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ESSAY

Reflections on MOOC supported by emerging technologies from the science, technology and society perspective

Reflexiones en torno a los MOOC apoyados por tecnologías emergentes desde la visión Ciencia, Tecnología y Sociedad

Reflexões sobre MOOCs apoiadas por tecnologias emergentes da visão de Ciência, Tecnologia e Sociedade

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ABSTRACT. The dynamics of science and technology are the primary elements of the sustainable development of society in all areas. In the educational context, they have given rise to new forms of flexible, open, and free or low-cost learning, such as MOOCs (Massive Open Online Courses) that, supported by emerging technologies, have a social effect and contribute to the democratization of knowledge. In this sense, the main objective of this work is to identify the implications (limitations and scope) of MOOCs for the development of an inclusive education supported by emerging technologies and their impact on society, taking into account the main factors that generate it and develop, from the CTS (Science, Technology and Society) vision, through the application of historical-logical, analysis and synthesis methods and finally generalization-abstraction, taking as important primary and secondary bibliographic sources, with the purpose that the institutions educational institutions incorporate MOOCs as an alternative for permanent training and updating of knowledge that the knowledge society demands so much.

RESUMEN. La dinámica de la ciencia y la tecnología son los elementos primordiales del desarrollo sostenible de la sociedad en todos los ámbitos. En el contexto educativo han dado lugar a nuevas formas de aprendizajes flexibles, abiertas y gratuitas o a bajo costo, como los MOOC (Massive

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| Cursos masivos abiertos en línea, CTS, educación inclusiva, tecnologías emergentes | Open Online Courses- Cursos masivos abiertos en línea) que apoyados en las tecnologías emergentes tienen un efecto social y contribuyen a la democratización del conocimiento. En este sentido el objetivo principal de este trabajo es identificar las implicaciones (limitaciones y alcances) de los MOOC para el desarrollo de una educación inclusiva apoyada por las tecnologías emergentes y su impacto en la sociedad, tomando en cuenta los principales factores que lo generan y desarrollan, desde la visión CTS (Ciencia, Tecnología y Sociedad), mediante la aplicación de los métodos histórico-lógicos, de análisis y síntesis y finalmente la generalización-abstracción, tomando como importante fuentes bibliográficas primarias y secundarias, con el propósito que las instituciones educativas incorporen a los MOOC como una   alternativa para la formación permanente y actualización de conocimientos que tanto demanda la sociedad del conocimiento. |

| **PALAVRAS-CHAVE** Massive Open Online Course, STC, educação inclusiva, tecnologias emergentes | **RESUMO.** A dinâmica da ciência e da tecnologia são os elementos primários do desenvolvimento sustentável da sociedade em todas as áreas. No âmbito educacional, deram origem a novas formas de aprendizagem flexível, aberta e gratuita ou de baixo custo, como os MOOCs (Massive Open Online Courses) que, apoiados em tecnologias emergentes, têm um efeito social e contribuem para a democratização do conhecimento. Nesse sentido, o objetivo principal deste trabalho é identificar as implicações (limitações e abrangência) dos MOOCs para o desenvolvimento de uma educação inclusiva apoiada em tecnologias emergentes e seu impacto na sociedade, levando em consideração os principais fatores que os geram e se desenvolvem. , a partir da visão CTS (Ciência, Tecnologia e Sociedade), através da aplicação de métodos histórico-lógicos, de análise e síntese e finalmente generalização-abstração, tomando como importantes fontes bibliográficas primárias e secundárias, com o propósito de que as instituições instituições de ensino incorporem MOOCs como alternativa de formação e atualização permanente dos saberes que a sociedade do conhecimento tanto exige. |

1. INTRODUCTION

Studies on Science, Technology and Society (STS) are constituted in a field of work, where it is a matter of understanding the scientific-technological phenomenon in its social context, both in relation to its social conditioning factors and in what "concerns its social and environmental impacts" (Quintero, 2010, p. 236), and "without denying scientific and technological development itself, which rationally promotes sustainable development that ensures the survival and well-being of current and future generations" (De la Carrera, 2021, p. 468).

The CTS approach addresses the perspective that emphasizes the relationship and interactions between the three concepts that compose it: science, technology and society, with a critical vision that guides the participation of citizens in the decisions that guide the development of science and technology. technology and its impacts on society.

Reflections on inclusive education supported by information and communication technologies (ICT) from "the CTS vision, tries to justify scientific research in virtual environments in university education, where science and technology have an appreciable social impact" (Loyola et al., 2014, p. 177).

From the emergence of the Internet in 1969 and its subsequent development as a network of networks and multimedia space that allows the reading of texts, access to images, sounds, animations, simulations, among others; computer-mediated learning has evolved. Today new e-learning alternatives are presented, based on the use of mobile technology and other tools. This has given rise to new, ubiquitous, flexible and open forms of learning, such as Massive Open Online Courses (MOOCs), which were born with the idea of democratization

and expansion, knowledge and that currently contributes continuous training and inclusive education, which today's society demands so much (Atiaja & Martínez, 2019, p. 203).

Regarding the definition of MOOC, in the scientific literature a number of definitions are observed; However, there is no formal definition, so the authors of this work, based on the participatory experience in different platforms and massive online courses, agree with the definition established by Atiaja and Guerrero, "MOOCs are the result of technology applied in education and the evolution of distance training, are online courses that allow massive, open, free or low-cost participation" (2016, p. 69) and tend to promote globalization and the expansion of knowledge.

Multiple prestigious educational institutions worldwide, in their desire to respond to the need for permanent training, are adopting this teaching modality, with the purpose not only to satisfy this demand, but also in order to achieve reconnection with graduate professionals who seek to return to the university that welcomed them from their beginnings in higher education; considering that they would not have to leave their job or service position, since this "online training alternative is flexible, ubiquitous and open and therefore contributes to inclusion" (Atiaja, Guerrero & Yamba-Yugsi, 2018, p. 419).

Inclusive education is understood to be one that responds to an education in diversity, giving an educational response according to the needs of the students and developing didactic proposals that stimulate and promote the participation and interest of all in learning. UNESCO defines inclusive education as the process of identifying and responding to the diversity of the needs of all students, through changes and modifications in content, structures and strategies, based on the principle of particularity of each student and that the context is the one that adapts to the characteristics of the subjects (UNESCO, 2011), a definition that is assumed in this work.

In this sense, it is pertinent to ask the following scientific question: What are the main limitations and scope of MOOCs for the development of inclusive education supported by emerging technologies and what are their impacts on society?

2. GROWTH

2.1. Science, technology and society: relationship with emerging technologies.

The traditional conception identifies science in a set of proven, true theories; and technology with a set of artifacts and techniques; assuming that techno-scientific development, inexorably driven by values of truth, efficiency and effectiveness, determines society (technological determinism) and experts are the only ones competent to influence decisions on technological development.

The Organization of Ibero-American States (OEI, 2009) considers that "CTS studies constitute a multidisciplinary collaboration that, emphasizing the social dimension of science and technology, share" (p. 24), in this sense the image of science is refute as a pure activity; while, the conception of technology is assumed as applied and neutral science, giving rise to the condemnation of the technocracy.

According to Núñez (1999) science can be analyzed as a "knowledge system that modifies our vision of the real world and enriches our imagination and our culture" (p. 22). In other words, science could be viewed from

various angles, not only that of knowledge, but also as a process, a productive force for social transformation, a profession that carries culture and identified social functions.

In this essay, the authors share the criteria of Núñez (1999) and the OEI, which consider that CTS comprises science and technology not as an autonomous process or activity; but as an inherently social process or product, whose techno-scientific trajectories are socially constructed from the constellation of social circumstances, values (technical, political, ethical, social) and interests that act in society; that is to say, the idea of the democratization of knowledge, in particular the right of society to intervene in the techno-scientific course.

Technology increasingly depends on science in technological innovation processes and its semantics have been extended to a new type of companies, services and organizations, encompassing the organizational, cultural and scientific-technical spheres.

Regarding technology, Díaz and Borrero (2011) consider the need to define technology "as an open system composed of essential features, such as the object, tangible or material aspect and the cognitive aspect" (p. 31-32). This definition of technology is assumed in this work, since it allows us to consider technology from broad essential features, ranging from the artifactual, cognitive, processual, to the cultural; on the other hand, technology creates new values in man and modifies existing ones. Undoubtedly, technological development affects the way of life of men, the policies established by each country, culture, and changes in plans and study programs in universities.

As has been highlighted, science and technology are social processes deeply marked by civilization, closely linked and have a direct impact on society and that "the future of the credibility of the scientific system and science rests, regardless of the pressures of the environment, in the pillars of individual ethics "(Abad-García, 2019, p. 57). However, the influence and impact they have on it is not always positive, especially in the environmental context when the issue of electronic waste (e-waste) is addressed.

The continuous technological advance that is glimpsed in our days, which, among other factors, involves a boom in the electronic, digital, computing, artificial intelligence, robotics, and very importantly, information and communication technologies (ICT). Has led today's society to be dependent on these creations to improve their lifestyle, facilitate their survival and, at the same time, develop intellectually, which is an important fact to take into account when analyzing emerging technologies, since they are linked to the field of knowledge acquisition and therefore in the educational environment, which contributes to the formation of citizens, students, professionals with a vast culture.

The use of these technologies focused on learning implies that educational institutions implement teaching methodologies where teachers, on the one hand, generate strategies so that they are able to externalize their knowledge and reach students through the use of ICT, and realize the functions and scope that technologies can have within the pedagogical environment, generating "countless opportunities to adapt and / or modify the traditional teaching-learning process to a dynamic, participatory and flexible one" (Díaz, 2020, p . 8). All of this is possible thanks to emerging technologies and ICT that have played a fundamental role for decades and allow the student to assume an active role in the teaching-learning process. On the other hand, students can take advantage of these techniques to awaken skills, attitudes and potentialities and therefore, be able to acquire training according to their needs and with a comprehensive and quality education.

In this way, teaching acquires a new archetype within education, where all members are immersed in new learning approaches, with access to a variety of electronic and digital media, such as virtual classrooms. These methods, due to "technology will have a direct impact on students" (Gómez, García & Therón, 2014, p. 237), which will be reflected in an improvement in retention and learning, as well as in the promotion of their skills, analytical thinking and innovative capacity.

The influence of emerging technologies in everyday life is becoming more and more evident, and specifically in pedagogical practices that generate encouraging results in students, since these media that are now common in society, as mentioned by Pennesi et al. (2012), technologies "exceed the physical and organizational limits of the classroom, uniting formal and informal learning contexts" (p. 27), which implies the use of different resources and tools that allow innovation and generate flexible, dynamic learning spaces and more accessible. "Emerging technologies provide a great opportunity to reinvent education" (Moreno, López & Leiva, 2018, p. 142) and the possibility of establishing contact with various sources of information, as well as access to communication and interaction with the rest with members involved in the process and with others who can serve as a guide or aid in learning; Furthermore, they are "subject to influences from their context and to adaptations and unpredictable changes" (Adell & Castañeda, 2015, p. 2).

Emerging technologies can be considered as projects, ideas, innovations, tools or advances, which arise from a human need and whose objective is to improve the quality and safety of life of a human being, helping him or solving problems in his different stages and tasks, protecting and preserving your planet as well as the beings that inhabit it.

Veletsianos (2016) states that "the term emerging technology does not fully capture what is emerging in digital education and considers that the notion of emerging phenomena in education can be better captured, differentiating between" emerging technologies "and emerging practices" (p 4), what Adell and Castañeda (2012) consider as an analogy of emerging pedagogies.

For the purposes of this research, the definition of emerging technologies in education is assumed, such as computer tools, technological resources and scientific innovations of different nature, which can transform or are transforming the ways of thinking and acting with ICT in education in a certain context and that are the product of the renewal of technology that has already been developed before in order to obtain greater benefits in education and more.

When referring to education, it is irrefutable to say that there have been great changes in the educational system due to emerging technologies, since an era of information and globalization has been entered, where the need for more and better prepared professionals is increasing, because educational institutions such as universities adapt to such demand by acquiring new learning tools and especially teaching methodology. It is for this reason that researchers and other professionals are looking for new strategies and tools that allow students to obtain access, identify, evaluate and critically corroborate the information available to them.

This technological revolution causes a revolution in education to take place, where the central axis is not the information and knowledge itself, rather it is the application of that knowledge and information in knowledge generation devices that allow a feedback loop cumulative.

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The educational level achieved in the countries is reflected in the progress of the community, in the improvement and construction of an ideal town in all approaches, industrial, economic, social, cultural, pedagogical, among others, which are based on in learning from educational centers, where emerging technologies, to a large extent, have a significant influence to achieve them.

The implementation of emerging technologies in the current educational system brings with it a series of benefits for each participant of the educational process, even according to the rhythms of work, study, adapting to the way in which each student assimilates the information provided and on the other hand "they are contextual to the needs of educational actors" (Sosa, 2019, p. 25). In this context, the incorporation of modern technologies in education fosters adaptive learning, which is adjusted to the characteristics of the student and the level of demonstrated performance and, as a consequence, foresees what type of content and resources students need at a specific moment in order to progress.

In a study carried out on the incorporation of emerging technologies in which several Ibero-American educational experts participated, it was determined that these "technologies are linked especially in educational processes" (Sosa, Salinas & De Benito, 2018, p.27), the main results achieved in this study can be summarized as:

a) It transforms educational practice, by offering new options and alternatives to teachers through meaningful and authentic learning environments, where issues and problems are contextualized and information is presented in a way that is attractive to the student, also allowing the student to breaking paradigms by innovating their practice, reflecting on the process, restructuring traditional models and understanding that the roles of both the student and the teacher change.

b) Improvement of skills by students, particularly those associated with collaborative and cooperative work, critical thinking, creativity, autonomy, and informational and digital literacy. Likewise, communication between teachers and students, interaction and interactivity, evaluation, exchange of ideas and socialization of products, feedback, monitoring of students and the systematization of experiences are promoted.

For the authors of this work, the positive impacts of the implementation of emerging technologies in education stand out as the connectivity of networks, which facilitates communication and interaction, new forms of learning, eliminating barriers of time and space (and -learning, b-learning, m-learning, flipped learning, MOOC, etc.), so that students decide their own way of learning, digital literacy, today the actors of the teaching-learning process demand digital skills and on the other hand, creativity and innovation promote the creation of enriched and very attractive outfits by teachers and students.

However, most of these technologies are produced and controlled by developed countries, which have turned them into instruments of economic and political domination and dependence. The challenge for developing countries is to adapt them to their realities and innovate the processes related to it, particularly educational ones.

The computer for many has become a symbol of power, intelligence and progress; Furthermore, thanks to the technology applied in education, it has given rise to new forms and modalities of learning that are increasingly "less expensive and affordable for a greater number of students in the developed and underdeveloped world" (Díaz & Borrero, 2011, p. 99).

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There is no predetermined relationship between ICT and changes in the teaching-learning process, if the same traditional practices continue to be used in the new digital media. A qualitative change within the teaching-learning process only occurs when ICT is adequately integrated within an innovative vision, which means that all the potentialities of each medium have been previously explored.

2.2. MOOCS and emerging technologies: limitations and scope.

Educating with new technologies today involves making use of emerging technologies that include telecommunications, mobile devices, augmented reality and learning analytics, leading to gamification, mobile learning (m-learning) and the classroom. Inverted (flipped classroom), MOOCs that "enhance inclusive education" (Atiaja & Martínez, 2020, p.20), but must be replanted from a comprehensive system perspective; among other new trends. Likewise, the conception of the open educational movement is strengthened, which "offers the possibility that teaching, learning and research resources are in the public domain" (Tagua, 2017, p. 8), which allows their free use and reuse.

MOOCs are the result of the evolution of distance education, given by technological advances in terms of e-learning platforms for the knowledge management system; Thus, nowadays, we find countless specific platforms for massive open online courses and if the premise of the creators of the first MOOC, George Siemens and Stephen Downes is taken up, it is mentioned that these courses were created with the idea of democratization and expansion of knowledge.

The main characteristics that distinguish MOOCs are the massive and free participation in accessing online courses[2], through a high level of interaction between the participants of these courses, the use of various communication tools and course management, to which should be added the emphasis on the learning process, rather than on evaluation and accreditation and the support they provide to the community.

There are many and diverse emerging technologies that can be used in MOOCs, but due to their importance and relevance, for the objectives pursued in this research, BYOD (Bring your own device - bring your own device) has been selected of learning, augmented reality, YouTube and Podcast (Johnson et al., 2016).

The main barriers or limitations for the implementation of emerging technologies, according to the criteria of the authors of this work are:

- Diversity of mobile devices. There is a great variety of mobile devices, with different characteristics (screens with different dimensions and operating systems, etc.), there is no standard; although in a certain way, this limitation is solved by many tools that have a responsive design.

- Adaptation of digitized content to a new environment (pedagogical and technological). Demand for technological skills or abilities and of course when it comes to the design of educational resources, it is necessary to adopt a teaching-learning methodology.

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[2] It should be noted that at present not all courses are totally free, but they are low cost, to try to guarantee their sustainability.

- The digital breakdown. In the world there are inequalities, not all the population has access to technology, especially in third world countries.

- Infoxication. From the STS point of view, ICTs are ostensibly modifying contemporary society, people's scale of values, lifestyle and ways of seeing and interpreting the world and the culture of communications. Especially in young people there is the growing concern of being "always connected" (procrastination) which means a difficulty in concentrating on the task and basically causes them to leave for tomorrow what they can do today.

- Resistance to change. One of the factors that can counteract this obstacle is training in the pedagogical use of ICT, aimed at the actors of the educational process.

- Generational gap. It refers to digital natives who are young and were born with technology and are fluent in the digital language of computers, video games and the Internet, that is, they are "digital immigrants are those who speak the digital language, but who show difficulties in understanding and express themselves digitally" (Prensky, 2001, p. 2), which implies a gap within the school between students (digital natives) and teachers (digital immigrants). While it is true that teachers must improve in the use of blended learning technologies and techniques, it is also true that students must assume their share of responsibility for their training.

Based on these barriers, the main challenges in the implementation of emerging technologies in inclusive education, according to the criteria of the authors of this essay, are framed in the use of these technologies in education to improve communication, collaboration, interactivity with students, so that they feel accompanied at all times and in all places in their learning process and the assumption of new roles by students and teachers. In particular, teachers must not only have mastery of the contents of the subject, adequately manage the teaching-learning process and use technology as a pedagogical resource, but also achieve a broader understanding of technology-based social networks and the variety of learning resources available online and the sociological and cultural understanding of the various learning environments and their characteristics.

For the implementation of emerging technologies in MOOCs, it is also required to generate policies to improve the infrastructure of Higher Education Institutions (HEIs), related to the availability of resources, connectivity, adaptation of spaces, among others, providing initial and permanent teacher training so that teachers evolve with the knowledge, skills, attitudes and values necessary to rethink, redesign and reconfigure traditional models of education and "develop new strategies to implement a change in education and in society" (Cabellon & Brown, 2017, p. 18).

From the CTS vision, this great variety of devices, tools and technologies was generated by the interests of the large number of manufacturing companies to produce innovative products to compete and be leaders in the market, with the absence of regulations for the creation of scientific technology and of standards for content production. This creates inconvenience for the technological and pedagogical adaptation of digitized content between different systems and devices, so it is essential to achieve an improvement in standards for inclusive teaching, because it is necessary to take into account the characteristics of the hardware and software. Emerging technologies are a fact, the current concern is how should they be used?

On the other hand, it is also important to mention that the STS approach in the knowledge society demands the conscious and responsible participation of citizens. On the website of the Organization of Ibero-American States (OEI)[3] it is stated that one of the objectives of CTS is to try to favor the development and consolidation of democratic attitudes and practices in matters of social importance related to technological innovation or environmental intervention. In this sense, MOOCs contribute to achieving this objective, which, although it is true for many universities, the implementation of MOOCs can represent a strategic investment, with the purpose of having indicators of technological innovation for learning, they allow to achieve greater visibility before the world and represent means of dissemination of the academic offer of universities, and of course represents an excellent opportunity to "increase access to education and contribute to the fulfillment of international educational commitments" (Gómez, Vázquez-Cano, & López -Meneses, 2016, p. 78).

The CTS approach tries to promote scientific literacy, showing science as a human activity of great social importance, it is part of the general culture in modern democratic societies, and it is there that this educational innovation, such as MOOCs, play an important role for scientific literacy, generating learning opportunities throughout life, which constitutes a benchmark for inclusive education.

2.3. Impacts of emerging technologies for inclusive education in society.

ICT and in particular emerging technologies are also a source of paradoxes. They are relatively cheap, with a low-cost infrastructure, and much more accessible than the knowledge, culture, representation and communication media that preceded them. Today many people can count on a mobile device, computer and more now in times of covid-19, these have become an essential tool to access education.

Increasingly and widely, people want to be able to work, learn and study whenever and wherever they want. This trend highlights the way in which education must adapt to the current rhythms of life. On the one hand, the daily conditions require establishing a balance between the demands of work, school and family, posing problems of organization and time management for students. Likewise, the world of work is becoming more professional and requires greater skills to respond to current demands. "A flexible, adaptable and easily accessible, segmented and valid training offer approach is appreciated and expected by society in general" (Durall et al., 2012, p. 17).

Based on the previous analyzes, one of the greatest impacts that emerging technologies have and will have on society is inclusion, since training proposals, particularly in Latin America, have included new actors instead of excluding, inasmuch as it is a fact that the number of mobile users is greater than that of the Internet, increases the flexibility of the relationship between the actors (not only can they choose different moments of study, but these extend even outside the traditional ones such as home-work- school); It contributes to the universalization of education (because sometimes mobile accesses need less infrastructure than the Internet or in some places there is no network connectivity but there is mobile access). It can also be argued that all this is part of a process of contribution to the globalization of knowledge.

Other positive impacts are the greater accessibility of students to teaching materials from anywhere, the increasing possibility of updating the teaching staff, greater social interest in bringing the university closer to

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[3] https://www.oei.es/historico/cts.htm#1

citizens far away from them, the contribution to the adaptation of the educational systems of higher level than the information and knowledge society and greater facility for individualized student training.

The changes that the authors of this essay recommend to implement a consistent practice in inclusive education supported by emerging technologies and achieve a positive impact on society would focus on the development of educational activity without space-time limitations, but in face-to-face moments. It is necessary to make the most of the richness of personal interaction, a horizontal relationship is required between teachers and students as members of the learning communities and that teachers accompany students in their learning at all times. Technology records and transmits meaning in multiple ways (visual, sound, oral, written), and in this way must be communication with students, with a level of abstraction and metacognitive strategies of a higher order; With emerging technologies, knowledge can be considered to be at hand since these devices have become an extension of our minds, but teachers are required to handle higher-order skills to build genuinely inclusive learning communities, of so that each student can give their best in this process.

The introduction of ICT and in particular emerging technologies in education, for the development of MOOCs, from the CTS perspective, is based on the critical construction of social knowledge that favors attention to diversity, the production of identities and the democratic notion of public life. In this context, "the educational discourse that leads this approach focuses on the rethinking of the various dimensions of action that it implies: school, students, teachers, curriculum, community" (Pérez, 2006, p. 5).

3. CONCLUSIONS

The relevance that the issue of inclusion has taken in the world has made it possible to break down borders and barriers of all kinds. However, despite the progress made, it is necessary to reflect that there is still much work to be done and more obstacles to overcome.

To achieve change and the integration of emerging technologies to support inclusive education requires a rethinking of the roles of students and teachers as a starting point. The duty of educational institutions is to expand and improve connectivity options ensuring equity, gradually evaluating and improving the existing ICT infrastructure. The above allows us to rethink and recreate the new virtual spaces for learning that are much more interactive, more friendly, participatory and collaborative, which allow us to improve educational processes and where it is possible to learn anywhere. The use of new didactic and innovation strategies is required if these technologies are to have a positive impact on the training of citizens.

The social responsibility of universities is to meet the requirements of society and for this they must work on research and development projects with the aim of innovating their services and meeting the objectives established by the constitution.

One of the alternatives is the implementation of MOOCs for the continuous training of graduates, since this type of course represents a flexible learning modality, aimed at the democratization of knowledge, through which professionals can easily access these courses for permanent training.

The new technologies that are currently being developed, such as robotics, virtual reality, makerspaces, artificial intelligence, the internet of things, blockchain, etc., can have a satisfactory impact on the educational processes

of HEIs, allowing the training of new professionals who will contribute to promoting the development of science, technology and society. The new paradigm of inclusive education is under construction and is currently an important meeting point between education and ICT, where what is truly important is not innovating with technology, but the teaching-learning process itself. The technology used does not matter, but rather how that technology is used pedagogically to learn.

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Rol de los autores / Authors Roles:

Lourdes Atiaja: Conceptualización, curación de datos, administración del proyecto, financiación del proyecto, supervisión.

Andrés García-Martínez: Conceptualización, metodología, redacción.

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