Remote teaching or virtual education. Dilemma of Mexican institutions of higher education

Enseñanza remota o educación virtual. Disyuntiva de las instituciones mexicanas de educación superior

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ABSTRACT

This article analyzes the impact that covid-19 caused among university professors of higher education institutions in 19 states of Mexico in their capacity to sustain distance education processes, as well as their willingness to use technical resources to supply the classroom education. This research is of a comparative and exploratory nature and follows the hypothesis that closing these institutions, as a containment measure in the face of the pandemic, urged the deployment of educational solutions based on digital technologies, which surprised the teachers, who did not have the necessary preparation or financial and technological resources, and without institutional help. As part of the methodology, systematic documentation was used, which allowed to frame the topic explored, and the survey, whose data confirm the information previously found. As part of the results, it is reported that the objective was met, and the hypothesis confirmed.

RESUMEN

Este artículo analiza el impacto que la covid-19 provocó entre los profesores universitarios de las instituciones de educación superior de 19 entidades federativas de México en su capacidad para sostener los procesos educativos a distancia, así como su disposición en el uso de recursos técnicos para suplir la educación presencial. Esta investigación es de tipo comparativa y exploratoria, y sigue la hipótesis de constatación de que cerrar estas instituciones, como medida de contención ante la pandemia, urgió desplegar soluciones educativas basadas en tecnologías digitales, lo que sorprendió a los profesores, quienes no contaban con la preparación, los recursos financieros y tecnológicos necesarios, ni la ayuda institucional. Como parte de la metodología se utilizó la documentación sistemática, que permitió enmarcar el tema explorado, y la encuesta, cuyos datos constatan la información previamente encontrada. Como parte de los resultados, se reporta que el objetivo fue cumplido y la hipótesis confirmada.

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INTRODUCTION

In December 2019, coronavirus type 2 (SARS-Cov-2) appeared as endemic in Wuhan, China. After three months it became epidemic, and by March 2020, as it spread around the world, it became the well-known covid-19 pandemic. Despite scientific warnings about the origin, causes and effects of this type of disease (Brown, 2008), the health crisis caught the social, political, health and educational systems of most countries off guard.

According to the report of the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the International Institute for Higher Education in Latin America and the Caribbean (IESALC, by its acronym in Spanish), 91.3% of the world's student population, that is, nearly 1.6 billion students in just under two hundred countries, were affected by the closure of their schools (UNESCO-IESALC, 2020). Faced with this situation, Stefania Giannini, Unesco's Assistant Director-General for Education, said: "We must recognize that we were not prepared for a disruption on such a scale. Almost overnight, schools and universities around the world closed their doors, affecting 1.57 billion students in 191 countries" (UNESCO-IESALC, 2020).

Higher education teachers and students in Mexico and Sinaloa

In Mexico, according to the Basic Higher Education Statistics 2017-2018, conducted by the General Directorate of University Higher Education (DGESU, by its acronym in Spanish) of the Ministry of Public Education (SEP, by its acronym in Spanish), enrollment in higher education, including undergraduate and graduate, is 4 561 792 students (DGESU, n/d), served by about 375 thousand teachers, of which 71% are subject teachers (Organization for Economic Co-operation and Development, OECD, 2019).

In Sinaloa, the 2018-2019 school year had an enrollment of 122 081 students in higher education in the university and technological bachelor's degree mode (attended by 8 346 teachers), 1 179 in the bachelor's degrees taught by the Normal schools (attended by 259 teachers), and 3 572 graduate students (attended by 804 teachers) (Centro de Información Estadística y Geográfica del Estado de Sinaloa, CIEGSIN, 2020). In sum, 126,832 students attended by 9,409 teachers were affected by the closure of higher education institutions (HEIs), an emergency measure to contain the pandemic, so they had to continue their classes at home.

The closure of HEIs forced the deployment of distance education solutions to ensure the continuity of the educational process, both in terms of student learning and teacher training.[1] This is remote learning in an

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[1] In general, teachers were trained by their peers through courses via telephone conference, internet, using pre-recorded videos or WhatsApp groups (Delgado, 2020).

emergency situation, as opposed to the one referred to as virtual education model; however, digital technologies are present in both, as well as information and communication technologies (ICT) or infotechnologies (Harari, 2018).

Technologies

Technology refers to "the set of theories and techniques that allow the practical use of scientific knowledge" (RAE, 2020). Technology implies a *logos* (treatise), besides being a resource that promotes intelligent solutions to human needs. With the first computers and the Internet came digital technology, which, due to its characteristics, allows mass communication and has the potential to provide solutions to daily life and simplify tasks in all areas, including education (Enzyme Advising Group Blog, 2019).

Digital technology is understood as "the use of computer-assisted tactics and technologies that promote learning in educational centers" (Fundación la Caixa, 2016). This includes: a) technologies in which students use applications or programs designed for open learning and problem solving, and b) teaching technology, such as learning platforms.

Remote teaching and the virtual education model

In recent years, remote teaching has been a reactive resource in the face of covid-19, adopted by universities in their face-to-face mode, which have reconverted methods during confinement. Ana María Raad, former director of the Educar Chile portal and current leader of EcosiSTEAM at Harvard University, states that it is necessary to distinguish between online education and remote or distance education.

A fully online education requires students to have a good connection and computer equipment at home, while distance education is more flexible in this aspect, since it uses technology intermittently (Pérez, 2020). Remote learning in an emergency[2] situation is different from the virtual educational model,[3] although both types require Internet connection. In this regard, Josep A. Planell, rector of the Universitat Oberta de Catalunya,[4] points out:

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2 The main objective of this form of teaching is to transfer to a remote, virtual, distance or online classroom, the courses that prior to the pandemic were taught face-to-face (Ibáñez, 2020).
3 This model requires mandatory technological resources, such as a computer or tablet, internet connection and the use of a multimedia platform. This method, unlike online education, works asynchronously, i.e., teachers do not have to coincide in schedules with students for the sessions (Ibáñez, 2020).
4 Declared the first open university in the world, unlike the on-site IES, oriented to 18 year olds, it is aimed at students with an average age of 30 years, who have left their studies or already have a career or a professional module; in addition, they must have devices and a good internet connection (Vallespín, 2020). The Universitat Oberta de Catalunya, Spain, does not have master classes, but the student learns subjects designed under a pattern of indicative programs.

In the model they now call online, the teacher stands in front of the camera and transmits his knowledge. With emergence, each teacher teaches the class as he or she considers it to be online and in the end it depends on his or her craft. [In] a videoconference with 40 participants it is difficult to maintain a dialogue, it is not very agile and ends up becoming small speeches without intervention (Vallespín, 2020).

Cristian Celedón, an education consultant at the University of Chile, argues that face-to-face education and online education are not the same thing, just as a class on the Zoom videoconferencing platform cannot automatically qualify as part of online training. An online course is designed with the knowledge that the students will not be in front, so apart from planning, the activities and tactics to transmit knowledge are different. There are even online courses without classes, where the student enters the platform, reads the material, watches the videos, participates in forums and is evaluated, which closes the module (Timeline Antofagasta, 2020).

In addition to the activities, the number of students per class must also be taken into account. Following their research, Lawrence Tomei and Douglas Nelson, professors at Robert Morris University and Seton Hill University respectively, determined that undergraduate face-to-face and mixed-model courses should have a maximum of 18 students, in contrast to online modes, which should not exceed twelve students; while graduate online classes should have no more than 14 students, and doctoral classes should have only nine students (Newton, 2020).

The problem

From low connectivity and lack of online content in curricula, to a technologically poorly educated higher-education community, were the various obstacles to continuing education in the "new normal" in pandemic times. This increased the risk of educational inequality and marginalization among students who could not continue their studies because they lacked the tools to do so (Giannini, 2020).

The closure of HEIs confined the teaching-learning process and the classroom moved into the homes of students and teachers to invade their privacy. Along with the increase in homework, the use of technologies and the balance between financial, personal and family resources, there was also the appearance of symptoms of depression, psychological distress and post-traumatic stress disorders among teachers and learners (Marquina and Jaramillo, 2020).

In higher education, above all, the need to rethink teacher training in the face of new technologies became more visible (Yáñez, 2021, p. 173), as teachers questioned having been "thrown into the ring" without proper training in digital platforms and resources (Yáñez, 2020).

The qualitative study by Yáñez (2020) indicates the costs of distance education, both in terms of Internet connection, electricity and cell phone, as well as the time and invasion of private life. At the same time, the author proposes to make what happens to female teachers visible "who are mothers, daughters, wives and housewives", for whom the responsibility and psychological burden has grown, to the point of feeling that their "mental health is at risk". It should be emphasized that the responsibility grew equally for all teachers (including men), who also saw their mental health disrupted by these conditions, as well as their time availability and invasion of their private lives. However, there are positive opinions about the flexibility allowed by technologies, the active use of time and the observable increase in student responsibility.

There is a major problem: not all teachers are trained to sustain educational processes at a distance, nor do they have sufficient or effective technical resources for a deployment that supplements their face-to-face educational exercise; likewise, some teachers are not always attentive to communication with their students, nor are they sensitive enough to understand their needs (Yáñez, 2021). Having experience in the use of technology makes the task less uncertain; and without experience, the challenge and possibilities are accepted, which is "wonderful" for those who have learned to use platforms and develop other ways of teaching.

Digital failure[5] threatens the stability of those who do not have the resources to teach or receive virtual classes in virtual mode, nor have they received training in the use of these tools (Giannini, 2020). Along these lines, since not all HEIs have designed plans and programs for an adequate online teaching practice, teachers suffer significant effects on their work, person and profession. Similarly, not all students are prepared to receive online education.

Although in the educational field there are no studies on the subject yet, there are studies on the general level of telework, defined in Article 311 of the Federal Labor Law as "that which is performed for an employer, in whose labor contract must provide for the conditions of service, technological means and environment to perform it" (Juarez, 2019). In Spain, for example, what concerns the equipment, costs and health of the worker must be borne by the employer, including the extra cost of energy and internet: if wifi is essential for work, the company must assume the proportional expense (Sanchez, 2020).

According to the study by Arias *et al.* (2020), three out of four HEI teachers in Latin America and the Caribbean are not prepared to incorporate digital technologies in the classroom, even though 90% of the

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[5] The expression "digital divide" was coined in the 1990s by the U.S. Department of Commerce to refer to inequality in access to ICTs (Lloyd, 2020). In English, both divide and gap ("gap", "difference") and breach ("violation", "rupture") are used. In Spanish, on the other hand, brecha means opening (of a wall or of a battle front) or chink, so here the use of falla or fisura is preferred.

institutions consider them useful. With this in mind, the challenges to overcome include the lack of technical and financial resources, planning, training and connectivity. One in four teachers say they are fully prepared to use digital technologies in their courses, and 74% say they know the tools applicable to the disciplines they teach. Before the pandemic, 19% of the educational programs (EP) of the HEIs were distance education and 16% of hybrid modes (blended) in universities with a virtual approach.

Thirty-eight percent of the teachers surveyed report that their HEIs do not have training programs for using digital technologies, while six out of ten that do have such programs find them effective (Arias *et al.*, 2020). Forty percent of these teachers reported they did not have access to Internet or that the network speed in the institution where they work is not optimal: in Mexico, 35% of teachers report low or no Internet connection in their HEIs, while 75% reported that their institution has some technological platform for learning management.

One out of every four teachers considers that their institution does not have a vision of how to use digital technologies to improve teaching and learning. Sixty percent of teachers whose institutions have digital training programs find them effective, while 59% report that their HEI has not defined any incentive system to develop digital technology projects (Arias *et al.*, 2020).

Internet, computers and smartphones in Mexico and Sinaloa.

In Mexico, according to the National Institute of Statistics and Geofigurey (INEGI, by its acronym in Spanish), 44.3% of households have a computer and only 56.4% have an internet connection. Similarly, it has been found that 65.8% of the population uses the network, and of these 73.1% includes the urban population and 40.6% the rural area (INEGI, 2019a). The relevant deficits illustrate the size of the remedial measures.

The National Survey on Availability and Use of Information Technologies in Households (ENDUTIH, by its acronym in Spanish), conducted by INEGI, states that among those who have studied an undergraduate or graduate degree, only 4.9% do not use the Internet, of those who have studied high school (or equivalent) add up to 11.5%, while those with primary or secondary school account for 45.1%. The activities that these users do online are: 1) entertainment (90.5%), 2) communication (90.3%), 3) information (86.9%), 4) education/training (83.6%), and 5) access to audiovisual content (78.1%) (INEGI, 2019a).

The same source reports that 73.5% of the population uses a cell phone: of these, 83.8% own at least one smart phone with internet connection, 15.4% have a cell phone with limited features, and 0.8% own both types of devices (INEGI, 2019a). Among those who connect to the internet, 89% do so via data, while 11% via wifi (INEGI, 2019a).

According to INEGI, Sinaloa is one of the states with the highest internet connectivity, with more than 60% of households (2019b). Among the uses of internet in Mexico, for 2017, prior to the pandemic, this institute reports 70.8% of users using that network to support education, 91.4% for entertainment, 89.9% to communicate, and 96.9% to obtain information. 53% use the Internet at home and 10.7% use the Internet outside the home (INEGI, 2022).

METHODOLOGY

The objective of this project was to determine the impact of the covid-19 pandemic among university professors in terms of their training to sustain distance education processes, as well as to know whether they have the efficient technical resources to supplement face-to-face education processes and if their institution helps them for this purpose. The hypothesis that guided this work was: the closure of higher education institutions, an emerging measure to contain the pandemic of covid-19, urged the deployment of educational solutions based on digital technologies and surprised professors without the necessary preparation, financial and technological resources, and without help from the institutions they work for.

To deploy this quantitative research, of exploratory scope and hypothesis of ascertainment, the following was used:

Systematic documentation. The documents reviewed for this study refer to the relationship between the covid-19 pandemic and digital technologies applicable to the teaching-learning process, with the intention of finding out the conditions that arose from the closure of campuses, differentiating what is a virtual educational model from what is not, as well as the possibility of designing and operating a virtual educational model for HEIs in Sinaloa and Mexico.

Survey. For the quantitative part, an instrument adapted from the study by Arias *et al.* (2020) was designed on the relationship of covid-19 with digital technologies and higher education, specifically to ascertain the opinion of Sinaloa HEI teachers, in the presence of a control group of Mexican HEI teachers.

The survey questionnaire was designed with dichotomous responses and a Likert scale, with a total of 24 questions in four sections. The first section included general data on the respondents: sex, age, academic degree, place of residence and type of institution where they work. The second section included questions about the grade in which they work, their area of specialization, their teaching experience and about the usefulness of online technologies in the educational process. Likewise, the third section asked about the knowledge and use of technologies applicable to the courses and disciplines they teach, how they use them, as well as whether their HEI

had online connectivity and online EP prior to the pandemic. The fourth section asked about the support offered by the specific institution in terms of training, financial and technological resources.

The sample was simple random, considering only professors who teach in higher education, particularly in Sinaloa (78.7%), in the presence of a control group of professors who work in public and private HEIs in 19 states (21.3%) of Mexico. Prior to the survey, a pilot test was conducted to evaluate the fluency and clarity of the questions. The questionnaire was applied from July 1 to 10, 2020, and 328 responses were obtained from the aforementioned states, thus ensuring a margin of error of 5.4% and a confidence level of 95%. The data were processed through Google Forms, which made it possible to send them via WhatsApp, Facebook and email. The information made it feasible to calculate the frequencies, with the support of the SPSS program (version 2.1), as well as to interpret and describe them by means of tables and figures.

RESULTS

Almost four-fifths of the surveys responded were received from HEIs in Sinaloa, with a proportion of 78.7%; followed by Colima with 4.8%; Mexico City with 4.1%; Guerrero with 1.6%; Yucatan also with 1.6%; Zacatecas with 1.3%; and, at the end, 14 entities which altogether total 7.9%.

Of the teachers partaking, 63.5% are women and 36.5% are men. The most frequent age group, with a portion of 35.6%, is between 46 and 55 years of age; followed by the 36 to 45 age range with 24.8%; then the 56 to 65 age group with 20.3%; then the 26 to 35 age group with 14%; the 66 and over age group reaches 5.1%; and the youngest, between 18 and 25 years of age, represent 0.3. In terms of academic degree, 43.5% have a master's degree in science; 43.2% have a doctorate, while the bachelor's degree represents 12.4% and the specialty 1% (see Table 1).

Tabla 1. Sexo, edad y grados académicos de los docentes consultados

SEXO		RANGOS DE EDAD						GRADO ACADÉMICO			
M	H	18-25	26-35	36-45	46-55	56-65	66 y más	Licenciatura	Especialidad	Maestría	Doctorado
63.5%	36.5%	0.3%	14%	24.8%	35.6%	20.3%	5.1%	12.4%	1%	43.5%	43.2%

Fuente: elaboración propia.

Table 2 shows the typology of the HEIs where the teachers work: academics from autonomous public universities stand out (76.2%), followed by teachers from state public HEIs (16.8%), those from private institutions (10.5%), and finally those from federal public HEIs (6.3%). Regarding the degree in which these teachers work, most of them have a bachelor's degree (92.7%), followed by a master's degree in science (25.9%) and a doctorate (12.8%).

Tabla 2. Tipo de institución y grado en el que trabajan los docentes consultados

Tipo de IES en la que usted trabaja (respuesta múltiple)				Grado en el que trabaja (respuesta múltiple)		
Pública autónoma	Pública federal	Pública estatal	Privada	Licenciatura	Maestría en ciencias	Doctorado en ciencias
76.2%	6.3%	16.8%	10.5%	92.7%	25.9%	12.8%

Fuente: elaboración propia.

Table 3 shows the areas of specialization and years of experience of the teachers who responded the survey: per area, 68.8% of them work in social sciences and humanities, 14.7% in economic-administrative sciences, 11.8% in engineering and technology, and 4.7% in natural and exact sciences. According to their time of experience: 55.9% have worked more than 15 years, 20.6% between 10 and 14 years, 11.1% from 6 to 9 years, 6.7% from 3 to 5 years and 5.7% up to 2 years.

Tabla 3. Área de especialización y experiencia de los docentes consultados

| Área de especialización				Experiencia como docente				
Ciencias económico-administrativas	Ciencias naturales y exactas	Ciencias sociales y humanidades	Ingenierías y tecnologías	0 a 2 años	3 a 5 años	6 a 9 años	10 a 14 años	Más de 15 años
14.7%	4.7%	68.8%	11.8%	5.7%	6.7%	11.1%	20.6%	55.9%

Fuente: elaboración propia.

Table 4 shows the consideration of teachers interviewed on how useful are the technologies applicable to the improvement of teaching-learning processes, as well as their knowledge of these technologies: 79.4% consider them very useful, 17.8% useful and 2.9% moderately useful. However, 60% are only somewhat familiar with these technologies, 25.7% are very familiar with them, 12.4% are not very familiar with them, 1.6% are almost not familiar with them, and 0.3% are not familiar with them.

Tabla 4. Consideración sobre la utilidad y conocimiento de las tecnologías aplicables en la enseñanza

Utilidad de las tecnologías aplicables a la enseñanza			Conocimiento de las tecnologías aplicables				
Mediana	Muy útiles	Útiles	Algo	Casi nada	Mucho	Nada	Poco
2.9%	79.4%	17.8%	60%	1.6%	25.7%	0.3%	12.4%

Fuente: elaboración propia.

Figure 1 shows the answers to the question: Do you know or have you heard of any of the following options for online teaching? The option with the highest frequency was Zoom (92.7%), followed by the Google Classroom platform (83.2%), Google Meet (76.2%), Moodle (57.0%), Web 2.0 (16.2%), Microsoft Virtual Academy (14%) and Edmodo (3.4%). Other options mentioned were: Microsoft Teams, Blackboard, Canvas, Jitsi Meet, Webex, Schoology, Skype, 7 Sky, Algebraix, Debut, EDUC, Khan Academy, Neolms, Facebook rooms and YouTube, and between them they reached 15.9%.
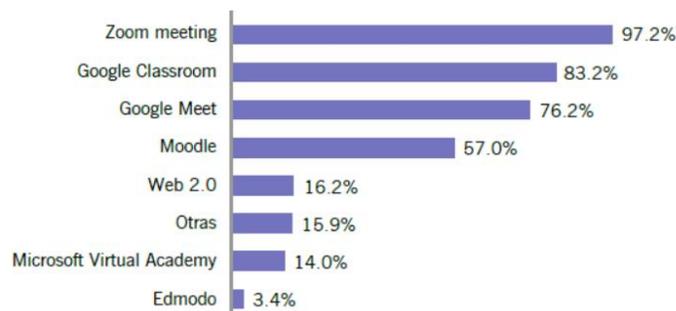
Gráfica 1. Conocimiento de las tecnologías opcionales para la enseñanza en línea.
Fuente: elaboración propia.

Table 5 shows the proportions in which the teachers interviewed think of themselves to be prepared to incorporate the technologies they know and apply them to the teaching-learning process.

Tabla 5. Preparación para incorporar las tecnologías aplicables al proceso educativo

NIVEL DE PREPARACIÓN	PORCENTAJE (%)
Entre 60 y 69%	9.8
Entre 70 y 79%	14.6
Entre 80 y 89%	39.1
Entre 90 y 100%	30.5
Menos de 59%	6
Total	100%

Fuente: elaboración propia.

Before covid-19, 52.7% of the teachers state that their institution had face-to-face EPs in a range of 76% to 100%, while 62.2% state that their distance EPs were from 0% to 25%. Regarding mixed EPs, 59.7% state that their institution had 0% to 25% of these programs. Table 6 shows more possible combinations: HEIs with more face-to-face EPs have fewer distance and mixed EPs, and vice versa.

Tabla 6. Programas educativos presenciales, a distancia y mixtos, por institución

ANTES DE LA COVID-19, ¿SU INSTITUCIÓN CONTABA CON PROGRAMAS EDUCATIVOS?	0 A 25%	26 A 50%	51 A 75%	76 A 100%	TOTAL (%)
Presenciales	2.5	3.5	41.3	52.7	100
A distancia	62.2	25.7	8.3	3.8	100
Mixto	59.7	24.4	12.1	3.8	100

Fuente: elaboración propia.

47.6% know that the HEI where they work has technological and financial resources to install and operate online education systems, 34% know little about this topic, and 18.4% stated that they do not know. Also, for 64.4% of the HEI where they work there is a vision of how to use digital

technology to improve the educational process, 21.9% do not know, and for 13.7% there is no such vision (see Table 7).

Tabla 7. Disposición y visión tecnológica y financiera de las IES para instalar y operar sistemas de educación en línea

¿Sabe si su institución cuenta con recursos tecnológicos y financieros para instalar y operar sistemas de educación en línea?			¿Tiene su institución una visión clara de cómo utilizar la tecnología digital para mejorar la enseñanza y el aprendizaje?		
No sabe	Sabe poco	Sí sabe	No	No sé	Sí
18.4%	34%	47.6%	13.7%	21.9%	64.4%

Fuente: elaboración propia.

In response to the question: Does your institution have a technological platform for learning management? 57.5% of the teachers state that the HEIs where they work has a platform, 23.5% do not know and 19% state that their institution does not have a platform (see Figure 2).
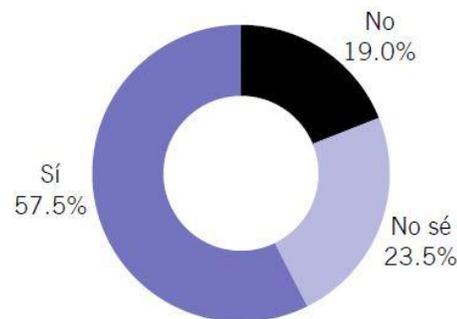
Gráfica 2. Disposición de plataformas tecnológicas por IES.
Fuente: elaboración propia.

Among those who responded that their institution does have a technological platform for learning management, 37.2% mentioned Moodle, 11% Google Classroom, 7.9% an institutional platform, 4.3% the virtual classroom, 4.2% the Virtual Education Unit of the Universidad Autónoma de Occidente, 3. 7% to the Educ Platform of the University of Colima, 3.6% the Virtual University Center of the Autonomous University of Sinaloa, 3% Canvas, 3% Zoom, 2.4% Microsoft Team, 1.2% Eminus and 1.2% the Virtual Campus of the Autonomous University of Guerrero; 4.2% did not remember. (see Table 8).

Tabla 8. Plataformas usadas por las IES referidas por los docentes consultados

Sɪ RESPONDIÓ QUE "sí" A LA PREGUNTA, MENCIONE CUÁLES SON	PORCENTAJE (%)
Moodle	37.2
Google Classroom	11
Plataforma institucional	7.9
Aula virtual	4.3
Unidad de Educación Virtual, Universidad Autónoma de Occidente	4.2
Plataforma Educ, Universidad de Colima	3.7
Centro de Universidad Virtual, Universidad Autónoma de Sinaloa	3.6
Canvas	3
Zoom	3
Microsoft Team	2.4
Eminus	1.2
Campus Virtual, Universidad Autónoma de Guerrero	1.2
Otras menciones	13.1
No recuerdo	4.2

Fuente: elaboración propia.

When asked how they evaluated the quality of Internet connection within their institution prior to the pandemic, participants responded: 57.8% moderately good, 27.9% poor, 11.1% very good and 3.2% none (see figure 3).

Gráfica 3. Calidad de la conexión a internet en las IES, previo a la pandemia.
Fuente: elaboración propia.

According to the professors consulted, 66.7% of their respective HEIs have a teacher training program in technologies applicable to online teaching,

18.7% do not have such programs, and 14.6% do not know. When asked to evaluate whether their institution has a program and how effective they consider it to be, 41% said somewhat, 23.8% said a lot, 15.2% do not know, 12.1% said a little, 5.4% said almost nothing, and 2.5% said not at all.

Regarding the question: Has your institution trained you in the use of technologies to operate an online educational system? The teachers answered 81.3% yes and 18.7% no. Among those who answered yes, 23% stated that the training lasted four hours, 22.2% said 20 hours, 16% said two hours (or less), another 16% said eight hours, and 8.2% said twelve hours.7 Other unspecified durations together reached a residual 14.8% (see Table 9).

Tabla 9. Capacitación en tecnologías para operar un sistema educativo en línea y duración

¿Su institución le ha capacitado en el uso de tecnologías para operar un sistema educativo en línea?		En caso que su respuesta sea "sí", ¿cuánto tiempo duró la capacitación?					
Sí	No	4 horas	20 horas	2 horas (o menos)	8 horas	12 horas	Duración no especificada
81.3%	18.7%	23%	22.2%	16%	16%	8.2%	14.8%

Fuente: elaboración propia.

When asked what they consider to be the main obstacle to the development of online courses, the teachers responded as follows: 76.8% believe it is the lack of Internet access in students' homes, 65.1% point out the lack of computer equipment at home, 60.6% mention the lack of training for teachers in the use of technologies and digital platforms, 41.9% estimate financial difficulties for teachers to acquire computer equipment and access the Internet, and 41% see it is an obstacle that students have to go to cybercafes to connect (see table 10).

Tabla 10. Principales obstáculos para el despliegue de cursos en línea

¿Cuál considera que pudiera ser el principal obstáculo para el desarrollo de cursos en línea? (opción múltiple)	Porcentaje (%)
Falta de capacitación de los docentes para utilizar las tecnologías y las plataformas digitales	60.6
Dificultades financieras de los docentes para adquirir equipo de cómputo y acceso a internet	41.9
Falta de equipo de cómputo (de escritorio o portátil) en los hogares de los estudiantes	65.1
Falta de conectividad (acceso a internet) en los hogares de los estudiantes	76.8
Que los estudiantes tengan que acudir a cibercafés para acceder a internet	41

Fuente: elaboración propia.

In this regard, 10.2% answered that their HEI has supported them in the acquisition of computer equipment, 1.6% in covering the costs of Internet connection, 0.6% in the costs of electricity consumption, 1.5% have received other support, and an overwhelming 86.1% confirmed that their institution has not supported them in any of the items considered (see Figure 4).

Gráfica 4. Ayuda financiera institucional para sufragar gastos del trabajo en casa.
Fuente: elaboración propia.

DISCUSSION

Beyond what has been shown in a qualitative manner, in terms of the use of the teachers' own resources and the effects thereof, the quantitative picture of the teachers is summarized in Table 11.

Table 11. Comparativa de los datos para América Latina y El Caribe / México y Sinaloa

	Latin America and the Caribbean	Mexico and Sinaloa
Preparation	75% of the teachers of the institutions of superior education does not feel prepared for using new digital technologies in the classroom.	30.5% considers themselves prepared from 90 to 100%, a 39% perceives themselves from 80% to 89% prepared for incorporating
Utility	90% of the teachers considers them useful	79.4% considers them very useful, 17.8% useful, and 2.9% barely useful
Knowledge	74% say they know the technological tools appliable to the disciplines they teach	60% knows something about these technologies, 25.7% knows a lot about them, 12.4% a little, 1.6% almost nothing, and 0.3% does not know them
Mixed programs	Before the pandemic, 19% of the programs of the ISE were about distance education and 16% mixed modalities in the universities with virtual focus	52.7% of the teachers affirms that before the pandemic the face-to-face programs in their institutions conformed from 76 to 100%, 62.2% says that their distance program were from 0 to 25%

Training	38% reports that their ISE does not have training programs for the use of digital technologies	66.7% affirms that their ISE count with teacher training programs in technologies appliable to online education, 18.7% does not have these programs, and 14.6% does not know
Effectivity	While six out of ten teachers say that they count with training programs, not all find them effective	41% say that their programs are barely effective, 23.8% says that are very effective, 15.2% does not know, 12.1% a little, 5.4% almost nothing and 2.5% consider that they are not effective at all
Connection	40% informs not to have internet connection or that the service speed in their ISE is not optimal; in Mexico, 35% of the teacher reports low or null internet connection in their ISE	About the internet connection, inside their institution, the consulted teachers answered: mildly good 57.8%, low and null 31.1%, and very good 11.1%
Platform	75% of them reported that their institution counts with a technological platform for the learning management	57% of the teachers declare that their ISE have some technological platform, 23.5% does not know, while 19% affirms that their institution does not have a platform
Vision	25% considers that their institution does not have a vision on how to use the digital technologies to improve the processes of teaching and learning	According to the 64.4% of the teachers, their ISE has clarity on how to use the digital technology to improve the teaching and learning; 21% does not know, and 13.7% thinks that there is not such vision
Incentives	59% reports that their ISE have not defined any incentive system yet to develop projects of digital technologies	10.2% thinks that their ISE has aided them acquiring computing equipment, 1.6% in the connectivity costs, 0.6% in the electric energy consumption, 1.5% has received other backup, and 86.1% affirms that their ISE has not provided any help

Source: Adapted from Arias *et al.* (2020) and the applied survey.

In this table, there are different nuances between the current research and the work of Arias *et al.* (2020), perhaps derived from the Likert scale used in the study on teachers of HEIs in Sinaloa and Mexico; however, both studies show deficits that, based on the classic curricular formula (Tyler, 1982), point out the distance between the norm and the data upon which the objectives to be met to satisfy this need are based. An example is that in the study conducted, only 30.5% of teachers consider themselves between 90 and 100% prepared to work with digital technologies, which leaves 69.5% of teachers that HEIs will have to train.

Technologies applicable to the educational process are useful, even if their knowledge is partial. Before covid-19, as could be conjectured, HEIs sustained most of their PE in the face-to-face mode, leaving the distance mode with less frequency. Now, the post-pandemic era demands a reconversion where HEIs must define, according to their strategic plan, the balanced proportion between face-to-face, virtual and mixed modes, making the necessary adjustments to achieve it. In the resulting proportion, if it is decided to design and operate the online mode, the characteristics of the virtual university and its educational model must be kept in mind. To this end, they should deploy a training program in technologies applicable to education that clarifies their use. As far as possible, HEIs should have their own platforms and improve connectivity, as well as support their academics in the acquisition of computer equipment, Internet connection costs and electricity consumption.

CONCLUSIONS AND RECOMMENDATIONS

The objective of this study was to know about the impact that the covid-19 pandemic had on teachers in Mexican HEIs in terms of their training to sustain virtual educational processes, as well as to know whether they have efficient technical resources to do so. The hypothesis was tested that the closure of HEIs as an emergency measure to contain the pandemic urged the deployment of distance education solutions based on digital technologies, catching teachers by surprise without the necessary preparation or financial and technological resources, and without the aid of institutions they work for.

The presence of covid-19 makes it possible to assume that this health problem, initially epidemic, has become an endemic disease. Therefore, what is now remote teaching in an emergency situation must move towards an educational model that balances virtual and face-to-face. This implies doing whatever is necessary to overcome the technological fissure of HEIs, teachers and students. One recommendation in this regard is that, between the SEP, the National Association of Universities and Higher Education Institutions (ANUIES, by its acronym in Spanish) and the HEIs, programs should be designed and operated to overcome this gap and that these three bodies should join forces to design and operate a user-friendly

and low-cost platform for the use of schools, universities, their teachers and students.

Finally, the strategic plans of the HEIs need to be rectified to contemplate the proportion of face-to-face, virtual and mixed EP, as well as the necessary provision of their own platform to support the articulation of content with the institutional curriculum and improve connectivity within each campus. Of course, within the virtual EP it is necessary to train teachers and support them in the purchase of efficient computer equipment as well as in their internet and electricity expenses.

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