Educación y sociedad
ISSN: 1811-9034 RNPS: 2073
Vol. 23, No. 3, septiembre-diciembre (2025)

The educational context 2.0 of Artificial Intelligence as a systemic activity; case of Mathematical Analysis

El contexto educativo 2.0 de la Inteligencia Artificial como actividad sistémica; caso del Análisis Matemático

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Abstract

This article shows that the educational context, within the university environment, is the starting point 2.0. As much as technology delimits precepts within the current academic society and cultural paradigms are changing within the pedagogical universe. Therefore, the educational contribution offered by Artificial Intelligence within the academy is plausible; helping every student who needs information and is not divisive with the Big Data process. Obviously that the interactivity of Digital Technological Massification escorts. For which, Mathematical Analysis, as a systemic activity, is not discarded and is a guarantee for the teaching-learning process. Much more, if, in an intelligent way, it is worked in the virtual environment and it is applied in subtle platforms; such as Wolfram Alpha. This is when collaborative typographic writing, in the composition of LaTeX type texts, becomes present and resizes Higher Education.

Artículo de investigación derivado del proceso de formación académica
Recibido: 06/04/2025 – Aceptado: 25/06/2025 – Publicado: 26/12/2025

Keywords: artificial intelligence, digitalization, education, internet, mathematics

Resumen

En este artículo se denota que el contexto educativo, dentro del ámbito universitario, es el punto de partida 2.0. Tanto cuanto, la tecnología delimite preceptos dentro de la sociedad académica actual y los paradigmas culturales sean cambiantes dentro del universo pedagógico. Por ende, es plausible el aporte educacional que ofrece la Inteligencia Artificial dentro de la academia; auxiliando a todo estudiante que necesite de información y no sea divisoria con el proceso del Big Data. Obviamente, que la interactividad de la Masificación Tecnológica Digital acompañe. Para lo cual, el Análisis Matemático, como actividad sistémica, no sea descartable y sea una garantía para el proceso de la enseñanza-aprendizaje; Mucho más, si, de manera inteligente, se trabaja en el entorno virtual y se lo aplica en plataformas sutiles; caso Wolfram Alpha. Entonces, es cuando la escritura tipográfica colaborativa, en composición de textos tipo LaTeX, se hace presente y redimensiona a la Educación Superior.

Palabras clave: digitalización, educación, inteligencia artificial, internet, matemáticas

Introduction

Digital technological advancement has introduced relevant changes in today's educational society; much more so, if cultural paradigms have been configured. Therefore, the arrival of the World Wide Web (WWW) changes student behavior and focuses on non-stochastic indicators. That is, the digitalization process opens paths to produce, distribute and use data for the evolution of the virtual environment 2.0; increasing the level of interactivity with the Internet and providing participation with critical thinking. Noting that this context does not disturb communication, knowledge or social interaction.

Which stimulates changes in the educational environment, its protagonists are transfigured and conjecture challenges for new training. But, for this, "...in the society in which we live, there are areas for virtual disconnection and in this, for the better, educational institutions are affected; but if they do not offer obstinacy" (Visvalingam et al., 2023, p. 18698). However, certain communities examine appropriate ways to face this challenge and thus, the technological perimeter ratifies cooperative work. It is in this way that paradigms supporting learning

based on 2.0 characteristics are developed; which causes innovation. It is here then, that, on the Internet, platforms emerge where techniques for technological drag are deployed and it is feasible to outline new strategies; above all, to obtain cybernetic concepts. At that time, the academic progress achieved by the Exact Sciences, as Mathematical Analysis, is accentuated by the contribution of Artificial Intelligence (AI) in routine tasks. That is to say, that the universe of Educational Administration, based on the massiveness of data, projects knowledge; as much as it fits its trajectories as achievable characteristics. Indistinctly, when addressing intelligent policies, it is the moment in which digital instruction perpetuates fear of AI and this amount of information, being immense, contributes to the ethics of systems based on Big Data; much more, so if there is no foresight in systemic activity and it is discarded.

But, for this, "…the AI has become a dissimilar expression, being accommodated to social distrust, due to the Digital Technological Massification; above all, in the pedagogical field of the present decade" (Yigitcanlar et al., 2024, p. 168). Remembering that Information Systems (IS) program ideals, as archetypes, by experiencing tasks that futurize competencies and put at risk the jobs of any social entity that does not adapt to this revolution. Much worse, if prototypes that, long ago, were science fiction, are not resized.

Development

In the course of this millennium, specifically in this quarter of a century, the educational society merges technological inventions with the challenges of the scientific universe. This is when failures are predicted when remembering failed mishaps; such as, virtual panoramas that were not nuanced when venturing towards an uncertain future. Then, today Higher Education is an argument that becomes tense. Even more so when the University, as the governing body, demands answers and the Higher Education system responds, little by little, without considering virtuality.

The educational context, within the university environment, as a starting point 2.0

According to history, in the technological field, at the beginning of the century and specifically in 2004, the term 'Web 2.0' became fashionable and this expression became a social phenomenon. So much so that it is disseminated in portals of various kinds; such as Facebook. That is to say, being supported by intelligent tools, it attracts content generators and "...the most

meritorious paradigm of Web 2.0 is the WWW. The same one that, being a cooperative work platform, acts as Collective Intelligence" (Orakcı & Gelişli, 2024, p. 18). At the same time, the mission of Databases, as a basic competence and being a programming model understandable to all users, is to show the reason for the development of Web 2.0; this being of a social and not technological order. But this becomes a collaborative work between users and the exchange of information argues cooperation. Although the intercreativity section explores a diversity of forms of communication and, being innovative, provides collective social knowledge, the fundamental principles of Education 2.0 come from expressive philosophical elements as part of interactive technological perceptions; which allow bidirectional communication between the user and the technology.

Consequently, the society that advances towards a Knowledge Society (KS) is competent as long as the development of technology is applicable to globalization and its complexity evolves towards the educational environment. That is, when a classroom social group evaluates its methodology, it is capable of designing new ways of learning; as long as it is used by any student. However, the technological endowment must be related to the exchange of the pedagogical conception; noting that the transmissive paradigms must adapt to the Chaos Theory. This means that communicative strategies become self-learning and their innovation tends to break the traditional teaching-learning methodology. Obviously, "…it is unlikely to build knowledge from certain convictions. However, conflicts must be introduced in the issue of uncertainty; the same, which questions the linear vision to get closer to globality" (Kauffman et al., 2024, p. 207).

Next, the pedagogical scope is broken down in conjunction with the variables not transmitted by a fractioned reality; educating under the principle of uncertainty and not favoring creative thinking. Also, inciting research on the subject of certainty. Therefore, the communicative precept prioritizes the educational-social interconnection and amplifies the currents of the environment that demand reflection. This, due to the massive information has to be selected and processed; since each competence specifies digitalization. It is at this moment, when validity is undone, it faces diversity of knowledge and its optics supports non-linear thoughts. So much so that, the Internet navigation of digital natives, necessarily, contains knowledge.

Much more, if the use of Information and Communication Technologies (ICT) offers contexts of interaction. Subsequently, constructivist creativity uses the same nomenclature and does not support the breaking of the technological classroom context. At the same time, mobile phones and social networks are recognized as guarantees of formal education and provide recreational entertainment. This is the time when students are prepared to face everyday life and are encouraged to think about a promising future. But, the 2.0 educational model embraces a diverse digital context and fosters new attitudes in students, guiding them toward learning and supporting their capacity for best learning; dispelling the misconception of in-person learning. Where the outdated learning model is established as a relationship in which the teacher teaches and the student learns. Then the acquired flexibility causes improvement in the pedagogical call and the virtual environment corroborates the ideal that ICT focus on changes within meaningful learning. Subsequently, the memorization process has no place in the transmission of knowledge and guidance becomes a requirement to achieve synchronous communication. Correspondingly, this is when the teaching experience is adapted to social relations and its creativity. This projects the image that "…the frame of reference pushes, instantly or gradually, to see the world in a different way; generating transformations in cybernetics and its intelligent consequences" (AL-Nuaimi, 2024, p. 94).

The educational contribution of Artificial Intelligence to the university environment

In the first instance, AI's contribution to the world of higher education is the creation of adaptive teaching systems; much more, if the GEB[1] book is considered as reference literature. Since these become, through intelligent platforms, customizable tutor systems; insofar as learning is based on profiles and the answers are direct interactions with the user. That is to say, that, despite some difficulty, it offers feedback in various subjects and that the class plan is adapted. Therefore, there is approval of this technological revolution. So much so, that AI projects extraordinary footprints in the educational field, human diligence provides scope in its massification and technological profiles support its development. Incontestably, the communicative aspect characterizes scientific research by establishing intelligent environments

[1]The Pulitzer Prize-winning work, 'Gödel, Escher, Bach: The Eternal Golden Braid', presents abstract AI concepts within the framework of higher mathematics; using formal systems in lithographs as an example. In addition, it captures topics of computer research in fables; such as the Turing Machine. At the same time, GEB is abbreviated to three of its protagonists: A mathematician, painter and musician.

that assimilate reasoning and simulate attitudes. However, history tells of the achievements of AI in the topic of Higher Education. At the same time, it guarantees technological development and shows virtual and intelligent applications in the area of Higher Mathematics; case of Wolfram Alpha. So, at least on this platform, the progress is evident; Since there are various university centers around the world that use it. It is because of this that the technology states the creation of algorithms for solving numerical problems and this advancement comes from the aforementioned 'Machine Learning'. The same, which is detailed within the logic of the systematic approach and is conceived within the Neural Networks; forging a human brain. Similarly, AI defines robotization in specific tasks; in which, its programming creates algorithmic processes that manipulate massive information. Therefore, learning ensures the recognition of forms based on Discrete Mathematics and in them, training is established through a database called Digital Repository.

Complementing, with that "…technological advancement tends to the marketing of non-analogue systems and the impact produced before the educational society detects Big Data patterns; in that sense, decision-making is vital and the speed of processing ensures action" (Song & Qiu, 2024, p. 7). Just as the analytical capabilities of logical frameworks, the advancement of AI contributes to the personalization of learning, and its effectiveness is absorbed by the environment; especially in the extrapolation of information.

In adding, that the educational aspect always comes out ahead and the technological challenge addresses canons that support the University. Consequently, in the teaching process, educational practice enables the precept of AI, as a collaborative contribution, in the learning methodology; as much as adaptive systems are seen. Also, that intelligent platforms are understood as expert tutors, offer personalized paths and become interaction; obviously, this will depend on the materials and applications predisposed. That is, that the academic needs of the student are considered as non-traditional means and part of the Syllabus. Supporting adaptive portals dedicated to learning; case of Cymath. Undeniably, this platform serves, online, students who seek and need help. Therefore, they share knowledge skills in the execution of an ideal university curriculum. Then, it is outlined as an adaptive portal and in which the help of AI is finalized. What is more, within South America and according to Comisión

Económica Para América Latina y el Caribe (CEPAL), the process of teaching Mathematics has become widespread; exemplifying that, in Ecuador, it reached 105799 students in 60 Universities. Unquestionably, this typology, predicts activities in line with the trajectory of each Higher Institution and its coupling is directed to its classroom rhythm; case of Geekie. Remembering, through indicators that support the precept of updating, the difficulty that each platform entails. Moreover, the registration of adaptive systems encourages the study of new algorithms that contain AI and the Big Data technique foresees the massiveness of the information immersed (Bourechak et al., 2023; Hackett et al., 2023; Rani et al., 2023). This happens, more than likely, because challenges become strengths and classroom motivation generates suitability; which adjusts to the culture appropriately. So that, at least in theory, initiatives are developed on the topic of cybernetic teaching staff and in this way there are recursive consultations; feeding back to the system. In order to generalize personalized education as a unique characteristic, being an example of universalization and the use of adaptive systems is condescending with the level of academic empowerment; apart from the fact that there is proactivity with commitment in the classroom, student and teacher.

Then, "…there must be variants and adaptive chatbots must be prioritized as automatisms; these being types of communication granted by Natural Language" (Lesage et al., 2024, p. 91); above all, when they derive answers to a question posed. Therefore, in this case, technology links computational topics and directs them towards Sciences; which is interesting. Since it fuels the power of systemic action within all forms of communication; incorporating the student into a multitude of activities.

Mathematical analysis, as a systemic activity, within higher education

According to the definition, systemic activities arise from the organization of information and its critical interpretation in every developed process. In addition, they arise from the identification of significant learning shared for the benefit of peers. In other words, this becomes an aid to increase the effectiveness and efficiency in the cognitive development of a student. Adding that the systemic approach itself opts for a set of well-ordered elements that interact with each other; in such a way, that systematic research is present.

Consequently, Higher Mathematics determines topologies of Calculus and its properties are

studied based on problems in some fields; naming the Limit, the Derivative and Integral. The theme of the Function y is also discovered; it delves into $y=f(x)$ as the foundation of the primitive and formalizes Taylor-type series. Therefore, this branch establishes a detailed study of real numbers; along with complex numbers. So that thus, the topology of Algebra is synthesized between sets and its derivational order, within the Limit of a function, expresses continuity. At the same time, differences are established between the Algebraic field and Mathematical Analysis. Noting that these concepts descend from antiquity; with Archimedes as an emblem. That is to say, that the generality of the Limit and its convergence give precepts to refer to the way in which a function behaves when approaching a value. Even the concept of *Pi* ( ) is contiguous and according to history, there was a mathematician who gave the green light to differential calculus; the case of Bhaskara (1114-1185). But, Greece was the predecessor country of Numerical Calculus and Geometry. However, sometime later, the determination of the Limit became convergent and it was the moment when "…the infinitesimal series made their appearance within the area of the circle; together with the fact that, in the 14th century, its formulation channeled the power series" (Lehmann, 2024, p. 5). Meanwhile, in Europe, notions of Mathematical Analysis were founded. So much so that Isaac Newton (1643-1727) developed the concept of Infinitesimal Calculus; René Descartes (1596-1650) as antecedent. That is to say, in this way, as a projection, in the 18th century Geometric Analysis was documented autonomously and differential equations were directed to discrete problems. Though, over time, in China, the precepts of the sphere were demarcated, giving way to the Trigonometric Functions. But, with the origin of Mathematical Analysis, the mandates of Analytical Geometry were defined. So, "…the maximum and minimum are defined as edges tangent to the curve; together, they are defined as a Cartesian System that establishes guidelines within finite mathematics" (Saha et al., 2023, p. 319).

Due to this, based on Calculus de B. Demidovich, the Limit defines the convergence and continuity of a function *f*. Therefore, its concept is based on the generalization of the topological space when using it in differential calculus; referring to the proximity between a value and a point. Likewise, its conceptualization provides a reference to the derivability of real functions. As much as, "…a function f that reaches a limit L at a point c means that, taking points sufficiently close to c, the value of f can be as close to L as desired" (Sadek &

Sami, 2024, p. 6129); as indicated in Figure 1(a). Sensibly to this, the Derivative is "… the measure of how quickly a function changes at a specific point. It can also be interpreted as the slope of the tangent line to the graph of the function at that point" (Trevisan et al., 2023, p. 42); this can be visualized in Figure 1(b). Thus, as specified in Figure 1(c), an Integral can be understood as "…operation that calculates the area under a curve or the sum of infinite infinitesimal summands. Insofar as it is the inverse operation to the derivative and is applied to calculate areas" (Aniswita et al., 2023, p. 74).

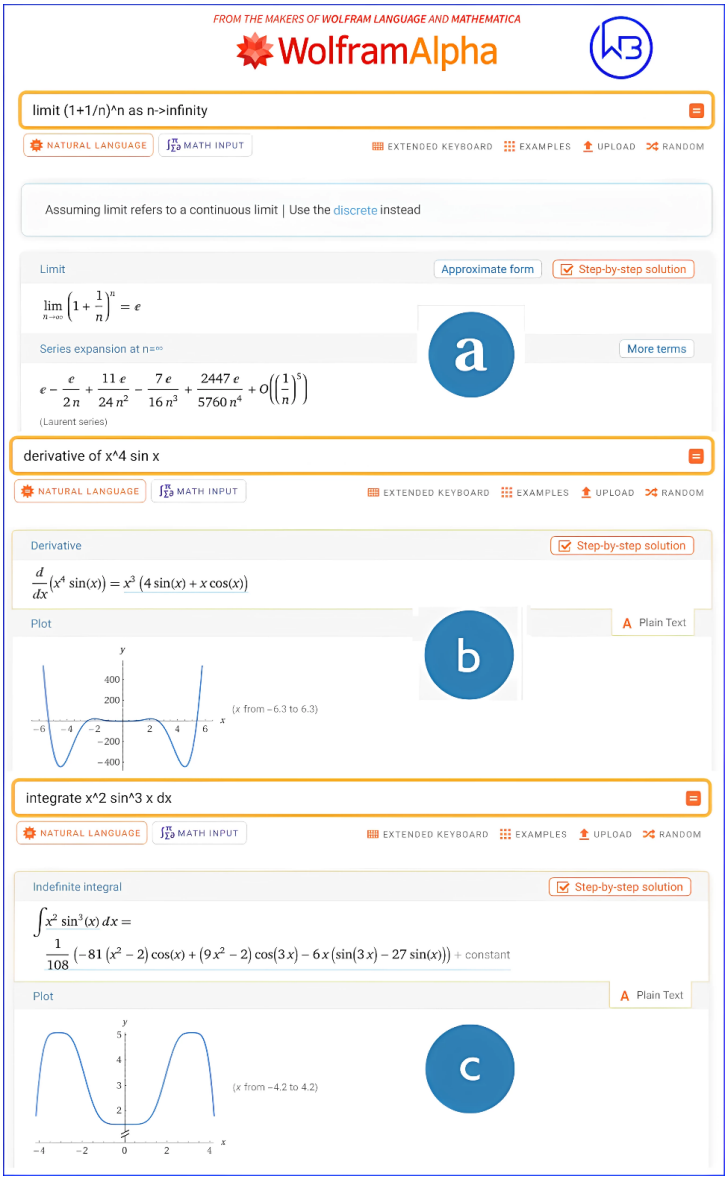

Figure 1

Platform specialized in solving mathematical problems through the application of AI

The typographic writing of Mathematical Analysis and its intelligent collaborative work

Typography is the ability to choose fonts to create professional texts and is currently used for the writing of scientific articles; years ago, for the subject of the Gutenberg Printing Press. Therefore, typographic writing is applied to convey knowledge through a set of characters that mediate the beauty of the design. So, typography involves distributing spaces and boxes evenly; especially in the areas of Mathematics and Computer Science. In addition, since the invention of the PC, through UNIX, programming in LaTeX was praiseworthy and consequently, now based on AI, it is possible to write scientific texts in a professional manner; as exemplified in Figure 2. Next, since this is a text composition system, through a compiler, high-resolution PDF files are obtained. Furthermore, its source code is plain text, based on Pascal, and international institutions, such as the American Mathematical Society (AMS), use it as a standard for writing scientific material. Also, renowned universities, such as Harvard University, use it in their research.

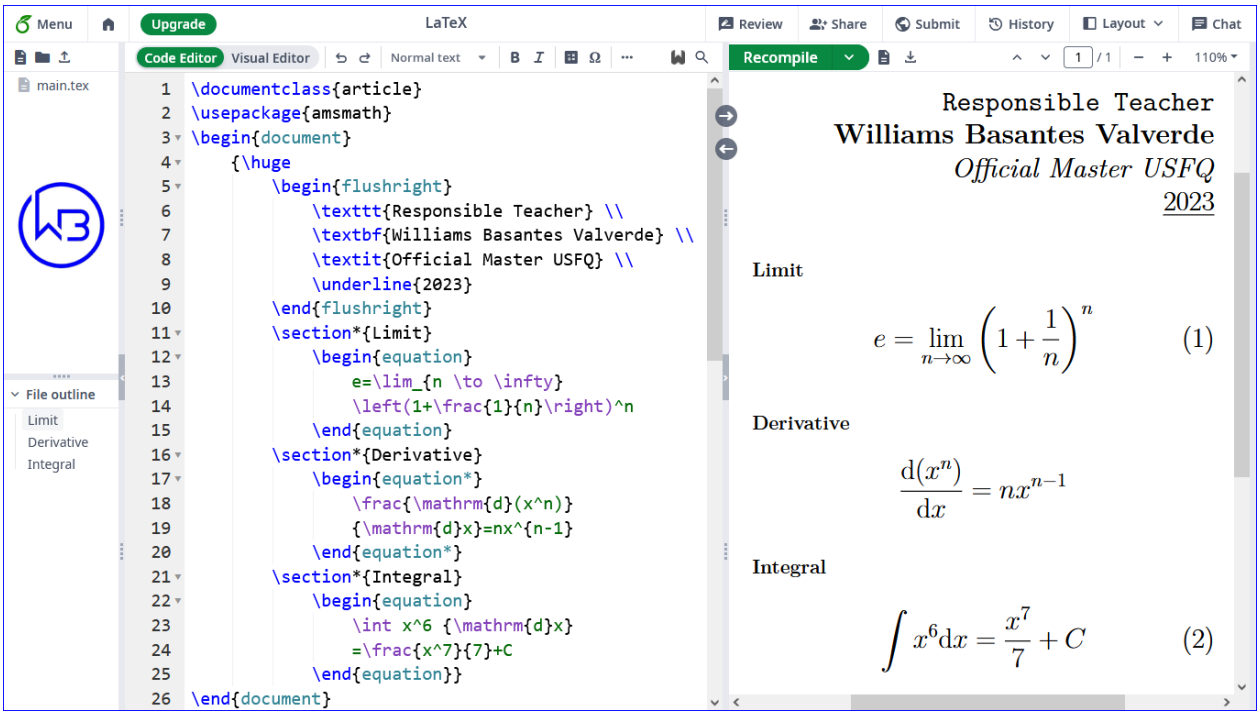

Figure 2

Typographic sample, on a smart platform, of a LaTeX script

Conclusions

As demonstrated in this article, educational technology sets precepts within modern academic society and so much so that cultural paradigms change daily. Even more so with the presence of the world wide web and the exchange of student behaviors; where non-stochastic indicators support this canon. Therefore, digitalization applies information within the virtual environment developing interactivity and facilitating critical thinking within social collaboration; with ideas, actions and feelings.

In this manner, the 2.0 characteristics of learning the Exact Sciences are revealed; specifically, Mathematical Analysis. Therefore, intelligent portals emerge to outline cybernetic strategies and delimit contributions from AI. That is to say, Educational Administration encourages affordable characteristics, addresses digital policies specific to AI and contributes to Big Data; much more so if systemic activity is not ruled out. This is why AI fits in with the mistrust and motive for the Digital Technological Massification (DTM) closely captivating the teaching of Mathematics. Next, "…in the pedagogical field, the support of Information Systems (IS), as ideal programs and being massive repositories of data guarantee decision-making; challenging with ideas that ensure future competencies" (Alowais et al., 2024, p. 738).

Finally, Mathematical Analysis, as a systemic activity belonging to Higher Education, guarantees that ICTs are an aid in the teaching-learning process and that typographic writing, such as LaTeX, supports intelligent collaborative work in any University; resizing new areas within training in the new millennium.

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