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# Influence of COVID-19 confinement on physics learning in engineering and science students

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**Abstract.** Due to the global alert about the risk of contagion and propagation of Covid-19, a situation that has changed in the educational processes, this has forced the system to migrate towards a more dynamic and connected model of teaching and learning, which has allowed not to interrupt and to continue with the training processes, in a remote and assisted way. In this research, the profile of the engineering and science student is analyzed, and its relationship with the learning of physics in this crisis. For this purpose, the technique of simple random sampling of a certain population was applied, a research instrument was designed and validated by pairs of experts, its reliability was established based on Cronbach's Alpha test, and the instrument was applied to 354 students of the faculty of engineering and basic sciences, of the Universidad Francisco de Paula Santander, located in the city of Cúcuta, Colombia, during a 15-day time window, the analysis of the data and variables is carried out from the design of a mathematical model of logistic regression, where the dependent variable represents the feeling of emotional affect by the obligatory social isolation. The results indicated that the students feel emotionally affected in 88.56% generating implications in the learning of physics and in their academic performance, especially those who comply the profile: being female, single, not having received training in the use of digital platforms, without academic difficulties but who feel that their academic performance has been affected.

## 1. Introduction

At the beginning of 2020, society, on a global level, is going through one of the most complex stages in history. Many activities carried out by people have been cancelled due to the consequences of the Covid-19. The physical presence of people in the same space implies the risk of massive contagion. Because of this and as a protective measure to reduce the risk of contagion of the Covid-19 virus, many countries have begun to isolate themselves physically and socially [1]. In some countries, such as Colombia, this is mandatory and results in quarantine [2]. In addition to the uncertainty caused by the spread of the virus, this has led to high levels of stress, tension, anxiety and nervousness [3].

Families and their members, especially children and young people, who are trapped by social isolation and the stress, anxiety and anguish that this situation can cause [4] seek to connect with the people around them [5] and one of the ways not to isolate themselves from the rest of society is through access to the Internet. The fact that everyone is confined, and that technological tools have become the



best option for carrying out activities from home, is an ally for communication and living connected during isolation. The tools available on the internet allow people, despite their geographical location, to connect, being a means of relational interaction. Today we live in a networked and globalized society, united through technology [6,7].

Fortunately, this crisis comes at an important moment in technological development. In Colombia, public and private operators have been asked to provide permanent access to the Internet. In this sense, it is necessary to include the use of Information and Communication Technologies (ICTs) by different actors in society. The appropriation and use of ICTs is important in order to be able to carry out their activities in the best possible way. From this perspective, it is necessary that people develop ICT or digital competences, these capacities allow a safe and efficient use of ICT.

In the case of education, the risk of contagion and propagation of Covid-19 among members of the educational community in the same environment is high, so it is risky to bring them together in a closed space that is a classroom. Faced with this situation, the use of ICTs has been prioritized in the crisis, which has forced the system to migrate to the digital environment and has made it possible not to interrupt and continue the training processes, remotely and with assistance. This migration has shown that it is exclusive, in that many students do not have access and right now it is limiting their learning process. Furthermore, it seems that this is leading teachers and students to deep levels of distress and depression. For this reason, educational institutions have set up databases to determine which students and teachers do not have connectivity or access devices in order to find other strategies that allow them to continue with the educational process, in an attempt to cause as little emotional distress as possible.

It is clear that this migration also has limitations in terms of its didactic use. The argument in favor of the use of these environments and technologies is the need for students to continue with the training action and the possibility of sharing objectives and non-physical virtual models. Among the main environments and technologies are the Learning Management Systems (LMS), as they allow both teachers and students to manage and participate in the different training activities programmed within an online or e-learning teaching process. This highlights the need for ICT skills in teachers [8-11] to build innovative environments by selecting the right strategies and ICTs for their students to achieve their learning goals [12].

In Colombia, the National Government, within its guidelines, invites educational institutions to adjust their schedule of activities and develop their theoretical components supported by ICTs, emphasizing the importance of using tools that prevent the proliferation of the virus. The most important points are the use of: ICTs for work at home, technological tools that facilitate communication, tools such as e-learning, knowledge portals, social networks and collaborative platforms, and last but not least, the use of virtual channels, live transmissions and social networks to carry out conversations, forums, conferences or any massive event, among others. In addition, during this emergency, territorial and socio-economic connectivity gaps have become evident. As part of the measures to address the social and economic emergency [13], in order to protect the rights of people with low payment capacity to access telecommunications services.

The current situation has led to digital transformation being seen as a matter of the immediate present, leaving behind those organizations that are unable to adapt their processes and capabilities to new ways of operating by taking advantage of ICTs. Universities as organizations have begun the digital transformation by adopting tools to make changes induced by technological and social trends towards digitalization [14] even before the crisis generated by the emergence of Covid-19, but which are necessary today to face it.

In this regard, it should be noted that the social distancing caused by the COVID-19 pandemic has led to abrupt changes in people's routines and habits. In the educational process in particular, students and teachers have experienced a significant change by having to make a rapid adaptation to distance education, supported by technology and other means, which has configured in a short term goals and challenges of high scope and impact associated with ensuring the continuity of classes during the isolation, for this reason we seek to determine the effects of isolation in the learning of physics as a science in students and teachers of engineering and science programs in a public university.

## 2. Methodology

This research fits the characteristics of field work with a quantitative approach at a descriptive cross-sectional level [15] since the data are collected from the primary source, at a specific moment in time and without any manipulation of variables, and a complete descriptive analysis is made of them.

The population consists of all students enrolled during the first semester of 2020 in the academic programs of the Faculty of Engineering and the Faculty of Basic Sciences of the Universidad Francisco de Paula Santander, located in the city of San José de Cúcuta, Colombia. For the selection of the sample, voluntary non-probabilistic sampling is used, given that each student was sent the link to the instrument and was invited to fill in the form, but in the end, it depends on their willingness to fill in the form completely. The instrument was enabled during a 15-day observation window, during which time more than 40 days of compulsory social isolation had already passed and classes were being held in a non-presential way.

**Table 1.** Sample demographic profile.

Characteristic	Dimension	Frequency	Percentage
Gender	Female	210	59.3%
	Male	142	40.1%
	Total	354	100.0%
Year of birth	1970 - 1980	1	0.3%
	1981 - 1990	6	1.7%
	1991 - 2000	258	72.9%
	2000 - 2010	89	25.1%
	Total	354	100.0%
Marital status	Married	3	0.8%
	Single	344	97.2%
	Other	7	2.0%
	Total	354	100.0%
Student's academic semester	First	49	13.8%
	Second	13	3.7%
	Third	29	8.2%
	Fourth	14	4.0%
	Fifth	37	10.5%
	Sixth	35	9.9%
	Seventh	48	13.6%
	Eighth	47	13.3%
	Ninth	39	11.0%
	Tenth	43	12.1%
Total	354	100.0%	

Once the time defined for data collection was completed, a sample of 354 students was formed, whose characteristics are shown in Table 1. The survey was used to collect data as a suggested instrument for diagnostic characterization in social studies [16]. The instrument had 23 items distributed in four categories described in Table 2, which was subjected to validation in two phases. In the first phase, its content was validated, and experts evaluated the relevance of the items with the objective of the research, their relationship with the variable, the four categories or dimensions, and the respective indicators [17]. Three sessions were held in which the relevance, wording and response options of each section and item of the instrument were analyzed. On the other hand, in the second phase, the reliability of the instrument, associated with the 23 items, was determined by determining the homogeneity of the questions at the general level of the instrument, calculating Cronbach's Alpha Coefficient, whose value is considered "high" with an alpha of 0.832

Finally, after data collection, an Excel file generated by Google Form was downloaded and then exported to SPSS v25.0 software to perform the respective characterization of the population.

**Table 2.** Instrument description.

Categories	Description	Indicators
Demographical profile	It corresponds to those characteristics of the informant.	Gender, age, marital status and current academic semester of the student.
Diagnosis of ICT skills in the social field.	It brings together various aspects of the use of ICTs in social interaction.	Management of social networks, training in virtual platforms, frequency and motivations of use, preferred social network.
Diagnosis of ICT skills with academic application.	The incorporation of ICTs into the teaching and learning processes is analyzed.	Motivations and sensations derived from the non-presence of education, platforms used in classes and their level of performance, frequency of use, difficulties, training received, modality developed in classes, among others.
Emotional effect of preventive social isolation.	The aim is to determine the level of emotional impact that compulsory social isolation has generated in students.	Stress, disappointment, guilt feelings, concentration level, sleep habits, crying, tension, indecision, irritability, energy level, changes in appetite and tiredness.

### 3. Results and discussion

The most relevant aspects found in each section of the instrument are mentioned below.

#### 3.1. *Diagnosis of information and communication technology skills in the social field*

Approximately 94% of the students consulted stated that their level of performance in the use of social networks is excellent. Of that percentage, 81% say that they have never been trained in the use of them, that their level of competence has been acquired from self-training or from the instruction of their social group, to which they dedicate five or fewer hours a day. Among the motivations that students show for the use of social networks, 92% of them concentrate on leisure and/or recreational activities, to study, to relate to friends and to be updated in news, among the most important ones. The domain of the WhatsApp application was identified as a means of communication and social interaction among the group of informants, displacing applications such as Facebook and Instagram.

#### 3.2. *Diagnosis of information and communication technologies skills with academic application*

An 86% of the students stated that in their academic training process they had never developed academic activities using ICT resources, *i.e.* classes were face-to-face, and all activity was concentrated on classroom work under the tutorship of the teacher. As an effect of the obligatory social isolation, the classes were no longer face-to-face. It was evident that the teachers had resorted mainly to the use of Hangouts Meet, the Institutional Platform to Support Teaching (PLAD, for its Spanish acronym), the institutional e-mail, the WhatsApp and Zoom Inc. as tools for the development of the classes and to maintain contact and communication with the students.

This migration to digital resources has required students to develop certain skills in terms of managing them, in this sense approximately 89% of them claim that their performance is good and 45% of them claim that it is excellent. When students are asked about the time, they spend using these virtual platforms for educational purposes, 68% of them say that they use them for up to five hours a day between attending classes and carrying out activities, while 28% say that they require much more than five hours to complete their homework. In this scenario, it is important to note that the remaining 4% state that they do not use these digital resources, which is evidence that some students do not have the technological resources to fulfill their academic commitments during these times of educational non-attendance.

Students were asked if they have had difficulties in the process of using and adapting virtual tools or platforms during the development of non-attendance classes, to which 92% state that they do not present difficulties despite never having received training or instruction in their use. Another important aspect

in the characterization of the dynamics around the execution of the classes, corresponds to the demand of the fulfillment of the class schedules on the part of the teachers, in this sense 33% of them affirm that their teachers have demanded that they connect in the class schedule for the development of the same one; while the remaining percentage affirms that their teachers have proposed activities as much synchronous as asynchronous, for example, within the asynchronous ones it is emphasized the revision of videos or material of support for the accomplishment of workshops or to participate in forums or groups of chat. Finally, 67% of the students surveyed maintain that this situation of non-presence in classes has affected their training process, which is reflected in a reduction in their academic performance.

### 3.3. Emotional effect of preventive social isolation

Due to the declaration of the pandemic, the national government abruptly decreed the preventive social isolation, which without giving space for adaptation forced people to change their daily routines of life, which surely has generated some kind of emotional effect on people, given the social nature of human beings. Therefore, in this section of the research, students were asked whether, after more than forty days of isolation, they had been emotionally affected. The results are shown in Table 3, from which it can be concluded that on average 63% of the students consulted maintain that they have been emotionally affected from the obligatory social isolation, highlighting mainly the increase in stress, tension, irritability, appetite, and the sensation of tiredness or fatigue in contrast with a reduction in the level of concentration and in the hours dedicated to sleep and rest.

**Table 3.** Emotional affectation derived from obligatory social isolation.

Feeling or emotion	Level of affectation		
	Has increased	Remains the same	Has been reduced
Stress	74.0%	20.9%	5.1%
Disappointment	43.2%	40.7%	16.1%
Dissatisfaction with yourself	34.5%	42.4%	23.2%
Feeling of guilt	23.2%	48.0%	28.8%
Level of concentration	19.5%	32.8%	47.7%
Sleeping habits	25.4%	15.9%	58.7%
Crying	19.2%	55.1%	25.7%
Agitation or tension	54.2%	32.2%	13.6%
Interest in activities	29.9%	38.7%	31.4%
Indecision	35.3%	48.0%	16.7%
Energy level in the development of activities	16.7%	40.7%	42.7%
Irritability	50.0%	38.4%	11.6%
Change in appetite	52.0%	32.7%	15.3%
Tiredness or fatigue	57.9%	31.1%	11.0%
Average	38.2%	37.0%	24.8%

Given that there are a series of aspects that stand out as regards the effect of obligatory isolation, an attempt is made to construct a logistic regression model with a qualitative dependent variable based on certain independent variables also of qualitative origin considered in this research. To this end, Equation (1) is presented, and fits the mathematical model.

$$Z = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_k X_k, \quad (1)$$

where  $Z$  corresponds to the napierian logarithm of the odds of being emotionally affected by compulsory social isolation,  $\beta_0$  corresponds to the  $Y$  axis intercept of the regression function,  $\beta_1, \beta_2, \dots, \beta_k$  represent the coefficients of the slope of the line and  $X_1, X_2, \dots, X_k$  would be those independent variables or possible factors that generate some effect on the emotional state of the student.

The following aspects, which have been coded as dummy variables, are considered to be independent variables of emotional affectation:

- a) Gender of the student -  $X_1$  (Female=1, Male=0).
- b) Marital status -  $X_2$  (1=Single, 0=Any other).
- c) Have you received training in the use of digital platforms or tools? -  $X_3$  (1=No, 0=Yes).
- d) Have you had any difficulties in fulfilling your academic duties? -  $X_4$  (1=No, 0=Yes).
- e) Do you feel that your academic performance has been affected by the non-presence of classes? -  $X_5$  (1=No, 0=Yes).

Therefore, the logistic regression model is calculated obtaining Equation (2), the values of the variables are inserted respectively and the result is obtained as shown in Equation (3), then the antilogarithm of the calculation made to obtain the value of the odds is calculated, as shown in Equation (4), and finally the probability of this event is calculated, according to Equation (5).

$$Z = \text{Ln}(\text{odds}) = -2.1179 + 1.4759X_1 + 1.0648X_2 + 0.4145X_3 + 0.6395X_4 + 0.5699X_5, \quad (2)$$

$$\text{Ln}(\text{odds}) = 2.0467, \quad (3)$$

$$\text{Odds} = \text{antilog}(2.0467) = 7.7423, \quad (4)$$

$$\text{probability} = \frac{\text{Odds}}{1+\text{Odds}} = \frac{7.7423}{8.7423} = 0.8856. \quad (5)$$

Then the proposed regression equation allows us to predict that 88.56% of the sample under study, may be affected emotionally as a result of the mandatory social isolation of students in the college of engineering and basic sciences, in their learning of physics as a science, especially those under the following characteristics: being female, single, not having received training in the use of digital platforms, who present themselves without academic difficulties but feel that their academic performance has been affected.

From the demographic profile indicator, we were able to identify that the participants were mostly female, while the participants ranged from ages 20 to 29 years, with a marital status of single, on the other hand, the most interested in participating in the study were students of first, seventh and eighth semester, this information leads us to conclude that most have mastered information technology tools, evidencing a greater handling in instant messaging tools, however, the influence of confinement due to COVID-19, really appeared in the indicator that deals with emotions, being stress, the main cause of problems in learning engineering sciences and so on, also present the agitation or tension, irritability, change of appetite, fatigue or tiredness. The present information was of valuable interest to the directors of the faculties of engineering and basic sciences, which is why institutional actions and guidelines were established to support these students, based on the development of a broader characterization, thus generating a program of attention by the welfare offices, services such as psychological care, accompaniment by student tutors with better academic performance, among others. However, the current situation also affects teachers, which is why it is interesting in the future to practice a study focused on the analysis of teachers and their behaviors in a crisis due to confinement. From this study, the faculties of engineering and basic sciences opted to develop proposals to train and improve the mastery of technology and communication tools for their teachers. This is a clear example of a reactive response to emergency situations and the continuous improvement of the quality of higher education.

#### 4. Conclusions

During the first months of 2020, measures have been taken to move from face-to-face to ICT-mediated remote education as a measure to counter the risk of contagion and spread of COVID-19. The advantages posed by adaptive, scalable and non-presential environments and technologies in the face of the risk of COVID-19, call for the need to immediately invest human and technical resources in their implementation and subsequent development, with the aim of providing continuity to educational action during the pandemic. Finally, with the results obtained from this research, it can be corroborated that students have been emotionally affected during the process of compulsory isolation, which will surely affect their academic performance.

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