

Collaboration Between ESPOL and Villanova University on the Development and Delivery of a Digital Literacy Program for Youth on the Galapagos Islands

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Abstract

Due to the COVID-19 pandemic, the Galapagos Islands in Ecuador faced major difficulties due to travel restrictions which affected tourism as their main source of income and education. The educational system in the Galapagos Islands is very limited because of a lack of connectivity and resources, including qualified computer teachers and access to computers. This paper describes a project collaboration between universities, including faculty, student volunteers, and alumni(ae) located in Ecuador, Canada, Sweden, and the United States. The focus of the project was on improving the quality of education in the Galapagos Islands. The goal of the project was to offer an online digital literacy program designed to enhance local high school students' digital skills to improve their prospects to continue their education at a university in the mainland or to find a job locally. Due to the limited bandwidth, a key aspect of the project was to focus on a combination of selected online and mostly offline activities to develop students' skills based on the DQ Institute's Digital Literacy Framework. Details of the program content, results of the program and the successes and challenges of this international education program will be shared in the paper.

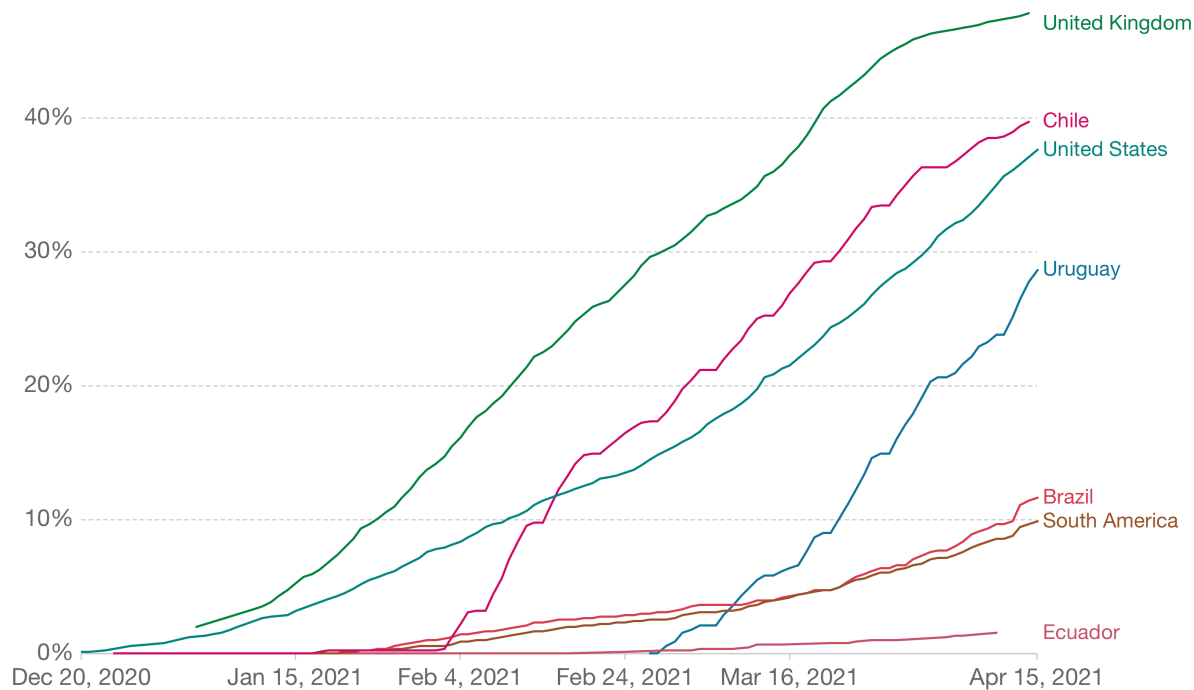
Introduction

The impact of the COVID-19 pandemic will continue to be studied for years to come given the disruption to our daily activities and its impact on the world's economy and public health [1-3]. While government and health authorities continue to reduce the large death rate suffered in the past year [4] through vaccination plans, several developed countries will start to lift restrictions in coming weeks and months[5, 6]. On the other hand, countries such as Ecuador, have just started to administer vaccines to healthcare workers and government officials and are projected to remain with some restrictions until the end of the year while they achieve the target of immunization by vaccinating 60% of the adult population in 2021 [7]. As of April 15, 2021, Ecuador is underperforming in terms of vaccine administration compared to some countries in South America and Worldwide, as shown in Fig. 1.

One of the most affected areas worldwide is the Education sector with students' school year unexpectedly changing from in-class sessions to online education. Recently, in-class sessions have started again in a limited capacity in some schools in Quito [9]. This change was suggested by UNICEF in Ecuador as 25.2% of students in schools don't have access to the internet and

Share of people who received at least one dose of COVID-19 vaccine

Share of the total population that received at least one vaccine dose. This may not equal the share that are fully vaccinated if the vaccine requires two doses.



Source: Official data collated by Our World in Data

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Figure 1: Current efforts for vaccination in different countries [8].

12.5% of students don't have access to an electronic learning device such as a tablet or computer. Also, 60% of students feel they have learned less, and 40% of students have experienced distress due to missing classes since the pandemic started [10]. Ecuador has different school cycles for the Highlands Region (where Quito is located) and the Coastal Region, where students are on school vacation until April. It is unclear when the rest of the schools in the country will open as principals and the Ministry of Education are still focusing on vaccination plans and completing the bio-security protocols for a safe return to classes.

Literature Review

During the lockdown, digital skills became essential as most of the people worldwide continued to work or study online from their homes. The concept of Digital Literacy was introduced by Paul Gilster in 1997 [11]. He describes Digital Literacy as "the ability to understand and use information in multiple formats from a wide variety of sources when it is presented via computers". Gilbert wrote his book in a time in which understanding digital literacy was to have the "technical skills" to use a computer and browse the Internet. Nowadays, it can be extrapolated to a broader framework [12] that not only combines technical skills but also competencies, such as problem-solving and design thinking, to interact with digital and non-digital technologies and how to apply them effectively to accomplish a task.

In [13] the authors analyze the impact of Digital Literacy during COVID-19 lockdown in higher education institutions in Spain, Italy, and Ecuador. A total of 376 students completed a survey for this study focusing on teachers' engagement and collaboration, teachers' skills, digital resources, and supporting students. The key findings show that students in Ecuador felt more supported during classes and teachers appear to be more coordinated in Ecuador than their European counterparts. It's also important to note that 76% of Ecuadorian students think that teachers have appropriate digital skills for online classes during the lockdown, although most of the students also thought classes were less stimulating and more demanding. Also, 73% of students in Ecuador felt confident about their digital skills, which was similar, but slightly lower than, in Spain and Italy, which respectively felt 74.8% and 76% confident on their digital skills. According to the authors, the results show that higher education institutions need to revise their learning environments to promote more digital environments while supporting and developing teacher's digital skills.

Almost as important is the selection of appropriate online tools for different activities. In [14], the author examines the merits of Zoom and private Facebook Groups to replace academic group meetings during COVID-19 lockdown. This paper describes the advantages of using Zoom for synchronous learning formats such as real-time interaction fostering meaningful discussions considering opinions and backgrounds, reduction of isolation, the application is easy to use and is available on multiple platforms. On the other hand, Zoom relies on a good internet connection and requires participants to have some organization about who and how long somebody will talk. The other alternative, private Facebook groups, allows for asynchronous and hybrid learning formats. This platform is useful, as it allows participants to access the content on their own time, cite others' contributions, and download the information more seamlessly as it is available even months after posting. Ultimately, the selection of the platform will be dependent on the needs of the application or program.

The Galapagos Islands in Ecuador faced major difficulties due to travel restrictions during the 2020 lockdown which affected tourism, the main source of income for people in the Islands, as well as education. The school year in the Galapagos Islands was supposed to start in early April 2020, but it was uncertain when the schools would re-open. Teachers have struggled to keep up with changes made to the curriculum and keep up to date with the required digital skills to be able to use computers and interact with students remotely. Parents were very concerned about the education of their children during this challenging school year[15] and so far there is no final decision on whether students will start their classes remotely in April 2021. The COVID-19 situation has highlighted that the educational system in the Galapagos Islands is very limited because of lack of connectivity and resources, including qualified teachers and access to computers[16]. Furthermore, teachers in the Galapagos Islands had to overcome additional issues such as not having accounts to log classes, not being paid, and going on strike during the school year.

While there are initiatives looking to improve the quality of education in the Galapagos such as a community Intranet to share Educational Resources [17, 18] and a program to train teachers on how to incorporate sustainability approaches into their curricula [19], the lack of digital skills of principals, teachers, and students remains a barrier to overcome to fully utilize the resources available through these initiatives. Furthermore, given the lack of "Digital Literacy" of teachers in the islands, students in the Galapagos must be encouraged to participate in extracurricular activities to be able to keep up with their peers in continental Ecuador while looking for

universities and job opportunities. Thus, this paper describes the creation of an online Digital Literacy program aimed to support the youth on the Galapagos Islands in developing their digital skills. Details of the program content, results of the program, and the successes and challenges of this international education program will be shared in the following sections.

Digital Literacy Program - “Jóvenes Líderes Digitales”

As stated in the previous section, the authors had initiated a technology-based education project on the Galapagos islands. After the COVID-19 pandemic reached Ecuador, the implementation of a subsequent phase of the project for educating the inhabitants on technology-related topics became more evident. The English translation for the name of the program is "Young Digital Leaders". This describes both the target people as well as the aim of the project. The parents of all the students in Ecuador were extremely concerned about how education will be held in these times of uncertainty, especially because of the lack of connectivity and resources both in equipment as well as in technically qualified teachers.

By targeting the United Nations Sustainable Development Goal (SDG) #4, Quality Education [20], this program was based on the Digital Intelligence (DQ) Framework related to Digital Literacy. While other frameworks are looking at Digital Literacy [21-23], the DQ Framework is the first global IEEE 3527.1™ standard to define digital literacy, skills, and readiness [24]. According to that standard, the areas of focus are digital identity, use, safety, security, emotional intelligence, communication, literacy, and rights, as shown in Fig. 2. Additional information is available in [25]. The program was structured to cover the basic topics to start reducing the digital divide. Therefore, it was extremely important to determine the level of knowledge in technology matters with the students that would be participating in the program.

Content for the Program

Before the start of the program, a campaign was launched to gather students from different islands with the help of the high school principals and local non-governmental organizations (NGOs). The goal was to establish a baseline of the digital skills of the potential participants for the program. This first step was crucial to tailor the program content to meet the students' needs and expectations. A total of 23 students were asked to fill out a survey to determine two key aspects of the development of the program. There were 16 questions on the survey on which the first 10 determined the level of competence in digital skills. The answers were based on a scale from 1 to 5 corresponding to how confident they felt with a certain digital topic. The following 6 questions were aimed at determining the students' access to connectivity and digital resources.

The results of this survey showed that more than the 65% of the students are extremely comfortable around new technology and around 85% had a lot of interest and showed curiosity when it comes to new devices or apps. These survey results indicated that the students were a good target group with which to start the program. When it comes to other skills, such as databases or programming, the surveys showed that the students lacked this knowledge. In the case of online security topics such as detecting malware, phishing, installing anti-virus software, and having a good password creation method, only about 50% of the students felt comfortable



Figure 2: DQ Digital Literacy Framework’s Competencies[25].

with these topics. More than 85% of the students indicated that they had WiFi access at their homes (Fig. 3), and most importantly, all of them had access to at least one device, either computer, smartphone, or tablet, as shown in Fig. 4. Based on the results of the survey, all the students were invited to enroll in the program, but only 17 regularly attended sessions (completing at least 80% of the sessions.)

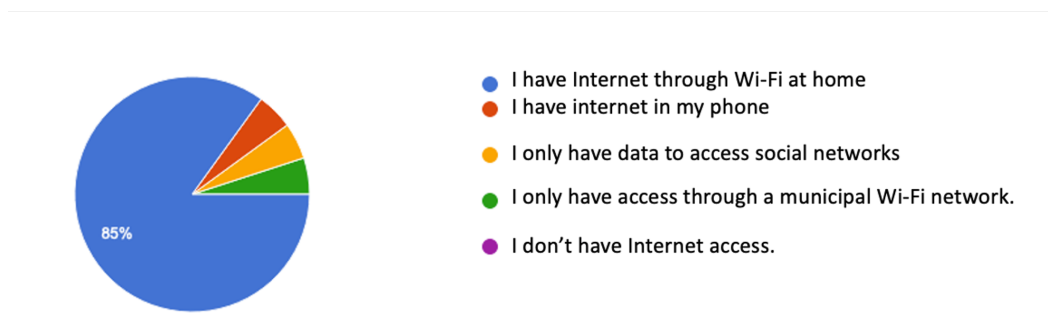


Figure 3: Results of the survey for the question on Internet access at home.

The DQ Institute framework defines the main areas of digital literacy but does not have a strict guideline to follow when it comes to activities or how to develop the skills included in the standard. Thus, the program developed in this project focused on understanding the requisite skills and tailoring to the Galapagos Islands context to make them locally and contextually relevant. Once the shortcomings on the students’ digital skills were determined, and based on the

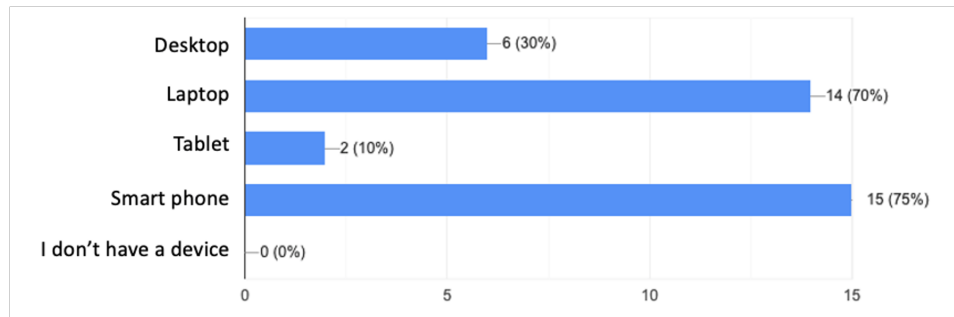


Figure 4: Results of the survey for the question on available digital devices at home.

topics covered by the DQ framework, the content was focused on the following topics: 1) creating a digital online identity, 2) appropriate management of time spent on using technology, 3) personal security and privacy management, 4) digital empathy, 5) online communication and collaboration, and 6) creation of online content.

The guidelines, activities, and presentations were developed by seven different volunteers, native Spanish speakers, located in different parts of the world including Ecuador, the United States, Canada, and Sweden. Each of them had skills in different areas which lead them to develop the material in their topic of interest. This content was presented and discussed amongst the volunteers every week to provide input and feedback and to ensure consistently high quality of developed material. One of the considerations discussed in these weekly meetings was to ensure that the content would work in the context of a lack of a stable internet connection. The program held its first seven sessions covering the following topics:

1. Digital Identity
2. Proper use of technology
3. Online communication and collaboration
4. Content creation and digital literacy
5. Technology in sustainability
6. Cyber risks and digital empathy
7. Online security and privacy

Each session began with a topic-related icebreaker activity. The small presentation from the volunteer and small engaging activities were typically related to tourism or small businesses from the students' respective communities. The goal was to lay strong foundations on how technology can help the students to achieve better results in their daily-life activities. Since the Galapagos Islands are famous for tourism, most of the time the students created content or elaborated their weekly activities around touristic places, promoting restaurants or hotels, and having small businesses being published on social media or through a website. An example of such an activity is shown in Fig. 5 which was developed by a student in the program.



Figure 5: Work submitted by a student for the Online communication and collaboration workshop.

Structure of the workshops

As mentioned in the previous section, volunteers developed the content for the program. These volunteers also served as mentors for small groups of participants, around 2 to 3 per group. This created a positive environment where the students felt confident enough to actively participate during the online sessions and the proposed activities. This structure also served as a "train the trainer" model since it aimed to make the participants involve more people in their communities to become aware of the benefits that technology can bring to their lives turning the students into new digital leaders in their communities.

Another aspect to consider in the small group dynamics is that the mentors were not there in a conventional teacher role. This program was meant to make the participants develop both soft and hard skills. The mentors were guiding the mentees throughout the process of learning. Their role saw them as coaches motivating students rather than teaching them. This was done for two important reasons: the students were already overwhelmed by their online school classes and assignments; and the unstable Internet connectivity that would turn into frustration when attending a live class. This did not mean that they felt alone during the program. On the contrary, they valued the help and guidance from their mentors to accomplish the goals of each session.

Due to the limited Internet bandwidth, the content was delivered through short videos, already

found online by different authors. Also, by posting short documents with well-developed exercises or activities, the download time was reasonable for these documents. Having worked for several years with students on the Galapagos Islands, and more frequently through online meetings after the pandemic started, it was recognized that the bandwidth accessibility is better at certain times of the day. Another solution to overcome the connectivity problem was the flexibility of the mentors and mentees to connect through different platforms like WhatsApp, Facebook, or Zoom to hold the weekly sessions. Phone plans in Ecuador typically offer unlimited access to these two social media apps and so they were considered the best platform choices for mentor-mentee communication.

Results

The goal of the present project was to offer an online digital literacy program to a core group of about 30 technically savvy students who also showed leadership potential. This core group of students could help to teach additional students and community members in the future. The recruitment process involved asking students to complete the survey prior to their enrollment in the program. This allowed the program to be tailored to the students' Digital Literacy needs as well as to assess their access to computers and to the internet in their homes. Part of the funding received for the project was used to purchase computers for motivated students who did not have one to allow them to participate in the program.

While only a total of 17 students participated remotely in interactive workshops led by mentors on a range of digital topics, it was still considered a success since the students who participated were very motivated. Students were particularly excited to learn how to create a Web-page, as this was a skill they could immediately use to promote their family businesses. Another workshop they enjoyed was the online communication and content creation as they were asked to promote the Galapagos Islands to the world.

In addition to increasing their digital skills, the program provided opportunities for students to learn about how professionals in the Galapagos Islands use their digital skills in their everyday activities. During the last session of the program, two local speakers, the IT Director at the Galapagos National Park and the IT Director of the ECU 911 presented to the students. During this session, the guest speakers described their work as well as their journeys to arriving at their present positions and how digital skills got them where they are today. The students found these presentations very inspiring. Also, during the final session, the students were awarded digital certificates of participation and completion of the Digital Literacy Program. A screenshot of the closing ceremony over Zoom is shown in Fig. 6.

Lessons learned

One of the biggest successes in the project was the relationship between mentors and students. Each mentor had 2 to 3 students who they guided through the program. This allowed for a personalized connection between them which provided a comfortable environment for students when requesting feedback or asking questions. Also, an important achievement was that content for the program was developed by mentors. Each mentor was asked to develop content for one of the modules for the program.

The content was based on the DQ Framework for Digital Literacy and socialized with experts on the different topics. Thus, the activities and content prepared were inventive and appropriate to the local context. Given this, students were very excited to be learning skills such as web design

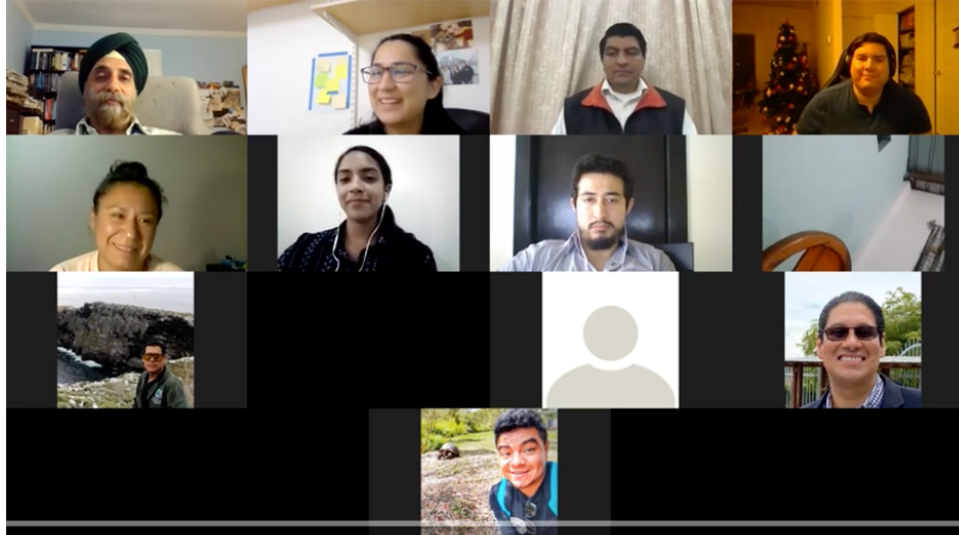


Figure 6: Closing ceremony where students received digital certificates.

which they can apply to their family businesses and towards getting a job on the islands. Their interest in creating a business with their digital skills lead to students asking to learn about E-Commerce to seek entrepreneurial opportunities in the Islands. This, as well as Entrepreneurship, will be included as additional topics for workshops in future phases of the program.

In overcoming connectivity issues, social network platforms can help to connect students and mentors. WhatsApp, Facebook, and Zoom were the main tools used during the preparation and delivery of workshops. Students favored the use of WhatsApp as it is an application widely used in Ecuador, so much that basic local mobile plans include unlimited messaging through this platform. The use of online platforms allowed for mentors to participate from anywhere in the world including Ecuador, USA, Canada, and Sweden. The main role of the mentors was to motivate students through the program using interactive “hands-on” activities.

Conclusion and Future Work

The results of the project included the implementation of a remotely delivered Digital Literacy Program to improve digital and leadership skills for local high school students in the Galapagos Islands. A total of 17 students engaged in 7 weekly interactive workshops prepared by mentors on diverse topics from Healthy Use of Technology, Cyber Security, and Sustainability in Technology. The content was developed by the mentors following the DQ Framework which is the IEEE standard for Digital Literacy. The students were very excited to be learning skills such as web design which they can apply to their family businesses and towards getting a job on the islands as well as continuing on to higher education in Ecuador.

The goal of the next phase is to expand the project to have students from the first phase of the project continue to enhance their digital skills including topics such as Web Design, E-Commerce, and Entrepreneurship. In addition, since the content from the first phase of the

project already exists, we would recruit a new cohort of students to participate in a new version of the program. This will continue to develop digital skills in the Galapageño community.

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References

- [1] Warwick McKibbin and Roshen Fernando. “The economic impact of COVID-19”. In: *Economics in the Time of COVID-19* 45 (2020).
- [2] Paul Carter, Michael Anderson, and Elias Mossialos. “Health system, public health, and economic implications of managing COVID-19 from a cardiovascular perspective”. In: *European heart journal* (2020).
- [3] Stefan Gössling, Daniel Scott, and C Michael Hall. “Pandemics, tourism and global change: a rapid assessment of COVID-19”. In: *Journal of Sustainable Tourism* (2020), pp. 1–20.
- [4] Lucy Tompkins et al. *Entering uncharted territory, the U.S. counts 500,000 Covid-related deaths*. 2021. URL: <https://www.nytimes.com/2021/02/22/us/us-covid-deaths-half-a-million.html>. (accessed: 03.01.2021).
- [5] BBC News. *Lockdown: Boris Johnson unveils plan to end England restrictions by 21 June*. 2021. URL: <https://www.bbc.com/news/uk-56158405>. (accessed: 03.01.2021).
- [6] Julie Bosman and Lucy Tompkins. *Texas Drops Its Virus Restrictions as a Wave of Reopenings Takes Hold*. 2021. URL: <https://www.nytimes.com/2021/03/02/us/coronavirus-reopening-texas.html>. (accessed: 03.04.2021).
- [7] Ministerio de Salud Pública. *Ecuador: 18 millones de vacunas negociadas para el 2021*. 2021. URL: <https://www.salud.gob.ec/ecuador-18-millones-de-vacunas-negociadas-para-el-2021-2/>. (accessed: 03.03.2021).
- [8] Our World in Data. *Coronavirus (COVID-19) Vaccinations*. 2021. URL: <https://ourworldindata.org/covid-vaccinations>. (accessed: 04.16.2021).
- [9] El Universo. *Retorno a clases presenciales de unidades educativas de Quito en zonas rurales inició hoy*. 2021. URL: <https://www.eluniverso.com/noticias/ecuador/retorno-clases-presenciales-ecuador-nota/>. (accessed: 03.04.2021).
- [10] UNICEF Ecuador. *Los niños no pueden seguir sin ir a la escuela, afirma UNICEF*. 2021. URL: <https://www.unicef.org/ecuador/comunicados-prensa/los-ni%C3%B1os-no-pueden-seguir-sin-ir-la-escuela-afirma-unicef>. (accessed: 03.04.2021).
- [11] Paul Gilster and Paul Glistler. *Digital literacy*. Wiley Computer Pub. New York, 1997.
- [12] David Bawden et al. “Origins and concepts of digital literacy”. In: *Digital literacies: Concepts, policies and practices* 30.2008 (2008), pp. 17–32.
- [13] Santiago Tejedor et al. “Digital literacy and higher education during COVID-19 lockdown: Spain, Italy, and Ecuador”. In: *Publications* 8.4 (2020), p. 48.
- [14] Carol Nash. “Report on digital literacy in academic meetings during the 2020 COVID-19 lockdown”. In: *Challenges* 11.2 (2020), p. 20.
- [15] Javier Urquizo et al. “Digital Technology Initiatives in Response to COVID-19 Challenges in the Galapagos Islands”. In: *2021 IEEE Mexican Humanitarian Technology Conference (MHTC)*. IEEE. 2021, pp. 1–6.

- [16] Javier Urquizo et al. “Assessing energy and communication needs for the sustainable and educational development of the inhabitants of the galapagos islands”. In: *2018 IEEE Global Humanitarian Technology Conference (GHTC)*. IEEE. 2018, pp. 1–7.
- [17] Javier Urquizo et al. “Improving the Quality of Education on the Galapagos Islands through a Community Intranet”. In: *2019 IEEE Global Humanitarian Technology Conference (GHTC)*. IEEE. 2019, pp. 1–8.
- [18] Javier Urquizo et al. “Laying the Foundations for a Digital Literacy Program in the Galapagos Islands”. In: *2020 IEEE Global Humanitarian Technology Conference (GHTC)*. IEEE. 2020, pp. 1–8.
- [19] Diego Román et al. “Education for sustainability in Galapagos: A public-private partnership for strengthening education in the Islands”. In: *GALAPAGOS REPORT 2013-2014* (2013), p. 60.
- [20] United Nations (UN). *Quality Education*. 2016. URL: <https://www.un.org/sustainabledevelopment/education/>. (accessed: 03.04.2021).
- [21] Cristina Sánchez-Cruzado, Raúl Santiago Campión, and M^a Sánchez-Compañá. “Teacher Digital Literacy: The Indisputable Challenge after COVID-19”. In: *Sustainability* 13.4 (2021), p. 1858.
- [22] Fernando M Reimers and Andreas Schleicher. “A framework to guide an education response to the COVID-19 Pandemic of 2020”. In: *OECD. Retrieved April 14.2020* (2020), pp. 2020–04.
- [23] Taufiqur Rahman, Ayu Amalia, and Zuhdan Aziz. “From Digital Literacy to Digital Intelligence”. In: *4th International Conference on Sustainable Innovation 2020–Social, Humanity, and Education (ICoSIHESS 2020)*. Atlantis Press. 2021, pp. 154–159.
- [24] DQ Institute. *What is the DQ Framework*. 2021. URL: <https://www.dqinstitute.org/dq-framework/>. (accessed: 03.04.2021).
- [25] DQ Institute. *DQ Global Standards Report 2019 Common Framework for Digital Literacy, Skills and Readiness*. 2019. URL: <https://www.dqinstitute.org/wp-content/uploads/2019/03/DQGlobalStandardsReport2019.pdf>. (accessed: 03.04.2021).