ICTs for Education during COVID-19

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The educational field has experienced a significant variation with the inclusion of information and communication technologies (ICTs), applying a wide range of tools, from drones, for the explanation of theoretical ideas, to virtual learning environments and virtual realities. These tools and multidisciplinary structures have given more flexibility, adaptability, and dynamics to the education system. The educational structures tend to include ICTs with a higher compliance capacity, accessibility, and end-user attractiveness. Additionally, the utilization of virtual realities via mobile devices and headsets is increasing, as they allow the immersion and acquiring of theoretical or practical skills. In mid-2020, the pandemic of COVID-19 forced the higher institutions (HEIs) to include several ICTs and to move to online teaching, trying to guarantee the continuity and quality in their teaching process.

Keywords: education ; ICTs ; covid-19

1. Sustainability, Education, and ICTs

Education plays a significant role in sustainability since it is the primary means to teach future generations, known as education for sustainability [1]. The education for sustainability focused on providing abilities and capacities for the citizens, so long-term sustained societies are possible [2]. This concept, created 30 years ago, focused on providing future inhabitants with knowledge and skills, so people are active agents in society's continuity and balance [3][4][5]. Moreover, quality education is essential for sustainable development in all levels of society since through it, the transformation of society is possible [4][6]. It is vital to reorientate education to develop knowledge, skills, values, and conduct to develop a sustainable society. These students will be significant agents to create and resolve the current challenges that the world faces, such as climate change, hunger, and social inequalities [1][7].

In this sense, the rapid growth of technological innovations has been welcomed as an unprecedented opportunity to address these social issues [8][9][10]. Teaching students in sustainable development requires that the teachers and systems are adapted to students' needs, teaching level, and modifications inside the society [5][11]. The younger generations are active users of social media, technologies, and mobile apps [8][12], implying that the systems and teachers need to include these technologies to appeal to these new generations to achieve the different skills needed in a sustainable world [13][14]. Several authors and the United Nations Educational, Scientific and Cultural Organization (UNESCO) have stated that sustainability needs to create interactive physical or virtual environments to promote quality education [1][6][7][11][15].

Moreover, UNESCO promotes ICTs as an asset to achieve Sustainable goals in different countries and emphasizes the South Hemisphere [7]. Despite the differences between developed and developing countries regarding incomes, the educational systems rely on the European countries' same structures [16][17][18]. An example would be Spain and other South American countries, like Ecuador, based on the same structures, laws, and principles cemented in the first legislation and created universities. Therefore, using or utilizing ICTs could not be significantly different from Institutions with similar roots [16][17][18]. Because the ICTs have a crucial role in education from a sustainable perspective, most countries have integrated them into educational environments [1]. All these measurements also focused on creating sustainable institutions or green universities, with the idea of implementing and creating sustainable policies [19][20].

However, environmental education is constantly changing because of social, political, or cultural modifications [15][21]. One significant change in the year 2020 was the pandemic of COVID-19, which spread throughout the world and obliged the governments to suspend all non-essential work, including teaching [22][23]. Especially at that moment, for the education system, there was a need to train the teachers in all levels to include the ICTs and virtual education [24]. Such interactive technologies promote students' active learning, allowing their growth and independence training, and further creating networks and collaborations, among others, to solve problems [25]. Due to the relevance of their role, most studies focused on the technologies and forgot about the teachers, especially in HEIs [26][27], whose role is to create the learning and teaching environment. Nevertheless, there are still missing data about university teachers' perspectives and most ICTs or their skills to create a sustainable educational system and achieve a sustainable environment [28][29][4]. Therefore,

in order to fully integrate the ICTs in the educational system for sustainability [21], it is necessary to understand the current difficulties better, the participants and willingness of the active agents, i.e., teachers, and the role of COVID-19, as an outside factor that obliged the integration [30][31].

2. Education, ICTs, and COVID-19

The pandemic of COVID-19 obliged countries worldwide to suspend face-to-face teaching, moving to online classes [1], putting at risk the achievement of the expectation for education according to the Goal Of Sustainability [1][6][7].

Most countries lacked resources for teachers and technological tools [32], which created difficulties for the continuation of education, its quality, and the creation of a sustainable environment [30][31]. These differences between countries were present in different continents, such as Latin America or Europe [33][34]. The report from UNESCO about education in Latin America indicated that among the countries with more resources and the possibility of live classes through online distance learning modalities were Bahamas, Costa Rica, Ecuador, and Panama. However, the government did not provide technological devices. Additionally, other Latin countries provided technical training to the teachers or further support [33][35]. For instance, the Ministry of Education of Ecuador launched a self-learning course for teachers called My Online Classroom [36]. This same Ministry created and implemented the “Plan of COVID-19”; through this plan, the government wanted to guarantee the educational service during the phases and scenarios of health emergency; support the educational community in prevention; and provide protection and emotional support to teachers, parents, and students [34].

In Europe, the European Union put a united front to change to online teaching [37]; however, there was a lack of digital resources described as essential and widely used by the different governments to cope with this switch [38]. The different organizations around Europe have created and made available courses for training the teachers. Nevertheless, each country has put online teaching differently, including different distance learning modalities and resources for the teachers [39]. In the case of Spain, different reports have indicated that COVID-19 has increased the inequalities of equipment and preparation that exist between families, centers, and teachers. Moreover, Spain is an example of relegating the educational policies to focus on health measures; this country presents much more disparity because of diversity between territories [40]. Meanwhile, Spanish researchers have highlighted how the use of ICTs has negatively impacted teachers’ health and how the students considered that the university teachers were capable and could change from face-to-face to online education [41][42]. Although few studies and reports have focused on the university level [43][44][45], the implementation of online teaching was carried out in some scenarios without training, resources, or skills, implying longer hours of working [46].

Despite the possible differences between countries or regions, Feyen indicated that the issue with COVID-19 was the pressure that the teachers at all levels may feel stress or experience some emotional distress. This stress was based on the estimation that the working hours per week with ICTs increased 20 h, being higher depending on the type of contract, working experience, age, or the country [46]. Nevertheless, these factors or comparisons between countries with similar structures or roots, such as Ecuador and Spain, with comparable ICTs and teachers’ skills, have not been studied (Table 1) [17][47][48].

Table 1. Differences between Spain and Ecuador.

Differences	Ecuador	Spain
Incomes	**Low-medium incomes (108.4 million in 2018)**	**High incomes (1.419 billons in 2018)**
Dynamic transformation	**Higher Education Law of 2010 to improve education and research**	**Organic Law 6/2001, from December 21**
Number of public/private institutions	**33 public/26 privates**	**50 public/32 privates**

Following the comparison between these two countries, fewer studies are available for understanding the Ecuadorian education changes caused by COVID-19 [36][49][50]. In Ecuador, recent researches have focused on the mental health of Ecuadorian students focusing on the pressure and impact of using ICTs [49], resources available at the time [36], and the experience of the teacher [49]. In Spain publications, researchers have focused on students’ perspectives regarding the change to the education, use of the ICTs, and only little has included the teachers’ point of view [43][41][44][49][51]. One Spanish research had as participants the university teachers training the future teachers from elementary schools, although the objective was to evaluate the impact of ICTs on the teaching process [52].

Moreover, few studies have been based on intercontinental analysis [53][54][55], with only two publications studying Ecuador and Spain [54][55]. Said-Hung et al. [53], in an Ibero-America study with a sample of 700 participants from six countries, including Spain, indicated that the perception of the teachers and students depended on individual variables, such as previous experience in virtual environments or the average number of daily hours devoted to the activities, and using ICTs. Meanwhile, Tejedor et al., analyzed the perspective of 376 students from Spain, Ecuador, and Italy regarding ICTS and HEIs, and whose results indicated the need to improve the teacher's digital skills or sources for learning [54]. Another study from this same research group studied the perspective of 196 university teachers from the same three countries, indicating the lack of information, training for the new scenario, or the limited skill of technical aspects [55].

These studies pointed out how the students identified the issues regarding their educational systems and difficulties to include ICTs, therefore, to create sustainable HEIs [5][21][31][54]. However, few studies included the teachers' perspective, skills, or experience, which are major factors in providing quality education and training future generations in sustainability [18][55][56].

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