Journal of **Engineering Research**

WHEN MIGRATING FROM FACE-TO-FACE EDUCATION TO REMOTE EDUCATION DURING THE COVID 19 PANDEMIC, DID WE HAVE ACCESS TO A COMPUTER, INTERNET, AND ELECTRICITY SERVICE?

María Elisa Espinosa Valdés
Research Professor in the Department of Basic Sciences at: Tecnológico Nacional de México, campus: Instituto Tecnológico de Minatitlán

Martha Ramírez López
Professor at: Tecnológico Nacional de México, campus: Interdisciplinary Research Center and Teaching in Technical Education, CIIDET

Rosa Alor Francisco
Master's Degree in University Teaching - Professor in the Department of Basic Sciences and Distance Education, at: Tecnológico Nacional de México, campus: Instituto Tecnológico de Minatitlán

Evangelina Rojas Rauda
Master of Finance - Professor of the Department of Administrative Economic Sciences at the: Tecnológico Nacional de México, campus: Instituto Tecnológico de Minatitlán

Julieta del Carmen Villalobos Espinosa
Professor at: Tecnológico Nacional de México/campus ITS Teziutlán

Mario Alberto Roman Rojas
Electromechanical Engineering student of the Tecnológico Nacional de México campus Instituto Tecnológico de Minatitlán

Abstract: The appearance of the SARS-CoV-2 health contingency, better known as the COVID-19 pandemic, caused the temporary closure of educational centers in Mexico and the adoption of a remote class model, this work tries to investigate the access they had to the internet, computers (cell phones or tablets) and electricity service, teachers and two groups of chemical engineering students, one who was in the first semester and the other in the fourth semester of the degree when the health contingency began and with it the confinement for students and teachers. The work was carried out with students (20 from the first semester and 16 from the fourth semester)) and teachers (17 from the first semester and 9 from the fourth semester) from an institution in the southeast of Mexico, of medium socio-economic level, who were I apply a survey. The results show that, despite being of a medium socioeconomic level, the majority of teachers and students had no problem accessing a computer, an internet connection and electricity service.

Keywords: COVID 19, computer, internet, electric power service.

INTRODUCTION

With the appearance of the SARS-CoV-2 health contingency (severe acute respiratory syndrome coronavirus 2), better known as the COVID-19 pandemic, and the temporary closure of educational institutions, according to studies, almost 35.6 million students and close to than 2.1 million teachers of all types and educational levels, as well as education support workers in the administrative offices of the federal entities and in the central areas entered into confinement (SEP, p.276 according to Mena, 2022). Provoking with this a massive access to the use of ICT, affecting students and teachers, from preschool to university and postgraduate level, it is known that in Mexico it is determined by the socio-

economic level, who could access online education and who does not (INEGI, 2018b).

One of the first barriers we encountered was accessing the technological area, since the solution was to migrate from face-to-face education to the education that at that time we call online, virtual, distance, internet, remote education, among others, that we From now on we will call it Remote Education, assuming that both students and teachers have the required equipment and connectivity. The latest figures available from the International Telecommunication Union offer a bleak picture: in Latin America, only 52% of homes have technological equipment and broadband connectivity. Although in the specific case of higher education students and teachers it can be assumed that the percentage is higher, it is not unreasonable to assume that a significant part of these actors did not have, right off the bat, the appropriate technological conditions for an immediate transition to distance education supported by technology (Frances, 2020).

Within this context, after the health contingency, when returning to face-to-face education, a retrospective analysis was proposed to investigate: What had happened to the access they had to the Internet, computers (cell phones or tablets) and electricity service both teachers and students, ¿to be able to migrate to remote education?

To answer the question, it was decided to survey two groups, one from the first semester and the other from the fourth semester of chemical engineering, from an institution in the South of Veracruz and the teachers who taught in those semesters, with the objective of knowing if At the time of confinement, they had the required equipment and the required connectivity.

With the information obtained in the survey, we proceeded to organize them in a matrix and graphs, since this type of visualization allows us to show a large number of data in a summarized way and helps us to make it easy and clear to read and interpret.

DEVELOPMENT

In a review of the state of the art of the key concepts that gave rise to the question of this work, the following topics are addressed:

INTERNET IN MEXICO

Lloyd (2016) mentions that, according to the results of the National System of Statistical and Geographic Information (INEG, 2018 a), Mexico ranked 87th in the world in access to ICTs and 8th in Latin America, in addition there are strong inequalities between the north and south of the country, since for example in the north in Baja California, Coahuila and Sonora, more than 80% of the population has access to the Internet, while in the south Michoacán, Guerrero and Oaxaca, only fifty percent has the service and the context in which we carry out the work is precisely the south east of Mexico.

On the other hand, the Organization for Economic Cooperation and Development (OECD) in 2015 mentions that the concentration in internet services has as a consequence that Mexico is in the worst situation in terms of prices, since it is located among the highest prices, with the lowest penetration rate and little service offer. While the Internet penetration rate in countries like Canada is 93.3%, in the United States 88.6%, in Costa Rica 86.9% and in Chile 79.9%, in Mexico it is barely 40%, these figures only exceed those of Colombia, Paraguay and Peru with 23.4%, 19.3% and 14% respectively. This reflects that the Internet is not distributed equitably, and that its distribution is linked to infrastructure, socioeconomic status, and competition (ITU, 2018).

In normal times, such differences are one more piece of the mosaic of inequalities

in Mexico, but in times of COVID-19, the digital divide has particularly harmful and far-reaching consequences, especially due to its impact on the educational system (INEGI, 2018).

COMPUTERS IN MEXICAN HOUSES

Many of the students and some teachers did not have access to a computer or did not have a mobile phone or simply did not have enough credit, especially the students, to take the class hours that were being taught, since more than 50% of the total number of students in Mexico they do not have the tools, place of study, accessibility, quality connectivity or with any possibility of continuing their classes outside the classroom (Didriksson, 2020), however, this data varies between the different socio-economic levels to which they belong the teachers and the students. The foregoing forced many teachers who did not use technology to have to equip themselves and prepare themselves in digital tools, presenting themselves as an area of opportunity and became one of the most important improvisations during the digitalization quarantine, since improvised self-learning required recognizing the abilities and weaknesses in their use and use them quickly and apply them for educational purposes (Díaz, 2020).

However, if the digital gap is not addressed, which is the inequality of possibilities that exist to access information, knowledge and education through new technologies, and only students who live in urban areas and who have more resources and infrastructure could study, which will increase educational inequality (Lloyd, 2020; López, 2020; Sagra, 2020).

On average, 18% of university students do not have access to a computer, internet or electricity service; that is, one in five cannot follow online classes from their homes at a higher level. For the upper secondary level, however, the gap is even more pronounced: 81 percent of the poorest have neither Internet nor a computer at home, while 40 percent do not have access to ICTs at home (INEGI, 2018b)

Although multiple factors influence how much students learn, during distance education two fundamental conditions have existed to make the teaching-learning process possible. First, having a device with internet access at home and second, having the support of another person who is capable of guiding the learning process. Considering these two elements, it is estimated that almost 2.2 million students are at high risk of not having made progress in learning during the COVID 19 pandemic (García, 2022).

An education strategy focused on television was the most viable option in a context where 45% of students did not have a technological device at home such as a computer, laptop, tablet or smartphone with Internet access (García, 2022).

ELECTRICITY SERVICE IN MEXICO

Other situations faced by teachers were continuous connection failures in private homes. Being responsible for a course implied the challenge of being certain of their own connectivity and of the students who reported and continues to report various failures in connectivity, in the qualities of their equipment or in the management of the software to take and follow the classes. Different feelings were expressed in the classes, which were reflected by the teachers in the virtual seminars where experiences were exchanged (Mena, 2022).

ELECTRIC SERVICE

The Federal Electricity Commission entered a stage that must be governed by two absolute priorities: maintaining the electric power service and caring for the health of its

workers.

In Mexico, there are more than 500,000 homes without electricity, mainly in indigenous and rural communities: "It is a reality that there are still lags in the electric power service, so it must be extended to all communities, areas, school classrooms, homes, clinics, health centers or institutions in the national territory, without any distinction (Aguirre, 2021).

In 2020, the CFE reported 10,461 electrical failures in the entity in Veracruz and, in the first quarter of 2021, 1,619 reports had already been recorded, in January 557 failures occurred; in February, 412 and in March 650. All these reports affected 114 municipalities of Veracruz (González, 2021).

METHODOLOGY

The work is cross-sectional and retrospective descriptive. The survey to obtain the data was structured with three questions for both students and teachers:

Questionnaire for teachers and students

We appreciate your collaboration to answer the following questionnaire, answering, marking with a cross or underlining the answer(s) that you consider correct, which will serve to know the work carried out in the institution when, in March 2020, the country entered in sanitary confinement due to SARS-CoV-2, hereinafter referred to only as the COVID 19 pandemic. We inform you that all your answers refer to **only** to the **semesters January - June 2020 and August-December 2020.** In addition, the answers to this questionnaire will serve to propose action strategies for when a contingency like the one that occurred in 2020 occurs again.

1.- *Did you have a computer*, tablet or cell phone to use in remote classes at the beginning of the COVID 19 pandemic?

_____YES

_____NO

_____I didn't have it, but the institution solved it.

Explan it:_____

_____I didn't have it, but I fixed it.

Explan it:_____

_____I didn't have one and I lost the semester for that reason.

2.- Did you have internet service for remote classes at the start of the COVID 19 pandemic?

_____YES

_____NO

_____I didn't have it, but the institution fixed it.

Explan it:_____

_____I didn't have it, but I fixed it.

Explan it:_____

_____I didn't have one and I lost the semester for that reason.

3.- Did you have electricity to use in remote classes at the beginning of the COVID-19 pandemic?

_____YES

_____NO

_____I didn't have it, but the institution solved it.

Explan it:_____

_____I didn't have it, but I fixed it. Explan it:_____

_____I didn't have one and I lost the semester for that reason.

THANK YOU VERY MUCH FOR YOUR PARTICIPATION!

RESULTS

Below is a matrix with the results obtained and then they are graphed to compare the values. The results that we present for the fourth semester have already been presented at a congress and the information is shown in

Espinosa et al. (2022), however, they are mentioned again here to see how they vary with respect to those of the first semester that was analyzed later:
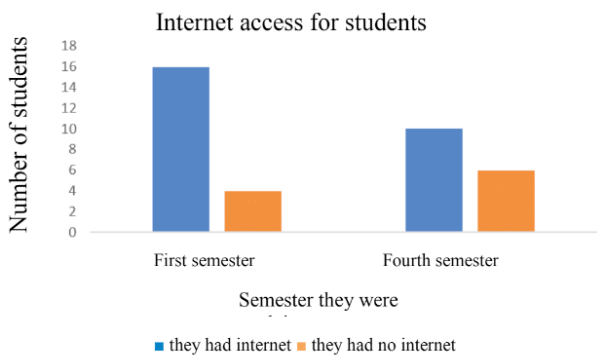
Of the students

Semester	Computer access				Internet access				Electric energy service			
	Yes		NO		Yes		NO		Yes		NO	
First semester	13	65%	7	35 %	16	80	4	20 %	20	100 %	0	0
Fourth semester	12	75 %	4	25 %	10	62.5 %	6	37.5 %	16	100 %	0	0

The results of the student survey are shown in the following graphs:
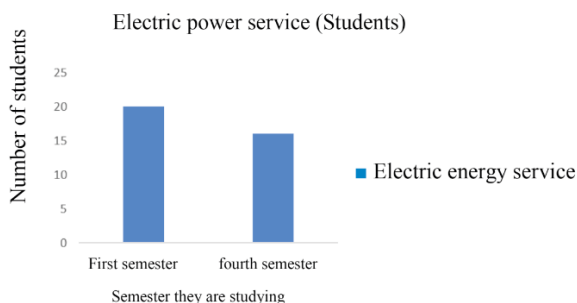

Computer access by students
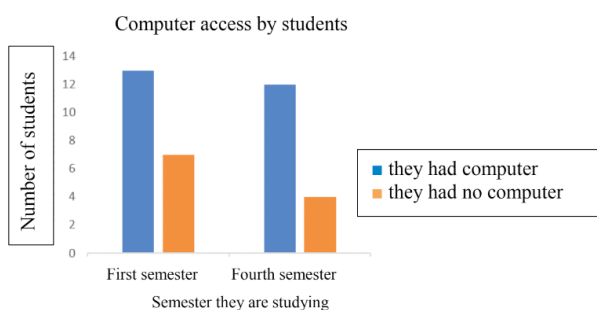
As we can see from this graph, the students who had the most difficulty accessing a computer were those in the first semester since 35% did not have a computer, two said that they were the ones who solved the problem by buying a computer and another stated that they had lost the semester due to lack of computer.

Internet access for students

Regarding the internet connection, 37.5% of the fourth semester students did not have an internet connection and 25% of the first semester did not have internet either, in the two semesters they ended up solving the problem by hiring their own internet.

Electric power service (Students)

Regarding the electric power service, as we can analyze both in the matrix and the graph, all the students had electric power when the confinement began.

Of the teachers

Semester	Computer access				Internet access				Electric energy service			
	YES		NO		YES		NO		YES		NO	
First semester	17	100 %	0	0	16	94.1 %	1	5.9 %	17	100 %	0	0
Fourth semester	9	100 %	0	0	8	88.8 %	1	11.11 %	9	100 %	0	0

The results of the teacher survey are shown in the following graphs:

computer access (Teachers)

Internet access (Teachers)

Electric energy service (Teachers)
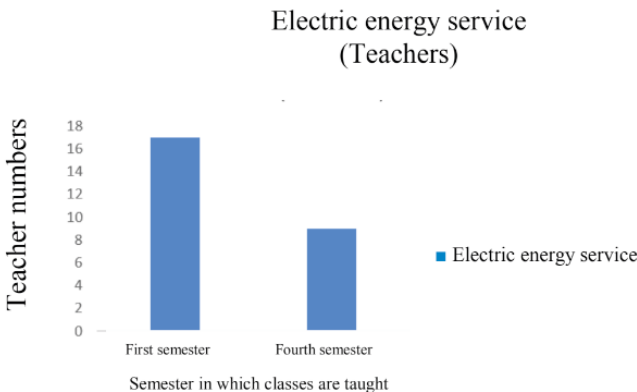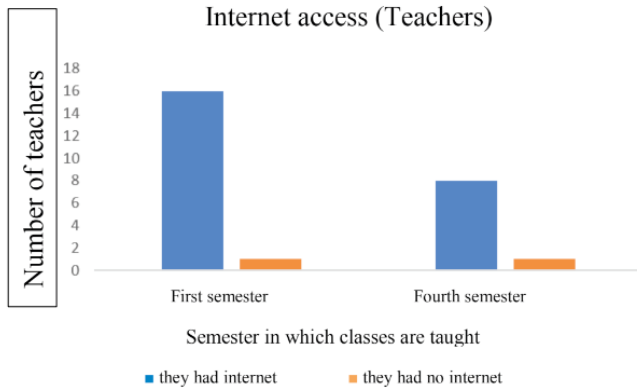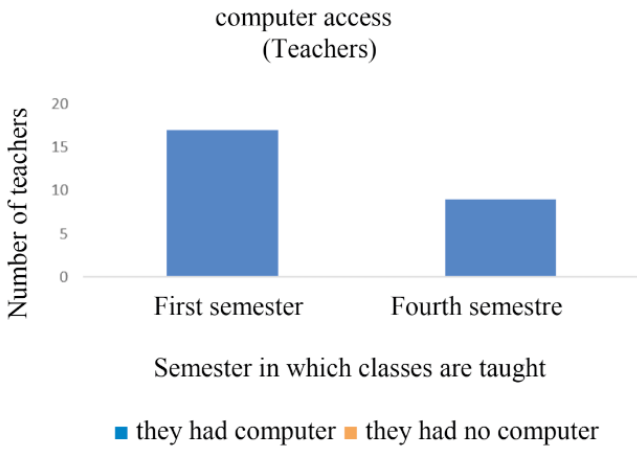
As we can analyze both the matrix and the graphs of the teachers, we can say that they all had a computer and electricity service when the confinement began and only 5.9% (one teacher) in the first semester and 11.11% (one teacher) They did not have internet at home and both stated that they had to contract it.

FINAL COMMENTS
SUMMARY OF RESULTS

The results include the responses of the survey applied to both students and teachers of two different groups, one for the first semester (20 students and 17 teachers) and another for the fourth semester (16 students and 9 teachers) that made up the sample; They are visualized through a matrix and corresponding graphs, which allows us to know in retrospect what happened, during the confinement, with the access they had to the internet, computers (cell phones or tablets) and electricity service to be able to migrate to education via remote.

CONCLUSIONS

The results show that in the first semester 65% of students had a computer and 35% did not have a computer, while in the fourth semester 75% of students had access to a computer, 25% did not have a computer and in both semesters they had to solve it by their own means. While 80% of the first semester had internet service and 20% did not have internet compared to the fourth semester, 62.5% of students did have internet service, 37.5% did not have that service.

Regarding the teachers, the results of the survey show that 100% had a computer and electricity service. 88.8% did have Internet access and only one (5.9%) in the first semester and one (11.11%) in the fourth semester had to contract the Internet service by their own means.

Regarding the institution's support option to meet the need for a computer, internet service and electricity service, none of the respondents, both students and teachers, stated that they had received support; It was simply taken for granted that everyone had a computer, internet, and electricity service, in order to be able to quickly join the class remotely.

With the information collected, we can conclude that in this sample group, the transition from face-to-face education to another remote route did not represent a problem with respect to access to a computer, internet, and electricity service for teachers and students when migrating to remote education. at the beginning of the COVID 19 pandemic; both teachers and students resolved the situation by their own means. But this raises other questions:

Was it enough, academically, to have the required equipment and the required connectivity? What results were obtained in relation to passing, failing and dropping out of school? Was it enough for the teachers to have the equipment and connectivity?

RECOMMENDATIONS

We might suggest that there is a plentiful field yet to be explored in regard to this work; The results that are presented are the first that have been obtained and are part of a research project that includes the application of surveys to other groups. results from only two groups were presented and we note that the results in both groups hold up thus far.

REFERENCES

Aguirre, C. *En México, hay 500 mil viviendas sin electricidad, principalmente en comunidades indígenas y rurales. Boletín No. 1343 de 2021*. Cámara de Diputados. 2016. http://www5.diputados.gob.mx/index.php/esl/Comunicacion/Boletines/2016/Abril/15/1343-En-Mexico-hay-500-mil-viviendas-sin-electricidad-principalmente-en-comunidades-indigenas-y-rurales.

CEPAL (Comisión Económica para América Latina y el Caribe). "Hacia una agenda regional de desarrollo social inclusivo: bases y propuesta inicial". (LC/MDS.2/2), Santiago. 2018.

Diaz, M. A. "Equipos directivos de educación primaria. Improvisar la alfabetización digital durante la cuarentena". En Educación y Pandemia. 2020.

Didriksson**. "**Ante la pandemia, evitar reproducir la desigualdad social y educativa". En **Educación y Pandemia**. 2020.

Espinosa, M.E., Ramírez, M., Alor, R., Rojas, E., Villalobos, J. del C. y Rojas, M. (2022). *El acceso a computadora, Internet y Servicio de Energía Eléctrica de los docentes y Alumnos al Emigrar a la educación remota en el inicio de la pandemia del COVID 19: Una mirada retrospectiva*. Artículos del congreso Internacional de Investigación Academia Journal de Celaya 2022.

Francesc, P**. "**COVID-19 y educación superior en américa latina y el caribe: efectos, impactos y recomendaciones políticas". *Análisis Carolina*. 2020.

García, P. C. "Educación en Pandemia: los riesgos de las clases a distancia". Instituto Mexicano para la competitividad A.C. 2022.

González, F." Más de doce mil cortes de luz afectan en 128 municipios del estado". *Diario de Jalapa*. 2021 consultado el 17 de mayo de 2021 INEGI, "Encuesta Nacional sobre Disponibilidad y Uso de Tecnologías de la Información en los Hogares". México. 2018a https//www.inegi.org.mx/programas/dutih/2018/

INEGI. "Encuesta Nacional de Ingresos y Gastos de los Hogares 2018", 2018b. https://www.inegi.org.mx/programas/enigh/nc/2018/

Lloyd, M. "Desigualdades educativas y la brecha digital en tiempos de COVID-19". En H. Casanova Cardiel (Coord.), Educación y pandemia: una visión académica (pp. 115-121). Ciudad de México: Universidad Nacional Autónoma de México, Instituto de Investigaciones sobre la Universidad y la Educación. 2020.

López, M. y Rodríguez, S. A. Trayectoria escolar en la educación superior ante la pandemia ¿continuar, interrumpir o desistir? En *Educación y Pandemia. 2020.*

Mena, R.A. "La pandemia COVID-19 en la Instituciones de Educación Superior (IES) en México". Entre la fragilidad y resistencia digital. En Educación e Investigación en tiempos de pandemia. Najera J.A., Sacarias, M y Castañeda, M.Y. Coordinadores. Pp. 21-46. 2022.

Sangra, A. "Enseñar y aprender en línea: superando la distancia social. Decálogo para la mejora de la docencia online propuesta para educar en contextos presenciales discontinuos". Coordinador: Albert Sangrá. Editorial: Sónia Poch. p. 27-43. 2020. http//www.editorialuoc.com.

UIT. "Development Index", 2017. http://www.itu.int/net4/ITU-D/idi/2017/indextml#idi2017byre-qion-tab

UNESCO IESALC. "La Educación superior virtual en América Latina y el Caribe, Caracas". UNESCO IESALC. 2017.