

Education 4.0 and its impact on the educational system during the pandemic and post pandemic Covid 19 in Ecuador

Educación 4.0 y su impacto en el sistema educativo durante la pandemia y post pandemia Covid 19 en el Ecuador

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Abstract

The technological advances that the world has experienced over the years have brought about important changes in the structures of society. Education is one of the fields in which the industrial revolution, driven by technological development, exerted a significant impact, as technology allowed the student to freely access more information and therefore more knowledge. Education 2.0 and 3.0 brought not only access to information, but also greater connectivity and interaction between people, particularly between teachers and their students. The dynamism of technology also brought opportunities for innovation with Education 4.0, changing the existing paradigm until its emergence by merging the digital, the biological and the physical, and influencing the way of life of the individual, his relationship with those around him and his skills to meet the demands and basic roles in society. These changes meant the application of new educational methodologies, oriented to a meaningful learning that prepares the individual with the necessary skills to face the working world.

Keywords: Education, Technology, Pandemic, Teaching-Learning, Teaching-Learning

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Resumen

Los avances tecnológicos que el mundo ha experimentado a través de los años han provocado importantes cambios en las estructuras de la sociedad. La educación es uno de los campos en los que la revolución industrial, impulsada por el desarrollo tecnológico, ejerció un impacto significativo, pues la tecnología permitió que el estudiante acceda libremente a mayor información y por tanto a un mayor conocimiento. La Educación 2.0 y 3.0 trajeron permitieron no solo el acceso a la información, sino a implantar una mayor conectividad e interacción entre las personas, y particularmente entre los maestros y sus alumnos. El dinamismo de la tecnología trajo además oportunidades de innovación con la Educación 4.0, cambiando el paradigma existente hasta su aparición al fusionar lo digital, lo biológico y lo físico, e influenciando la forma de vida del individuo, su relación con quienes lo rodean y sus aptitudes para cumplir con las exigencias y roles básicos en la sociedad. Estos cambios significaron la aplicación de nuevas metodologías educativas, orientadas a un aprendizaje significativo que prepare al individuo con las destrezas necesarias para enfrentar el mundo laboral.

Palabras clave: Educación, Tecnología, Pandemia, Enseñanza-Aprendizaje

Introduction

There is no revolution without disruption. Its consequences shatter traditions, behaviors, relationships, ways of thinking and, of course, of educating. Over time, societies have undergone major transformations due to the advance of technology, which brought about important changes in their structures and altered the existing statism. Since the industrial revolution, education began to contribute to the economic development of countries, focusing on pedagogy for the working class.

The technological development driven by the industrial revolutions has a direct impact on education. Thus, Education 2.0 transformed memoristic education when the student began to have access to information and greater knowledge, all thanks to the use and application of emerging technologies. With the globalization of the internet, the generation of greater forms of research, and the variety of knowledge and sources, the student was immersed in Education 3.0. Virtual platforms appeared, connectivity and interaction between students and teachers increased, and a more personalized and reflective learning model was applied. On the other hand, the key element of Education 4.0 is innovation, and it has radically

modified the way in which individuals live, work and establish relationships with others. Thus, it is not only changing what to do and how to do it, but also who we are.

Today, the world is experiencing a time of important transformations. The learning activities carried out by students, as well as the application of methodologies and techniques by their tutors, constitute the basis of a dynamic and changing educational model. This process of structural innovation has bet through time on the development and transformation of science and technology, until evolving to the current Education 4.0. An important aspect is the development of students' skills during the learning process, which enables them to be able to enter the labor market and meet the requirements of labor competencies. In this way, society will be able to count on a workforce that, in addition to fulfilling its basic roles, is proactive, resourceful and creative.

Education in the 21st century has not only had to face the accelerated pace of technological advances, but also a global health crisis due to the HIV/AIDS pandemic, which highlighted the shortcomings in teaching skills and the lack of preparation of institutions to face the technological challenge in education.

Technology began to have a place in educational processes in a basic way at the beginning of the new millennium, and was known as Education 2.0. At this stage, the teacher was not only dedicated to teaching, but also acted as a moderator to promote interaction in the classroom, while discovering the talents of his students through collaborative work.

On the other hand, Education 3.0 has allowed Information and Communication Technologies (ICT) to be incorporated into educational processes, thus integrating new tools that have improved the form of education over the last few years. Education established a closer connection with different sources of information. Learning was self-directed and the search for information was encouraged in a 100% digital way. This new concept stimulated students' competencies, directing them to create new content from research, which significantly helped both students and teachers to change their mentality where interaction became more dynamic, participative and creative.

Among the benefits of ICT implementation in education are:

Access to information and education from any device regardless of location.

Develop skills that allow us to develop in a digital environment.

Low cost of education, both for students and institutions.

Education adapted to the needs of the students.

Improvement of knowledge acquired in student groups since the discussion between teachers and classmates is more fluid.

The arrival of Education 4.0 represents an ideal approach, aligning the Fourth Industrial Revolution with education; this is because the industrial revolution bases its development on robotics, smart technology, artificial intelligence, augmented reality, gamification, teacher evaluation and student self-evaluation, Big data, use of digital platforms; facilitating our daily lives.

Universities are challenged to produce successful graduates using these new ways of teaching, where students and teachers live together in an environment that is up to par with Industry 4.0 and where cyber physical systems are applied in all industries. Part of the curriculum should always include these technologies. In this way the learning approach will always be based on the new ways of studying and their application in the new work environments.

Through Education 4.0, the desirable skills of graduates can be improved, making them innovative and creative employees; with the ability to adapt to the use of new technologies.

Some of the characteristics of Education 4.0 are the following:

- The basis of teaching is the cooperation between teacher and student.
- The main way of learning is through communication.
- Problem solving is exercised as close to real life as possible.
- One of the main drivers of learning is games and the creation of real environments.
- The use of ICT as a tool for accessing, creating, organizing and disseminating content.

The evolution of education can be seen through a timeline. The contributions to the social structure and superstructure of the state of the First Industrial Revolution that took place in England at the end of the 18th century created a new model of life, causing transformations in the economic, political, social, cultural and environmental pillars of countries. An educational model emerged that primarily considered the needs of society and whose premise was economic development. Schools were the engines that supplied the professionals of an industrial society, whose base was mass production and consumption, to facilitate the development of their

skills and abilities. This gave rise to the ability of human beings to adapt to the needs and advances of science.

Orozco et al., (2015) refers to one of the most revolutionary inventions in the history of mankind: gunpowder. The author explains that although it was China that invented it, it was not Europe that used it for war purposes, as described in English historiography. The inventions of steam power invented by the Chinese and put into practice in British industry, plus the application of hydraulics, allowed the appearance of machinery, steam trains and generated the First Industrial Revolution in 1784, contributing to the invention of the first mechanical loom. The input industries were strengthened and distributed to large extensions of populations in less time than was originally the case.

On the other hand, technological innovations based on the use of electricity, automation and the enormous chain transformations generated during the Second Industrial Revolution that emerged in the 19th century, affected not only science or work, but also education. The result was the massification of educational processes, and the consequent need to develop different types of pedagogies. According to López & Valenzuela, (2015) the Second Revolution of 1870, developed the production line, with the appearance of the first conveyor belt. The invention of electric power and the creation of assembly lines, causing an increase in the production of goods, with a fall in costs and prices of products, as both mass production and mass consumption of the same occurred. The large industrialists were strengthened and the small artisans were absorbed by the market, some disappeared, others joined together even though with their insipient economies it was difficult for them to maintain themselves, others became unemployed and had to change their trade. Great boom in mass production such as vehicles.

The Third Industrial Revolution in the mid-twentieth century gave rise to the computer and information and communication technologies (ICT). Education took a great leap forward, since the appearance of the Internet and its vertiginous expansion made it possible to offer online education, massifying educational processes due to the flexibility in terms of time and space. This Third Industrial Revolution, or Industry 3.0, generated automation, improving production lines and giving rise to robotics for industrial and commercial applications, which expanded to other fields such as health, education, production, energy use, among others.

Today's advances in science and technology are part of the Fourth Industrial Revolution, which developed over the course of the year 2000 and is also known as Education 4.0. E-commerce and cellular communication led society to enter a world of technological challenges at an accelerated pace, with astonishing levels of information speed and the sending and receiving of data. The development of new information and communication technologies emerged, such as the so-called disruptive technologies, among which are applications (Apps), intelligent systems and digital production processes, facilitating the way in which the individual learns and teaches the new generations.

Similarly, productive processes are standardized and systematized thanks to technologies that mark innovation, such as robotics, virtual reality, artificial intelligence, IoT or Internet of Things, gamification, or Big data, among other technologies, which are impressively marking technological innovation in various economic sectors worldwide, such as the industrial sector, commerce, or communications, as well as in the way business is done, in politics, or in marketing.

In each industrial revolution, knowledge transfer has been required, and currently in Industry 4.0, it is necessary to carry out a digital transformation process. The implementation of new technologies requires the redesign of the enterprise architecture, to work by processes, solutions and software applications, mobile, remote, with the use of data from appropriate sources, integration of information and communication technologies.

In order to create new sources of work framed to this new reality, the company that implemented the advances will require new forms of work from the market, but until this happens, traditional work options that require repetitive processes in customer service, telemarketing, delivery drivers, cab drivers, among others, are gradually being eliminated; the same that should be analyzed by governments to focus on developing a contemporary education to the new era, Education 4.0, which is the subject of discussion of this article.

In agreement, Rojas, (2014) the Traditional Educational System has been characterized by transmitting content to students, with a methodology of rote learning without further development of creativity, development of skills and abilities of students, who are

evaluated through tests that are mainly written and oral, to have the supposed evidence of learning. It should be noted that this education has the teacher as the axis of the teaching-learning process, without allowing a greater feedback of knowledge and skills of their students, who are instructed passively.

In practice, it has been scientifically proven that long-term memory is not achieved with memorizing efforts at the moment. What is not applied by students, in accordance with technological advances and the development of their daily lives, is memory that is lost, limiting meaningful and lasting learning.

Traditional education evolved into an education with feedback processes for the student who had access to several sources of knowledge consultation and was able to contrast the information provided by his teacher. The student went from being only a receiver of information to a generator of ideas from the compendium of acquired knowledge, capable of sharing it through virtual media and also globalizing knowledge. It is not enough for students to learn content by heart, since in the globalized world we live in, anyone has access to information easily and quickly to any content to research and learn. It is necessary to change the traditional memoristic education of contents, to an education that is constantly fed by knowledge and that, in virtual modality, online, is dynamic, integrating the universality of knowledge. Education 4.0 requires educational models that are different from the traditional models still in force, as well as teachers who become tutors and facilitators of access to learning, who provide feedback on what they have learned, who recommend and why not, who learn from their students' learning.

Face-to-face, blended and virtual education, with the use of applications and educational platforms, has allowed the generation of learning environments that facilitate the tutor to implement efficient alternatives and promote new skills and abilities in students, inside and outside the classroom. The modern teacher influences the student to be inserted in the education of the XXI century, education 4.0 and considering rhythms and learning styles of students, generates changes to be implemented in both public and private educational institutions, with redesign of teaching-learning strategies within the student-teacher relationship.

The impact of the industrial revolution on education, particularly in Education 4.0, requires digital transformations on a par with the

technological era, to meet the needs of the information society at the pace of scientific and technological transformations and innovations, framed in a new educational model. To achieve this, it is necessary to change the behavior and social customs of each culture. The co-responsibility of the teacher in the construction of this new model requires efforts to adapt to this dynamic, the didactics, his own training and professionalization, the continuous acquisition of knowledge and all with the use of technological tools inside and outside the classroom as a transversal axis.

The Fourth Industrial Revolution, or Education 4.0, is only 50 years away from its predecessor. For Marúm-Espinosa & Reynoso-Cantú, (2014) the most important particularity of this era is the enormous variety of technologies that converge and make the previously existing boundaries between the digital, the biological and the physical disappear, merging these three planes and changing the paradigm that reigned until then. The Internet made possible the emergence of a new technological map, in which all social actors are connected in real time through various devices and digital platforms. This connectivity also reaches objects through the Internet of Things (IoT), showing technological advances achieved at an unprecedented speed.

Martinic & Villalta, (2015) states that Education 4.0 is based on ten technological pillars, which are explained as follows:

Integration systems, which integrate operational technologies with those of information and communication, impacting both the internal and external management of a company.

Robots, or intelligent systems that automate tasks that were previously performed by humans. This pillar seeks to strengthen and increase collaborative robotics.

Internet of Things (IoT), the same that makes possible multidirectional communication between people, machines and products, through sensors that are combined with Cloud computing, and Big data analysis.

Additive manufacturing, by means of which it is possible to manufacture parts by superimposing layers of materials based on a previous design. It does not use molds. Instead it takes a virtual model.

Big data, characterized by the volume, velocity and variety of both structured and unstructured information, which can come from various sources and reported by various means. The greatest

advantage it presents is the generation of reports based on the process of analyzing the data.

Cloud. This pillar offers online storage, access and use of IT services. In this way, businesses access existing technologies with little administrative effort and in a flexible and agile manner.

Simulation of virtual environments. This pillar has to do with a joint way in which machines, people and processes work in a direct way. It prevents breakdowns, saves money and evaluates the final results in a controlled environment.

Artificial intelligence. It refers to a set of algorithms fed with information and previous experiences, improving them to provide machines with cognitive skills similar to those of the human brain.

Cybersecurity. Technological advances require the use of cybersecurity mechanisms in industrial environments, detecting, anticipating and neutralizing threats.

Augmented reality. It complements a real environment with a digital one, facilitating product design and organizing processes.

It can be perceived that the pillars of the Fourth Industrial Revolution are focused on the digitization of the manufacturing sector, driven by the large volumes of data being handled, connectivity and powerful computing systems. However, these disruptive technologies exert a strong influence on education and have changed the way teaching and learning takes place. It is important to consider that these pillars are complemented by the supply of other existing technologies such as drones, controllers, platforms and systems for locating and self-identifying, which play as important a role as the aforementioned pillars in the expansion of the current technological matrix. The rapid spread of the COVID-19 pathology is closely linked to the immense network of global movement of people. Contagions were inevitable. The difference with pathological events of the past is that in the current century, information circulates instantaneously, and in the case of the SAR virus, it proliferates at the same speed as the increase in the number of infected people. In the educational sphere, the massive closure of educational institutions globally to mitigate the spread of the virus posed an unprecedented risk to education, and the well-being of individuals. The closure of schools, colleges and universities also affected the nutrition of the student population, especially those belonging to vulnerable segments.

Despite the emergency, societies opted for technology to continue with the educational process, causing a change in people's way of life, but also revealing shortcomings in terms of infrastructure and teaching skills.

The technology and knowledge transfer of Education 4.0 before the COVID-19 pandemic grew in similar proportion to the levels of investment that governments allocated to their Gross Domestic Product (GDP) and to the variables of innovation, development and research in science and technology. In other words, if a country's investment levels were low, the development and implementation of Education 4.0 would not be globalized beyond small business and academic spaces. However, in the transition from the pandemic, drastic changes occurred in face-to-face education, e-commerce and delivery sales.

Most of the countries decided to establish ways of continuing the educational process in various distance modalities. Some opted to implement forms of online learning, while others decided to establish distance learning strategies in offline mode. (Tobón et al., 2014, p. 90)

This caused a significant increase in the need for access to ICT, as well as to the educational model inserted in Education 4.0, which includes intelligent technology, artificial intelligence and robotics to adapt to the new way of teaching and learning in the new business era. Students went from the face-to-face methodology to the virtual education methodology, encountering an education system in which the teaching staff was not prepared to assume another educational model and leave the traditional method.

Most countries were able to count on the appropriate resources and digital platforms to establish a remote connection. In this case, many found it necessary to boost speed to unprecedented levels, and to implement open radio or television programs.

Societies around the world benefit daily from technology, as it brings a series of advantages, especially in the educational field where it has revolutionized the way of teaching and learning.

A pedagogical training model that remains in force despite the arrival of Education 4.0 are the Massive Open Online Courses (MOOCs), the same that appeared with Education 3.0. This model revolutionized at the time the way in which teachers acquired knowledge and skills to improve their practices. According to Núñez-Peña et al., (2015); (Jiménez-Valverde & Núñez-Cruz,

2009)the first MOOC was implemented by the University of Manitoba, Canada, in 2009, with around 2,000 students enrolled. This platform had the characteristic of combining either a Webinar or blog posts by expert professionals with Twitter social network messages from course participants. These courses were open to anyone who was interested, and did not include formal evaluations. The author explains that in 2012, two Stanford University professors offered a MOOC course based on the action of capturing lectures on AI, which attracted around 100,000 participants. William assures that from that moment on, MOOCs spread rapidly all over the planet. The platforms on e-learning education have evolved so much that the environment that creates a virtual classroom and the virtual university campus, provide facilities for the learning of the student of the new era and inserts it to the rhythm of the world market. The projection of job offers and acceleration of the application of science and technology, we are already living in our days, even as an effect of the confinement caused by the pandemic caused by Covid 19. There has been such a serious school desertion, caused by causes such as the lack of access to computer equipment, whether laptops or desktops, the lack of access to the Internet, by elderly teachers who refuse to join virtual education and therefore cannot apply pedagogies that allow students to enjoy virtual classes.

According to Rodríguez et al., (2014); Mendoza-Rojas, (2015) it is to be expected that there will be an increase in school dropout in the world of approximately 24 million children. According to the entity, in Ecuador alone there are more than 90 thousand students who have left the education system, and approximately 15% of the student body that has not left the system, indicates that they have not had regular contact with teachers in at least two weeks. UNICEF emphasizes that it is important to consider that the loss of contact between teacher and student increases the possibility of the student dropping out, and that the experience of such a high number of dropouts only increases the 268 thousand children who had already dropped out of the education system and the 187.3 thousand who were already behind in school.

In addition, another international entity, the World Bank (WB), reports an estimate of USD 10 trillion in lost income worldwide, due to the lowest level of education, with the consequent risk of causing children to drop out of the education system. According to this entity, there is a global worsening of children's skills in reading, writing and

mathematics. Additionally, the WB mentions that in Ecuador, 6 out of 10 students indicate that they are learning much less since the COVID-19 pandemic began. Therefore, it is concluded that despite the increase in connectivity, with 74.8% of students with access to public Internet, only 1 out of 8 students have computers or some equipment that facilitates access to the Internet for personal use. This reality, as stated by the WB, has a significant impact on students' online learning.

The year 2020 brought with it important changes, especially in the traditional forms of the teaching-learning process, leading the world population to the inclusion of virtual education to remedy the limitations due to the COVID-19 pandemic. This new way of working left important learnings, and the premise of continuing with the innovations that Education 4.0 has brought at a dizzying pace.

Materials and methods

In order to develop the present study, in the first instance we resorted to bibliographic material (which serves to explicitly cite all bibliographic references required in the elaboration of the theoretical framework, citing the authorship of each contributor to the subject raised). The historical method was used as a second methodology in order to establish the foundations for analyzing the descriptive research methodology and thus be able to answer questions about the reality of the study carried out. This allowed to establish a before as a starting point and an after education in the present study. With this, changes in the methodology of teaching and learning throughout the 20th century up to the present time were evidenced. Both teachers and students were immersed in new forms of education along the way. It is that education has been changing from the first industrial revolution to the current Industry 4.0 which has required workforce of 4.0 educated personnel.

Results

Pedagogical renewal and innovation, which are generally postponed, but which are implicit in Education 4.0, now have the great opportunity to become a reality and allow for both quality and equity in education. Therefore, it is recommended that in the immediate future, educational systems should be implemented that consider

technology as their main resource, that are resilient, that can respond efficiently to emerging situations presented by this changing world, and that can face the challenge of reducing the inequalities that were aggravated as never before with the pandemic, through Education 4.0. The technological advances that the world is dealing with today, such as robotics, artificial intelligence, Big data, or the Internet of Things (IoT), which have greatly impacted the world, have resulted in the need to give it the importance it deserves and to prioritize the development and strengthening of teachers' technological competencies, as well as the equipment of institutions, and to implement an educational approach that considers Education 4.0 as the basis of the teaching-learning process.

Discussion

The drastic change in daily life caused by the COVID-19 pandemic, coupled with the generalized economic crisis, has led to a major change in the way, place and time in which student learning occurs. Human beings have had to adapt quickly to different ways of teaching and learning, and teachers have been forced to develop new skills and abilities, especially in the area of education-oriented technology, in order to maintain the quality of education.

Education 4.0 has had a great impact on education under the pandemic scenario that the world is experiencing, as it has allowed teachers to implement innovative strategies, and to seek adequate resources to maintain student participation and motivation, thus highlighting the importance of this fourth industrial revolution.

The evolution of e-learning education platforms guarantees a suitable environment for the virtual classroom, and even for a virtual university campus, since it offers all the facilities that student learning needs in modern times, and inserts it into the rhythm of the world market.

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