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Implicaciones de la educación virtual durante la pandemia covid-19: una encuesta a estudiantes del Tecnológico Nacional de México

Implications of Virtual Education During the COVID-19 Pandemic: A Survey of Students at the Tecnológico Nacional de México

Implicações da educação virtual durante a pandemia de covid-19: uma pesquisa com alunos do Tecnológico Nacional de México

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Resumen

En este documento se presenta un estudio de las implicaciones educativas que ha tenido la pandemia generada por la covid-19 desde la perspectiva de estudiantes de educación superior. El objetivo fue describir la percepción de estudiantes acerca de la educación virtual durante la pandemia. Para ello, se aplicó una encuesta en el semestre agosto-diciembre 2021 a estudiantes del Tecnológico Nacional de México, Campus Jerez. Se elaboró un instrumento de medición de 21 reactivos y se validó con el coeficiente alfa de Cronbach. La muestra fue de 250 alumnos y los datos obtenidos fueron analizados con el *software* SPSS versión 25. Los resultados indican que los alumnos tienen conexión y equipo adecuado para conectarse a sus clases virtuales; además, que los materiales que fueron utilizados por los profesores favorecieron su aprendizaje; también se encontró que durante el confinamiento se sintieron estresados en la realización de sus tareas escolares; desarrollaron la habilidad del autoaprendizaje; su rendimiento escolar no mejoró, y por último, que prefieren las clases presenciales.

Palabras clave: aprendizaje, educación superior, educación virtual, pandemia covid-19.

Abstract

This paper presents a study of the educational implications of the covid-19 pandemic from the perspective of higher education students. The objective was to describe the perception of students about virtual education during the pandemic. For this purpose, a survey was applied during the August-December 2021 semester to students of the Tecnológico Nacional de México, Campus Jerez. A measurement instrument of 21 items was developed and validated with Cronbach's alpha coefficient. The sample was of 250 students and the data obtained were analyzed with SPSS software version 25. The results indicate that the students have adequate connection and equipment to connect to their virtual classes; furthermore, that the materials used by the professors favored their learning; it was also found that during the confinement they felt stressed in carrying out their school tasks; they developed the ability of self-learning; their school performance did not improve, and finally, that they prefer face-to-face classes.

Keywords: learning, higher education, virtual education, COVID-19 pandemic.

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Resumo

Este documento apresenta um estudo sobre as implicações educativas que a pandemia gerada pela covid-19 teve na perspetiva dos estudantes do ensino superior. O objetivo foi descrever a percepção dos alunos sobre a educação virtual durante a pandemia. Para isso, foi aplicada uma pesquisa no semestre de agosto a dezembro de 2021 aos alunos do Tecnológico Nacional de México, Campus Jerez. Um instrumento de medida com 21 itens foi desenvolvido e validado com o coeficiente alfa de Cronbach. A amostra foi composta por 250 alunos e os dados obtidos foram analisados com o software SPSS versão 25. Os resultados indicam que os alunos possuem conexão e equipamentos adequados para se conectarem às suas aulas virtuais; além disso, que os materiais utilizados pelos professores favoreceram seu aprendizado; Constatou-se também que durante o confinamento sentiram-se estressados na realização de suas tarefas escolares; desenvolveram a capacidade de autoaprendizagem; seu rendimento escolar não melhorou e, por fim, que preferem as aulas presenciais.

Palavras-chave: aprendizagem, ensino superior, educação virtual, pandemia de covid-19.

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Introduction

The Secretary of Public Education (SEP) has as its essential purpose "to create conditions that allow ensuring access for all Mexican men and women to quality education, at the level and modality that they require and in the place where they demand it" (Government de México, n.d., paragraph 2), conditions that have been difficult to satisfy as of March 11, 2020, when the World Health Organization (WHO) characterized the 2019 coronavirus disease (covid-19) as a global pandemic (Pan American Health Organization [PAHO], March 11, 2020), since the home became the only possible space to carry out academic activities (Crespo and Palaguachi, 2020). In effect, the school stopped working in person and homes became the safest places to do homework. The impact of experiencing a health crisis of this nature was present in all sectors: economic, social, productive, among others, although with especially marked effects in the educational field (Paredes, Inciarte and Walles, 2020).

This pandemic has demonstrated the urgent and imminent need to transform traditional educational systems and the significance of having a virtual education strategy in line with the time and age in which we live, where information technologies play a preponderant role in global society (Tejedor, Cervi, Tusa and Parola, 2020).

During the last months, institutions and companies from both the public and private sectors around the world had to make adjustments in their plans to carry out their work remotely and virtually. Undoubtedly, this new ability to respond with initiatives based on the use of digital technologies has been an unprecedented event (Paredes et al., 2020).

And for the same reason, the pandemic generated by covid-19 has made it clear that the difference between social classes is more marked than ever. In the educational system, the impact of the inequalities caused by this gap has not been minor. This is reflected in the absence, at all levels, of technological/digital preparation and the lack of internet connectivity of large sectors of the population (Archer and De Gracia, 2020; International Institute for Higher Education in Latin America and the Caribbean [Iesalc], 2020; Jiménez and Ruiz, 2021; Ruiz, 2020).

The pandemic came to transform each and every one of the aspects of the life of the population in the world: our daily life, the way of relating to others, the way of working and, of course, the teaching-learning process in all educational levels.

The covid-19 awakened a reality that seemed hidden: the great lag in the subject of education; However, this crisis represents an opportunity to transform the present, to encourage the creativity of students and teachers, so that students find new learning spaces (Figallo, González and Diestra, 2020).

In order to renew and improve some areas of the educational field, it is necessary to know the perception and assessment of the students of the virtual teaching-learning processes, due to the fact that the process of adaptation to virtuality has not occurred in the best conditions (Roig, Urrea and Merma, 2021).

Knowing the real impact of the pandemic in the field of education in the world will take several years, however, specifically knowing the implications that covid-19 has had on students will help to improve and correct some areas in the education sector. By having a real measurement of the implications in higher education, then we can be effective in building new and better learning strategies. It is undeniable that education in the world has been divided into a before and after the covid-19 pandemic, since the changes it brought and continues to bring are still being determined.

Particularly, this research focused on making an analysis of the experience of students from the Instituto Tecnológico Superior de Jerez, belonging to the Tecnológico Nacional de México (TecNM). The TecNM is made up of 254 institutions distributed throughout the

national territory. The first technological institutes arose in Mexico in 1948. It is one of the institutions most committed to the economic, social and cultural development of the country.

The research question was formulated in the following terms: what is the perception of students about virtual education that was implemented during the covid-19 pandemic? Therefore, the objective was to describe the perception of the students of the TecNM, Campus Jerez, about virtual education during the pandemic generated by covid-19 through a survey applied in August-December 2021.

Background

There are several investigations related to the impact that the covid-19 pandemic has had at the higher level. Tejedor et al. (2020) carried out a comparative study of three countries, Spain, Italy and Ecuador, to analyze the perception of students and teachers about virtual teaching during said health crisis. These authors conclude that there is a negative appreciation of the transition to virtual classes in higher education. On the other hand, Gazca (2020) carried out an investigation in Mexico on the implications that covid-19 has had on teaching processes. To do this, he used a sample of 512 teachers and found that, despite having adequate technological infrastructure, teachers are not prepared for fully virtual work. In another study carried out by Balderas, Roque, López, Salazar and Juárez (2021), it was found that the main disadvantage is that they do not have the technological resources available. In addition, they indicate that students are in favor of taking classes in person.

Miguel (2020), for his part, analyzed the feelings, difficulties and challenges of students, teachers and administrative staff in times of the covid-19 pandemic. Among his results, he found that there is a discrepancy between technological advances and the skills to learn and teach them. Likewise, de Borges, Dias and Santos (2021) conducted research with a sample of 48 students to find out their perception of online learning during the covid-19 pandemic. Among their main findings, they found that in order to self-learn, students need to maintain self-discipline. In addition to this, Pérez, Vázquez and Cambero (2021) carried out research at a Spanish university on 548 students during the isolation period and their results indicate that students who come from families with a low educational level have fewer opportunities to use digital technology. Also, Fardoun, González, Collazos and Yousef (2020) carried out an exploratory study on the main problems encountered by educational institutions in Ibero-America during the pandemic: online assessment requires teachers to know the technological tools, in addition to redesigning the evaluative strategies, they

concluded. And Rigo (2020), based on a sample of 109 students from three Argentine universities, analyzed the perspectives of their acquired academic commitment and the climate of the virtual classroom in the context of the pandemic. The results show that students they tend to feel committed and positively value the classroom climate mediated by digital platforms as an emerging education model.

In an investigation carried out by Ordoñez, Hernández, Escoto and Cabrera (2020), which included the participation of 500 students from a university in Mexico, the vulnerability and emotional feeling of the student regarding how their academic life develops caused by the pandemic. One of the main findings is that confinement and lack of socialization can have consequences for the mental health of university students. At another Mexican university, Sapién, Piñón, Gutiérrez and Bordas (2020) carried out a study with 1,198 students where the use of information and communication technologies (ICT) was analyzed as learning tools in the face of the covid-19 contingency. The students have a very good command of ICT to handle technological tools, that was in this case one of the most striking findings. Finally, Barroso, Ardini and Corzo (2020) analyzed the conditions, practices and experiences of virtual learning of 196 students during the health contingency. Among its main results, they indicate that approximately 90% of students think that once the health crisis is over, education will be different.

Materials and methods

Study population

The population of this study was made up of 620 students enrolled in the August-December 2021 semester of the TecNM Campus Jerez.

Table 1 shows the number of students per semester that the TecNM Campus Jerez has had from 2015 to 2021.

Table 1. Distribution of Campus Jerez enrollment

School year	Semester January-June	Semester August-December
2015	607	577
2016	550	625
2017	515	650
2018	501	670
2019	547	639
2020	541	560
2021	440	620

Source: Department of School Services, Campus Jerez

Sample size

The sample size was calculated taking into account that the population is 620 students, a confidence level of 95%, an error of e = 4.8%, a probability of success of 50% and using the proportion estimation formula with a known population (finite), for which n = 250 was obtained. The sample size is indicated in Table 2, and simple random sampling was used.

Table 2. Distribution of students sampled from Campus Jerez

Degree	Men	Women	Total
Computer Systems Engineering	27	11	38
Mechatronics Engineering	36	14	50
Food Industries Engineering	7	17	24
Bachelor's Degree in Administration	32	58	90
Public Accountant	14	34	48
Total	116	134	250

Source: Department of School Services, Campus Jerez

Multidimensional instrument

The descriptive analysis of this work was based on the design of a multidimensional instrument (IMD) (see Annex 1) that had four dimensions and 21 questions (Q_1, i = 1...21). The four dimensions were: Technological (DT), Teachers (DP), Emotions (DE) and School Performance (DR). This instrument was applied to the five academic programs of TecNM, Campus Jerez: Computer Systems Engineering (ISC), Mechatronics Engineering (IM), Food Industries Engineering (IIA), Bachelor's Degree in Administration (LA) and Public Accountant (CP).

$$n = 250;$$
$$= ISC + IM + IIA + LA + CP;$$
$$= 38 + 50 + 24 + 90 + 48$$

The distribution of the samples by academic program is associated with the enrollment of each one; despite this, homogeneity was sought in order to avoid statistical bias. Regarding the IMD, a series of methods were carried out, validation through the L. C. Lawshe test, which provides the content validity index (CVI), and Cronbach's alpha, expressed as α, to ensure the quality of the information. Information collected.

$$IMD = DT + DP + DE + DR$$
$$= (Q_1 - Q_6) + (Q_7 - Q_{11}) + (Q_{12} - Q_{14}) + (Q_{15} - Q_{21})$$
$$CVI = 0.99$$
$$\alpha = 0.776$$

The instrument designed for this research was processed through the L. C. Lawshe test, which resulted in an CVI of 0.99, and through Cronbach's alpha, whose result was α = 0.776. To use the technique of L.C. Lawshe, Tristán (2008) proposes to form a committee of experts in the area to be evaluated, which will be called judges or panelists. For the instrument to be valid, it is necessary that for every 100 items there are at least 10 judges. In this case, the instrument developed has 21 items and five panelists were considered for its validation, so that even what is recommended in Table 3 was exceeded, the breakdown of results can be observed.

Table 3. Instrument validity indicators

Indicator	**Value**
Number of panelists	5
Number of questions	21
Included questions	21
Excluded questions	0
CVI	0.99

Source: Own elaboration based

This is positioned through the CVI scale, which is shown below, in Table 4.

Table 4. CVI scale

Null	Very low	Low	Regular	Acceptable	High
0					1
					0.99

Source: Own elaboration based

On the other hand, the reliability of said applied instrument, n = 250, refers to the degree to which its repeated application to the same individual or object produces the same results (Hernández, Fernández and Baptista, 2010). If the value obtained is greater than 0.8, it can be established that the instrument used has a high degree of reliability. For this experiment it was obtained that $\alpha = 0.776$. This is shown in Table 5.

Table 5. Reliability indicators

Rate	Value
K	21
$\sum Vi$	13.3353
V_t	51.0646
α	0.776

Source: Own elaboration based

Therefore, the value obtained is positioned within the Cronbach reliability line, where one as a value is extremely reliable and zero indicates zero confidence. That said, $\alpha = 0.776$ can be positioned in the acceptable reliability range. This is shown in Table 6.

Table 6. Cronbach's reliability scale

Null	Very Low	Low	Regular	Acceptable	High
0				0.776	1

Source: Own elaboration based

Procedure

The research method was carried out under a quantitative approach of a descriptive type since characteristics and traits of a phenomenon that was analyzed were sought. Likewise, traits of a specific population were described (Hernández et al., 2010). The procedure was carried out as follows: first, a survey (IMD) of 21 items was prepared to find out the implications that covid-19 has had on the students of the TecNM Campus Jerez (Annex 1); secondly, the survey was validated through the L. C. Lawshe method; thirdly, Cronbach's alpha coefficient (0.776) was calculated using the SPSS version 25 software, and finally the survey was applied to a sample of n = 250 students from Campus Jerez during the August-December 2021 semester.

Results

The applied instrument was designed expressly and was validated by the judgment of five panelists. This process was carried out between April 28, 2021 and May 11, 2021. The questionnaire was applied between September 13 and 30, 2021 in situ, this was achieved with the support of 10 teachers from the same institution.

- Below is the analysis of the four dimensions (IMD) applied in Annex 1, as well as a description of each of the 21 items. In terms of demographics, 46.4% of respondents are male and 53.6% are female. In addition, there is an average age of 20.1 years, with a standard deviation of 1.98, that is, a relatively young mean and there is no high age dispersion. It should be noted that the following scale was used:
- 1= Totally disagree (TD).
- 2 = Disagree (D).
- 3 = Agree (A).
- 4 = Totally agree (TA).

Technological

In this dimension, questions were made related to the Internet connection, the devices they used and the means used by students to communicate with teachers during the health contingency.

Internet connection

Of the total number of respondents, 82.8% indicate that they have an adequate connection to carry out their school tasks.

Appropriate computer equipment

The majority, 75.2%, say they have the appropriate equipment to connect to their virtual classes.

Necessary devices

In this case, 56.8% do not have the devices (speaker, scanner, printer, to name a few) necessary to carry out their school work.

Peripherals suitable for teachers

In this reagent it was obtained that 95.6% of the students consider that teachers use the appropriate devices and software to teach their virtual classes, such as: camera, audio, Google Meet, Zoom, Google Forms.

Digital skills

The vast majority, 90.8% of students, consider having the digital skills necessary to take their classes virtually (such as: browsing and searching for information, connecting virtually, capturing and managing information, working in a team, and collaborating online).

Educational platform

Finally, 88.4% of students think that the educational platform (Schoology) used by Campus Jerez favors teaching and learning.

Table 7 shows the percentages of the Technological dimension.

Table 7. Technological dimension

Question	Q_1	Q_2	Q_3	Q_4	Q_5	Q_6
TD	4.0 %	8.0 %	14.8 %	2.4 %	2.4 %	2.4 %
D	13.2 %	16.8 %	42.0 %	2.0 %	6.8 %	9.2 %
A	52.8 %	46.8 %	32.0 %	35.2 %	52.8 %	49.6 %
TA	30.0 %	28.4 %	11.2 %	60.4 %	38.0 %	38.8 %
Total Agreement	*82.8 %*	*75.2 %*	*43.2 %*	*95.6 %*	*90.8 %*	*88.4 %*

Source: Own elaboration based

Teachers

In this dimension, questions related to the availability, tools, software, teaching materials and skills of teachers during the health contingency were asked.

Virtual tools for teachers

In this first item, 60.4% of the students indicated that the teachers had the necessary tools to teach their classes virtually.

Teaching materials

Regarding the teaching materials (videos, audios, books, software, etc.) that teachers use in their virtual classes, 84.8% of students say that they favor their learning.

Consult teachers

Likewise, 86.4% of the students say that when they have any doubt, question or query about a particular topic that has already been explained in a virtual class, the teachers help them solve it.

Professional practices

Of the total number of participants, 71.6% mentioned that the professional practices organized by the teacher allowed them to achieve the objectives set out in the graduation profile.

Skills to teach classes virtually

Finally, 90.8% of the students expressed that after more than a year of health contingency, their teachers have the necessary skills to teach their classes virtually.

Table 8 shows the percentages of the Teachers dimension.

Table 8. Teachers dimension

Question	Q_7	Q_8	Q_9	Q_{10}	Q_{11}
TD	8.0 %	2.4 %	2.8 %	4.8 %	2.0 %
D	31.6 %	12.8 %	10.8 %	23.6 %	7.2 %
A	41.2 %	60.0 %	52.0 %	61.6 %	54.4 %
TA	19.2 %	24.8 %	34.4 %	10.0 %	36.4 %
Total Agreement	*60.4 %*	*84.8 %*	*86.4 %*	*71.6 %*	*90.8 %*

Source: Own elaboration based

Emotions

In this dimension, questions were asked related to the way the students felt during the health contingency.

Student's mood

In this first item, 75.2% of the students confessed that they have felt exhausted, stressed, anguished, little tolerant, etc., during the confinement caused by covid-19.

Student stress management

Here 82.4% of the students felt stressed in carrying out school tasks during the health contingency.

Virtual classes as emotional support

Only 27.2% of students virtual classes, activities and homework helped them relax during the health contingency.

Table 9 shows the percentages of the Emotions dimension.

Table 9. Emotions dimension

Question	Q_{12}	Q_{13}	Q_{14}
TD	7.6 %	4.8 %	31.6 %
D	17.2 %	12.8 %	41.2 %
A	27.6 %	36.4 %	20.4 %
TA	47.6 %	46.0 %	6.8 %
Total Agreement	*75.2 %*	*82.4 %*	*27.2 %*

Source: Own elaboration based

School performance

In this dimension, students were asked questions regarding the impact of learning, evaluations, homework, and school performance during the health contingency.

The impact that the contingency has had

Of the total, 64.8% of the participants confessed that the health contingency has caused them harm or harm in their learning process.

Way to evaluate

In this reagent, 90.4% of the students indicated that when evaluating their virtual courses, evidence such as: tasks, exhibitions, projects, forums, video production, exams, summaries, practices, among others, were considered. That is, there was a great variety of forms of evaluation.

Management of school activities

According to 86.4% of the students, the organization of their school tasks has been decisive for their final grades.

Self-learning ability

During this period of teaching virtual classes, 76.8% of the students said that they have developed the ability to self-learn.

Optimism

Just over half, 59.6% of the students, said that despite the health situation we have been experiencing, their attitude has always been optimistic.

School performance

Only 37.6% of the students considered that, during the health contingency, their school performance improved.

Modality

Finally, 76.4% of students prefer education in person. In other words, a little more than three quarters of the students prefer to take classes in person.

Table 10 shows the percentages of the School Performance dimension.

Table 10. School Performance dimension

Question	Q_{15}	Q_{16}	Q_{17}	Q_{18}	Q_{19}	Q_{20}	Q_{21}
TD	8.0 %	2.0 %	2.4 %	4.4 %	8.4 %	17.2 %	9.6 %
D	27.2 %	7.6 %	11.2 %	18.8 %	32.0 %	45.2 %	14.0 %
A	48.0 %	44.8 %	59.6 %	54.8 %	41.2 %	30.4 %	23.2 %
TA	16.8 %	45.6 %	26.8 %	22.0 %	18.4 %	7.2 %	53.2 %
Total Agreement	64.8 %	90.4 %	86.4 %	76.8 %	59.6 %	37.6 %	76.4 %

Source: Own elaboration based

Mean of each dimension

Finally, Table 11 shows the percentages with the mean of each dimension. It is observed that, on average, 79.3% of the students said they agreed or totally agreed with having the appropriate equipment, devices and software to connect to virtual classes; Also, have the necessary skills to take virtual classes, as well as have the appropriate internet connection. On the other hand, an average of 78.8% of the students agreed or totally agreed that the teaching materials in the virtual classes favored their learning; that when they had any doubt, question or query, the teachers helped them to resolve it; that after more than a year of health contingency, teachers have the necessary skills to teach their virtual classes.

In the same way, 61.6% of the students agree or totally agree that they felt exhausted, stressed, anguished, not very tolerant, etc., when carrying out school tasks; that the virtual classes, activities and tasks did not help them to relax during the confinement caused by the health contingency. In turn, it is identified that 70.3% of the students surveyed adequately managed their academic activities.

Table 11. Mean of the dimensions

Question	DT	DP	DE	DR
TD	5.7 %	4.0 %	14.7 %	7.4 %
D	15.0 %	17.2 %	23.7 %	22.3 %
A	44.9 %	53.8 %	28.1 %	43.1 %
TA	34.5 %	25.0 %	33.5 %	27.1 %
Total Agreement	79.3 %	78.8 %	61.6 %	70.3 %

Source: Own elaboration based

Discussion

One of the limitations of this research resided in the fact that the study was only carried out at Campus Jerez, considering that at a national level there are 254 institutions that make up the TecNM. Another weakness of the research was that the research instrument is focused exclusively on students; the appreciation of teachers and administrative staff would be lacking.

However, one of the most striking results obtained was that 76.4% of students prefer to take classes in person, a result similar to that of Borges et al. (2021), whose work showed that 69% of their respondents prefer education in person. This same result also coincides with that of Balderas et al. (2021), where it is concluded that the students are in favor of the face-to-face modality.

From the perception of the students, in the dimension of Teachers, one of the results indicates that after more than a year of health contingency, teachers have the necessary skills to teach their virtual classes (90.8%), a fact that harmonizes with the research de Miguel (2020) where he found that 53.13% of teachers developed digital skills in the face of the changes implied by the adjustment of face-to-face classes to virtual ones due to the health contingency.

In the Emotions dimension, it was found that 75.2% of the students felt exhausted, stressed, anguished, and not very tolerant during confinement, a result that coincides with that of Maldonado, De los Ángeles, Stratta, Barreda, and Zingaretti (2020), who found that The students expressed stress and anguish in the face of the isolation situation.

If this research is compared with that of Balderas et al. (2021), who found that a disadvantage is that students and teachers do not have the technological resources available, here, on the contrary, it stands out that most of the students (75.2%) and teachers (60.4%) do have the resources technological.

More than half of the students surveyed (76.8%) consider that they have developed the ability to self-learn, a fact that we can compare with what was dictated by de Borges et al. (2021), who indicate that for self-learning to occur it is necessary for students to be disciplined.

Conclusions

This pandemic generated by covid-19 has been a reference in the history of humanity. The implications of this pandemic have caused changes in all areas, especially in the education sector.

Carrying out an analysis of the IMD, the following can be concluded. Regarding the Technological dimension, it can be inferred that there is a resource gap between teachers and educational institutions and the economic reality of students. This underlines the importance of the face-to-face modality, which democratizes education universally. In relation to the Teachers dimension, it is inferred that teachers have the skills and technical capacity to teach classes virtually despite the conditions of their workplace; However, it is observed as a phenomenon that the educational institution only democratizes education for students, but does not significantly interfere in teaching performance.

However, based on the results obtained in the dimension of School Performance, it is concluded that the face-to-face modality is prevailing in the teaching-learning process, since regardless of whether teachers have the ideal conditions, if among the students there are contextual differences, school performance will be affected. To reinforce the above, despite the fact that the students strengthened their self-learning skills, their emotional stability was affected. In summary, it cannot be denied that virtual classes taught in an atypical context such as the pandemic generated by covid-19 contribute to the development of new skills and ways of carrying out the teaching-learning process; however, this research supports , based

on the evidence obtained, that formal education, understood as face-to-face school education, continues to be the main engine to reduce the contextual gaps among the younger population, by acting as an agent for the democratization of education.

So, the pandemic and the economic crisis that covid-19 created must lead to a rethinking of educational institutions, they must be capable of transforming themselves, not only covering academic content, but also creating environments for the comprehensive development of students. students; it is a new opportunity to conceive a change in our society.

Future lines of research

The implications of this research were deduced from higher level students, that is, there is an assessment of students regarding virtual education during the pandemic, specifically about technology, their teachers, their emotions, and their school performance. For future lines of research, the scope of the study can be extended and approached from the perspective of teachers. Also, in other future research, the workload of students (or teachers) in face-to-face education can be compared with the workload of students (or teachers) in virtual education. In addition, for future research, other TecNM campuses can be considered.

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Annex 1. Multidimensional instrument

We are researching the implications that covid-19 has had on the students of the TecNM, Campus Jerez. We ask that you answer all questions as honestly as possible. Your responses will be treated confidentially. Next to each question in Table 12, four options are presented on a scale from 1 to 4. Read each sentence carefully and then circle the number that best relates to what you do or think. You must choose only one.

• 1 = Totally disagree (TD).

• 2 = Disagree (D).

• 3 = Agree (A).

• 4 = Totally agree (TA).

Thank you for your collaboration!

a) Educational institution:

b) Degree:

c) Age:

d) Gender:

Table 12. Multidimensional instrument

	Question	TD	D	A	TA
Technological	*1)* I have an appropriate internet connection at home to do my homework.	1	2	3	4
	2) I have the appropriate computer equipment to connect to my virtual classes.	1	2	3	4
	3) I have the necessary devices to do my homework (speaker, scanner, printer, to name a few).	1	2	3	4
	4) Teachers use appropriate devices and software to teach their virtual classes (camera, audio, Google Meet, Zoom, Google Forms, among others).	1	2	3	4
	5) I have the necessary digital skills to take my virtual classes (navigate and search for information, virtual connectivity, manage information, work as a	1	2	3	4

	team and online collaboration, etc.).				
	6) The institution where study has an educational platform that favors teaching and learning.	1	2	3	4
Teachers	*7)* When the health contingency began, teachers had the necessary tools to teach their classes virtually.	1	2	3	4
	8) The teaching materials (videos, audios, books, software, etc.) that teachers use in their virtual classes favor my learning.	1	2	3	4
	9) When I have any concern, question or doubt about a particular topic that has already been explained in a virtual class, the teachers help me solve it.	1	2	3	4
	10) The professional practices that the teacher organized allowed the achievement of the objectives set for my graduation profile.	1	2	3	4
	11) After more than a year of health contingency, my teachers have the necessary skills to teach their classes virtually.	1	2	3	4
Emotions	*12)* I have felt exhausted, stressed, anguished, little tolerant, etc., during the confinement caused by the health contingency.	1	2	3	4

	13) I felt stressed while doing homework, during the health contingency.	1	2	3	4
	14) Virtual classes, activities and homework helped me relaxed during the health contingency.	1	2	3	4
School performance	*15)* The impact that the health contingency produced by COVID-19 has caused damage or prejudice in my learning process.	1	2	3	4
	16) The way in which my virtual courses were evaluated considered evidence such as: homework, exhibitions, projects, forums, video production, exams, summaries, practices, among others.	1	2	3	4
	17) Planning my homework has been decisive for my final grades.	1	2	3	4
	18) During this period of teaching virtual classes, I have developed the ability to self-learn.	1	2	3	4
	19) Despite the health situation that we have been experiencing, my attitude has always been optimistic.	1	2	3	4
	20) During the health contingency, my school performance improved.	1	2	3	4
	21) In the next academic period, the type of education I prefer is face-to-face.	1	2	3	4

Source: Own elaboration based

Contribution role	Author/s
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