DISTANCE EDUCATION IN THE EDUCATION 4.0 ENVIRONMENT

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Abstract

Distance education (ED) has its antecedents in the 19th century, with the sending of contents by mail; since the 20th century, technology has changed the educational environment, not only in sending information - now digitally - but also in learning strategies, both for face-to-face and in distance environments.

At present, in the educational context the so-called "Education 4.0" appears, which is still controversial because, on the one hand, it refers to trends in educational innovation mainly in the digital context, a fact that already existed without being called "education 4.0". On the other hand, Industry 4.0 emerges, which considers that education must adapt its structures and design ad hoc learning experiences to achieve the desirable objectives of the modern productive sector (Flores et al., 2020).

In the context of the Covid-19 pandemic, face-to-face education is transferred to distance learning, and therefore, some consider that we are in the context of education 4.0, when in fact a detailed evaluation has not been prepared.

This paper presents the results of a qualitative research carried out with key informants to determine the degree of effectiveness of education 4.0 at the higher level. For this we rely on constructivist theories that indicate that the center of pedagogical activity is the student as an active agent of learning. The analysis was complemented with the theory of Connectivism (Downes and Siemens). This paper presents a part of a broader investigation carried out in Mexico, at the National Polytechnic Institute (SIP-20201596).

Among the results obtained, we can say that it has not been possible to move efficiently to education 4.0 without students receiving training in the use of technological tools, in addition that students need to be trained in relation to new ways of studying in online, which are different from face-to-face education. It is necessary for the teacher to redesign their materials to generate more collaborative activities.

This research provides important elements to enrich the clarity of the term Education 4.0, as well as its main actors and the trends of change in learning management that are heading towards the 21st century.

Keywords: Distance Education, Education 4.0, Industry 4.0, conceptualization.

1 INTRODUCTION

In the society in which we live, many different fields have embraced information and communication technologies to such a degree that they have become essential to their activities. For example in economics, where digital transactions are already indispensable, or in the production of goods, where high-speed manufacturing is now possible thanks to systematized processes and the use of robotics for precision details, or also in global communications, medicine, or space exploration, among other fields. However, thinking about education, the first image that comes to mind is a teacher with a blackboard. In the current context of social distancing due to COVID-19, distance learning with the help of a computer also comes to

mind. So, what about education and technology? Is the use of technology the only relevant element of a transformative change in education? The short answer is no, so what can be done to address the needs of 21st-century education? The 21st-century is immersed in the 4th Industrial Revolution, or Industry 4.0, but what is happening with education?

1.1 Industry 4.0

We will start by defining Industry 4.0 to then identify the concept of Education 4.0.

In this globalized world, the convergence of digital technologies enables artificial intelligence, genetic engineering, the IoT, nanotechnology, and the high level of automation of different processes. These advancements have inspired new business models and, therefore, new forms of labor and social relationships.

Cotteleer & Sniderman, (2017) indicate: "the Fourth Industrial Revolution, commonly known as Industry 4.0, appears to be changing the way businesses function and, by extension, the stakes by which they are forced to compete", although the concept refers to business, its impact is broader due to its importance in the economy and therefore in society:

Industry 4.0, refers to the marriage of physical assets and advanced digital technologies—the internet of things (IoT), artificial intelligence (AI), robots, drones, autonomous vehicles, 3D printing, cloud computing, nanotechnology, and more—that communicate, analyze, and act upon information, enabling organizations, consumers, and society to be more flexible and responsive and make more intelligent, data-driven decisions. (Deloitte Development LCC, 2020, p. 3)

That is to say, production processes use advanced machinery for automated production, which is interconnected with smart technologies, creating, in turn, an intelligent, flexible industry, thus generating a new value chain and transforming the traditional business model. These smart technologies are nine, according to Rubmann, see fig. 1
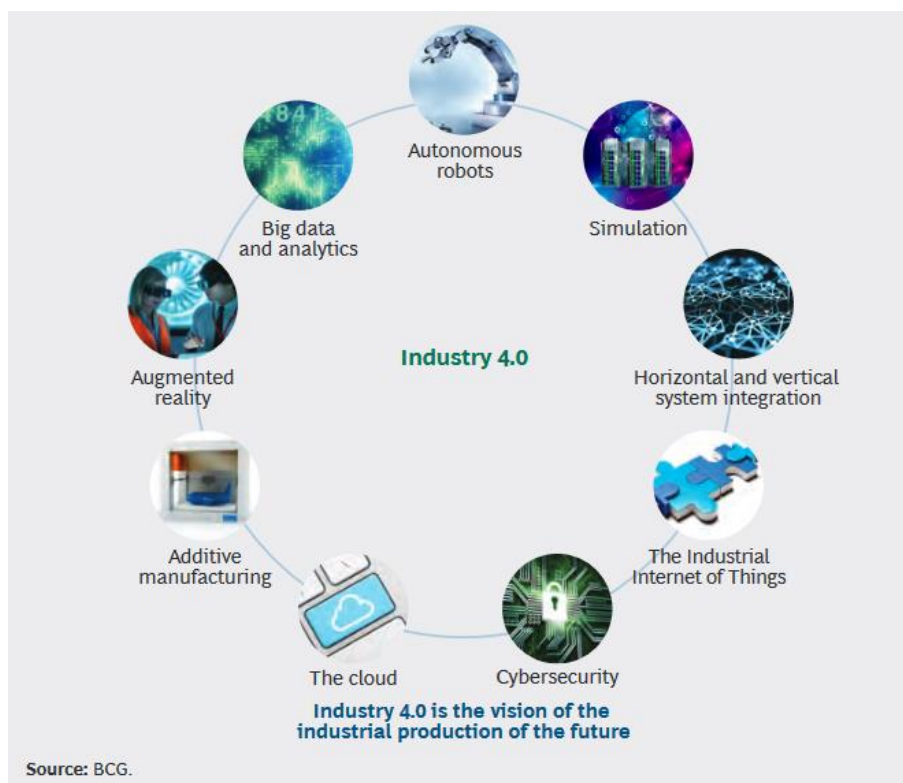

Fig. 1: Nine technologies are transforming Industrial Production. (Rubmann et al., 2015, p. 3)

For the transformation towards Industry 4.0 to take place, high economic investment is necessary to acquire technology; it is also necessary to have a legal framework to define regulatory issues, a vision of constant product innovation, and services for flexible schemes that allow greater customization by the client, including the concern about the possible rise in unemployment rates (due to the extensive use of automated technologies). Thus, it is recommendable to innovate in employment policies and in particular in the training

of personnel with specialized knowledge of digital and operational systems, with transversal skills such as languages, but also with the ability to work collaboratively, creatively, and proactively, using self-management and practicing resilience (Blanco Díaz et al., 2017). This leads us to the next concept, Education 4.0.

1.2 Education 4.0

The term Education 4.0 appears in the context of the 4th Industrial Revolution or Industry 4.0; therefore, a criticism of this term is that its only goal is that students develop the background necessary to support Industry 4.0.

In this regard, different researchers have focused on identifying whether Education 4.0 (E4.0) is an educational model or a pedagogical model. However, an ideal view of how teaching or learning should be approached or the functions of the educational actors is yet to be defined. In this regard, authors such as Silvia Fernández (2020) conclude that it is not an educational or pedagogical model but a trend that has three basic postulates: personalized learning, schools as centers for the development of student talent, and the acquisition of 21st-century competencies; that is, the concept is more than a mere personnel profile for Industry 4.0.

Education 4.0 did not originate from a particular learning theory. However, it is related to constructivism in considering the importance of the student's self-management of knowledge and skills and the social factors of learning; it is also related to connectivism, which considers that learning occurs through connections between networks (either directly with people or through digital networks), generating new forms of knowledge. *

There is mention of the need for 21st-century education to respond to the new society (for some authors, that society would be the one in which Industry 4.0 prevails, for others, Industry 4.0 still does not reach all countries). However, it is necessary to respond to the century's new educational challenges, the new needs, and the new citizens. Education 4.0 will require flexible and personalized plans supported by technology to produce new citizens with a proactive vision of the new society, a new approach to the labor challenges ahead, a renewed vision for practical and active education, novel teacher and student roles, and new ways of using technology.

Education 4.0 must be:

1. Adaptive. It designs in-person or virtual learning ecosystems according to the characteristics and needs of educators and students.

2. Self-regulated. It assumes that the students can control their behavior and, consequently, be proactive in complex situations.

3. Experimental. It creates educational situations where the students explore their skills to manipulate reality.

4. Active. It turns the student into an agent of change instead of being an information storage.

5. Interactive. It fosters relationships among students, with other agents, and with their environment.

6. Collaborative. Students achieve common goals through the sum of efforts and resources.

7. Self-directed. Students make appropriate decisions based on the content they want to learn.

8. Rhizomatic. It makes the students recognize their potential to develop their talents with autonomy and promotes their resilience in the face of adverse situations.

9. Ubiquitous. It formulates the thesis that educational situations can occur at all times and in all places. Therefore, the student can continue their education throughout life.

10. Problem-based. Involves students in solving real problems.

11. Project-based. It involves students in the execution of an action plan focused on the attention to a particular need or the solution to a specific problem. (Flores et al., 2019, p.658).

Faced with this scenario, Mexico's ANUIES, an organization that groups together the country's main public and private higher education institutions, recommends promoting the development of new educational models within the framework of Education 4.0, which should respond to the challenges of this new era and make the approach to society and the knowledge economy feasible, that is, whether or not the concept of

Education 4.0 has a clear meaning or not, its foray into the social sphere is ongoing.

1.3 Educación a Distancia en el Periodo por Confinamiento por Covid 19

As a result of the confinement period, Mexico, like other countries, went from in-person classes to online classes practically overnight. Since the beginning of this confinement in Mexico, in March 2020, all classes of the various educational levels had to be taught using emerging technology. Thus, the basic education levels used educational television programs because 92.5% of Mexican households have at least one television. Online classes were offered via the internet; this was problematic since national coverage is low (only 52% of households have internet access), or the coverage was not free and, additionally, it required equipment, be it a personal computer, laptop, or smartphone.

The technologies that were used to continue the distance classes, for the high school and higher educational level, went mainly to educational platforms such as *Moodle, Classroom, Microsoft Teams*, among others. Video calls and videoconferences such as *Zoom, Webex, Google Meet,* even *WhatsApp*, among other videophone services, were also used as support, for all this the use of the Internet has been essential.

Although technology had to be present in this period, not because of the use of technology for this educational purpose, it can be said that it has ventured into Education 4.0

However, E4.0 does not refer to a single modality: it can refer to both in-person and online classes. Although E4.0 requires an infrastructure for connectivity, such as distance education platforms and equipment (hardware), the technological element is not the only one.

E4.0 is not a pedagogical model, nor does it contain an educational philosophy. Instead, it refers to the knowledge, competencies, and abilities that students must have according to a social context (in the 21st-century). It must be reflected in the curricular design and redesign of study plans and programs, which should link them to the goods and services production sectors. It requires personnel who have the scientific, technological, and problem-solving capacity, as well as creativity and capacity to innovate and interact with human beings and computer systems, all of which is characteristic of Connectivism theory. Therefore, E4.0 also requires didactic strategies that help to fulfill those curricular contents.

2 METHODOLOGY

This presentation shows the results of qualitative research carried out with key informants to determine the effectiveness of Education 4.0 at the undergraduate and graduate levels. We conducted seven in-depth interviews with undergraduate and graduate-level teachers (four men and three women) and four interviews with students (two men and two women), all of them from the National Polytechnic Institute (IPN).

3 RESULTS

Due to the limited space, we will present the main results only. An extensive presentation of the various testimonials cannot be done for the above reason, although some are mentioned. In order to preserve the anonymity of the interviewees, some testimonies are identified by consecutive numbering, using a T for teachers and an S for students, and M for men and W for women.

Results are presented by categories.

3.1 Technologies

All the interviewees, teachers and students, indicated that they taught or took online classes via videoconference (Teams, Zoom, Meet); some were complemented with exercises, readings, or homework on platforms such as Moodle and Classroom. One of the interviewed teachers, TW1, indicated that she first used Moodle (to provide asynchronous remote content as there were interconnection problems) and then: "*My students asked me when we are going to have a class? The class was just a videoconference."*

All the teachers mentioned the importance of having a good internet connection. More than half of them had to increase their bandwidth, especially since they were not the only people in the household using the service; considering that the whole family was in confinement doing home office, all family members required a good connection.

Teachers indicated that, although they had the technology (software and hardware) at the time of in-person education, the first problem was obtaining specialized software when it came time for distance education. Some were able to obtain it through a distance-learning license that the institution provided, but it was not immediately; paperwork had to be done to obtain it. Another problem was that they could only show this on

screen for the students since they did not have access to laboratories where they could access the software

In the case of higher-level and postgraduate students, some of them had "very slow" laptops and sometimes, especially at the beginning of the confinement, their smartphone sometimes worked better, so some commented that they had to buy more updated equipment or with a member of their family, they shared a better team. Some students commented on cases that sometimes the Internet failed and they had to resort to time on their cell phones and buy prepaid cards for this type of interconnection service.

3.2 Advantages and Disadvantages of Education in Times of Confinement

All the interviewees (teachers and students) indicated that the main disadvantages of working at home are noise (from home, from the street) and interruptions by relatives. Some did not have a special place to teach or take classes, so sometimes online classes were in the living room, the dining room, the kitchen, or the laundry room. Sometimes they went out to the street to avoid the noise from the house, but the noise from the street was no better, and connectivity was often compromised.

The main advantage, in all cases, was avoiding travel times from home to school that they considered they could take advantage of during this period.

To different degrees, all the students reported having stress due to confinement, different concerns, boredom, depression, and anxiety.

All the teachers indicated increased work since they were asked for evidence of their distance work and required more time to prepare classes, exercises, schedule remote sessions, and work meetings; the loss of a regular work schedule meant they worked all day, including weekends.

3.3 Design/Redesign of Study Plans and Programs

Regarding this category, the students indicated that they did not know whether or not a redesign was carried out, although they knew that adjustments were likely made to the course.

The IPN has a formal process to comply with for the design and redesign of the course, but since the teachers were in confinement, it could not be made official. Therefore, all teachers stated that they made thematic adjustments but could not redesign since official permits were required, which shows a lack of institutional flexibility in the redesign process.

3.4 Teaching Strategies

Some students complained about the teacher repeating the same thing but now in a videoconference. One student indicated that he now felt that they were being assigned more readings. Another student, SM3, said: "*Sometimes I feel like they forgot about me, like I don't know if they are talking to me*." Other students indicated that they preferred not to turn on their camera during the videoconference. "*Why turn on the camcorder? This way, I can have breakfast."*

This point of analysis was very diverse. Some teachers used strategies such as flipped classroom, others sought to interact with students by asking questions, while others continued teaching with PowerPoint, some presented videos, photos, diagrams (depending on the subjects they taught), and others indicated that distance education is more difficult since practices or demonstrations cannot be done. A teacher, TW2, indicated that she designed practices in the chemical field with products that they could find at home. Another teacher, TW3, asked for practical exercises and asked the students to send small videos taken with their smartphones. Sometimes those videos did not show well what they had done, but their grades could not suffer for having a bad cell phone camera.

Other teachers indicated that the IPN offered courses about new teaching strategies during the pandemic. Some of these could be applied, such as making an educational video, but other strategies required a long time to prepare, which was not available.

Little use of collaborative strategies was observed, for example, project-based learning, among others, indicating that, although these scenarios are sometimes designed, technology and the students themselves sometimes fail to become adequately involved, preferring to work independently.

3.5 Skills and Competencies Developed

This category was difficult to evaluate by teachers and students. TW1 indicated that: "*Some students seem not interested in anything, so they surely haven't learned anything, [...] They are in a family environment where we sometimes do not know if they support them or not with schooling."*

Some students indicate that they have learned, others indicate that they do not learn in the same way, *"in the classroom the classes were better."*

3.6 Self-Management of Knowledge

Teachers consider that students have not developed self-management of knowledge; they still have to direct them in great detail. TW3: *"As a teacher, if I don't know how something works, I look for someone to explain it to me, be it to the IT people, to my colleagues, even to my students, but I have to solve it."* TM1: *"the software and platforms are very intuitive, if you don't know, press here or there, but you solve the problem, you can even search for it on the internet".* TM4: *"Students have to change their way of studying. It is not the same for face-to-face mode as for distance mode".*

4 CONCLUSIONS

We evaluated a series of categories related to Education 4.0 during the COVID-19 pandemic. We observed that Education 4.0 is not yet a reality, at least in this case study (IPN). There are no flexible processes for redesigning or designing study plans, as an official process is required in this regard. The use of technologies is a good step, but the elements of access and remote licenses are yet to be perfected. However, it must be recognized that the IPN supported those students who indicated they did not have good equipment (mainly through loans of portable equipment and even giving out equipment to teachers and students who required it). Although the institution provides training to use the equipment and support the didactic processes, there is still a long way to go since not all teachers have taken advantage of the courses, nor are all teachers at the same level. Hence, it is still a work in process. By the time of this evaluation, students and the teachers will have continued perfecting their skills and competencies regarding innovation, creativity, and even self-management of knowledge.

The teacher must try to design new strategies so that there can be a more significant relationship between theory and practice that leads to the development of cross-sectional skills; examples exist, but apparently, administrative meetings and showing evidence of work consumes much of the teacher's time, who could well try to work with more innovative teaching strategies.

The context of Education 4.0 still needs to be worked on, not to create exclusive personnel for Industry 4.0, but because it also promises skills for citizens who will have to face a world with new challenges, models, and opportunities.

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