The Use of ICT and its Effect on University Students’ Wellbeing During COVID-19

Abstract

The COVID-19 pandemic has created an unprecedented need for information and communication technology (ICT), which has allowed university studies to continue in an online different environment, because social isolation is compulsory. This article designed and validated an instrument to assess the use of ICT and its effect on the wellbeing of Ecuadorian university students. A theoretical framework was constructed based on documentary analysis. A draft questionnaire considered students’ and experts’ suggestions. A pilot questionnaire was then validated with a 1,952 students sample. Finally, a reliability instrument was proposed that can be used in studies of similar situations and is able to investigate the relationship between students' wellbeing and ICT during the learning process. The questionnaire analysis revealed that not all of the world’s educational systems are prepared to take on the challenge of online classes, and not all students’ are equipped with conditions needed to participate in online distance education.

*Keywords***:** Information and communication technology, university students, virtual education, pandemic.

**The Use of ICT and its Effect on University Students’ Wellbeing During COVID-19**

 When the history of 2020 is written, it will reveal that all areas of human life were disrupted by the COVID-19 pandemic. The outbreak started in Wuhan, China, in December 2019. Although it was thought that the disease would be controlled in that region, in January 2020, the World Health Organization’s (WHO) Director General declared COVID-19 a public health emergency of international importance. It was then declared a pandemic on 7 March 2020 when over 100,000 cases were confirmed (WHO, 2020).

 At the beginning of March, the epicenter of the pandemic moved to Europe and then to the United States, which had the most confirmed cases. In April, the epicenter moved to Latin America. In May, WHO (2020) confirmed that this region exceeded Europe, Asia, and the United States in the number of daily cases of infection. The situation made real the threat to the stability of the social order, evidencing its latent fragility.

 Due to the spread of the virus, information and communication technology (ICT) has played a prominent role during the crisis (Sánchez et al., 2020). For example, distance education activities have moved from universities to home in online mode, and ICT has reduced the devastation at the national and international level caused by the pandemic, especially on health, which is defined in this paper as the “state of complete physical, mental, and social well-being; not only the absence of infections or diseases” WHO, 1946, p. 2)

 Thanks to ICT, one of the sectors least affected during this crisis has been the educational system. The closure of schools and universities has limited face-to-face courses, and approximately 72.4% of the total number of enrolled students have been affected (UNESCO, 2020). In this situation, teaching in a virtual environment is the best option to ensure the safety of the teaching community and students ( Economic Commission for Latin America and the Carbbean [ECLAC], 2020). However, this measure has raised other unforeseen problems: Although virtual education emerged in the second half of the 20th century, not all the world’s educational systems are prepared for the challenge of online classes.

 In this context, research on the consequences for university students has been conducted (Sánchez et al., 2020; Whittet, 2020). The main objective of this article is to theoretically discuss the advantages and disadvantages of the use of ICT on university students’ wellbeing as they continue their studies through digital platforms, and to report an instrument designed to investigate the relationship between students and ICT in learning.

# Literature Review

# Online Education: Advantages and Disadvantages for Learning

 Distance education is not new, but the emergence of ICT has created better conditions for its implementation. E-learning, as it is also known, consists of the use of ICT to improve and support learning in tertiary education ([Organisation for Economic Co-operation and Development](https://en.wikipedia.org/wiki/Organisation_for_Economic_Co-operation_and_Development) [OECD], 2005). Its advantages include the use of technical resources, applications, and specific methodologies to achieve learning objectives. This alternative has expanded as several universities have invested in learning management systems (LMS) to facilitate their teaching-learning processes (Fathema et al., 2015). In Ecuador, some university centers only use the Web as a complementary resource; other cases use mixed environments (face-to-face and virtual); and for some, there is a growing boom in total online modality (OECD, 2017).

 Several specialists recognize the benefits of online education (García, 2017). ICT constitutes a flexible and open way of accessing a university that can democratize its educational system, making it more inclusive. Then, through ICT usage, higher education institutions have been able to diversify and extend their programs in the same time and space with the same resources and facilities. However, some disadvantages remain, such as the high cost of tuition, expenses for technology and the Internet, students’ abilities in handling technological applications, and institutional technological support (Segura & Gallardo, 2013; Domingo & Bradley, 2018).

 During the COVID-19 pandemic, social isolation has been the only way to avoid contagion, and students have accordingly moved toward virtual distance education. Thus, they have faced a variety of challenges of access to and use of technology, disruption to the family environment, adverse socioeconomic conditions of their homes, and additional concerns for those living in socially-vulnerable situations, all serving to demonstrate the inability of distance education to provide the most disadvantaged sectors with equity and social justice.

 In this context, it is necessary to consider the universalization of Internet access in households in Latin America. Galperin (2017) conducted a study of digital disparities in the region and found that only half of households have access to this service, highlighting that more than 200 million Latin Americans remain unconnected. By 2018 in Ecuador, 24.2% of households possessed a laptop, and the percentage of households with Internet access increased by only 14.7% nationwide (National Institute of Statistics and Census [INEC], 2018). However, in Mexico, 44.3% of households had computers, 56.4% had Internet access, and 44.6% used a computer as a school support tool (National Institute of Statistics, Geography, and Informatics [INEGI], 2019).

 These data illustrate the inequalities in Internet coverage and access to distance education. The digital gap is obvious: Students who lack technological equipment are excluded from the virtual educational process. Therefore, their abilities to manage technologies are limited, affecting their adaptation to the online education process (Aldas, et al., 2013; Sánchez et al., 2020). This discrepancy reflects the existing economic and social differences in the region.

 Furthermore, the statistics in this geographical area show an unquestionable disparity in the conditions in study in a large percentage of households. Among other aspects, families persist at a limited socioeconomic level, leaving them vulnerable to adversity. Children do not have appropriate spaces in their homes allowing them to focus on their studies, and thus they carry out their tasks or learning activities in unhealthy environments where overcrowding is common (Galperin, 2017). The inequalities in housing conditions limit the construction of the inclusive and adaptive learning environments needed to ensure a successful virtual distance education.

 The challenges imposed on populations in confined conditions reinforce Bauman’s (2007) thesis about liquid modernity, which involves an uncertain and indecisive situation that extends to the most diverse spheres in social life, including global educational processes, where human interactions and ties among family members and academic partners have been altered (UNESCO, 2020). Virtual learning environments place greater emphasis on students living in vulnerable homes.

 Under the circumstances of the COVID-19 pandemic, university learning via ICT is the only alternative to avoid the virus spreading and to safeguard health. Therefore, it is necessary to consider some of the associated situations that influence the learning process such as Internet access, provision and use of computer equipment, platform management and circumstances related to time administration, the organizational conditions of physical spaces to work remotely, and the emotional and health conditions faced by students (Robinson et al., 2015; Sánchez et al., 2020).

 Consequently, teachers face new challenges in the organization of educational practices, and it is necessary to consider the incorporation of technologies since profound changes are required. According to Barrón (2020, p. 73), the challenge involves “making of this opportunity a disruptive pedagogical project of long breath, inclusive, intercultural, equitable, sustainable and linked to the constantly changing social reality.” Moreover, Falls et al. (2014) showed how virtual activities, when appropriately designed, effectively contribute to learning, interaction, individual responsibility, and positive interrelation.

 However, while technology helps maintain educational processes even in times of crisis, the way exchanges are conducted do not always complement pedagogical objectives without inconvenience. While technology introduces changes in education, “it has not led to the radical revolution in higher education that many anticipated” (Helmeid & Vincent-Lancrin, cited in OECD, 2017, p. 66), and communication between professors and students and feedback strategies are made over a short amount of time (Mandernach, 2018). Collaborative communication between students leads to the creation of outstanding results, making professional learning remarkable (Valenzuela & Soriano de Alencar, 2006).

 One of the issues that most affects this is the rejection of virtual education by some teachers because they have had limited training in the use of ICT during their career preparation, and the applications and systems designed for online education have become difficult for them to work with (Sánchez et al., 2020). Teachers who work in a virtual distance mode must not only possess knowledge about their subject and teaching methodologies (Lepp et al., 2019), but also have practical and social skills for managing Internet tools and technological application (Swicord et al., 2013)

 Whittet (2020) found that the effects of teaching online were also detrimental to the health of teachers, as they felt that they had scarcely met their students’ learning needs. For the students, this has meant assuming a more active role during the teaching-learning process, yet how gratified are those who face compulsory virtual courses due to COVID-19?

# Impact of Technology on University Students’ Wellbeing

 During the literature review, it was also possible to verify the fact that there has been little scientific investigation of the incidence of university students’ exposure to ICT in the online or virtual teaching process. Outside the educational setting, problems can be identified such as cyber addiction from students’ dependence on video games and social media platforms such as Facebook, or nomophobia, referring to the feeling of anguish from not being able to use a mobile phone (Arpaci, 2017), which exceeds the computer in this respect (Quintero et al., 2015).

 Belçaguy et al. (2015) conducted a study of the impact of the excessive use of technologies such as the Internet, mobile phones, and social networks, and identified various physical and mental disorders among university students. Other studies have detected muscle tension from exposure to more than eight hours of screen time as well as issues of overweight or obesity (Fung et al., 2012; Yang et al.2017), while other studies have found excessive use to cause insomnia due to anxiety from consuming technologies **(**Mikolajczyk et al., 2008).

 Other studies have verified, among the psychological problems, the phenomenon known as “imaginary calls,” which is the sensation of a mobile phone ringing or vibrating without it having done so. Studies have also found respondents to experience depression when viewing other people’s progress via Facebook. For instance, the more depressive the mood, the more Facebook is used to communicate with people without familiar or close bonds (Jeri-Yabar et al., 2019; Pontic, 2014), and these users become depressed when comparing their lives with what they see of others’ (Eisenchlas, 2013). Finally, there are students who have “double check” syndrome, anxiety experienced when the recipient receives a message but does not reply (Belçaguy et al., 2015).

 These previous studies are from other areas of knowledge than the field of educational research. However, the continuous use of ICT throughout the entire teaching process is known to have an impact on students’ health. For example, the results of a study that focused on the effects on teachers concluded that exposure to virtual education may have can also have involuntary consequences for students (Whittet, 2020). On the physical level, conditions such as shoulder and neck pain, damage to posture, eye strain and headaches, skin problems, and sleep problems have been identified. Moreover, exposure to technological equipment tends to increase fatigue in students and teachers (Ching & Amidi-Nouri, 2019).

 From a social viewpoint, student isolation generates depression and sadness in some cases and anxiety in others (Breuer & Barker, 2015; Mikolajczyk et al., 2008). There is usually a loss in the sense of time, meaning that students spend more time than intended in front of the computer, which threatens their health. Likewise, the time previously dedicated to recreation such as socializing with friends and family begins to be invested in academic tasks, and the time allocated to rest is reduced.

 In the social sphere, these physical and emotional issues degrade mental health by producing feelings of sadness, guilt, and stress. This is reflected in students’ academic performance, and they begin to show anxiety, lack of concentration and interest in didactic activities, low motivation, and little understanding of the content, resulting in a decline in grades (Belçaguy et al., 2015).

 The use of ICT could generate addiction among young university students in the future (Echeburúa, 2010), and the effects of technology abuse could be irreparable (Aldas, et al., 2013) . Therefore, it is necessary to study this phenomenon, and this article attempts to provide answers by designing and validating a research instrument for university students.

# Method

 This study began with documentary research (Tancara, 2003) to understand the use of ICT for learning and its effects on students’ health. The theoretical and empirical approaches used texts, books, magazine, articles, and research related to the topic. The selection criteria were scientific quality and relevance to the objective of this study. Finally, qualitative and quantitative tests of validity were conducted, and the reliability of the instrument was determined following Paniagua (2015). It was then applied to a sample of 1,952 students whom study in a private university in Ecuador’s Sierra, and some of its implications for instruction are discussed.

 Theoretical systematization allowed the definition of the dimensions of the assessment of the impact of the use of ICT on university students’ health in the context of COVID-19. The questions were then constructed based on these dimensions. The resulting questionnaire allows empirical examination of a phenomenon widely discussed by the scientific community. Furthermore, its relevance is greater due to the obligatorily imposed effects on students, especially among those without adequate access to appropriate conditions and electronic devices. The objective of this instrument was to obtain a large amount of data in a short time.

## Design, Validity, and Reliability of the Questionnaire

 The theoretical determined the epistemological basis of the design of the questionnaire to evaluate the use of ICT and its impact on university students’ wellbeing in the context of COVID-19. Once the general objective of the questionnaire was defined, it was necessary to identify the analytical categories or concepts regarding the relation between the “use of ICT” and “effects on health.”

According to the literature review, the first category depended on the following factors: infrastructure and technological access, adaptation to the virtual context and learning strategies, learning environment at home, family coexistence, communication, and development of creativity. The second category involved only one dimension: influence on health.

 These elements were placed along the dimensions of the questionnaire. However, for better interpretability of the instrument, the indicators to measure each dimension were identified and then the questions were determined. Table 1 lists the different indicators of each dimension and the corresponding survey questions.

**Table 1:** Operationalization of Analytical Variables

|  |  |  |  |
| --- | --- | --- | --- |
| Concepts | Dimensions | Indicators | Questions:1st Version |
|  Use of ICT | Infrastructure and access   | Availability of devices for learning (computer, tablet, telephone)Internet accessibility Connection quality  | Q1–Q3 |
| Adaptation to the virtual context and learning strategies  | Motivation and facilities for digital learningDigital learning strategies Reading and understanding digital texts  | Q4–Q6 |
| Learning environment in the home | Availability and acoustics of study areaErgonomic furnitureOrganization and coloration of the study area | Q7–Q9 |
| Family coexistence | Device use within the familyFamily interference during the study activityRole diversity among family members | Q10–Q13 |
| Communication  | Teachers’ feedback Interaction with other students in the group Collaboration between students and the role of the other in learning | Q14–Q15 |
| Creativity development  | Expansion of scientific technical knowledgeTeamwork in the construction of novel products Significance of professional learning | Q17–Q19 |
| Health effects | Students’ health | Sleep disturbancesIncreasing food intake or nutritional changesSedentary changesMusculoskeletal symptomsIncreased consumption of toxic substancesVisual disturbancesStress from work overload, time organization, personalized attention from the teacher, and influence of the environment | Q20–Q29 |

Source: Compiled by researchers

 Open and closed questions were used, despite the aim of a statistical analysis of the data, to assess some issues qualitatively so as to better understand the phenomenon. The language used was precise and clear to allow for the participants’ immediate understanding. Each item referred to a single element and was concisely written to avoid confusion or student fatigue. Moreover, as the participants were young people, simple, direct, and colloquial language was chosen to promote their understanding and motivation to participate in the study.

 In the first version of the instrument, 29 questions were determined. Seven dimensions were scored on Likert-type scales to illuminate the extent of students’ use of technology. The questionnaire was arranged in such a way that the questions progressed from general information to the instrument’s particular issues. The questions were shaped so that the students did not delay in answering and were able to answer all the questions despite their number. This process was followed in the design of the first version of the instrument. However, the validation and reliability processes to determine its optimal use are explained below.

**Content Validity**

 It is important to validate that the items of the questionnaire appropriately measure previously established categories (Paniagua, 2015). Thus, the Delphi method was implemented with the participation of six experts. This method uses their experience from the theoretical and empirical viewpoints of a topic to verify that what is being investigated is in fact being asked in the questionnaire (George & Trujillo, 2018) . The six experts were selected using the following criteria:

1. They taught subjects such as education and health technology.
2. They were researchers of the phenomenon in Latin America, and had directly conducted research and published on the topic.
3. They held a PhD.
4. They had more than seven years of experience in the education and health field.
5. They were available and impartial regarding the present investigation.

 The experts were individually presented with the instrument during two work sessions in which they assessed it under four criteria: (1) sufficiency: When an item in the instrument belonged to a given dimension, it adequately measured it; (2) clarity: If an item was easily understood, it was syntactically and semantically adequate; (3) coherence: If an item was logically related with the dimension or indicator it was measuring; and (4) relevance: That an item was essential and showed high response rates, and that an item avoided difficult, threatening, or judgmental responses.

 Based on these criteria, the experts were offered four response options: (1) *does not* *meet the criteria*; (2) *low level*; (3) *moderate level*; and (4) *high level*. At the end of the first session, it was determined that two questions should be eliminated and that the wording should be changed on 8 of the 29 items originally proposed; the order of the first question should be changed; and requests for students’ addresses and information who they lived with should be included in the general data. After these adjustments were made, the second version of the instrument was deemed suitable.

**Instrument Reliability**

 The next step was the empirical validation of the reliability of the questionnaire based on a pilot survey in two steps, one qualitative and the other quantitative. The first assessed whether the students who would be exposed to the instrument correctly understood the different items.

 The survey was applied to 22 Ecuadorian students in an intentional and convenient manner. They were representatives from different fields of knowledge such as Engineering and Social Sciences. They came from provinces located in the all different areas of the country like the coast, Sierra and the amazon region. In addition, there were representatives from the first to the fourth year of studies. One of the students in the sample had a dyslexic condition and another belonged to an indigenous culture; both were willing to participate in the exercise as volunteers. Students were asked to submit their observations freely without their responses.

 After consideration of the participants’ comments, some aspects of the instrument were modified to yield a clear, precise, and direct instrument. In addition, concerns expressed by the students (described below) that were not addressed by the experts and researchers were considered (see Appendix).

 Among the questions corresponding to general information, the item *Career* was made to be an open question that did not exclude any student from participating in the study. For the question *Number of children* that the participants helped in their learning, the option of “siblings or another relative” was added to gain information about people that the participants helped. ­In the question related to *Disability*, the option “none” was added to explicitly accommodate participants without a disability.

 Among the responses for the item *Estimated time that you dedicate to your academic activities in front of a computer/laptop/tablet/mobile*, the option of “1–2 hours” was set instead of “less than 2 hours” to maintain consistency with the format of the other options.

The item *The number of children you must help in their learning was reworded* to specify people belonging to that family as *The number of children, siblings, or other family members that you must help in their learning.*

In the item *Equipment* *used to carry out academic activities*, the word *Equipment* was replaced by the word “device” since it is a clearer term better conveying what is being referred to. In the item *Estimated time dedicated to academic activities in front of a “computer/laptop/tablet/mobile,”* the words enclosed in quotation marks replaced “electronic devices” as they were more understandable for most students, who were not acquainted with cybernetic terms.

 Among the questions that corresponded to the validated items, two were very similar. This was resolved by deleting one item and retaining the following:

Item 1, I have a personal computer/tablet at home to carry out academic activities whenever I need or want that I do not share with anyone else in the family

One student suggested asking if the participating students knew how to access and work with the new university platforms in class with the teacher. For this reason, Item 3 was reworded thus: *I use a computer/tablet/mobile phone daily to carry out academic activities, and the teacher has taken into account the digital tools with which I best learn for their training project.*

Item 8, which previously read: *The room/study area is painted with light colors that make me feel calm when doing my homework*, was revised to read: The room/study area is organized and painted with light colors and is located in a place with natural lighting that makes me feel calm. There is no noise, so I can focus and do my homewor

 An item regarding various kinds of help was worded as follows:

Item 9, *At home, I help my family members to use the computer/tablet or do homework for the little ones when they don’t know how to do it*

Other items were shortened or words were added because the original forms were imprecise and did not provide the piloting students clarity and focus. The wording was changed as follows:

Item 24, *The increase use of computer/tablet to carry out academic activities has negatively affected my health by decreasing my regular physical activity.*

Item 25, *When I use technological tools, I get nervous without knowing what to prioritize and how to use the new platforms in synchronous communication with the teacher*

Item 26, *When I use technology at home, I am concerned about the teachers’ delays in orientation and feedback on academic activities.*

 Another suggestion given by almost all of the students that was taken into consideration was to place an open option for the students to comment about the reason for choosing their answer without making it compulsory. Thus, the following statement was added to every question: “*If you want to explain the option selected above, you can do so here,”* as this would contribute to better understand the aspect being studied.

 After making the changes suggested by the students, in the second phase Cronbach’s alpha was calculated using the IBM-SPSS Statistics 24 program, which enabled a preliminary descriptive statistical analysis and the determination of internal consistency between items based on the covariance (intercorrelations) between the items of the scale, the total variance of the scale, and the number of items on the scale. Reliability can assume a value ​​between 0 and 1, and the closer it is to 1, the more reliable the instrument is (Quero, 2010).

 As shown in Table 2, the reliability index was calculated for the 27 items in the questionnaire, yielding a value of Cronbach’s alpha of .804. This showed good internal consistency, as a value higher than .80 is considered acceptable. For the case processing summary, there were a total of 1,952 participants and none were excluded from the analysis (100% validity rate)

A través del programa de SPSS, también se puede observar el cuadro de “Estadísticos de la escala”, es decir, los estadísticos de la prueba en conjunto. La media de la escala es de 70,67. Esto constituye un elemento a tener en cuenta a la hora de eliminar un ítem, que en este caso no fue necesario, pues se cuenta con un buen valor de Alfa de Cronbach.

**Tabla 2:** Estadísticas de escala

|  |  |  |  |
| --- | --- | --- | --- |
| Media | Varianza | Desviación estándar | N de elementos |
| 70,67 | 197,278 | 14,046 | 27 |

 Table 3 displays the scale statistics table; that is, the statistics for the test as a whole. The scale average was 70.67, which constitutes an element to take into account when deleting an item or not. This was not necessary in this case, since it had a good internal consistency.

**Table 3:** Scale Statistics

|  |  |  |  |
| --- | --- | --- | --- |
| Half | Variance | Standard deviation | No. of elements |
| 70.67 | 197. 278 | 14. 046 | 27 |

 The intraclass correlation coefficient, which quantifies the reliability of the measurements associated with the continuous quantitative variables, was also calculated (Table 4), allowing the evaluation of the general agreements between items.

**Table 4:** Intraclass Correlation Coefficient

|  |  |  |  |
| --- | --- | --- | --- |
|  | Intraclass correlation b | 95% Confidence interval | Fisher-Test with true value 0 |
| Lower limit | Upper limit | Value | *Degrees freedom**(df)1* | *Degrees freedom**(df)2* | S.I.G |
| Unique measurements |  .132a | .123 | .141 | 5.102 | 1951 | 50726 | .000 |
| Average measurements | .804c | .791 | .816 | 5.102 | 1951 | 50726 | .000 |
|  *Note.* In the bidirectional combined effects model, the individual effects are random and the effects of measures are fixed.a. The estimator is the same, whether the interaction effect is present or not. |
| b Correlation coefficients between classes of type C using a definition of coherence. The intermediate measure variance is excluded from the denominator variance. |
| c This estimate is calculated assuming that the interaction effect is absent because it cannot be estimated otherwise. |
|  |

 The Table 5 of the total element statistics is indicating the average of the scale in case any of the items were eliminated. This allows the determination of the items to omit to improve Cronbach’s alpha.

|  |
| --- |
| **Table 5: Total element statistics**  |
|  | Scale average if the element has been deleted  | Variance of scale if the element has been deleted  | Corrected total element correlation | Multiple Squared Correlation | Cronbach's Alpha if the element has been removed  |
| Question 1 | 67.91 | 178.849 | .411 | .318 | .794 |
| Question 2 | 68.09 | 186.882 | .249 | .298 | .801 |
| Question 3 | 68.40 | 190.128 | .188 | .175 | .803 |
| Question 4 | 68.65 | 192.041 | .180 | .262 | 803 |
| Question 5 | 67.62 | 182.485 | .375 | .204 | .796 |
| Question 6 | 68.06 | 188.676 | .210 | .136 | .803 |
| Question 7 | 68.04 | 187.416 | .236 | .366 | .802 |
| Question 8 | 68.40 | 188.823 | .237 | .388 | .801 |
| Question 9 | 68.17 | 188.058 | .244 | .401 | .801 |
| Question 10 | 68.77 | 190.628 | .186 | .173 | .803 |
| Question 11 | 67.61 | 180.672 | .377 | .416 | .795 |
| Question 12 | 6776 | 178.650 | .444 | .275 | .792 |
| Question 13 | 68.34 | 185.390 | .244 | .218 | .802 |
| Question 14 | 68.43 | 190.368 | .182 | .153 | .804 |
| Question 15 | 68.29 | 189.974 | .186 | .309 | .804 |
| Question 16 | 68.31 | 190.800 | .167 | .357 | .804 |
| Question 17 | 68.78 | 193.704 | .130 | .263 | .804 |
| Question 18 | 68.13 | 186.689 | .303 | .113 | .799 |
| Question 19 | 67.39 | 178.772 | .463 | .459 | .791 |
| Question 20 | 67.48 | 176.081 | .508 | .471 | .789 |
| Question 21 | 67.65 | 176.605 | .492 | .491 | .790 |
| Question 22 | 67.79 | 176.716 | .447 | .413 | .792 |
| Question 23 | 68.01 | 178.172 | .406 | .360 | .794 |
| Question 24 | 67.52 | 179.027 | .409 | .362 | .794 |
| Question 25 | 6.02 | 179.793 | .438 | .466 | .793 |
| Question 26 | 67.89 | 180.574 | .423 | .449 | .793 |
| Question 27 | 67.87 | 180.531 | .417 | .372 | .794 |

 In this case, it was not necessary to eliminate any items because the final value obtained was appropriate. Moreover, it would not be convenient since the table indicates that the value of Cronbach’s alpha would decrease with the elimination of almost any item. Furthermore, the greater the number of items, the greater the reliability of the scale.

 This result shows that to find the reliability of a research instrument, it is not convenient to only calculate Cronbach’s alpha. While the internal consistency would be acceptable, consultation with the participants in the survey found that they did not understand or disapproved of some of the questions. Therefore, it was beneficial for this study to first conduct the piloting questionnaire and then calculate the value of the items’ internal consistency. The calculation of Cronbach’s alpha not only confirmed that the instrument was content-enabled, but also confirmed that the questions were applied correctly.

 The final instrument constituted 26 items and was preceded by the request for general data such as personal and demographic information, which may be related to the answers in order to obtain their frequency of appearance in the data and meet the objectives of the research. The instrument is shown in the Appendix.

 In order to explain the value of the instrument in more detail and gain an idea of​​the effects of ICT in the Latin American university student population, the most significant results for the participants in the pilot study are described below. These only include data about the general information from the sample regarding the number of students living at home who study or work using the Internet; the number of children, siblings, or other family members who require help in their learning; disabilities that limit virtual work; the devices used to carry out academic activities; the usual hours of sleep; and estimated time dedicated to academic activities in front of a computer/laptop/tablet/mobile.

 A total of 966 students lived at home and studied or worked using the Internet for four or more hours per week, which represents 50% of the sample (Graph 1), while a total of 975 students had an Internet service speed that was rated between regular and poor, indicating that 71% have connection difficulties (Graph 2). A total of 227 students used a tablet or smartphone to carry out academic activities, while 32 did not have any devices (Graph 3), meaning that 14% had difficulties in this matter. In relation to the home environment, most of the students must dedicate time to helping other family members—referring to children, siblings, or another family member—with virtual learning, while 33% did not have that responsibility (Graph 4).

|  |  |
| --- | --- |
|  |  |
| Graph 1. People who live together or use the internet |  Graph 2. Internet speed |
|  |  |
| Graph 3. Electronic machine | Graph 4. Number of family members to be helped in their learning |

 Other factor is related to students who have a disability that limits their virtual learning. For example, 471 students had visual problems, meaning that 24% have a limiting disability. Those who answered “other” to this question reported anxiety, depression, and pregnancy problems that make learning difficult (Graph 5). Another trigger for health problems was sleep quality. In this sample, the data of 248 students (14%) stand out, as they sleep for less than 4 hours a day (Graph 6). This is possibly associated with the fact that most of them have jobs and only have nighttime hours to study. Finally, the time that they dedicate to academic activities is affected, since 70% dedicate between one and four hours a day, which may be insufficient to develop professional skills and competences (Graph 7).

|  |  |
| --- | --- |
|  |  |
| Graph 5. Disability |  Graph 6. sleeping hours |
|  |
|  Graph 7. Dedication hours |  |

The adaptation to virtual education has resulted in an increase in tuition and access to higher education in developing economies. In Latin America and Caribbean countries, it has also enabled the expansion of digital literacy (Boisselle, 2014). Particularly during the COVID-19 pandemic, it has mitigated the pressure on universities around the world to continue their training processes. Human and technological resources are being used simultaneously, meaning a reduction of economic expenses (Baelo & Cantón, 2009).

 ICT in virtual education should be implemented for academic purposes using responsible procedures. Additionally, it is necessary to consider the conditions of students attempting to continue their online studies, especially those without access to technological devices and the Internet, those lacking skills and competencies to manage virtual applications, and those who possess any disabilities or find it difficult to adapt to the emerging socialization scenarios (Wissick & Gardner, 2008).

 To introduce such changes, it is necessary to understand the reality of the conditions that students face when accessing virtual education. For instance, do they have access to technological devices and the Internet? Are they familiar with digital learning strategies? Do they have the infrastructure conditions at home to remain in front of the computer without damaging their health? Do they have a good family atmosphere that makes it easier for them to focus during classes? Do they maintain satisfactory communication with the teacher? Does the teacher have the ability to conduct distance education? Is the change from a face-to-face modality to online affecting students’ mental and physical health?

 The answers to these questions and others must be known if the student is to be placed at the center of the teaching and learning process. In this way, the teacher will have more possibilities of working according to the particular needs of students (García, 2017). The academic process more becomes effective and economical because it reduces the expenses of young people for traveling, accommodation, lateness, absences, and study materials.

 Virtual distance education also results in a change of perspective regarding students’ roles in the teaching and learning process. The notion of being a passive receptacle of content is transformed to being an active subject within a virtual classroom who can build her/his knowledge based on the teacher’s guidelines and the search for knowledge among peers. In this context, García (2019, p. 19) explained the scope of learning in this educational modality, and stated that it can be promoted through the following:

Open, active, interactive, community, social, and collaborative learning for critical thinking; flexible, innovative, creative, connected, personalized, multidisciplinary, and motivating learning which encourages learning; and learning through different channels and supports [such as] text, images, audio, and video.

In this way the student will have access to innovative initiatives in classroom methods because young people often have superior skills in managing technological resources and applications for self-learning.

 However, the advantages of using ICT are insufficient. The material available to university students becomes a determining factor in meeting academic goals through online education. Environmental conditions and adequate psychological predispositions should be taken into account, for otherwise students will be dissatisfied by failing to meet the objectives of the teaching-learning process. In addition, the teacher must be trained in technological content and pedagogical knowledge (Cabero et al., 2014).

 The preliminary results of the information on the pilot participants show the problems that might have arisen in many countries in the context of the COVID-19 pandemic, where the conditions for virtual learning are still unsatisfactory. Therefore, the authors suggest the application of the questionnaire to the entire university student population in order to understand the scope of the problem and provide guidance from a variety of specialists to ensure that students are able to learn under virtual conditions in a healthy way.

# Conclusion

 There has been much discussion of the advantages and disadvantages of the use of ICT for education, but few studies have dealt with its effect on university students’ health. It is thus necessary to construct a research instrument to investigate the realistic material and psychological conditions that students face in compulsory virtual distance education during COVID-19 or other crises without affecting their quality of life.

 The validity of the presented questionnaire’s content was based on criteria offered by the experts through the Delphi method, the internal consistency (Cronbach’s alpha = .804), and the results of the pilot. This gives the questionnaire theoretical-methodological credibility and shows that it may be applied in studies of problematic situations related to the objective of this article.

 Once universities’ educational processes have switched to virtual education, professionals are more likely to enter the labor market and adapt to a globalized and changing world. However, in previous studies of students’ exposure to online teaching, a variety of responses to that experience can be discerned. Individual human bodies can respond very differently to technological stimuli. While some students prefer online classes, others reject or avoid this type of experience, especially in Latin American countries, where conditions have not been entirely created for quality virtual pedagogy. In addition, students need to maintain a personal relationship with their peers and have social bonds.

 It would be relevant for further investigation to: (1) find the mechanisms whereby this link will be generated naturally and strengthened without affecting students’ mental and physical health or academic performance; and (2) articulate the responses from the perspective of pedagogues, sociologists, and psychologists in the field of education and from medical specialists. It is also necessary to search for the answers that will guide the interpretation of and intervention in contemporary educational reality, where university students’ health conditions and security issues related to the use of new technological tools and dynamic platforms during health crises impact their learning.

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**Appendix**

**The Instrument**

Dear students,

The academic coordinators are interested in knowing more about the conditions of technology use. The teachers seek strategies for planning/executing the learning processes with the results.

General information:

1. College:
2. Career/program:
3. Semester:
4. Age: \_\_\_ years.
5. Sex:

Male \_\_\_

Female \_\_\_

1. Province: \_\_\_
2. Number of people living at home who study or work using the Internet: \_\_\_
3. What is the speed ​​of your Internet service? You can determine the speed using this link: <https://fast.com/es/>

Bad (1–4 Mbps)

Good (10–15 Mbps)

Regular (5–9 Mbps)

1. What device is used to carry out academic activities?

Desktop computer \_\_\_ Laptop \_\_\_ Tablet \_\_\_ Smartphone\_\_\_ Various \_\_\_

None \_\_\_

1. Number of children, siblings, or other family members who must be assisted in their learning \_\_\_
2. You have a disability that limits your virtual work:

Visual impairment \_\_\_\_ Hearing impairment \_\_\_\_ Motor disability\_\_\_ Intellectual disability \_\_\_ Other \_\_\_ None \_\_\_

1. Total hours of sleep

8 hours \_\_\_

6–8 hours \_\_\_

≤ 4 hours \_\_\_

1. Estimated time dedicated to your academic activities in front of a computer/laptop/tablet/mobile phone:

1–2 hours \_\_\_

3–4 hours a day\_\_\_

5–8 hours a day \_\_\_

≥ 8 hours \_\_\_

Please read the following statements carefully. Mark with an X the option that is closest to your reality.

|  |
| --- |
| TECHNOLOGICAL INFRASTRUCTURE AND INTERNET ACCESS |
| 1. I have a personal computer/tablet at home to carry out academic activities whenever I need or want that I do not share with anyone else in the family
2. I have good quality Internet access, which means that I can research, download content, and exchange information with reasonable speed, without problems, with multiple connected devices at once.
 |
| ADAPTATION TO THE VIRTUAL CONTEXT AND LEARNING STRATEGIES |
| 1. I use a computer/tablet/mobile phone daily to carry out academic activities, and the teacher has taken into account the digital tools with which I best learn for their training project.
2. It is difficult to read and understand scientific texts using the computer/tablet, so I prefer to read books in a physical library*.*
3. Experimental-practical learning using the computer/tablet is interesting, so I prefer virtual laboratories or simulations of situations in the professional context.
 |
| LEARNING ENVIRONMENT IN THE HOME |
| 1. I have a private area where I live to carry out my homework and study quietly without noise continuously interrupting me.
2. I have a desk/table/chair with a good backrest and have good lighting for my homework or study.
3. The room/study area is organized and painted with light colors and is located in a place with natural lighting that makes me feel calm. There is no noise, so I can focus and do my homework
 |
| FAMILY COEXISTENCE |
| 1. At home, I help my family members to use the computer/tablet or do homework for the little ones when they don’t know how to do it.
2. When I am at home, it is difficult for me to study or use technology to learn because there are too many interactions with my relatives and I cannot focus.
3. In my family, everyone has a personal device to do their work or distract themselves, be it a smartphone, tablet, or computer.
4. At home, I help my family to do household chores or work outside the home to earn a living.
 |
| COMMUNICATION |
| 1. I support the teachers’ responses or feedback if I have any questions or difficulties to complete tasks, study, or search for academic information.
2. I exchange applications and all kinds of information that can be used for homework or study or use new technologies (mobile/computer/tablet) with my classmates.
3. I consider that online exchange with my classmates allows me to better carry out my academic activities, homework, or learning if I have any difficulties.
 |
| CREATIVITY DEVELOPMENT |
| 1. I use the computer/tablet to complete my homework with better quality because I consider that I will have a greater spectrum of possible ideas and better learning results*.*
2. Classes in which technology is not used to link my classmates to different groups and develop innovative products related to the problems of the profession seem of little use.
3. I find it difficult to use the computer/tablet to carry out my tasks because my time is wasted with excessively insignificant tasks.
 |
| WELLBEING |
| 1. I believe that using technology to learn makes it impossible to keep my usual sleep schedule, so I frequently feel tired and irritable in the morning.
2. During the last month, I have noticed that as I spent a long time in front of the computer/tablet, my appetite increased impulsively at times when I was not used to eating before.
3. The use of technology for my academic activities has caused me shoulder or back discomfort that I did not have before, so I feel tired, despite having less physical activity.
4. As the use of technology to carry out my academic activities has caused discomfort in my eyes such as redness, itching, or tearing, I have thought about consulting an ophthalmologist.
5. With the use of technology, my consumption of coffee and/or tobacco has increased because I feel that they may help me to stay awake, since I stay up late working with the computer/tablet/mobile.
6. The increased use of a computer/tablet to carry out academic activities has negatively affected my health by decreasing my regular physical activity.
7. When I use technological tools, I get nervous without knowing what to prioritize and how to use the new platforms in synchronous communication with the teacher.
8. When I use technology at home, I am concerned about the teachers’ delays in orientation and feedback on academic activities.
 |