in the use of artificial intelligence in early educational areas: – Content semanticization, prediction algorithms, and decision-making in e-learning projects.

2. Sufrescuela: A system for prediction and automation of online didactic resources.

3. SCALA: A system for the approximation of educational resources on the web.

4. PASO: Predictive and assistive interpretation of student interactions in an automated manner.

5. Aula-Esfera: A formal descriptive environment for the CLUSTER LMS.

6. Analysis of international scientific literature on the use of artificial intelligence in teaching.

7. The Use of AI and Teachers: More than Just Techniques – Disciplinary Challenges and Passions.

8. A Specific University Context: InterAmerican Open University – A Total of 39 Steps! – Didactic supports for preparing flipped face-to-face classes!

Teacher Training in the Use of AI Tools.

The current gap in AI education between data science professionals and teachers worldwide highlights the need to support and enhance existing specialists while also encouraging the formation of new teams. At the same time, efforts must contribute to the development and strengthening of methodological and attitudinal professional skills related to addressing issues from diverse contexts. This allows students to develop research skills, both within their specific discipline and in related areas tied to their professional performance.

It has been observed that students are beginning to include the term "artificial intelligence" in their project reports. This situation should prompt reflection among teachers and course organizers in several directions. Among these: Do students really understand what they mean by that expression? Will the discipline (or at least some of its core themes) actually benefit their current training, or is it merely a passing trend that, like all trends, will eventually fade? Does it create "false expectations" about the professional realities they will face? And if they choose to research a particular technology—or the digitization of scientific thinking—will it be useful to them, even if that technology is already considered outdated?

Research and Future Trends in the Application of Artificial Intelligence in Teaching.

Another noteworthy study was conducted by Banjare and Malik (2017), who identified a total of 32 tools, all highly useful, including various Google tools and extensions, such as Formative. Other emerging trends in the application of AI in education highlight cognitive technologies, some of which are already in use across diverse fields.

Generalized cognitive methods began to take shape in the late 1950s, originating from work linked systems for (cognitive) instruction. This approach led to the creation of cognitive machines such as THEMIS, EHE, JEIDA, and WEI—all derived from US Cortex to simulate the human "smooth cortex"—and Helios I and II, which aimed to simulate the "highly versatile stratified cortex" (coactive intelligence). The design of these replicating systems with a specific emphasis must simultaneously consider analytical, empirical, ethical-aesthetic aspects, as well as collaboration and the necessary processes.

The future of education presents itself as a complex scenario with challenges that have acquired an innovative dimension due to the outbreak of the digital revolution within the Knowledge Society. All of this demands a shift in the current ways of teaching and learning. Critical pedagogical theory brings us closer to new educational keys. Advancements in specific disciplines, the development of computer science, and the emergence of robotics and so-called artificial intelligence are moving us toward complex and unpredictable contexts.

These new approaches to the teaching-learning process require changes in planning methodologies, design, and implementation of educational actions, in teacher training, in staff qualifications, in school organization and leadership, and in educational-social coordination, interaction, and collaboration in a globalized context. Recognizing the potential of these scenarios and the role of the post-Fordist educator, where tradition remains predominant in formative contexts, and belief in oneself and the allure of tradition (problem, discipline, theory, method) persists, is essential. An analysis of the pedagogical dimension reveals the need to break away from the approach traditionally associated with Educational Technology.

Studies on Effectiveness and Efficiency.

Garzón, M.C. (2008) presents a review of teaching practices by educators in a study of ethnographic and micro sociological nature, focusing on the integration of ICT (Information and Communication Technologies). She highlights the following teaching actions: encouraging, guiding, and sustaining students' interest until specific objectives are met; making content explicit and "solidifying" it through ICT to enhance understanding and learning; provoking and guiding student work through ICT; supporting and enriching learning both during and after the use of ICT; conveying content and economically assessing students' technical skills with computers—particularly as reflected in participants' perceptions of the computer, the student, and the teacher.

According to Choi (2003), the presence of a virtual tutor brought significant benefits in terms of academic performance, perceived social support, and satisfaction

outcomes. These positive impacts of virtual tutoring were especially pronounced in terms of effectiveness and efficiency for students with dual family and professional responsibilities—making the results particularly meaningful for such groups. Learning objects can enhance learning efficiency by providing students access to essential and basic content information (Valdivia, 2006), and by enabling more efficient acquisition of algorithms and data (Friedman, 2005).

Guitert Gené, M., Romero Lastra, B., et al. (2008) conducted a study to analyze whether the efficiency and effectiveness of autonomous learning in the subject Psychopedagogical Intervention could be improved in different contexts through two types of videos: one with a human speaker in front of a static background (Experimental Condition, EC) and another with a narrator giving the same explanations but without a human presence (Control Condition, CC).

Emerging Technological Developments.

Today, we see a rapid shift in how we understand technologies and their impact on professional tasks related to education. This change is clearly reflected in how mobile devices are transforming our habits. Industry professionals have labeled this trend a point of no return, where mobile computing is replacing tasks that were previously carried out on desktop PCs. Coupled with advances in the manufacturing and sale of increasingly sophisticated and energy-efficient devices, this shift is creating challenges for traditional desktop computers.

This document explores the emerging market of ed-tech designed to enhance education across different levels. While there is a history of technology entering education, this study moves away from the traditional flipped classroom model and instead focuses on the rise of Massive Open Online Courses (MOOC) and the development of adaptive learning. It takes into account the broader educational process and the technologies involved.

If today's mobile devices are to offer new learning experiences (where learning is defined as a behavioral change achieved through a set of structured activities and memories stored in long-term memory), as desktop computers once did, then techniques must be developed to enable machines to observe, emulate, and enhance learning. One approach to create a MOOC within a reasonable timeframe is to use computing techniques or intelligent systems, as well as participatory computational intelligence from the community.

CONCLUSIONS.

1. The teacher's expertise in the subject area under study is essential to ensure that educational process remains relevant and grounded in the specific context of the discipline.

2. Disciplinary micro-curricular structuring enables the teacher to bring into their teaching practice the object of study for which they are academically prepared, along with empirical, epistemological, theoretical, and methodological elements to propose a relevant and coherent instructional approach.

3. Pedagogical micro-curricular structuring provides the teacher with the "how" of teaching. This requires grounding their professional practice in a pedagogical theory that allows for understanding the educational act, a didactic method that enables assertive communication within the classroom, and didactic techniques to foster student interaction and the collective construction of learning environments.

4. Artificial intelligence must have a meaningful role in educational practice, with the teacher deciding what type of AI to use, when to use it, and for what purpose, ensuring that grasp the significance of AI in shaping their own learning process.

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