

# Use and adoption of digital educommunication media by university professors during the Covid-19 pandemic: cases of the *National Autonomous University of Mexico* and the *Autonomous University of Chihuahua*

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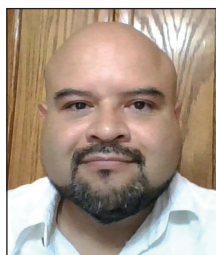
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## Abstract

This article analyzes the educational use of digital educommunication media (DEM) by four groups of professors working at the faculties of *Philosophy and Letters* and of *Engineering* at the *Autonomous University of Chihuahua (UACH)* and at the *National Autonomous University of Mexico (UNAM)*. Seven hypotheses and three research questions were posed, which were related to the use of DEM (specifically: images, animations, and video; presentations (*PowerPoint/Prezi*); digital texts; the Cloud; social media/instant messaging; and email), their qualities and the differences regarding their use, among the different groups studied. A two-phase mixed-methods explanatory sequential approach was employed, with a first phase of quantitative data collection and a second qualitative phase. A stratified sample of 177 professors was selected, which was distributed proportionally between the two selected faculties and universities. All professors completed a 144-item questionnaire in the first phase, and on the basis of their answers, ten professors were selected to be interviewed in the second phase, to ensure the diversity of the interviewed group in terms of sex, age, faculty, and educational level at which they teach, as well as their teaching experience and experience in the use of DEM. Among the results, we found that: a) the choice between using DEM or traditional media in class was not determined by teachers' perception about their students' learning with technology; b) the characteristics of each DEM determined its use, but the use of a given DEM was not related to the activities that it could enable; c) the professors exclusively teaching in graduate programs, the younger ones, those from *UNAM*, or those of *Engineering* did not present significant differences to their counterparts in terms of their use and assessment of DEM; and d) the qualitative data reaffirmed these trends and helped typify the challenges and opportunities of using DEM, particularly those that arose from the period of the exclusively online education model that was adopted owing to the COVID-19 pandemic.

## Keywords

Digital media; Digitalization; Educommunication; Educational technology; Technology use; Technology adoption; Higher education; University professors; Digital competences; Skills; University pedagogy; Teaching; Covid-19; Coronavirus; Pandemics; Distance teaching; E-learning.

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## 1. Introduction

Before defining ‘educommunication,’ it is pertinent to conceptualize its two components. Firstly, education can be conceptualized as the sum of activities that aim to seek, investigate, and create valuable legacies: to integrate the most significant; and foster the curiosity toward knowledge. Additionally,

“an educational fact is, essentially, a communicative fact” (Martínez-Salanova-Sánchez, 2018, p. 1).

Then, communication is a social act that implies two individuals interacting with each other (Mead, 1973). Such interaction integrates three sequential elements: an individual’s expression, a response to such expression by an interlocutor, and the result of the initial expression (Garza-Guzmán, 2009). Various theorists define communication as the activity in which a person (or group) sends and receives messages (Moore, 2015). It can also be defined as the process by which one acts upon receiving information, as well as the situation in which a source transmits a message to a receiver, with the aim of influencing their behaviour. In addition, communication includes the transmission of information (De-Miguel, 2010), and it is different from the process of disseminating information, because some feedback must emerge from within the sender-message-receiver circuit. In this way, a dynamic phenomenon of information exchange and role switching occurs, since the receiver then becomes the sender during feedback.

Between the 1920s and 1930s, the first educommunication experiences were conducted in schools by Célestin Freinet and Frank Raymond Leavis (Méndez-Ojeda *et al.*, 2014). Freinet founded a school newspaper in the Bar-sur-Loup (France) rural school, under the novel concept of learning using communication tools. Freinet found that students built their literary and communicational skills by participating in the school newspaper, through the analysis of sociocultural facets that other teachers did not consider before. This was

“a channel of free expression that fostered communication among peers, but also among elementary school teachers” (Méndez-Ojeda; Luque-Ortiz; Pérez-Curiel, p. 16).

Years later, Freinet’s work was replicated and enriched worldwide by his successors, such as Paulo Freire, Mario Kaplún, and Francisco Gutiérrez (Prieto-Castillo, 2010; Méndez-Ojeda *et al.*, 2014).

Considering the cited background, the concept of digital educommunication media (DEM) refers to the information and communication technologies (ICTs) that are within professors’ reach and that can be used to facilitate teaching, learning, and communicational processes. We

chose the term ‘educommunication’ instead of other concepts such as ‘technology-mediated education’ or ‘digital literacy’ (or even ‘media literacy’) since, according to Narváez (2021), the latter imply a combination of technology, culture, training, qualification, and education. On the contrary, focusing on the DEM, their use, and adoption allows adopting an inter- and transdisciplinary approach between education and communication (Barbas-Coslado, 2012, p. 158).

“Between the 1920s and 1930s the first educommunication experiences occurred in schools”

ICT-supported teaching and learning should not be assumed to imply an inferior education; rather, it is an integral part of the changes in the processes intended to learn about the world and explaining it, which in turn is tuned to and depends upon the technological tools used in each historical moment (Cardona-Ossa, 2006). ICTs enable professors to better monitor their students’ individual learning and aids them in improving the organization of their teaching materials. In addition, they help combat professors’ boredom and monotony (Jarvis, 2015). Díaz-Barriga (2008) points out some positive aspects of teaching and learning in online environments:

- Generates digital literacy in students and professors, which is related to “high-level thinking” models through searching, analysing, and discovering digital information collections.
- Facilitates the access to trustworthy data and to specialists in different fields of knowledge and allows for the inclusion of meaningful tasks.
- Provides alternatives to turn learning processes into tasks that involve self-regulated and metacognitive reflections.
- Engages students in case analyses, projects and problem-solving, as well as in activities that enable collaboration, dialogue and the generation of their own criteria and knowledge.

- Promotes personal and online communication for educational and social purposes, fostering a sense of community and reducing the perception of isolation.
- Motivates the production of digital portfolios and evaluations that reflect students' achievements, the skills they acquired, and enables self-assessment.
- Provides constant evaluation to students, in addition to offering them working alternatives in a challenging, but approachable, environment.
- Allows understanding and helping students with their individual needs by using digital formats that do not imply a single answer to a given question or problem, rather, they show the various correct choices employing texts and multimedia.
- Considers the inclusion of diverse mentoring and online participation levels.

In this way, DEM

“can be privileged as instruments and resources for treating curricular areas at different educational levels, due to their capacity to motivate, their informational potential, their global focus, and their transcendence” (**Araque-Hontangas**, 2009, p. 3).

Using DEM in higher education may lead to the establishment of three characteristics: a) interactivity and flexibility; b) link professors and students; and c) facilitate the access to educational materials and other information sources (**Duart Sangrà**, 2000). According to **Jarvis** (2015), some of the benefits of using DEM are:

- Save time and money: less photocopying and reliance on expensive books.
- Selection and retention of information: print documents can be lost or thrown away once the exam/unit in question has been passed. This does not happen when the information is digitally stored, which also facilitates its organization.
- Transferability: it is easy to upload the material of an entire course to the cloud and ask a student to grant their classmates with access to it, or to send pertinent information by email to a couple of students and then ask them to disseminate it among their peers.
- Student achievement: using DEM effectively and consciously in the classroom contributes to develop a sense of achievement among students.
- Inclusion: demographic, social or health factors can be obstacles to learning, but they can be reduced, or even eliminated, by using DEM.

However, there are mixed perspectives when assessing how DEM have been permeating education. If we only consider the impact of ICTs on education, specifically regarding learning, teaching and evaluation, changes have been arguably modest (**Natriello**, 2005). **Piccoli, Ahmad**

and **Ives** (2001) warn that the poor design and execution of educational programs enhanced by ICTs can increase students' levels of anxiety, confusion, and isolation. Another problem is that DEM are seen by many professors not as solutions, but as requirements demanded by their institutions (**Jarvis**, 2015). Furthermore, it should be noted that the positive impact of using DEM in the classroom could vary from course to course. In fact, **Machin, McNally** and **Silva** (2007) found it difficult to measure long-term learning outcomes when these were enabled by DEM. They do not necessarily ensure educational inclusion, equity, quality, or innovation if they are employed as information repositories and are exclusively used to send information to students (**Díaz-Barriga**, 2008).

“ Digital educommunication media facilitate teaching, learning and communicational processes ”

In addition, online classes can be unsuccessful when students' expectations of satisfaction and quality are not met, which could be further harmed if professors lack digital skills and if students do not have enough motivation or self-teaching skills. The lack of human contact, and of appropriate social and educational contexts within courses are other affecting factors (**Ojeda-Castañeda**, 2005).

Although there are abundant studies on the use of DEM in the classroom, they mostly focus on students, while those centred on professors and the relationships with their adoption and use of DEM are scarcer. This latter point of view allows identifying positive aspects in favour of using DEM in the classroom as means to save time and money, and as the mandatory technologies that were employed worldwide to offer educational processes during the COVID-19 pandemic.

## 2. Methodology

This research was non-experimental, cross-sectional, and descriptive, and was conducted under an explanatory and sequential mixed methodology, which, according to **Creswell** (2013), begins with a quantitative phase of data collection and analysis that informs the design and implementation of a second phase of qualitative data collection and analysis. A stratified sample of professors from two Mexican universities was employed: from the *National Autonomous University of Mexico (UNAM)* and the *Autonomous University of Chihuahua (UACH)*, focusing on two faculties for each university: *Philosophy and Letters (FFyL)*, and *Engineering (ENG)*. Sampling was carried out under the criteria of maintaining a 10% standard error, a confidence level of 90% ( $Z=1.645$ ) and a probability of success of 50%, and 50% of failure, meaning that 50% of professors from the sample should use DEM for teaching, as opposed to traditional methods.

These two universities were chosen to have two dissimilar cases in terms of university size (in number of students and professors), of assets, ranking and geographic location (north of Mexico *versus* centre); under the assumption that these two dissimilar cases would yield marked differences, or rather, interesting similarities. *UNAM* is the largest university in Mexico, its campus is located in Mexico City, it leads the national ranking of universities, and it is among the top 105 in the world, according to the *QS World University Rankings 2022 (UNAM, 2021)*. Meanwhile, *UACH* is one of the two state universities in the state of Chihuahua, located in the north of the country and its main campus is in the city of Chihuahua (*UACH, 2020*). Table 1 specifies the resulting sample and the total number of professors in each of the four groups.

Table 1. Calculation of the sample for the questionnaire

University	Faculty	Population	Sample
<i>UACH</i>	<i>FFyL</i>	52	30
	<i>ENG</i>	91	40
<i>UNAM</i>	<i>FFyL</i>	238	53
	<i>ENG</i>	260	54
	Total	641	177

A first version of the questionnaire was piloted with 43 professors from *UACH*, both from *FFyL* and from the *Faculty of Political and Social Sciences*. Their responses resulted in a Cronbach's alpha value of  $\alpha=.972$  across the 92 items of the pilot questionnaire, the data was then analysed, and the questionnaire's items were improved. After applying such improvements, the final version of the questionnaire, which contained 144 items, was sent to the sample of 177 professors. In this application, a Cronbach's alpha of  $\alpha=.961$  was obtained. Based on the responses to the latest version of the questionnaire, ten professors were chosen to be interviewed, prioritizing diversity in terms of sex, age, faculty, educational levels in which they teach, and their years of teaching experience and of using DEM. Table 2 presents the general characteristics of the professors interviewed.

Table 2. Characteristics and codes of the interviewees

Interviewee	Sex	Age	Institution	Programs in which they teach	Teaching experience(years)	Experience using DEM
Int1	Female	50	<i>UACH-FFyL</i>	Bachelor	33	29
Int2	Male	37	<i>UACH-FFyL</i>	Bachelor, master, and doctorate	6	6
Int3	Female	38	<i>UNAM-FFyL</i>	Doctorate	7	7
Int4	Female	62	<i>UNAM-FFyL</i>	Bachelor	2	1
Int5	Male	69	<i>UNAM-ENG</i>	Bachelor, and master	45	15
Int6	Male	41	<i>UNAM-FFyL</i>	Bachelor, master, and doctorate	16	10
Int7	Male	32	<i>UNAM-ENG</i>	Bachelor	5	4
Int8	Female	41	<i>UACH-ENG</i>	Bachelor, and master	12	12
Int9	Female	31	<i>UACH-ENG</i>	Bachelor	8	5
Int10	Male	49	<i>UNAM-ENG</i>	Bachelor	27	12

In the first phase of this research (quantitative), data was collected by using the mentioned questionnaire, which included open and closed-ended questions (multiple choice questions, rankings and items that employed a Likert-type scale). The second phase (qualitative) involved conducting structured interviews with professors who were selected based on their years of teaching experience and using DEM, as well as their age and institutional affiliation. Given the context of the COVID-19 pandemic, professors' years of experience under a virtual education scheme was also considered.

It is important to note that the data collection was carried out between 2020 and 2021, it was unintentionally started when the *World Health Organization* declared the beginning of the pandemic, while interviews took place months later. This represented certain limitations for conducting this research, since professors could only be contacted by email or telephone, thus extending the time it took for data collection to conclude, and thus it required multiple contacts and reminders. In addition, both instruments were applied online, the questionnaires were conducted through *Google Forms* and the interviews through *Google Meet*.

This study was driven by three research questions:

- How do professors' perceptions toward their students' learning influence their decision of using DEM or traditional methods in class?
- How does DEM's assessment influence professors' decision to use them in class?
- Are there significant differences in the use of DEM between professors of different ages, universities, faculties and among those teaching at specific educational levels?

Six DEM were studied: 1) digital texts; 2) images, animations and videos; 3) presentations (e.g., *PowerPoint/Prezi*); 4) email; 5) social media and instant messaging programs (e.g., *Facebook, Twitter, WhatsApp, Telegram*); and 6) cloud-based file and information hosting services (e.g., *Dropbox, Google Drive*).

Given the above and emphasizing that the focus was on studying the use and adoption of the six DEM selected by university professors from the dissimilar groups of the selected institutions and faculties, the following hypotheses were proposed, which exclusively considered professors' perceptions:

H<sub>1</sub>: Professors using DEM more frequently consider that their students learn better.

H<sub>2</sub>: Professors using traditional methods more frequently consider that their students learn better.

H<sub>3</sub>: DEM are more frequently used if they are better evaluated through TAM, QUM, and the activities that they enable

H<sub>4</sub>: Professors teaching in graduate programs use DEM less, but more effectively than professors in undergraduate programs.

H<sub>5</sub>: Younger professors use DEM more frequently and effectively than older professors.

H<sub>6</sub>: UNAM professors use DEM more frequently than UACH professors.

H<sub>7</sub>: ENG professors use DEM more than FFyL professors.

## 2.1. Design of the questionnaire

Adhering to the order in which this research was carried out, we present below the design of the questionnaire that was used in the first quantitative phase. This questionnaire was divided into the following four sections and contained a total of 144 items, 123 of which were intended to be rated with a Likert-type scale. Additionally, it included five open questions.

a) General data: this first part requested the following general data from the professors: sex, age, institution where they work (faculty and university); field of study, educational levels in which they teach (bachelor, master, or doctorate programs), years of teaching experience and of using DEM in the classroom. These general data were collected to cross-reference and segment the data obtained throughout the entire questionnaire, to determine professors' profiles and their characteristics, in addition to conducting statistical analyses.

b) Generalities of DEM (abbreviated 'generalities'): this second section sought to collect data about professors' preference of using DEM in class, or if they opted for more traditional teaching methods. This allowed verifying how dependent they were on DEM to carry out their teaching and determining certain generalities about their classes and particularities behind teaching processes for specific fields of knowledge.

c) Evaluation of DEM ('I consider'): this third part of the questionnaire presented 72 items to be rated using a five-point Likert-type scale (0 to 4, zero being 'totally disagree', and four 'totally agree'). Questions about DEM's characteristics were included, which used the key concepts of the Technology Acceptance Model (TAM) (Davis; Bagozzi; Warshaw, 1989), in combination with their 'qualities of use' model (QUM), a conceptual model that was generated for this research, to serve as a complement to TAM and it was grounded on the review of the specialized literature. The key concepts of the TAM, which is commonly used to study the use and adoption of ICTs, include: useful, easy, motivates its use, frequently used; while QUM's adjectives were: reliable, simple, versatile, fun, time-saving, transmits information better, solves problems, makes it easier to express myself. Both models (TAM and QUM) were used to ask professors to evaluate the six DEM studied (images, animations and video; presentations (*PowerPoint/Prezi*); digital texts; cloud-based file and information hosting services; social media/instant messaging; email), by using these models' concepts. TAM is used to analyse users' acceptance and evaluate systems (Davis; Bagozzi; Warshaw, 1989). It includes the concepts of ease of use and perception of usefulness, which influence individuals' behaviour regarding their acceptance of a given technology, as well as the intensity of their current use of the ICT in question. Similarly, QUM was used as a complement and contrasting element to TAM, to investigate professors' perceptions regarding DEM's effectiveness, use and adoption when teaching their classes.

“ Online classes can be unsuccessful when students' expectations of satisfaction and quality are not met ”

d) Use of DEM in class (subdivided into three parts: 'prioritize', 'activities', 'student learning'). The prioritize subsection sought to collect data on the six DEM under study, as they were used by professors, and which ones they used the most. The activities subsection inquired about their preferences for using each DEM, depending on how they enable the following activities:

- transmit information;
- motivate or raise awareness;
- exemplify/explain; and
- encourage creativity.

The student learning subsection asked professors to express their perception of their students' learning, focusing on DEM, and the importance and use of its graphic and aesthetic possibilities.

Finally, professors' reflections and perceptions were collected through a series of open-ended questions:

- their opinion regarding in which courses they consider that DEM are mostly used;
- positive and a negative aspects of using technology in their classes;
- if they have received any training on using DEM in their classes;
- the websites they mostly use to enrich their classes;
- the technical difficulties they have experienced while working with DEM;
- the number of *WhatsApp* university-related groups in which they are included;
- the number of unread emails in their inboxes;
- recommendations for their institutions to further facilitate the use of technology in their classes; and finally,
- an invitation to participate in the interview.

The results obtained through the questionnaire were useful to learn more about the use of DEM by professors (e.g., which ones they used for a specific activity or which ones are for general use), and to determine the pros and cons of using DEM in education.

## 2.2. Design of the interview questions

The data collection instrument used in the second phase of research (qualitative) was the interview, which included nine questions, divided in four topics:

- current and future changes of using DEM in education;
- graphic and aesthetic possibilities;
- experiences during the COVID-19 pandemic; and
- considerations about the questionnaire's results.

## 3. Results

Regarding the analysis of quantitative data obtained from the questionnaire, at a descriptive level, 75% of the professors from both institutions declared having

75% of the professors declared having previous experiences in virtual education

previous experiences in virtual education, which was to be expected, since the beginning of the data collection coincided with the declaration of the COVID-19 pandemic, at the beginning of 2020. Therefore, it may be assumed that professors responded from their current experiences at the time of answering the questionnaire, instead of considering their entire teaching careers. Most professors (80%) relied on DEM when explaining or presenting a topic, they preferred using a projector to present their visual aids instead of relying on the blackboard, 70% versus 30%, respectively.

Regarding the provision of reading materials, all participants declared that they send digital reading materials to their students, instead of using print documents. In terms of how they approach teaching problems and case studies, professors relied almost entirely on DEM (80%), as opposed to traditional methods (20%).

The results from DEM's evaluations by using TAM included that all DEM were adopted almost equally. The three most widely used by professors were, in order of importance: email, images, animations and video; and cloud-based file and information hosting services. In contrast, presentations (*PowerPoint/Prezi*) scored the lowest. Regarding the most and least important DEM, according to the statistical medians obtained in each TAM adjective, the following was obtained:

- Useful: the cloud was typified as the most useful DEM, while professors perceived social media and instant messaging programs as less useful.
- Easy: the easiest to use was email, while the cloud was its counterpart.
- Motivates its use: the DEM that most motivated professors toward using it were images, animations and video, in the opposite extreme, participants chose email.
- Frequently used: the most frequently used DEM turned out to be email and the least, images, animations and video.

Regarding QUM's adjectives, images, animations and video, as well as presentations (*PowerPoint/Prezi*) and digital texts were preponderant in their adoption; in contrast to social media and instant messaging programs, which reported the lowest scores. Images, animations and video were evaluated well both in terms of TAM and QUM. Regarding the most and least important DEM, according to the statistical medians obtained in each quality of use adjective, the following was obtained:

- Reliable: *PowerPoint/Prezi* turned out to be the most reliable, while social media and instant messaging programs were the least reliable.
- Simple: email was the simplest, while images, animations and video were considered more complex.
- Versatile: images, animations and video were the most versatile, while digital texts were considered to be the most one-dimensional for educational work.
- Fun: images, animations and video were typified as the most fun to use, while email was the furthest from this concept.
- Time-saving: the cloud was considered the most time-saving DEM, while social media and messaging programs showed the opposite trend.
- Transmits information better: the preferred DEM for this was images, animations and video, as opposed to social media and instant messaging programs, which was unexpected, as this is apparently the primary function of the latter.

- Solves problems: the cloud was the best qualified for this purpose, while social media and instant messaging programs were the worst qualified.
- Makes it easier to express myself: to express themselves better, professors reported resorting more to images, animations and video, while social media were less preferred.

Regarding the specific DEM that professors would like to learn to use better, images, animations and videos were mentioned the most (32.2%), followed by the cloud (29.4%), social media and instant messaging programs (9%), digital texts (1.7%) and PowerPoint/Prezi (0.6%). Although we compared the answers of the professors from the four groups, no significant differences were found regarding the previous topics. However, differences between UACH and UNAM could be perceived in their answers to the open-ended questions included in the questionnaire. We approached the analysis of the answers to these questions by applying a content analysis method, generating a codification of categories from the answers' themes. We then compared the categories initially created to integrate a stronger final categorization, by avoiding ambiguity and ensuring that the categories presented adequate uniqueness. The final categorization is used below.

When asking professors to mention a positive and negative aspect of using DEM, the following categories were obtained. Their frequency and response percentage are presented in Table 3.

Table 3. Comparison of positive and negative aspects by institution

Aspects		UACH		UNAM	
		Frequency	Percentage	Frequency	Percentage
Positive	Comfortable	8	11.4	12	11.2
	Didactic	11	15.7	32	29.9
	Dynamic	21	30.0	22	20.6
	Information provision	14	20.0	23	21.5
	Economic	4	5.7	11	10.3
	Motivating	9	12.9	2	1.9
	Did not know/did not answer	3	4.3	5	4.7
	Total	70	100	107	100
Negative	Digital divide	10	14.3	23	21.5
	Time consuming	6	8.6	9	8.4
	Technological dependence	4	5.7	3	2.8
	Lack of educational materials	6	8.6	3	2.8
	Less student engagement	10	14.3	15	14.0
	Less personal interaction	9	12.9	20	18.7
	Did not know/Did not answer	4	5.7	11	10.3
	Technical issues	12	17.1	11	10.3
	Tedious	6	8.6	5	4.7
	Illegitimate use by students	3	4.3	7	6.5
	Total	70	100	107	100

In summary, UNAM professors perceived DEM as more didactic and economic (that is, effective; since they make it easier to do more with less), for almost twice as much as UACH professors. UNAM considered the digital divide to be much more serious, in addition to pointing out more frequently the problem caused by a lack of social interaction in online education. UACH professors perceived DEM as much more motivating, considering them to be attractive, stimulating, eye-catching and dynamic; that is, practical, simple, easy, fast, agile, versatile, and

Table 4. Comparison of the most used resources by institution

Resources	UACH		UNAM	
	Frequency	Percentage	Frequency	Percentage
Various	22	31.4	35	32.7
Repositories	17	24.3	36	33.6
YouTube	10	14.3	17	15.9
Did not use any/Did not know	6	8.6	2	1.9
Learning platforms	6	8.6	4	3.7
Google	5	7.1	6	5.6
Preparation of graphic material	3	4.3	6	5.6
Survey administration	1	1.4	1	0.9
Total	70	100	107	100

immediate. To a much lesser extent, professors from both universities considered relevant the topics of technological dependence, lack of educational materials, technical issues, and tedious. Regarding the most used websites to enrich their classes, Table 4 presents the comparison between institutions.

Within the various category, professors mentioned the following: *Google Scholar*, *Google Classroom*, *Genially*, *Canva*, *Moodle*, *Google Meet*, *Edmodo*, *Google Drive*, *Kahoot*, and *Prezi*. UNAM professors declared to make more use of repositories and information systems (e.g., *Ebsco*, *Latindex*, *Dialnet*, *Redalyc*, *Conricyt*, *Elsevier*, *SciELO*, *Sci-Hub* or *Libgen*); but at the same time, they made less use of educational platforms. In contrast, a very low percentage of UACH professors do not use websites to enrich their classes. Instead, they rely on educational platforms.

When asked about the greatest technical difficulties they face, the responses of the participants were divided into the following seven categories:

- DEM training and use;
- hardware issues;
- unstable internet connection;
- did not know/did not answer;
- other difficulties;
- software issues; and
- various.

Table 5 presents the comparison between institutions in this regard.

UNAM professors highlighted the poor quality of the internet connection as the main difficulty, communicating their discomfort regarding its poor conditions and instability, which was unexpected, given the difference in resources between UNAM and UACH.

UACH professors mostly resented the lack of training, in addition to noticing more difficulties related to their students, perceiving that they do not read or study the digital materials provided to them, as well as a lack of visual communication (i.e., when they connect to online classes, they do not turn on their camera). The types of recommendations that professors would make to their respective universities are presented in Table 6.

Although these recommendations were distributed almost evenly between the two universities, UNAM professors leaned slightly more toward suggesting more training for using DEM. Participants demanded advanced courses about using DEM (to take place ideally one week before starting each semester, or on weekends). UACH professors requested more digital resources and better conditions for their students.

### 3.1. Results from the interviews

In this section we present the results derived from the interviews, grouped into three main categories:

- current and future changes of using DEM in education;
- graphic and aesthetic possibilities; and
- experiences during the COVID-19 pandemic.

Regarding the analysis of the interviews, we used the transcripts to group the answers in the three main categories mentioned. Using content analysis, we compared professors' responses to generate specific categories and registered the

Table 5. Comparison of technical difficulties by institution

Technical difficulties	UACH		UNAM	
	Frequency	Percentage	Frequency	Percentage
DEM training and use	18	25.7	16	15.0
Hardware issues	13	18.6	15	14.0
Unstable internet connection	10	14.3	50	46.7
Did not know/Did not answer	10	14.3	11	10.3
Other difficulties	10	14.3	2	1.9
Software issues	6	8.6	5	4.7
Various	3	4.3	8	7.5
Total	70	100	107	100

Table 6. Comparison of recommendations by institution

Recommendations	UACH		UNAM	
	Frequency	Percentage	Frequency	Percentage
Support for using digital resources	16	22.9	20	18.7
Training on using DEM	15	21.4	29	27.1
More and better hardware	15	21.4	20	18.7
Improve internet quality	11	15.7	14	13.1
Improve students' conditions	7	10.0	4	3.7
Did not know/Did not answer	4	5.7	14	13.1
Various	2	2.9	6	5.6
Total	70	100	107	100



topics on which interviewees showed both common and dissimilar perspectives. The results shown below are supported by citations from the interviews, to further illustrate such agreements or disagreements, which were extracted from the most compelling verbal expressions.

“ Digital educommunication media usage frequency does not affect professors’ perception of their students’ learning ”

Regarding current and future changes of using DEM in education, the professors interviewed expressed that the most notable include certain changes in the professor-student contact and the time dedicated for preparing lectures. They commented that distance education will not be able to overcome face-to-face communication and DEM will not represent valuable resources if professors are not very communicative themselves, highlighting the importance of social interaction for teaching. Some DEM, in addition to generating technological dependency, are not so easy to use (Int1, *UACH-FFyL*; Int5, *UNAM-ENG*; Int10, *UNAM-ENG*). Regarding future perspectives, interviewees agreed that using DEM in education, in any modality (hybrid, distance, synchronous or asynchronous), is here to stay.

They warned about the risks associated to a poor implementation of technology in the classroom. However, two interviewees expressed relatively positive perspectives and acceptance toward a higher use of DEM in future education, pointing out the following:

“I think we will have a pandemic for a while and without wanting to be apocalyptic, virtuality is going to increase and with it, its challenges and difficulties” (Int2, *UACH-FFyL*).

In addition,

“if we really manage to implement and properly appropriate technology, it can represent a great advance for having a circular and complete education. If we cannot appropriate and make proper use of the media, it will be a failure” (Int3, *UNAM-FFyL*).

Regarding the graphic and aesthetic possibilities of the materials generated through DEM and used by professors to enrich their classes, they highlighted the importance of graphic design, as

“digital knowledge and time are required to develop graphic materials with a certain aesthetic” (Int8, *UACH-ENG*).

It was even suggested that

“we should all have a short course [about this] at some point in our lives” (Int7, *UNAM-ENG*).

The interviewees mentioned the following graphic and aesthetic aspects as transcendental when relying on technology for their teaching:

- Backgrounds: blank backgrounds or with a minimalist design, so that students focus more on the contents (Int3, *UNAM-FFyL*). It is useful to contrast the colour of the text with the background (Int9, *UACH-ENG*).
- Avoid animations and gifs, as they end up stealing attention (Int8, *UACH-ENG*).
- Prevent reading aloud a screen full of text, as this was characterized as nonsense (Int5, *UNAM-ENG*). It is also an error to load visual aids with too much text (Int10, *UNAM-ENG*).
- Font: as sober, serious, and legible as possible (Int3, *UNAM-FFyL*; Int8, *UACH-ENG*).
- It is not appropriate to exclusively provide students with multimedia materials, since they should also be taught or invited to read and analyse (Int8, *UACH-ENG*).
- Videos must be clear, short, concise, without background noise. No student will watch a long video in its entirety, and it is crucial to plan when it would be appropriate to play it in class (Int6, *UNAM-FFyL*).
- Digital documents must not be overloaded with graphic content (Int9, *UACH-ENG*).
- At the graduate level, the simpler the graphic content, the better (Int3, *UNAM-FFyL*). Several interviewees stated that if it is a presentation intended from professors for professors, it is recommended to avoid visual aids.
- For abstract topics (e.g., philosophical themes), it is a good idea to use videos (Int6, *UNAM-FFyL*).
- Students tend to work intuitively with the Google suite. Also, *Meet*, *Zoom*, *Facebook* or *Padlet* have a more user-friendly visual aesthetic (Int6, *UNAM-FFyL*).

Regarding the issues related to the COVID-19 pandemic, professors identified various challenges. They resented the lack of contact with their students, which they perceived had an impact on their learning outcomes. In addition, they declared that this situation, from the outset, generated some fear and reluctance toward technology, as they had to be urgently trained just to catch up. Participants mentioned that the DEM they implemented during the pandemic included video, presentations, cloud-based file and information hosting services, social media, instant messaging programs, video conferencing systems, and learning management systems. However, these were not implemented in such an orthodox way, as it would have occurred within the usual scheme of face-to-face classes and tied to

“ Professors’ technological preferences were not influenced by their university, the level of the programs where they teach, nor by their faculty or age ”

a classroom environment. Undoubtedly, the most noticeable change was the daily use of digital materials in education, turning them from a complement into the basis for generating daily lectures:

“I had to incorporate new tools, in particular *Zoom* ... Now I conduct evaluations with *Google Classroom*. I also started using *One Note*. I had already heard of all these tools, but I did not start using them properly until this pandemic detonated” (Int10, UNAM-ENG).

Professors found several opportunities, such as the considerable amount of online educational materials that they had access to, schedule flexibility, a better capacity for synthesis, and the ease of being able to access class contents anytime, given the advantages of asynchronous communication. Another advantage they pointed out included the proliferation and the easy access of massive open online courses (MOOC), typical of distance education and which can be accessed by any interested person.

“The most used information systems included *Ebsco*, *Latindex*, *Dialnet*, *Redalyc*, *Conricyt*, *ScienceDirect*, *SciELO*, *Sci-Hub* and *Libgen*”

### 3.2. Hypothesis testing

In this section, we present the analysis of each hypothesis that was posed at the beginning of this study, by carrying out the relevant tests. The results are shown below.

- $H_1$ : Professors using DEM more frequently consider that their students learn better

To test this hypothesis, we generated the ‘use DEM’ analysis dimension, which we calculated by averaging the five variables related to professors’ actions in the virtual education modality: presenting and explaining with DEM, presenting visual aids with a projector, using digital reading materials, and using DEM for problems and case studies. For this and other hypotheses that implied averaging the values of several variables to group them on a dimension of analysis, we conducted the appropriate Tukey tests of linearity and additivity, confirming the presence of the additivity effect in all the cases where we grouped several variables (at a level of significance between elements of  $\text{sig}=0.000$ ).

In the case of this first hypothesis, we divided the sample in two groups, depending on the values of the calculated variable (use DEM): a) professors using DEM less frequently (0-50 points); b) professors using DEM frequently (51-100). The other variable involved in this hypothesis corresponded to the ‘learning’ analysis dimension, which in turn averaged the nine variables that were related to professors’ perceptions of their students’ learning when using DEM. Given the variables involved and that the ‘use DEM’ variable presented a non-normal distribution, a non-parametric test of independent samples was carried out, which rejected this first hypothesis ( $\text{sig}=0.943$ ). In other words, DEM’s usage frequency does not affect professors’ perception of their students’ learning.

- $H_2$ : Professors using traditional methods more frequently consider that their students learn better

To test this hypothesis, we generated the ‘Traditional use’ analysis dimension, which we calculated by averaging the variables related to the use of traditional media in class, which included: explaining topics without DEM support, using the blackboard, providing students with print materials, and not using DEM to present problems and case studies. Given the distribution of this variable, a non-parametric test of independent samples was used again, which also resulted in rejecting this hypothesis ( $\text{sig}=0.892$ ). This implied that professors’ perception of their students’ learning does not influence their choice to use traditional media either.

- $H_3$ : DEM are more frequently used if they are better evaluated through TAM, QUM, and the activities that they enable

This hypothesis involved three dimensions of analysis: ‘TAM’, ‘QUM’ and ‘activities’, which were variables calculated by averaging other variables, as indicated in the test of  $H_1$ . Given the distribution of these variables, we used a non-parametric test of independent samples, with which  $H_3$  was supported if the DEM evaluations are carried out by using TAM ( $\text{sig}=0.031$ ) or QUM ( $\text{sig}=0.050$ ), but it was rejected when evaluating DEM through the activities that they enable ( $\text{sig}=0.823$ ).

- $H_4$ : Professors teaching in graduate programs use DEM less, but more effectively than professors in undergraduate programs

This hypothesis involved dividing the sample into two groups, according to the educational levels at which they teach: a) those not teaching in graduate programs; and b) those teaching at graduate programs. This hypothesis involved carrying out two tests, which resulted in rejecting this hypothesis in all cases: a) regarding DEM usage frequency (employing ‘use DEM’ variable, see  $H_1$ ) ( $\text{sig}=0.386$ ); and b) regarding usage effectiveness (see  $H_3$ ) through TAM ( $\text{sig}=0.879$ ) and QUM ( $\text{sig}=0.777$ ).

- $H_5$ : Younger professors use DEM more frequently and effectively than older professors

To test this hypothesis, the variables ‘use DEM’, ‘TAM’ and ‘QUM’ were used, as well as an age variable, which was calculated to divide the sample in four groups: a) less than or equal to 39 years old; b) from 40 to 46; c) from 47 to 54; and d) more than 55. Since this test involved comparing values among four groups, an analysis of variance (Anova) was conducted and resulted in rejecting this hypothesis. That is, young professors do not use DEM more frequently than their older colleagues ( $\text{sig}=0.477$ ); nor do they use them more effectively, either if we measure effectiveness by employing TAM ( $\text{sig}=0.833$ ), or QUM ( $\text{sig}=0.873$ ).

- $H_0$ : UNAM professors use DEM more frequently than UACH professors

The sample was divided in two groups: a) UNAM professors; and b) UACH professors. A non-parametric test of independent samples was carried out, which resulted in rejecting this hypothesis ( $\text{sig}=.247$ ), which implied that there was no distinction between the preferences of the professors from either university in terms of using DEM.

- $H_1$ : ENG professors use DEM more than FFyL professors

The sample was divided into two groups: a) FFyL professors; and b) ENG professors. A non-parametric test of independent samples was carried out, which resulted in rejecting this hypothesis ( $\text{sig}=.441$ ); meaning that ENG professors do not use DEM more frequently than FFyL professors.

#### 4. Discussion

Email was considered the simplest and easiest DEM to use, it was also widely used to share information; but it was not characterized as the most fun, versatile, or the one that most motivated its use. No professor expressed any motivation to learn to use it better. Moreover, 45.8% of the professors commented that they did not have any unread mail, which may indicate some of their information management habits; although this percentage may fluctuate daily: in the same day you can have a dozen unread emails, and on that same day you may delete or read them. Surprisingly, email turned out to be the highest rated DEM under TAM, but this did not set it too far apart from the other five.

Professors claimed that distance education will not surpass face-to-face models, but either will benefit from having professors with high communication skills

Regarding images, animations and video, it turned out to be the DEM that most motivated its use and, therefore, it was the most frequently used. 30% of the professors declared that they would like to learn to use them better, considering them the most fun and that allow them to best express themselves; but at the same time, they are the least simple. In addition, they were characterized as versatile, being considered as viable tools to motivate, exemplify or explain. They expressed using them to communicate complex ideas and enrich classes. If videos are to be used or created, they should be short, straightforward, and free of background noise. Length is crucial, as long videos will tend to be ignored by students, even partially. Producing videos takes time and effort, they tend to occupy considerable hard drive space on professors' devices; but they can be reused. Regarding the moment to use videos in the class, it can be in the middle for an activity, at the beginning as an introduction to a given topic, or at the end, to enable students' reflections.

Regarding presentations (*PowerPoint/Prezi*), they were frequently used and were qualified as useful to exemplify or explain topics in class. It was also considered the most reliable, but professors would not like to learn how to use them better. Jarvis (2015) comments that graphic content must be relevant to the learner, while he suggests including references to pop culture. Professors claimed that they are needed the least for graduate studies, since the emphasis is switched to students' self-learning skills and their ability to read, analyse, interpret, and write independently.

Although in an optimistic and propositional manner, Jarvis (2015) invites to increase students' participation through social media and instant messaging programs, Noguera-Fructoso (2015) warns that students tend to feel uncomfortable when professors enrich their classes with less hierarchical means. The professors who were part of this research considered privacy protection in social media to be poor, which were coupled with other negative aspects of this DEM, such as its tendency to distract users' attention and the presence of hoaxes or fake news. This was considered the least useful and reliable DEM, and they considered it the most difficult for expressing themselves. However, the effectiveness of social media and instant messaging programs lies in their ability for answering questions and sending messages quickly and easily, surpassing more conventional means, such as email.

Cloud-based file and information hosting services turned out to best support sharing information with students, professors claimed that they would like to learn to use these better, they considered it as the most useful DEM under TAM, it was characterized as the least easy to use, but the best for problem-solving. The largest concern toward this DEM is the mistrust it generates regarding the potentially inappropriate use of the information stored (e.g., accidentally deleting a shared folder, sharing with third parties without consent). But, if managed well, it can be a great document management tool. Finally, digital texts were considered more useful and suitable for sharing information, but they were less relevant for professors in terms of the other aspects studied.

##### 4.1. Digital educommunication media: current and constant challenges

The digital divide stood out as one of the greatest challenges, as pointed out by participants. Berrío-Zapata and Rojas (2014) warn that

“globalization marginalizes the populations that are not compatible or close to their interests and ICTs are attached to this process” (p. 135).

Unfortunately, in Mexico there is a large socioeconomic disparity, as well as inequalities of access to capable computer equipment among students and even for classrooms.

It can be difficult for professors to implement ICTs in their classes, since they may lack enough training or skills (Díaz-Barriga, 2008; Jarvis, 2015; Nupairoj, 2016) Consistently, the professors who participated in this study stated that they require more training to improve their knowledge about the quantity, scope, and advantages of the tools available for education.

Jarvis (2015) mentions a series of recurrent problems behind the use of DEM, which were reflected in professors' answers, such as:

- limited compatibility among the various hardware available in each classroom or in their homes;
- the investments that many professors make from their own resources to acquire the most recent or comfortable software and hardware to work with;
- the size and quality of digital files; and
- the lack of software and hardware updates in educational institutions.

#### 4.2. Profile of the digital professor

Professors with more experience in teaching and in using DEM recognized that, more than the technological tool, it is the didactic strategy employed what achieves a successful education. After all, and as Jarvis (2015) deduced, the use of technology in the classroom will not change professors' personality, enthusiasm, or teaching methods by itself. According to Nupairoj (2016), regardless of the media, professors must develop a series of specific characteristics and skills.

It became clear that, through the accelerated DEM training experienced by professors during the pandemic, they developed more digital competencies and adopted DEM more widely than ever before. Still, some were hesitant and uneasy about whether they were making a good use of ICTs, while others stressed the need to be stricter about preserving their personal time and weekends. For example, they found it inappropriate that their students would seek their advice on Sunday mornings.

However, it is commendable that professors were able to implement ICTs with such haste and under such a drastic change to a completely online educational model, due to the context of the pandemic; being forced to practically redo their lectures and adapt them in a very short time, while in many cases lacking the experience or training to do so. Otherwise, it would have been impossible for formal education to continue during the pandemic. However, it should be noted that Piccoli *et al.* (2001) warn of the risks of a poorly designed virtual class, considering that this can increase students' anxiety, confusion, and feelings of isolation. Studying from home was not an easy process and students went through this for almost three years (2020-2022); judging by professors' impressions and comments, stress and these emotions were present among students. When using technology to enrich their own training, professors considered it prudent to be more aware of the level of their students' visual aids and to exploiting their curiosity, because more than ever, today they have all the media at their disposal.

“ In Mexico, there is a large socioeconomic disparity, as well as inequalities of access to capable computer equipment among students and even for classrooms ”

### 5. Conclusions

This research allowed determining some pros and cons of using DEM in higher education. Among the positive aspects, we found that the DEM were qualified by professors as predominantly dynamic and didactic, and as such:

- They are practical, agile, and quick, to the degree of achieving immediacy in terms of response times.
- They imply simplicity and ease.
- They are versatile and effective, contributing to the personalization of the content at the professor's discretion.
- They facilitate synthesising contents, thereby, helping to reduce the time consumed.
- They improve students' understanding, attention, and learning, reinforcing information.
- They invite students to interact more in class.
- They support teaching with a variety of digital resources, which are complementary and reusable.

On the other hand, and parallel to the issue of the digital divide, participants found three notorious negative aspects of DEM: a) precarious personal interaction, b) lack of commitment from students, and c) technical problems. Therefore, the cons identified are the following:

- Remote work might hinder socialization. Lack of trust will limit student participation.
- While not in a physical classroom, non-verbal communication is drastically affected, reducing the feedback that professors can receive from their students. For example, several professors complained that few students wanted to turn on their cameras.
- DEM can be unmemorable for students, to the point of becoming distractions and not aids to education.
- Professors should not rely exclusively on DEM, since technical failures such as blackouts, outdated or damaged equipment, and a poor internet connection will reduce the quality of the class or even make it impossible to take place.
- Lack of training and ignoring the available digital tools may negatively affect lectures' quality.

The COVID-19 pandemic and the distance education model brought about a series of phenomena worldwide. Almost paradoxically, while a tremendous reach was achieved in terms of communication, lockdowns also decontextualized education, taking it out of the controlled environment represented by the classroom and placing it in homes around the

world –something that added a notorious difficulty to teaching–learning processes and might have decreased their seriousness. Although professors’ digital training was sudden, those who participated in this research claimed to be happy with the results. Although in a forced and sudden way, they declared that they had learned to use and exploit some DEM that, in another moment, they may have not considered.

“The pandemic amplified communications’ reach, but it also decontextualized education”

It was notable that, during the pandemic and under the subsequent and exclusively online education model, the concept of “digital natives” was more frequently questioned; such concept implies that younger people are more receptive to ICTs and hence they can adopt them more easily, efficiently, and immediately. During lockdowns and faced with the typical problems of using the ICTs at their disposal, this might not have been so simple, especially when young people must use ICTs for academic work. Such doubts toward the notion of digital natives were already pointed out by previous research (e.g., **Margaryan et al.**, 2011) and perhaps the pandemic has accentuated them, as evidenced by the observations of some of the surveyed professors and in more recent post-COVID-19 research (**Smith et al.**, 2020; **Janschitz; Penker**, 2022; **Zvacek**, 2021).

Inferentially and by addressing the research questions, we can conclude that professors’ perception about their students’ learning does not influence their choice using DEM or traditional methods. However, if professors assess a given DEM positively, this determines its usage for enriching their lectures, which is consistent with TAM. Finally, there were no significant differences in DEM usage between professors of different ages, universities, and faculties or between those teaching at different academic levels. Regarding the hypotheses, all were rejected except for H<sub>3</sub>: DEM are more frequently used if they are better evaluated through TAM, QUM, and the activities that they enable. The rejection of the other hypotheses might also allow refuting certain stereotypes held around the use of ICTs by professors, at least within the context studied. In other words, rejecting these hypotheses implies that, contrary to what one might think, owing to its size and resources, UNAM professors do not necessarily use DEM more frequently or effectively than UACH professors; neither engineers necessarily use them the most, nor the youngest. The use and adoption of DEM is not that simple.

## 6. References

- Araque-Hontangas, Natividad** (2009). “Los medios de comunicación desde su vertiente didáctica dentro de la universidad”. *Prisma social*, n. 3, 21 pp.  
[https://www.isdfundacion.org/publicaciones/revista/pdf/09\\_N3\\_PrismaSocial\\_natividadaraque.pdf](https://www.isdfundacion.org/publicaciones/revista/pdf/09_N3_PrismaSocial_natividadaraque.pdf)
- Barbas-Coslado, Ángel** (2012). “Educomunicación: desarrollo, enfoques y desafíos en un mundo interconectado”. *Foro de educación*, n. 14, pp. 157-175.  
<https://dialnet.unirioja.es/servlet/articulo?codigo=4184243>
- Berrío-Zapata, Cristian; Rojas-Hernández, Hernando** (2014). “La brecha digital universitaria: la apropiación de las TIC en estudiantes de educación superior en Bogotá (Colombia)”. *Comunicar*, v. 22, n. 43, pp. 133-142.  
<https://doi.org/10.3916/C43-2014-13>
- Cardona-Ossa, Guillermo** (2006). “Tendencias educativas para el siglo XXI: educación virtual, online y @learning. Elementos para la discusión”. *EduTec: revista electrónica de tecnología educativa*, n. 15, a025.  
<https://doi.org/10.21556/edutec.2002.15.542>
- Creswell, John** (2014). *Research design: Qualitative, quantitative, and mixed methods approaches*. Thousand Oaks: SAGE. ISBN: 978 1 4522 2609 5
- Davis, Fred D.; Bagozzi, Richard P.; Warshaw, Paul R.** (1989). “User acceptance of computer technology: a comparison of two theoretical models”. *Management science*, v. 35, n. 8, pp. 982-1003.  
<https://doi.org/10.1287/mnsc.35.8.982>
- De-Miguel, Roberto** (2010). *Fundamentos de la comunicación humana*. San Vicente: Editorial Club Universitario. ISBN: 978 84 8454 497 5
- Díaz-Barriga, Frida** (2008). “Educación y nuevas tecnologías de la información y comunicación: ¿hacia un paradigma educativo innovador?”. *Revista electrónica sinéctica*, n. 30, 15 pp.  
<https://sinectica.iteso.mx/index.php/SINECTICA/article/view/192>
- Duart, Josep M.; Sangrà, Albert** (2000). *Aprender en la virtualidad*. Barcelona: Gedisa. ISBN: 84 8429 161 8
- Garza-Guzmán, María-Rosalía** (2009). “Fuentes genealógicas y teorías esenciales de la comunicación interpersonal”. *Razón y palabra*, v. 14, n. 67.  
<https://www.redalyc.org/articulo.oa?id=199520725003>

- Janschitz, Gerlinde; Penker, Matthias** (2022). "How digital are 'digital natives' actually? Developing an instrument to measure the degree of digitalisation of university students - the DDS-Index". *Bulletin of sociological methodology*, v. 153, n. 1, pp. 127-159.  
<https://doi.org/10.1177/07591063211061760>
- Jarvis, Matt** (2015). *Brilliant ideas for using ICT in the classroom*. Abingdon: Routledge. ISBN: 978 0 415 64050 3
- Machin, Stephen; McNally, Sandra; Silva, Olmo** (2007). "New technology in schools: is there a pay-off?". *Economic journal*, v. 117, n. 522, pp. 1145-1167.  
<https://doi.org/10.1111/j.1468-0297.2007.02070.x>
- Margaryan, Anoush; Littlejohn, Allison; Vojt, Gabrielle** (2011). "Are digital natives a myth or reality? University students' use of digital technologies". *Computers & education*, v. 56, n. 2, pp. 429-440.  
<https://doi.org/10.1016/j.compedu.2010.09.004>
- Martínez-Salanova-Sánchez, Enrique** (2018). *Educomunicación*.  
<https://educomunicacion.es/didactica/0016educomunicacion.htm>
- Mead, George-Herbert** (1973). *Espíritu, persona y sociedad*. Barcelona: Paidós. ISBN: 978 84 493 0715 7
- Méndez-Ojeda, José-Israel; Luque-Ortiz, Sergio; Pérez-Curiel, Concha** (2014). "La educomunicación aplicada a televisiones locales". *Anduli*, n. 13, pp. 13-28.  
<https://doi.org/10.12795/anduli.2014.i13.01>
- Moore, Kenneth** (2015). *Effective instructional strategies: from theory to practice*. Thousand Oaks: SAGE. ISBN: 978 1 4833 0658 2
- Narváez, Ancízar** (2021). "Educomunicación y alfabetización mediática: ¿tecnología o cultura? ¿Adiestramiento o educación?". *Pedagogía y saberes*, n. 55, pp. 155-174.  
<https://doi.org/10.17227/pys.num55-12245>
- Natriello, Gary** (2005). "Modest changes, revolutionary possibilities: distance learning and the future of education". *Teachers college record*, v. 107, n. 8, pp. 1885-1904.  
<https://doi.org/10.1111/j.1467-9620.2005.00545.x>
- Noguera-Fructuoso, Ingrid** (2015). "How millennials are changing the way we learn: the state of the art of ICT integration in education". *Revista iberoamericana de educación a distancia*, v. 18, n. 1, pp. 45-65.  
<https://doi.org/10.5944/ried.18.1.13800>
- Nupairoj, Nudée** (2016). "The ecosystem of media literacy: a holistic approach to media education". *Comunicar*, v. 24, n. 49, pp. 29-37.  
<https://doi.org/10.3916/C49-2016-03>
- Ojeda-Castañeda, Gerardo** (2005). "Apuntes en línea: la comunicación mediatizada ante la convergencia digital de las TIC en la educación virtual y a distancia". *Tecnología y comunicación educativas*, n. 40, pp. 60-67.  
<https://biblat.unam.mx/es/revista/tecnologia-y-comunicacion-educativas/articulo/apuntes-en-linea-la-comunicacion-mediatizada-ante-la-convergencia-digital-de-las-tic-en-la-educacion-virtual-y-a-distancia>
- Piccoli, Gabriele; Ahmad, Rami; Ives, Blake** (2001). "Web-based virtual learning environments: a research framework and a preliminary assessment of effectiveness in basic IT skills training". *MIS quarterly*, v. 25, n. 4, pp. 401-426.  
<https://doi.org/10.2307/3250989>
- Prieto-Castillo, Daniel** (2010). "Construir nuestra palabra de educadores". En: Aparici, Roberto. *Educomunicación: más allá del 2.0*. Barcelona: Editorial Gedisa, pp. 27-40. ISBN: 978 84 9784 605 9
- Smith, Erika E.; Kahlke, Renate; Judd, Terry** (2020). "Not just digital natives: integrating technologies in professional education contexts". *Australasian journal of educational technology*, v. 36, n. 3.  
<https://doi.org/10.14742/ajet.5689>
- Universidad Autónoma de Chihuahua (2020). *Estadística básica*.  
[https://uach.mx/assets/media/publications/2017/10/143\\_agenda-estadistica/estadistica-basica-2020-2021.pdf](https://uach.mx/assets/media/publications/2017/10/143_agenda-estadistica/estadistica-basica-2020-2021.pdf)
- Universidad Nacional Autónoma de México. (2021). *La UNAM en números*.  
<https://www.estadistica.unam.mx/numeralia>
- Zvacek, Susan** (2021). "Digital natives and other mythical beasts". In: Trimmer, Scott; Handler, Eric; Wilk, Tom. *ACM SIGUCCS annual conference*. New York: Association for Computing Machinery, 3 pp. ISBN: 978 1 4503 8141 3  
<https://doi.org/10.1145/3419944.3440726>