

Education management in times of the COVID-19 pandemic at the Tecnológico Nacional de México Campus Region Carbonífera

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ABSTRACT

The present work explains the development carried out in the Tecnológico Nacional de México Campus Region Carbonífera when migrating from the face-to-face educational modality to virtual. Once the Covid-19 health contingency was controlled, classrooms were adapted to come back to school in a hybrid and staggered manner in order to maintain the educational quality that characterizes the Institution. This was carried out in four stages, 1) dissemination in order to preserve the life of the entire community within the Institution, 2) steps were taken to start virtual classes, 3) the Tecnológico focused on reviewing the infrastructure conditions of both classrooms, laboratories, furniture, equipment and internet broadband, and 4) hybrid return phases were implemented.

Keywords: COVID-19, educational organizations, management, virtual, leadership, hybrid.

1 INTRODUCTION

The present work shows the management and participation at the Tecnológico Nacional de México in the face of the COVID-19 health contingency and everything that it implied, such as the transition in

work styles with the aim of improving educational processes in order to achieve organizational success, permanency and competitiveness. An investigation was carried out compiling data at different times, making comparisons of the use of technological resources and tools used before and during the COVID-19 pandemic in the college teaching-learning process, steps taken to subsequently analyze the information and design proposals for improvement effectively promoting knowledge. Adaptation of the teaching-learning process to current needs can serve as a background, as well as suddenly migrating to a digital world where, thanks to innovation, it was possible to continue teaching - learning. The transfer of courses from classroom to home brought with it a series of complications such as lack of access to the necessary technology and connectivity to a virtual classroom, a need impossible to cover since it had been heavily present in previous years. Even with the changes made, educational organizations have encountered great limitations due to the context of educational institutions, students, parents, coupled with economic inequality and access the educational service. From this context, an approach presented with attenuation to the commitment of developing educational models appropriate to current needs, where it's suggested to replant based on the knowledge acquired from the experiences in the COVID-19 crisis. A new educational vision, design a teaching model where the values, emotions and technological tools are synchronized in the teaching-learning process. All of this obtained based on the experiences from the transition of a traditional to a virtual classroom, gradually reintegrating into a hybrid modality and ending in a face-to-face modality greatly strengthened with the use of technologies acquired in the COVID-19 Pandemic.

2 DEVELOPMENT

2.1 BACKGROUND

The Tecnológico Nacional de México Campus Region Carbonifera is located in Carretera 57 Km. 120, Villa de Agujita, Coahuila, Mexico. Its area of influence is the Region Carbonifera (Carboniferous Region), offering 6 Engineering Courses: Industrial, Mechatronics, Electromechanical, Computer Systems, Administration and Petroleum, offered from the beginning of the Technological operations. 71.4% of the teachers in the programs have a Master's degree, 36% of the teachers have more than 16 years of service, 21% between 11 and 16 years of service, and 43% are teachers with up to 5 years of service. The school enrollment is 2272 students. Out of these, 247 are in distance learning, allowing teachers to become familiar with the Moodle platform in order to teach online.

All of the teachers from the different programs are in constant pedagogical, disciplinary and updating training during the semester, keeping them up to date and equipped with the necessary infrastructure to offer a quality educational service to students, such as the acquisition of the TEAMS platform, microphones, cameras, computers, cleaning and sanitizing material in the classroom. Working

and governed by international regulations such as ISO 9001:2015, allowing precise planning, execution, evaluation and monitoring of each of the processes, from career promotion to following up with our graduates, providing information that helps analyzing results as well as making decisions in order to facilitate and improve the services offered in the future.

Since the student presents their entrance exam to the Institute, there is a way of identifying certain strengths and weaknesses, which allows channeling students who have certain deficiencies. With the help of remedial courses, a tutor is assigned and they meet with their group once a week.

The participation of students in research activities and contests allows them to develop, strengthen and sometimes discover virtues they didn't know they possessed, bringing with them an increase in self-confidence, performance, self-esteem, maturity and most importantly and knowledge. Linking with the productive sectors in order carrying out internships and company visits. The acceptance and integration of all students regardless of their cultural background, socioeconomic level, ethnicity, ideas, among others makes class life more productive. Psychological attention by specialized personnel greatly helps the student's learning. Medical (IMSS) and nursing services offered to all students from admission to graduation.

2.2 THEORETICAL DISCUSSION

In March 2020, educational institutions at all levels were affected by the Covid-19 health crisis, in such a way that they found it necessary to close their doors or in some cases restricted access to educational institutions, following the recommendations issued by the World Health Organization to modify human interaction and from the prevention guidelines of the so-called social distancing or physical distancing (Martínez 2022, p.188).

According to Crawford et al., (2020 as cited in Bedoya et al., 2021, p.252) mentions that, although the existence of digital platforms and internet access has made migration to online education possible, some research considers that this sudden change has led to a decline in the quality of teaching, despite the best efforts that have been made. Likewise, this context has revealed the need to adopt technological tools both for innovation in education and for the periods after the pandemic crisis, essential to continue with distanced education.

In another approach, we have to take advantage of the opportunities offered by information technologies, as mentioned by De Vaujany, et al (2021, p. 687), this new world of work generates tension between autonomy and control, where technologies promote greater flexibility in terms of time and work space, while increasing control and surveillance. We must take tools to develop new tactical strategies and make decisions based on the benefits that these information technologies provide us. Schools are

required to promote reasoning as well as the search for information and knowledge to contribute with the environment in an assertive way.

Jimeno (2021) highlights that the current use of technological tools is a priority driven by globalization and all the changes required by the population are trends that we must attend. The world's panorama offers us different ways of working and interacting in an organization, a) mobile work, b) coworking, c) the flexible office, d) platform-based entrepreneurship, e) virtual collaborations, f) the Do It Yourself (DIY), g) remote work, h) digital nomads, among other trends personify ways of organizing work practice that supposedly align productivity with freedom (De Vaujany et al., 2021).

It should be noted that educational organizations, in addition to being focused on offering a quality education by defining indicators that allow them to achieve the proposed quality, they are required to be aware that a human being is not manufactured, but formed. Teachers must have the teaching capacity that allows them to accompany the students, train them in academic aspects but also encourage research, culture, socialization, sports, civil and environmental responsibility, of integration and interaction with others, solidarity and something very important to promote the autonomy of the student (Meirieu, 2021).

To reinforce the identity of the Institution, the teacher must first have a vocation to teach, integrate new knowledge, as well as learn and unlearn, continue using virtual learning platforms, since having class content on video and scheduling tasks online automatically generates greater controls for teaching-learning. Mercado (2014, as cited in Martínez, 2021) identifies social constructions in teacher knowledge due to the "historical burden that teachers are integrating from the experiences obtained in their school, professional and experiential training. These processes also allow them to build an identity regarding the profession and make specific decisions, as required by the historical moment" (p.182). Likewise, it is important to point out that, in this distance education at the higher level, teaching-learning is based on the trust of the teacher with the student and the latter with his autonomy and freedom in the comfort of home.

Likewise, Rojas et al (2020) points out that, in recent years, leadership has been defined as a relationship of influence in which both leaders and collaborators play a relevant role. This approach focuses on the relationship that the leader is capable of creating with his followers. Various models can be framed within the relational paradigm; among them is the transformative leadership model.

Transformational leadership is made up of four dimensions of behavior and can be referred to as the four "I's": Idealized Influence, Inspiring Motivation, Individual Consideration, and Intellectual Stimulation (Bass & Abolio, 2012, as cited in Rojas et al., 2020). Transformational leadership has a strong impact on modern organizations, since a transformational leader exerts a certain influence, inspires, encourages rationality, intelligence, innovation, considering each one of the collaborators individually and recognizing each of their capacities and abilities so that later all these individuals interact with each other to achieve common objectives.

Transformational leadership as mentioned (Bracho, 2013, p.167) seeks to motivate and encourage followers to actively participate in changes in the internal environment, for which it sensitizes each one of them so that they empower themselves with the mission and the vision; Consequently, they are activated to achieve it, within a healthy work environment, working with enthusiasm, mystique, responsibility, productivity, and a high sense of commitment to the achievement of organizational purposes.

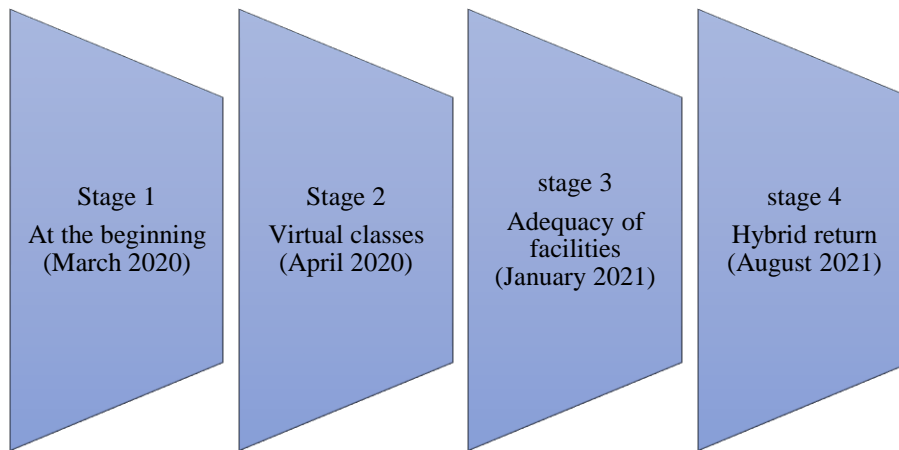
2.3 METHOD

The information was obtained through the institutional health and safety committees that, since March 2020, have been collecting and documenting each of the procedures and actions carried out to meet the needs derived from the Covid-19 health contingency. Likewise, the need arose to design a survey instrument that was very useful to know the current situation of the student, that is, to know if he had a computer, cell phone, internet at home, health issues, his vaccination schedule and his preferences upon returning to the face-to-face modality. As a result of the instrument application, a database was obtained and the information was later analyzed using chi-square statistical methods as well as summary tables of each of the actions and procedures. Throughout each of the stages and phases in which the health contingency was developed and attended at the Instituto Tecnológico de Estudios Superiores de la Region Carbonifera.

2.4 RESULTS

The situation experienced worldwide due to the Covid-19 health contingency has been the reason for all organizations to make changes in their activities, such is the case of Tecnológico Nacional de México Campus Region Carbonifera where adaptations in the teaching process were made with the support of technology and other forms of work and carried out in four stages, as shown in Figure 1.

Figure 1. Development stages



Note : The figure represents the 4 management stages necessary to deal with the Covid-19 health contingency
 Source: Own creation

According to the reports of the Ministry of Health, during Stage 1 the decision was made to suspend face-to-face work for students, teaching staff, as well as the rest of the Technological population. Table 1 shows the procedures and actions carried out in the first stage, their respective actions, as well as the means used, including the different information technologies included to continue providing a quality service with the safety clauses defined by the health committee.

Table 1. Procedures carried out in stage 1

Procedures and actions carried out	medium used
Dissemination on social networks about recommendations and care with the Covid-19 virus.	Institutional social networks
Evacuate the facilities to avoid contagion of 1873 students, asking that they retire to their homes for their safety.	Direct communication through direct bosses
Facilities disinfection campaign.	Technological Facilities
Telephone attention for reports and procedures by administrative and managerial staff with guard roles.	Technological facilities assigned
Incorporate the preference mechanisms for each of the teachers to work online from home, focusing on reviews of the classes taught before leaving the facilities.	Platforms : Meet, Classroom, WhatsApp, Zoom, mail electronic
Dissemination of videos to make the student community aware of the importance of staying at home, a healthy distance and being aware of the indications issued by the Institute and the Health Committee.	Institutional social networks

Note: The table presents the procedures carried out in stage 1 and the means used.
 Source: Own creation

In stage 2, efforts were made to start the virtual classes during the month of April. Table 2 shows the actions carried out by the Technological Institute in detail.

Table 2. Procedures carried out in stage 2

Procedures and actions carried out	medium used
Acquisition of the license and permission of office 365 that includes the platform of teams for the entire student community and staff of the Technological.	High direction
Assignment of official email accounts with the subdomain @rcarbonifera.tecnm.mx for the entire Tecnológico community.	Information technology
Training on the use of the TEAMS platform	Virtual course on the Mexico X platform
Activation of the platforms: ead.tec-carbonifera.edu.mx (For all students) https://ceres.tec-carbonifera.edu.mx/ (For school students) Teams (on the office365.com platform) (Applies to the entire Tec Carbonifera community) https://www.netacad.com/ (applies to Systems Engineering in the subjects of networks, Internet of things and support)	Information technology
Start of classes in the virtual classroom modality through the TEAMS platform	I work from home
Adaptation of academic spaces, laboratories and classrooms with computer equipment with internet to serve students who did not have electronic means, prepared with hygiene and safety measures. With the online attention of the teachers.	Technological Facilities
Intensive course for students who could not access online classes due to lack of technological resources, data obtained through a survey of approximately 15% of the student population (280 students), attention includes the required complementation exams.	Technological Facilities
They will be distributed in the 28 classrooms and 14 laboratories from 07:00 to 21:00. With the online attention of the teachers.	

Note: The table presents the procedures carried out in stage 2 and the means used.
Source: Own creation

In Stage 3, the Technological Center focused on reviewing the conditions of the infrastructure in both classrooms, laboratories, furniture, equipment, and Internet broadband. Table 3 presents the actions carried out during that stage.

Table 3. Procedures and actions carried out in stage 3

Procedures and actions carried out	medium used
Together, the safety committee and the health committee and in accordance with the indications of the technical health committee defined the number of students per classroom.	Safety committee and health committee
Define space for students who will attend face-to-face classes, respecting a healthy distance.	lay design out of classroom Safety committee and health committee
Review of the conditions of the classrooms, laboratories, furniture, computer equipment, internet connection.	Information Technologies and Material Resources
Review of fiber optic speed of 1Gbps, bandwidth, a dedicated link of 20 Mbps symmetrical with support 365 days a year, 24 hours a day, 7 infinitums of 20 Mbps each with the option of increasing each one to 50 Mbps asymmetric, 1 variable link on demand with a base speed of 50 Mbps up to 200 Mbps symmetric.	Information technology
Adaptation of 28 classrooms and 14 laboratories with environmental microphone and webcam	Information technology
Filter area to receive students. Acquisition of an infrared thermometer for taking temperatures, antibacterial gel (with 70% isopropyl alcohol) and gel dispensers	Safety committee and health committee
Acquisition of equipment to verify CO2 levels in closed spaces.	Safety committee and health committee
Acquisition of hepa filters for climates	Material resources

Note: The table presents the procedures carried out in stage 3 and the means used.
Source: Own creation

With the necessary adaptations to classrooms, laboratories and infrastructure in general, it was essential for the students’ hybrid return, based on the application of surveys that were very useful to define the volunteer students who would come to the Technological in each of the phases, procedures and actions carried out during stage 4 are described in Table 4.

Table 4. Procedures carried out in stage 4

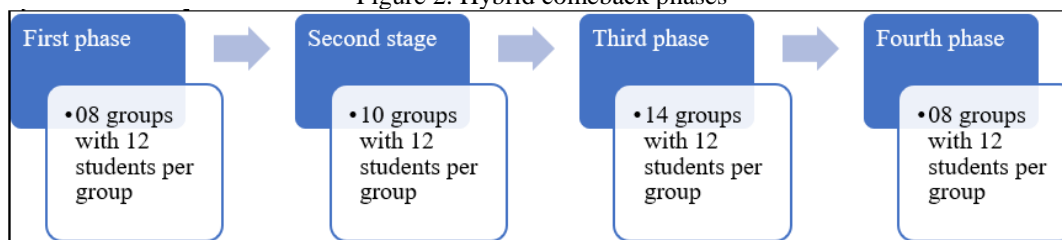
Procedures and actions carried out	medium used
Dissemination of the prevention protocol against Covid-19 for school reopening of the ITES of the Carboniferous Region	Safety committee and health committee
Dissemination of institutional measures against Covid-19	lay design out of classroom Safety committee and health committee
Dissemination of illustrative video for the return to classrooms.	Information Technologies and Material Resources
Biweekly survey application for voluntary return	
List of students, semester, days to attend face-to-face classes.	

Note: The table presents the procedures carried out in stage 4 and the means used.

Source: Own creation

In the August-December 2021 semester, from October 4 to December 9, 585 students were received in hybrid modality distributed in four phases. For all those students who chose the face-to-face modality in addition to a primary requirement that they have their vaccination scheme, and did not have any discomfort when attending the face-to-face classes, Figure 2 shows the phases and groups that were incorporated according to the provisions of the Technological health and safety committees.

Figure 2. Hybrid comeback phases



Note: the figure shows the number of groups and students that were incorporated by phases.

Source: Own creation

Table 5 shows the incorporation of students who voluntarily preferred to go to the Tecnológico to take their face-to-face classes during the January-June 2022 semester.

Table 5 Phases of hybrid return semester January-June 2022

Period of incorporation to the Technological	Student body
From January 31 to February 11	Students who do not have equipment at home. With full vaccination schedule
From February 14 to February 25	Students of the 6th and 8th semesters
From February 28 to March 11	4th semester students
From March 14 to March 25	1st and 2nd year students

Note: The table shows the dates of the students' reasons for the face-to-face return.

Source: Own creation

Thanks to leadership and inclusion strategies, the student population was maintained within normal limits, 1,875 students in the period Jan-June 2020, 2,294 students in Aug-Dec 2020, 1,911 students in the period Jan-Jun 2021, 2,186 students in Aug -Dec 2021 and 1853 students in the different careers in the period Jan-June 2022

In order to know the students' different needs and adapt the service, surveys applied at different times. One of them applied in September 2020 to the students from sixth semester of Industrial Engineering where it said that 97.6% of the students had a cell phone, 9.7% of the respondents had a desktop computer and 34.8% at that time had a laptop. According to the resources 76.2% of the students used the cell phone, 19% Laptop and 4.8% desktop computer to take classes in virtual mode, 85% had internet at home and 9.5% internet with data and 4.8% both. Among the platforms used in the previous semester were TEAMS, Moodle and Classroom.

A second survey applied in March 2021 among the students from sixth-semester Industrial Engineering, where it said that 90.3% of the students had a cell phone, 9.7% of the respondents had a desktop computer and 44.8% at that time had a laptop. 73.3% of the students used their cell phones, 20% a laptop and 6.7% a desktop computer to take classes online, 85% had internet at home and 15% had data internet or borrowed with a family member or neighbor, situations that have occurred in a pandemic for students, internet failure, COVID infections, economic situations, loss of family members, computer problems. The platforms used in the previous semester are TEAMS and Moodle.

A third survey was applied February 2022 to students from sixth semester of Industrial Engineering where it said that 54.2% of the students used the cell phone, 44.6% Laptop and 1.2% desktop computer as a means to take virtual classes, 99% had internet at home, 53% are willing to return to face-to-face classes for the reasons, socializing with teachers and classmates. They consider that learning would be better, doing practices, not having distractions, and 47% mention they aren't willing to attend face-to-face classes, the reasons for economic situations, work, risk of COVID infection, work and mobility problems, they aren't vaccinated and do not like the hybrid model, among others.

A survey was applied in January 2022, to a population of 1,853 students enrolled in that period, with a confidence level of 99% and an error of 3%, obtaining a sample of 925 students, from the 6 different face-to-face modality careers and the Industrial Engineering virtual modality for the safe return (hybrid modality) to class, resulted that 96.28% of the students are vaccinated with at least one vaccine, of which 76.26% are Pfzler, 20.82% AstraZeneca, 1.40 % Sinovac, 0.825% CanSino, 0.47% with Moderna and 0.23% with another type. In relation to the question: Do you have internet at home? 98.2% of the students answered that if they had internet at home, 89.1% have a computer, only 43.9% mentioned that they would like to attend in person at that moment because they were working, don't have money for transportation and were afraid of getting infected and others did not mention reasons.

The information was analyzed by a study plan in order to verify if there were differences in the decisions. Table 6 includes the data to analyze based on the questions: Do you have internet at home? Computer at home? and the preference to return to modality face-to-face. Initially a hybrid modality was planned to be able to comply with the statutes established by the health committee. The results are presented in percentages according to the decisions of the students. For these dates, the students with the support of their parents hired internet at home, increasing from 35% of students who have a computer at home to over 95%, even though all family members share it. The greatest area of opportunity exists in the resistance to return to face-to-face classes, where there were careers such as Business Management that only 28.50% were willing to return to a hybrid model for two main reasons, economic situations where students start working and their available hours to travel are small and risk of infection.

Table 6. Analysis of the survey for the hybrid return

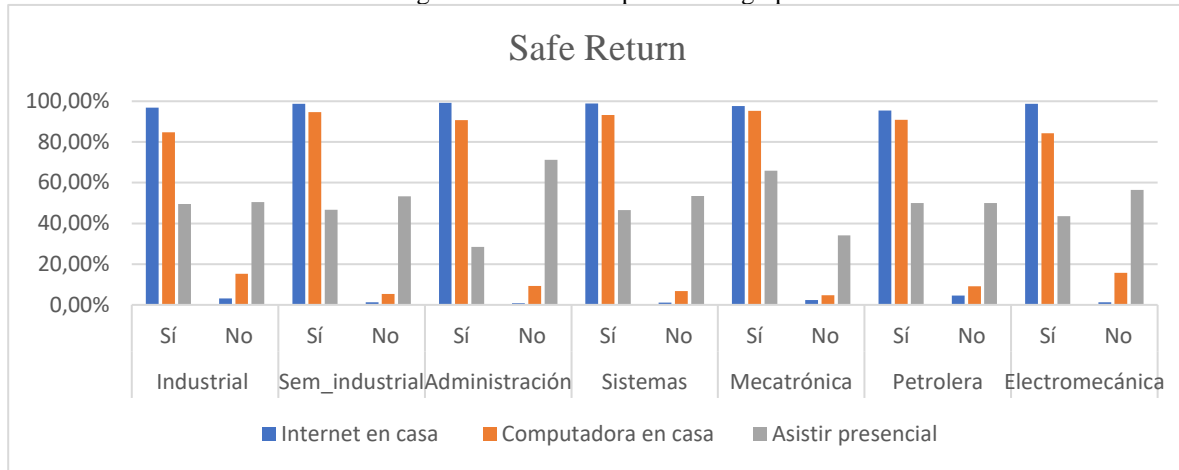
Curriculum	Sample	Decision	internet at home	computer at home	attend face-to-face
Industrial	222	Yeah	96.80%	84.70%	49.55%
		No	3.20%	15.30%	50.50%
Semi-Industrial	75	Yeah	98.70%	94.70%	46.70%
		No	1.30%	5.30%	53.30%
Business Management	246	Yeah	99.20%	90.70%	28.50%
		No	0.80%	9.30%	71.25%
Computer Systems	88	Yeah	98.90%	93.25%	46.60%
		No	1.10%	6.80%	53.40%
Mechatronic	85	Yeah	97.60%	95.30%	65.90%
		No	2.40%	4.70%	34.10%
Petroleum	44	Yeah	95.50%	90.90%	fifty%
		No	4.50%	9.10%	fifty%
Electromechanical	165	Yeah	98.80%	84.20%	43.60%
		No	1.20%	15.80%	56.40%

Note: Responses in percentage of the different study plans, semester January-June 2022.

Source: Own creation

Figure 3 presents the graph of responses in percentage of the different study plans corresponding to Table 6, it can be seen that there is a significant difference in relation to the preference of returning to classes in person and if they have a computer at home. , unlike the Internet resource at home in all careers is very similar.

Figure 3. Safe return preference graph



Note: The graph represents the percentage of responses of the study plans
 Source: Own creation

A chi-square analysis was performed in order to statistically determine if there was a significant difference between the responses of the different study plans. The results are presented in Table 7.

Table 7. Chi-square analysis safe return by study plan.

Ask	calculated chi square	critical value with $\alpha=.05$ df 6	Decision	Comment
Do you have internet at home?	6,178	12.5916	Ho hypothesis is accepted	The percentage of students with internet at home is the same for all majors
Do you have a computer at home?	16,458	12.5916	Hypothesis Ha is accepted	The percentage of students with a computer at home is different in at least one major
Do you want to attend the Tecnológico to take its face-to-face classes?	44,545	12.5916	Hypothesis Ha is accepted	The percentage of students who wish to attend the Tecnológico to take their face-to-face classes is different in at least one major

Note: The table presents the chi-square analysis to find out if there was a significant difference by study plan.
 Source: Own creation

According to the chi-square analysis, in the question about having a computer at home, majors such as Industrial Engineering with 84.7% and Electromechanical 84.2% mentioned that they do, while the rest of the respondents mentioned that more than 90% did have a computer at home. Therefore, there is a difference in relation to having a computer at home according to the different careers.

In the question that if you want to attend the Tecnológico in order to take its face-to-face classes, 28.5% of the students of the Business Management study plan answered yes, unlike Mechatronics where 65.9% of the students agreed to return to face-to-face classes.

3 CONCLUSIONS

Obviously, the health crisis caused by Covid-19 has forced educational institutions to respond according to the day to day needs presented since March 2020 and the Tecnológico Nacional de México Campus Region Carbonifera has responded assertively, adopting digital technology in its administrative and mission processes as well as taking as reference the guidelines and provisions of the World Health Organization through the health committees of local governments. After the establishment of the institutional health and safety committees, the Tecnológico resorted to the TEAMS platform in order to offer online classes. During the four management stages carried out, the Tecnológico found itself in the need to acquire equipment, furniture, supplies, training, as well as the link with the municipalities to expand the coverage of digital services to those students who did not have access to them, all this to respond to the transition and guarantee quality educational service.

Contact was made by different means with the students to find out their needs and generate a work plan according to the environment. The transition and change in the students are seen, and the support of the parents with the acquisition of computer equipment and hiring internet at home. With 96.28% of the students vaccinated, the strategies by the health committee made a hybrid return easier. The leadership on the part of managers and teachers was essential so that the enrollment would remain during the Covid-19 pandemic.

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