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The Use of Artificial Intelligence in University Classrooms: The Case of the Bachelor's Degree in Mathematics and the Bachelor's Degree in Arts at the Popular University of Cesar

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This article presents the analysis of the results of the research proposed by teachers and students of the Bachelor's Degrees in Mathematics and Art of the Popular University of Cesar, which had as its main objective to analyze the impact of the use of artificial intelligence in the classes of these two programs. Using a mixed method for the collection and analysis of information, it was possible to determine that artificial intelligence has been implemented to facilitate the teaching processes oriented to two academic programs of the Popular University of Cesar. First, for the Bachelor's Degree in Mathematics, providing an adaptable multimedia environment that provides possibilities for immediate feedback to the student and, at the same time, provides reports aimed at the teacher and the designer. Likewise, in the development of the Virtual Educational Environments workshop course, a subject that belongs to the curriculum of the Bachelor of Musical Arts, an environment is provided that favors the integration of elements to promote significant learning.

1. Introduction

Artificial intelligence (AI) is here to stay. The application of AI in education is one of the trends that is advancing by leaps and bounds thanks to its many benefits. Just as AI has already revolutionized other spheres, intelligent tools and systems are beginning to be introduced in different educational settings, from kindergarten to the university level. When we talk about AI in education, we refer to systems that allow us to analyze the behavior of students in a certain environment to offer them a specifically personalized learning experience. The study of AI leads us to learn about intelligent systems, the use of natural language, computer vision, machine learning, fuzzy logic, neural networks or optimization techniques, among others (Talamilla et al. 2022). Knowing these and sother equally relevant concepts means that

educators approach a series of very specific and specialized concepts that must always be mediated. However, if there is one thing that characterizes the use of the computer in the educational environment, it is that it simplifies all the computational learning effort necessary to carry out the task. In fact, there are a multitude of educational systems and platforms in which the use of bio-inspired techniques offers the teacher tools capable of emulating the tutelary role, both educational and social, of the teacher. It is also interesting to know that within the field of education and research there are fields of great interest. Some of them are the development of techniques based on the movement of bio-inspired principles, as well as new paradigms in machine learning.

2. Background and evolution of artificial intelligence in education

It has been notorious that in the last century, the use of information and communication technologies (ICT) has increased in the educational environment (Olivera and Rosell, 2023). An example of this improvement is the use of the Internet as a consultation tool, more specifically the use of a web search engine. Nowadays, the weight of the student body has changed due to digital resources, which has led to the creation of e-learning, b-learning and m-learning learning environments. Among them are blogs, wikis, podcasts, multimedia channels, among others, for example, the electronic textbook that makes available to the student; digital objects that can be viewed by other students, access to a repository of resources or immediate ease of answering searches with products stored on the network.

The report on learning technologies points out that "there is no precedent for the impact of information and communication technologies on teaching-learning processes", that although "most institutions have not only incorporated e-learning into their educational offer, in its different modalities presented, they are also using ICT in the programming of face-to-face activities" (Armas-Alba and Alonso-Rodríguez2022). The same publication points out that "in the last decade, formal and non-formal education institutions, ranging from primary schools to international organizations, have become interested in the development and extension of these intelligent systems. In the training opportunities that have taken place (courses, seminars), numerous interesting technical solutions based on artificial intelligence have been experimented with. All this has motivated computer science researchers, as well as pedagogues, to be interested in the so-called 'intelligent tutoring systems'. As we have noted, interest in research in this area of artificial intelligence dates back a long time, although it is in the last two decades that specific tutoring systems based on these techniques have appeared.

3. Applications of artificial intelligence in university education

Next, some applications of artificial intelligence in the field of university education will be presented. The evolution of higher-order teaching in higher education is warned: the approaches associated with experiential, conceptual, contextual, and strategic learning have as a correlate the classic AOA method and problem-based learning (Paredes-Chacín and Vargas-López, 2024). The learning (individual and collective) that would be accessible in the future with the help of AI will enable individual students, as well as those who learn in small groups, advanced learning training techniques, allowing the associated knowledge structures to be

fixed.

Memorizing some of the experiences to which others have had access does not contain information about all the practical experiences of teachers in the development of a specific part of the subject, which could well be used in future teaching actions. Memory generally improves performance at a physical and technical level. This also improves strategic knowledge structures. Among other aspects, AI makes it possible to develop more complex knowledge structures through access to a wide variety of materials, collaborating to adapt them to the profile of each student; facilitate the creation and incorporation of new resources.

3.1. Applications in the Bachelor's Degree in Mathematics

The most interesting application in information management is through COMPASS. Undoubtedly, among these possible applications, the implementation of virtualized laboratories stands out, through a tool that has been developed to efficiently handle all the information related to the simulation of mathematical and logical algorithms from a wide variety of areas of interest, including: linear algebra, nonlinear analysis, Boolean algebra, calculus, and others (Mera-Menéndez & López-González, 2023). These consider the various studies in statistics, pure mathematics and numeracy involved in the curriculum and the field of work of the future professionals of the program.

With this application, the teacher will be able to develop simulation workshops with the students, so that they can be in charge of modifying the pre-designed mathematical problems. There will be a cascade of possible variations of the problem and students will be able to autonomously establish the characteristics of certain parameters in the algorithms studied and explain the consequences of their changes. The use of the tool in the compulsory courses of the programme will be framed within ICT and the Internet. Technologies, through which the student will develop skills for the management, search, use and transformation of information, through access and appropriate use of different sources of information such as libraries, books, the Internet, databases and other virtual environments.

3.2. Applications in the Bachelor of Arts

This points to the need to carry out meaningful tasks that motivate the acquisition of flexible, autonomous, collaborative and meaningful learning. Therefore, formal intelligence and similarity reasoning are the main cognitive strategies in cognitive multimedia that involve awareness, intentionality, control, and voluntary application. Many times, logical reasoned thinking and formal strategies have complementary involvement, and formal logical reasoned strategies are used to understand and know problems with certainty. Therefore, interactive animations can play an important role in presenting and describing phenomena, bodies and physical mechanisms with an impressive "digital reality", increasing the student's possibilities to acquire and generalize knowledge. On the other hand, multimedia technologies play a cutting-edge role in the art world and entail substantial changes in the processes of production and dissemination of works (Rossetti, 2021). This also affects the processes of teaching and learning art, given that the different artistic languages undergo constant evolution. The use of multimedia in the field of artistic productions does not simply mean adding technological supports to existing ones; Many production strategies, languages and habits, in addition to the attitudes and values of the agents involved in them, cause changes in the symbolic, social and

cultural field of art, regardless of whether these productions are proposed by artists, designers, publicists, filmmakers, musicians, dancers or publishers.

4. Benefits and challenges of using artificial intelligence in university classrooms

As benefits, the implementation of artificial intelligence could not only automate the teaching-learning processes, but also adapt to the particularities of each student in order to provide higher quality instruction (Ronquillo et al., 2023). Likewise, the system could assume the role of guide for the teaching-learning process and let knowledge be built from the manipulation and interaction. Likewise, the personalization of the system based on the preferences of the students makes them motivated to continue learning. The use of artificial intelligence in the teaching-learning processes in mathematics could contribute to the student in the active construction of their knowledge, taking advantage of the potential that artificial intelligence offers. In addition, it would also reduce the stress inherent in learning it, gaining confidence and improving academic performance. Artificial intelligence systems offer continuous learning beyond the course, which favors the well-known extinction, divergence. On the other hand, the adaptive learning system by achieving continuous learning will allow the student to accumulate points, medals, bonuses, etc., which make learning more enjoyable through the so-called game mechanics.

As challenges, adapting to change always represents a challenge for educational institutions. And the ability to modify in the face of the new needs for continuous training of students and the evolution of knowledge and technologies. Teachers are required to be able to adapt to the continuous changes inherent in the advances of this discipline. The contributions that AI can have in the classroom will depend on the ability of trainers to adapt and use these tools. Another challenge that AI will encounter is overcoming its own limitations, mainly related to the arrival of thought or its faithful ally, consciousness. Despite the advancement of AI, there is currently no machine that possesses consciousness. Even if it is a single machine, which is capable of affirming without any doubt or concern that its feet are burning, we would already have a monstrous Hamletian nebula in the hands of psychologists.

5. Implementation of artificial intelligence in the bachelor's degree in mathematics

Artificial intelligence has been implemented through the use of the learning platform and the corresponding LMS. To this end, in the reverse class subject, real, effective and face-to-face work in the classroom and at the student's home, which requires time and intensity in the implementation of previous activities for the achievement of learning, is carried out through some ICTs, including the platform. Likewise, the advancement of the organization of education has served. In developed nations, typical examples in the use and application of ICTs, such facts and the development of artificial intelligence and deep learning, benefit the challenges of massification due to the diversity of providers, internal regulation, national diversity, the export of academic programs and the great diversity of audiences. So, ironically, the arrival of information and communication to organizations and families occurs for the processing of information and communication, an extreme that is palpable in the classrooms.

The learning platform is free and easy to access for users, which has several features and

functionalities, among which it has tools that allow the creation and organization of tasks and homework; the review by the teacher of the different activities of the students and, finally, the grading and sending of feedback on the work developed. Likewise, the LMS corresponds to a pedagogical tool that facilitates the management of the teaching and learning process, allowing the teacher to create, design, customize and manage their own content, and the student to access them to carry out their academic activities according to their own pace.

5.1. Curriculum design and innovative content

Currently, work with artificial intelligence that goes beyond the mere use of software by doing statistical processing is still practically non-existent in the Hispanic context, especially in teacher training programs (Campo Campo & Vélez Carmona, 2024). However, for the application of methods, languages, techniques and instruments of Knowledge Engineering, Development of Knowledge-Based Systems and Signal Analysis, 3 out of 4 subjects are taken. Based on its importance and versatility in the context of our studies and the increasingly clear growing trend to apply artificial intelligence techniques to problems in the textual field, it is proposed that future graduates in Art have an adequate level in the management of this type of techniques through the introduction, among others, natural language processing.

Within this subject, the importance of artificial intelligence in the creation and development of educational content will be studied using artificial intelligence techniques adapted to e-learning environments. The subject will introduce and study the theory associated with expert systems through internships and the validation of components to create planned, visual, intelligent, diagnostic, designer, predictive artificial intelligence systems, etc.

5.2. Technological tools and resources used

This analysis will be carried out in the context of university classrooms, where the application of artificial intelligence techniques has become a topic of increasing relevance. Based on the computational results obtained through various technological tools, it is proposed that this integration could represent a significant improvement in the quality of higher education. This study is based on an instructional design that, in certain cases, adapts to what is established in the Didactic Unit Plans of the different disciplines that make up the academic programs. The discussions generated in this area are classified into four categories: (a) in relation to geometric algorithms, as is the case of overdetermination, focusing particularly on the analysis of the Dirichlet-Voronoi model; (b) the historical argumentation that is used to introduce the motto of duality, which is fundamental in the development of critical thinking; (c) the critique of forms, addressing this aspect from the perspective of first-year students, who face the complexity of learning; and (d) the clarification of theorems and basic concepts that are essential both in the first year of training and in the two academic paths that are offered, aligned with the occupational interests of the students. This comprehensive approach will allow not only a better understanding of the topics covered, but also a deep reflection on the way in which artificial intelligence can transform and enrich the educational process at the university.

This exhibition will be held at the Popular University of Cesar, specifically in the laboratory of new technologies in mathematics, where tools and technological resources are available for the area of Basic Mathematics, covering subjects such as Algebra, Geometry and Trigonometry. Additionally, virtual classes are offered in disciplines that include Differential

Calculus, Integral Calculus, Vector Calculus, Differential Equations, Mechanics, Stability and Resistance of Materials, Numerical Methods, as well as laboratories in Electrical Systems. This Center also incorporates interactive activities that complement the exercise guides of the various disciplines. It is important to note that a diagnosis of the entry competencies in Basic Mathematics is carried out for each UPC student, who, for the most part, have very deficient competencies and, in turn, do not attend the workshops in a considerable percentage (Guerrero Celis & Yrigoyen Fajardo..., 2022). This situation highlights the need to implement strategies that encourage greater involvement and improvement in student learning.

5.3. Results and impact assessment

The work has had a relevant impact, especially with regard to the following aspects:

The work efficiency rate is 75%. Of the 73 students who completed their studies, 55 met the performance indicators established by the model (within this average, the green flags stand out in the courses with 100% of the students). In the case of PEC2, an average of 80% was achieved. In the PEC3 course, 75% and in the PEC5, 68%. Desertion, the short time for the analysis of the results of the work and the implementation of the model due to the high turnover of teachers and the inability to give it continuity, were the main difficulties.

The training strategy has had a positive impact and has decreased the failure rates, which ranged between 10% and 37%, decreasing them to 7.5%, 5.4%, 9.7%, 10.9% and 9.7% respectively in the 5 courses; This is an environment conducive to telematic training. There has been a greater interest on the part of students in the subject. Pedagogical improvement has been made by having a virtual training platform and the training and learning processes have been successfully adapted to the blended learning modality.

Therefore, as in the different pedagogical spaces, the virtual training model as a didactic tool in virtual education goes beyond the use of technology itself; its feasibility lies in the possibility offered by the educational environment not only for the incorporation of technological elements, but also for their appropriation by the teacher in the sense of inserting it as a proactive element in decision-making in favor of the teaching work itself, allowing the creation of new scenarios and pedagogical processes that motivate and enrich their work (Vivar and Dominici, 2022).

6. Implementing Artificial Intelligence in the Bachelor of Arts

This UPC Arts proposal is aimed at mitigating the dropout rates and academic failure that have been evidenced in the field of education of this degree, through a transformation in the methodology for addressing learning difficulties. This will be achieved through a significant impact on the training of teachers linked to this discipline. In this sense, artificial intelligence has been incorporated into the academic curriculum, with the purpose of revitalizing training processes. Consequently, the Statistics II Course is offered, whose fundamental purpose is to investigate methodologies that facilitate the exploration, description, inference and prediction from a set of data. The first module of the course focuses on the field of Machine Learning, allowing students to: - Gain an in-depth understanding of the key concepts of machine learning and their real-world applications. - Develop Machine Learning algorithms from their mathematical foundations, thus reinforcing their skills in computational mathematics. -

Implement Machine Learning algorithms using the most advanced and recognized libraries in the field. - Perform effective evaluations of Machine Learning models. Likewise, future Bachelors of Arts incorporate didactic engineering, proposing that the teaching of mathematics, far from being a repetitive and monotonous process, can be transformed through creativity and innovation in the design of activities. For this reason, it is imperative to integrate artificial intelligence into the Bachelor of Arts, with the aim of optimizing the learning of curricular content that complements teacher training. This integration seeks to store and organize information that is available to the user, with the vision of establishing expert systems in the future that allow the student to evidence their process of apprehending new knowledge, subsequently applying this knowledge in the didactic and pedagogical planning of their educational environment (Narváez Orellana, 2024).

6.1. Curricular design and innovative content

The curricular structures of the mathematics and arts programs of the Popular University of Cesar were based on the concepts of real mathematical functions, art and literature, as fundamental areas of their discipline, for the design of the contents; as well as with a theoretical-practical orientation by areas, for methodological designs. Emphasis is placed on the incorporation of contextual issues, when intervening with problems of national or international realities in some subjects, compatible with the application of ICT and computer science, when starting training in computer technologies, applying various artistic-literary techniques through specialized programs and software. The general purpose of the use of artificial intelligence contributes to the strengthening of the teaching-learning process that leads to the integral development of students and their training as recursive professionals, which implies education in the solution of systems and problems with the purpose of making them competent to perform effectively in situations that arise in academic scenarios. social, cultural, and labor in the world of training (Solís et al.2023). In accordance with the need to establish general criteria and orientations on the various guidelines and orientations proposed for undergraduate programs in Colombia, this document that reveals the articulation of artificial intelligence in university education, taking into account that our university is oriented towards learning processes centered on the student and their training needs that result in the improvement of their intellectual capital, social, economic and cultural in favor of a more just and inclusive society in the West.

6.2. Technological tools and resources used

Technological resources. At our university there is a technological platform that works with a static database and that only allows teachers to upload and download information in it, so that the student could only download in the virtual spaces of each subject, notifying students of the messaging assignments about the content of each subject. It does not have forums to develop academic exercises that can generate discussion and exchange of information. Nor does it include communicative or intermediation elements that allow connecting with the symbolic, cultural and historical realities of the territory in which the students find themselves.

Tools. Similarly, numerical calculation tools appear as a key element for the student to make use of them and discover their qualities; in short, to approach such a symbolic reality (Ynga Moreno, 2023). Symbolic calculation software is used to perform some exercises. In order to improve the development of the training work that we carry out in the process, we tried to

provide the degree with a virtual laboratory to develop them, using the platform for the development of an exercise in the tool. Since it does not have laboratories for the development of teaching content, technological tools were integrated to carry out experiments that would allow the development of academic content that a real laboratory can offer.

6.3. Results and impact assessment

Regarding the results and impact evaluation, and taking into account the nature of the subjects and the structure of the programs, we have focused the question on three aspects: the grade obtained by the students, the design, we compared the students who achieved the approval of the courses and, finally, we inquired in a more general way if the learning acquired after passing the exam of each unit was worthwhile. The results are presented below. According to the information generated in the execution stage of the validation of the effect of the artificial intelligence scheme on academic performance in mathematics, 14 students homologated the intensities of basic academic training of Mathematics 1 in the mathematics degree. Their performance automatically improved in relation to the performance in introduction to university mathematics that they took in the first semester of 2022. This was demonstrated by the fact that the weighted average of 16 of the students who validated the scheme increased from 3.07 in 2017 to 3.47 in 2023. As shown by the results achieved.

In the current stage of formative development that is being reviewed, based on the application of the instructional design methodology, including virtual tutoring and the intelligent pattern recognition tool of the research seminar, a follow-up and monitoring of the contributions and pedagogical impact will be carried out. For the Mathematics 1 course for future arts graduates, the methodology was evident, pertinent and effective. The use of artificial intelligence schema software, which included clear pedagogical activities and entertaining activities, gave the student more autonomy, making it possible for him to learn at his own pace, appreciate the subject more and understand the activities to be carried out and the thematic units.

7. Comparison of the results between the two bachelor's degrees

Finally, in this section a comparison is made between the results obtained by the students of Mathematics and those of Arts, with the aim of identifying the difference between these two groups and, therefore, the effect of technological applications on the results. To make the comparison, it was decided to use a tool that performs a multigroup analysis using the Least Squares algorithm (Soriano and Mejía-Trejo2022).

It shows the subgroup comparisons of the weight values for each hypothesis in a fully graphed manner, visually comparing a subgroup with the average of all the values in the set. Some differences between the groups are significant. It shows some interesting differences between its subgroups. Education in Bogotá presents statistically significant differences with respect to the other regions that present variances in favor of the rest of the cities due to the use of FI and AI. Private education represents a statistically significant advantage over others in terms of the use of FI. The effect size of the tests of variance was small.

Regarding belonging to Group A or B, it is found that the expected difference is found in Group A, obtaining greater weight in both factors, which leads to perceiving a difference against Group B. The differences are significant for FI, against which Group A exceeds the

weight of Group B by more than 23%; it is also the only variable except for the IF that shows higher averages in relative terms for Group A, which obtains an average index of 74% and Group B, as usual in all, an average between 0.05 and 0.07.

8. Ethical and legal considerations in the use of artificial intelligence in university education

In Colombia, the Popular University of Cesar, in fulfillment of its institutional mission, serves a high number of both undergraduate and graduate students and in most cases under the modality of face-to-face education. In recent years, the university has focused on the implementation of technologies for learning and knowledge and has adopted various technological resources that seek to improve the teaching-learning process and that are coupled with an educational innovation policy. Such is the case of the research project using artificial intelligence in the design of learning environments. The interest of the Popular University of Cesar in the articulation of artificial intelligence software in the virtual classroom leads to consider, from an ethical point of view, the implications that they may have on the teacher-student-collaborator relationship in the formulation and development of a course in CAT, where the ubiquity of the materials challenges the pedagogical and guiding mediation of the teacher or tutor in the personalized follow-up of students. particularly those with weak autonomy or who express the need for frequent interaction with the teacher.

What is the ethical consideration required by academic institutions in their involvement in the research of companies that develop software and artificial intelligence systems in the education sector? What are the legal implications of the adoption of guide programs aimed at the training of subjects in academic institutions? These are questions that will be dealt with in this reflection essay. First, I will start from the axiological dimension of education to contrast with issues related to ethical conciliation both corporate, starting from what type of alliance is strategic for the firm, with the implications and responsibility in the training of future professionals that the academic institution assumes. I will highlight the challenges in the education sector that the implementation of artificial intelligence and education can pose and its effects on the degree of professionalism of the actors involved: tutors, students and developers in the face of the commodification of knowledge.

9. Conclusions and recommendations for future implementations

Conclusions This research shows the way in which artificial intelligence has been implemented to facilitate the teaching processes oriented to two academic programs of the Popular University of Cesar. First, for the Bachelor's Degree in Mathematics, providing an adaptable multimedia environment that provides possibilities for immediate feedback to the student and, at the same time, provides reports aimed at the teacher and the designer. Likewise, in the development of the Virtual Educational Environments workshop course, a subject that belongs to the curricular mesh of the Bachelor of Musical Arts, an environment is provided that favors the integration of elements to promote meaningful learning. The admission of students to the Popular University of Cesar does not always reflect a good management of basic mathematical skills, according to the national and international external measurement

that is taken. If it is taken into account that the university is a source for society of future professionals, with the implementation of the VLE in courses related to Mathematics it is expected to contribute to the process of promoting teaching activities that allow a significant learning of Mathematics, favor the development of forms of autonomous and independent work and produce changes in the approach of teachers and students from an innovative approach. mediated by the computer in virtual learning environments. For this reason, teachers who are interested in improving their teaching practice are obliged to build types of activities and tasks from a pedagogical-didactic base called the virtual educational environment. Recommendations for future implementations In the future, it would be advisable to review the incentive with some type of bonus for UPC teachers. to insert didactic catalogs as a slogan in the vacation space; until the Directorate of Research and Innovation has sufficient resources for this.

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