

Academic perception of barriers to the adoption of technological innovations during the covid-19 pandemic

Percepción académica sobre las barreras en la adopción de innovaciones tecnológicas durante la pandemia por la covid-19

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ABSTRACT

The objective of this research was to identify barriers to the adoption of a technological innovation perceived by professors at a public university in southeastern Mexico, in which a strategy for the use of virtual classrooms was implemented as a measure to address the social distancing forced by the covid-19 pandemic. A descriptive, non-experimental, cross-sectional, quantitative descriptive study was carried out in which two groups of incident factors were considered: intrinsic (attitudes and beliefs; knowledge and skills) and extrinsic (available resources and educational system). A questionnaire with 30 items was designed and measured with a Likert-type scale and applied to 805 teachers. The results showed that teachers perceive extrinsic barriers as the most important in adopting technological innovations, especially those related to equipment and connectivity, while intrinsic barriers are mainly focused on the beliefs, so the early adopters and early majority profiles are distinguished.

RESUMEN

La investigación tuvo por objetivo identificar las barreras en la adopción de una innovación tecnológica percibidas por los profesores de una universidad pública del sureste de México, en la que se implementó una estrategia de uso de aulas virtuales como una medida para afrontar el distanciamiento social obligado por la pandemia provocada por la covid-19. Se llevó a cabo un estudio de tipo cuantitativo descriptivo, no experimental y transversal, en el que se consideraron dos grupos de factores incidentes: intrínsecos (actitudes y creencias; conocimientos y habilidades) y extrínsecos (recursos disponibles y sistema educativo). Para esto se diseñó un cuestionario con 30 ítems que se midió con una escala tipo Likert, el cual fue aplicado a 805 docentes. Los resultados apuntaron a que los profesores perciben las barreras extrínsecas como las de mayor peso en la adopción de innovaciones tecnológicas, en especial las relacionadas con equipamiento y conectividad, mientras que las barreras intrínsecas se centran principalmente en las creencias, por lo que se distinguen los perfiles de primeros adoptantes y mayoría temprana.

Keywords

Digital gap;
university
professors; distance
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educational
innovation

Palabras clave

Brecha digital;
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INTRODUCTION

The growth of programs for the integration of technological innovations in teaching requires teachers to employ different devices (United Nations Educational, Scientific and Cultural Organization, Unesco, 2016 and 2019), so one of the concerns of higher education institutions (HEIs) is the training of their teachers to assume the changes that technology has brought about in the process of knowledge transfer.

Unesco points out that although the use of technology in everyday life is becoming increasingly frequent, its formal adoption in education has been delayed because it is trapped between traditional paradigms and the way in which its impact on learning is measured. Many circumstances converge in this lag, among these the rapid configuration of public policies in countries to integrate information and communication technologies (ICT) in education, which “do not include resources or contemplate the necessary time for the acceptance and adaptation of all actors in educational institutions, particularly teachers” (Arias and Cristia, 2014, p. 28), and the idea that technology by itself can become confusing, intimidating and frustrating for students (King, 2002).

Technological innovation (TI) is defined by Rogers (1983) as “a practical idea or object that is perceived as new by an individual or other unit of adoption” (p. 11). TI implies the acceptance of new forms of behavior and a different consideration of learners, while requiring systematization, formalization, monitoring and evaluation throughout the process (Salinas, 2004). However, what has been discovered in different geographical contexts so far suggests that IT is mostly used to support, and to a lesser extent to transform traditional teaching (Talanquer, 2009). Today more than ever, the integration of digital technologies into the classroom involves a kind of emerging pedagogies aimed at modifying existing ones and developing new learning proposals (Mortis, Rosas and García, 2021).

The adoption of IT has become a commonly used concept among experts and stakeholders on the subject. In educational practice, Reyes and Guevara (2009) point out that, in order to conceptualize the use that teachers make of technological innovations -also called emerging technologies (Sosa, Salinas and De Benito, 2017)-, different terms are used, such as implementation, appropriation or adoption, although each of these come to be differentiated from each other in the terminology of studies on the subject. According to Rogers (1983), implementation begins when the innovation is launched, and culminates when operations with it are regularized (Reyes and Guevara, 2009).

Appropriation is oriented to the application of technological innovations in any context, including education, and is manifested in the teacher's degree of mastery of the technology (McAnally-Salas, Navarro and

Rodríguez, 2006). With this in mind, for the purposes of this paper the term adoption of technological innovations (AIT) will be used. According to Curry (1992), the TIA process involves three substantial stages: 1) mobilization, the phase of preparing the system for a change; 2) implementation, where the change is introduced; and 3) institutionalization, when the system adapts to the new situation.

Generally speaking, this approach has continued with some variations. For Abraham (2010) there are five principles on which TIA rests, which are related to the group that should adopt it; in short, the characteristics of this group, its positive or negative perception of the innovation, as well as the differences in the rate of adoption, are the elements that determine the probability of success. In this sense, Surry, Ensminger and Haab (2005) affirm that there is a greater possibility that the TIA will be successful when the group perceives that they can try it before adopting it, that it is compatible with their personal and professional objectives, that it is simple and that it has more benefits than another.

Studies based on technology adoption and diffusion models -which have been developed over three decades (Arancibia, Cabero and Valdivia, 2019; Davis, 1993)- evidence the importance of the perceived usefulness and ease of technologies in the positive or negative attitudes of students and teachers regarding their use and acceptance. These studies demonstrate the influence of user characteristics on the adoption of IT, so that one of their purposes has been to identify profiles or types of users according to the degree to which the innovation is assumed in a particular social or professional system (Martín-García, Hernández and Sánchez, 2014). Barriers of various kinds that impede the successful integration of innovations have also been recognized, which is a topic of specific importance and analysis.

BARRIERS TO THE ADOPTION OF INNOVATIONS

There are factors that hinder the acceptance and implementation of an IT in organizations. The presence of these obstacles in educational practice causes stress and generates resistance to change (Benítez and Ávila, 2012), which can be understood as the individual's opposition to the rupture of his or her status quo (Sánchez-Prieto, Olmos-Migueláñez and García-Peñalvo, 2017). Fear of the unknown, distrust or any kind of similar feelings, attitudes or perceptions become barriers that prevent the assumption of TI, since many times those involved see their security threatened (Núñez and Gómez, 2005). Authors such as Ottenbreit-Leftwich, Glazewski, Newby and Ertmer (2010) and Silva and Astudillo (2012) consider that teachers' negative beliefs and attitudes about the integration of student-centered technology represent the most important barrier preventing its adoption in an

educational space, while a stance that is prone to this introduction process will favor technological adoption.

Claiming that the understanding and use of technology ensures effective use is a fallacy, since by itself it does not lead to the improvement of educational practice (Reyes and Guevara, 2009; Rodríguez, 2011; Tapasco and Giraldo, 2017). An AIT strategy must be accompanied by a methodological and a didactic component, which justify the presence of technology in the formative process, while anticipating the obstacles that may arise. Ertmer (1999) identified two groups of barriers in TIA: a) first-order or external, which refer to the resources available to the teacher (technological equipment, technical assistance, space); and b) second-order or internal, those considerations of the teacher about his or her practice in relation to technology (feelings, beliefs and attitudes). In this sense, Buchanan, Sainter and Saunders (2013) assert that it is necessary to consider both individual and contextual factors to understand how teachers use IT.

According to Boza, Tirado and Guzmán-Franco (2010), external or contextual barriers do not represent an insurmountable problem for institutions, since supranational bodies and governments have been concerned with offering them funding programs, in addition to providing them -to a greater or lesser extent- with technological infrastructure, especially higher education schools. On the other hand, internal or individual barriers have shown a more important impact on TIA, since, as mentioned by different authors (Chen, Looi & Chen, 2009; Silva & Astudillo, 2012), the evidence highlights the figure of the teacher as one of the most relevant elements for the success of this adoption.

There are several proposals (derived from studies in educational organizations) that talk about the barriers in TIA processes. In the last few years alone, a large amount of literature has been developed in this regard, so it is impossible to cover all these studies. However, in an effort to systematize and synthesize the proposals reviewed, they are organized in Table 1 according to the most identifiable types considered by the authors (some are repeated because they represent their findings).

In the genealogy presented, the first two categories correspond to aspects related to the context, and the next two to individuals -this typology fits with the first and second order factors proposed by Ertmer (1999)-. For the purposes of the present study, emphasis is placed on those that fit with teachers, since they are the primary element on which the success or failure of TIA rests.

The exercise of developing teacher profiles with respect to IT and the adoption or integration processes is very useful, since it has been shown that the teacher is a determining factor in the successful integration of technology into education. Abraham (2010) suggests considering theory

and conceptual mapping to form a structured framework that facilitates the management and optimization of resources when carrying out an ITA. The study and use of diffusion theory, according to this author, can contribute to the establishment of a more systematic process among those involved, and although it does not ensure success, it would help in the implementation of IT.

Table 1. Types of barriers in the AIT

Organizational or administrative	
Lack of financial support Lack of institutional support Lack of commitment at high levels Concern about cost reduction Little conceptualized and unclear reasons Ambitious changes Lack of commitment of the key subjects Isolated changes in structure Lack of vision or reason for the use of technology Lack of support for teacher training Lack of assessment of teaching practices in learning Lack of training Classroom restrictions Group courses with in person teaching techniques Failures in the educational system Lack of institutional support Pedagogical barriers Quality	Abraham (2010) Benítez y Ávila (2012) Butler y Sellbom (2010) Chizmar y Williams (2001) Marcelo (2001) Muir-Herzig (2004) Nicholas y Guzman (2009) Plumb y& Kautz (2015) Sánchez-Prieto, Olmos-Migueláñez y García-Peñalvo (2017) Rodríguez, Campaña y Gallego (2018) Talanquer (2009)
Materials or technology	
Technology support Speed of technological change Poorly equipped classrooms Frustration with unreliable or difficult to use equipment Problems of access and expansion of technological resources Problems associated with “computing density” Scale or unstable resources	Abraham (2010) Benítez y Ávila (2012) Chizmar y Williams (2001) Marcelo (2001) Muir-Herzig (2004) Nicholas y Guzman (2009) Plumb y Kautz (2015) Rodríguez, Campaña y Gallego (2018)

<p>Limited access and high cost of equipment Lack of equipment Lack of appropriate educational software IT technical problems Lack of funds Resources not available Technology-related barriers Ever-changing educational hardware and software Lack of financial support Technical barriers Resources not available</p>	
Individual	
<p>Perception, resistance to change and technophobia Lack of time to learn Lack of technology skills Conservative stance of teachers Speed or slowness with which change is assumed Lack of teacher time Educators' beliefs and attitudes Lack of knowledge and skills Lack of educator confidence Attitudes and beliefs, knowledge and skills Technological discomfort Privacy issues Lack of perceived relative advantage Problems related to teachers Teachers who did not learn with ICT Lack of time to learn the use of ICT Attitudes and beliefs, knowledge and skills</p>	<p>Abraham (2010) Benítez y Ávila (2012) Butler y Sellbom (2010) Chizmar y Williams (2001) Muir-Herzig (2004) Plumb y Kautz (2015) Rodríguez (2011) Talanquer (2009) Young, Willis, Cameron y Geana (2014)</p>
Social	
<p>Student problems Lack of a community Student resistance Didactic and disciplinary culture Problems related to students</p>	<p>Marcelo (2001) Rodríguez (2011) Rodríguez, Campaña y Gallego (2018)</p>

THEORETICAL PERSPECTIVES ON THE ADOPTION OF INNOVATIONS

There is currently a wide variety of currents and models that explain the incorporation of technology into social systems. One of the main theoretical proposals when discussing the integration of innovations is that formulated by Rogers (1983), where diffusion is defined as “a process through which an innovation is communicated through certain channels over time among the members of a social system” (p. 5).

According to Rogers' (1983) theoretical model, innovation has five attributes that influence its adoption, which correspond to the five stages of his innovation diffusion model: 1) the relative advantage with which it is perceived as a good idea; 2) compatibility with existing values and beliefs in the social system; 3) the complexity of the degree to which the difficulty of use is perceived; 4) experimentability, which refers to the particularity of being part of a plan and being tested; and 5) observability, which corresponds to the degree to which its results are evidenced. Another of the contributions of this model is the definition of profiles, by relating them to the characteristics of individuals and institutions with regard to the adoption of IT; the five that were identified are:

- Innovators. Active subjects that are part of external networks and interact with them.
- Early adopters. Teachers who act as referents because they are leaders, influential and have a positive impact on integration.
- Early majority. Subjects who are analytical and cautious in the use of technological tools because of a possible risk.
- Late majority. Individuals resistant to change, who need to be influenced by leaders.
- Relegated. Skeptics, subjects who show less interest. Increased frequency of evaluation

Likewise, Rogers (1983) presents an adoption curve where he points out the participation values of the profiles in a TIA, and identifies two major categories of social system according to their degree of promotion to change: heterophiles (it is prone) and homophiles (it is closed).

Another important proposal in the TIA process is the technology acceptance model (TAM) proposed by Davis (1993), whose epistemological foundation is the theory of reasoned action. The four variables underlying the model are: perceived usefulness, perceived ease of use, attitude towards the use of technology and intention to use it. The first two, determine the individual's acceptance of the technology, while

attitude is an emotional reaction that in turn influences intention and predicts IT use. The TAM considers that the individual is influenced by external variables (environment) and internal variables (beliefs), which filter the effects of the former.

The TAM has been taken up by other authors (Venkatesh & Davis, 2000; Amoako-Gyampah & Salam, 2004) to apply it in different environments and add other variables, such as the shared belief in the benefits of the system, i.e., how users mutually understand that the system will be productive. Similarly, the TAM2 (extended technology acceptance model) was proposed, an adjustment of the first version, where the variable corresponding to the attitude towards the use of the technology was eliminated, since it was assumed that the perceived usefulness and ease of use were sufficient to condition the intention to use it. To reach this conclusion, the theory of planned behavior was taken as a basis; however, it was later discovered that the parameters on the experience of use also played an important role in TIA (Morlán, 2019).

In the field of education, and in particular educational technology, the TAM has been widely used to identify how teachers and students at the higher level accept the use of technology in teaching-learning processes (Bervell & Umar, 2017). Some authors such as Cano-Giner, Fernández and Díaz-Boladeras (2015) consider it one of the most influential theories when developing research in the educational context.

Both in the theoretical models presented and in others formulated in the literature that is not cited in this article, patterns of regularity are found focused on different variables related to subjects, process or conditions. Martín-García, Hernández and Sánchez (2014) identify some key elements that are recurrently presented in the theories on the adoption and diffusion of IT and that, in turn, have defined three clear lines of research. One refers to the attributes or characteristics observed in an innovation, another to the definition of profiles of the subjects participating in the process, and a third to the description of the adoption phases followed by a subject with respect to a given innovation. Based on this, for the present study, the subjects and their perception of IT are considered important for an adaptation process to take place.

THE CASE OF A PUBLIC UNIVERSITY IN SOUTHEASTERN MEXICO

The case of a public university located in the southeast of Mexico, with a faculty population of 2,547, was taken as the basis for this study. The educational programs (PE) that this institution has are mostly face-to-face, but there is an area of distance education that coordinates some online degrees, the general subjects of all the PE and the training courses that are taught in this mode. Despite the fact that the university has this

type of resources, most of the professors teach in face-to-face mode, and only a few give classes in both modalities.

At the beginning of 2020, the infectious disease Covid-19 arrived in Mexico, and as a measure to prevent its spread, schools at all educational levels suspended their classroom activities and implemented a series of alternatives to continue with the contents established in the programs. In the case of the institution in question, an agreement was reached with Microsoft, through Microsoft Teams (MST), to introduce a virtual classroom strategy through the university's platform.

MST is a learning management system -a tele-training platform- designed to be used by all types of organizations, including educational ones, to support collaborative tasks. The essence of the application is the creation of purposeful work teams (WT), which can make use of a range of digital tools in a virtual space, linked to the MST classroom manager. In these “microsites”, TEs can perform a variety of activities, such as creating multimedia content, scheduling videoconferences, assigning activities or evaluating tasks. To log in, the user must have an MS Office account, managed by the organization as a corporate resource.

Thus, at the beginning of the pandemic, the adoption of this technological innovation began in response to the need to provide continuity to the subjects taught in the 53 educational programs of the institution. Through various channels, professors and students were invited to access the platform in order to carry out as many activities as possible under the virtual system. The response to this approach generated a series of positions, ranging from open acceptance to express rejection (of the total number of professors assigned to the PE, less than 50% accepted to work on the MST platform). In order to alleviate the uncertainty caused by the measure, a diploma course was given to explore the digital resources available on the platform (approximately 400 professors took it).

It was also considered essential to conduct a survey to learn about the perceptions of teachers and students about the barriers that this type of resources represent, since they somehow disrupt the status quo, and at the same time require a series of changes in their practices. For the purposes of this paper, only data related to teachers are reported.

METHODOLOGY

The study was a descriptive, non-experimental, cross-sectional, quantitative descriptive study. The steps of the empirical work were as follows: the research group drafted the items (30 questions) that made up the instrument; subsequently, it was sent to a panel of experts to validate its appropriateness to the context; once reviewed, the recommendations

were addressed and it was adapted to an electronic form that was sent to the teachers assigned to the IES. The survey was shared for nine weeks, the database obtained was emptied into Excel, and then transferred to the SPSS 23 program to perform the corresponding statistical analyses.

Context and participants

The population was considered based on the criteria of accessibility and heterogeneity (Valdés, García, Torres, Urías & Grijalva, 2019), by virtue of which all professors at the institution were invited to participate. The instrument considered the variables gender, age, seniority in the institution, number of hours in front of a group, academic degree, category, type of contract and area of training of their last academic degree.

Of these, 53% were men (427) (M age = 46.95, SD = 10.61 years) and 47% were women (378) (M age = 44.18, SD = 9.76 years). Ages ranged from 24 to 80 years of age, with an overall mean of 45.65 years (SD = 10.31). The total mean number of years working at the institution was 14.18 (SD = 10.38) and the total mean number of hours in front of the group was 19.05 (SD = 7.26). Table 2 shows the percentage distribution and frequency of the maximum degree, as well as the category and type of contract of the professors, while Table 3 presents the data in relation to the area of training of their last academic degree.

Table 2. Maximum degree of studies, category and type of contract

Maximum grade	Frequency (%)	Category	Frequency (%)	Type of contract	Frequency (%)
Bachelor's degree	68 (8.4%)	Full time	454 (56.4%)	Base	561 (69%)
Master's degree	368 (45.7%)	Halftime	61 (7.6%)	Interim	22 (30.3%)
Specialty	37(4.6%)	Subject	290 (36%)	-	-
Doctorate	332 (41.2%)	-	-	-	-
Total	805		805		805

Table 3. Training area of the last degree of studies

Area	Frequency	%
Physics, Mathematics and Earth Sciences	59	7.3
Biology and Chemistry	60	7.5
Medicine and health	166	20.6

Area	Frequency	%
Humanities and conduct	159	19.8
Social and Economic Sciences	202	25.1
Biotechnology and Agricultural	67	8.3
Engineering and Industry	92	11.4

Instruments

Five response options were considered (0 = strongly disagree, 1 = disagree, 2 = neither disagree nor agree, 3 = agree, 4 = strongly agree), and the questionnaire was sectioned according to four categories:

- Extrinsic available resources (EAR). Limited availability and access, lack of technical support to solve problems, and reliability of resources (six items).
- Extrinsic Educational System (ESS). Competencies assessed and evaluated, teacher time available for planning activities, and school structure (nine items).
- Intrinsic attitudes and beliefs (ACI). Technophobia and distrust of resources, teachers' beliefs about teaching and learning in their discipline, as well as teachers' perceptions of the constraints, costs and benefits associated with the use of IT (eight items).
- Intrinsic knowledge and skills (CHI). Teachers' lack of technical preparation to use IT or available software, as well as deficiency in content knowledge and technical and pedagogical preparation to take advantage of IT applications (seven items).

Data collection and analysis

The questionnaires were handed out individually by sending a form, which had an average response time of 15 minutes. Informed consent was requested from the researchers to participate in the study and they were guaranteed confidentiality in the handling of the information they provided. Multivariate descriptive and inferential statistics in SPSS version 23 (George & Mallery, 2003) were used for data processing.

RESULTS

The objective of the present study was to identify both intrinsic and extrinsic factors involved in the adoption of innovations among teachers at a higher education institution, which integrated emerging technologies

to the educational task as an alternative to the pandemic caused by Covid-19. The literature assumes the teacher as the most important element in the adoption of technology as part of the educational process, so it is relevant to identify the factors that can promote or slow down technological adoption.

Below is the percentage distribution of the perception that the teachers participating in the study have of the RDEs (see Table 4), the SEE (see Table 5), the ICAs (see Table 6) and the CHIs (see Table 7).

Table 4. Percentage distribution over RDE

Item	Percentage				
	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Totally agree
There are shortcomings in the technological infrastructure to support teaching activities at the university	6.1	18.5	12	40.7	22.6
The technological equipment to support teaching activities is scarce	6.8	18.1	15.9	40.9	18.3
Network connectivity is a recurring problem	5	11.1	9.6	32.4	42
Internet accessibility un university spaces is unstable	4.6	10.2	9.2	35.9	40.1
When I have a problem with equipment, it is difficult to get technical support	12.9	28.2	20.2	25	13.7
Helping you solve software problems at university is complicated	10.6	26.8	25.2	22.2	15.2

Table 5. Percentage distribution over SEE

Item	Percentage				
	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Totally agree
There is an unclear institutional policy that promotes the adoption of technology in the classroom	7.7	18.5	21.5	34.7	17.6
The administrative structure is inadequate to establish an efficient technology utilization system	7.3	21.6	23.2	32.5	15.3
The institution lacks a system that diagnoses the technological skills of its staff	4.3	11.3	22.7	39.6	22
The institution lacks a system that assesses the technological skills of its staff	4	10.4	22.4	41.2	22
It is necessary to reward teachers who adopt innovations	6.5	12.7	27	31.7	22.2
It is necessary to reward teachers who promote innovations	4.5	11.4	23.9	35.9	24.3
There is little time that I can dedicate to planning academic activities with technology	10.7	34.2	25	23	7.2
Working with new technological resources alters my routines too much	18.3	40	23.4	13.7	4.7
I would like to spend more time learning to work with virtual environments	2.5	3.6	13.9	51.2	28.8

Table 6. Percentage distribution over ACI

Item	Percentage				
	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Totally agree
Technology has a certain risk for the teaching-learning process	13	23.7	22.7	31.2	9.3
Traditional teaching will always be better than virtual teaching	10.1	21.2	39.9	17.6	11.2
Technology generates many academic vices in students	7.6	23.5	28	31.1	9.9
Technology induces bad academic practices in students	8.8	28.4	33.2	23.1	6.5
It is impossible to manage technological resources due to the speed of advances	13.5	43.1	23.9	15.2	4.3
My discipline does not help master technology for teaching	28.2	44.5	16.9	8	2.5
Knowing how to use technology requires a high and constant investment of all kinds of resources	5.7	27.3	20.1	37.1	9.7
The investment (time-money) that must be made with technology is greater than the benefit it brings	20	49.4	20.1	8.2	2.2

Table 7. Percentage distribution over CHI

Item	Percentage				
	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Totally agree
I avoid using the internet for everyday procedures (payments, banks and others)	44.8	36.8	8	7.3	3.1
I have spent little time preparing to use technology in my teaching practice	29.6	40.9	11.8	15.7	2.1
I have invested few economic resources in preparing myself to use technology in my teaching practice	27.7	38.4	14.4	17.3	2.2
I consider it unimportant to invest my own resources in technological equipment to use in my classes	34.4	46.8	11.9	5.1	1.7
Searching the internet for educational resources for learning is a waste of time	46.5	42.9	8.1	1.6	1
Working remotely with technology causes me stress	26	34.5	21.9	14.5	3.1
Taking online training courses makes me anxious or desperate	30.8	39.9	16.1	10.8	2.4

DISCUSSION

Social isolation has represented a test for companies, educational institutions and society. Faced with this scenario, Barrón (2020) points out that it is necessary to carry out an in-depth analysis of curricula, the contents of teaching practice and academic-administrative management.

Along with this, it is crucial that university professors learn to see the context that surrounds them, so that they can reflect on their own attributions and contributions to change in teaching. IT alone does not lead to innovative processes (Barrón, 2020), these must be undertaken by those who make use of it.

Reyes and Guevara (2009) warn that mental processes emerge when the individual acts with the instrument, setting in motion his own resources and implementing technologies in specific educational contexts; thus, in crisis situations, adaptive mechanisms are activated. These are closely related to what Molinero, Chávez and Lara (2021) call “people's ways of living”, derived from the experience during the pandemic, and identify two types: self-regulated and resilient, and hopelessness, disorganization and loneliness. In the former, responsibilities are assumed and thoughts and emotions are regulated, while in the latter, feelings of not being able to cope with change and stress are experienced.

These ways of responding to emerging events, such as the pandemic or the adoption of technology, should be considered by educational institutions, especially higher education institutions, specifically by observing the extrinsic factors that provoke these reactions and limit the adoption of IT. In this sense, Tapasco and Giraldo (2017) point out that there is a general tendency on the part of teachers to consider themselves as having sufficient training in the management of technologies, but insufficient when it comes to carrying out a deep integration of IT in their teaching practice.

Campos and Ramírez (2018) highlight the importance of the human factor in the adoption of technology in the educational field, as this has the potential to become the engine that drives a new teaching mode or to slow down its effective incorporation. Innovation cannot be reduced to school equipment or to the preparation of teachers and students as users (Vera, Torres and Martínez, 2014); in order to ensure acceptable technological adoption, the articulation of all components is indispensable.

CONCLUSIONS

According to the frequencies obtained in the survey, a greater weight was observed in extrinsic factors than in intrinsic ones. An example of this is the Microsoft Teams virtual classrooms, which were perceived as barriers in the adoption of technological innovations. In terms of shortcomings, the lack of equipment and inefficient connectivity were highlighted, in contrast to technical support and advice from specialists, which were rated positively. Another limitation identified is an institutional policy that harbors the lack of competencies that teachers can develop, as well as the existence of an administrative structure uninterested in recognizing both the absence and the presence of influential actors in the adoption of IT. On

the other hand, teachers did not perceive the lack of time or willingness to take on innovations in their practice as a barrier.

Intrinsic factors related to knowledge and skills point to good self-qualification by teachers, since the daily need for the Internet drives them to use it. Likewise, they do not consider that searching for educational tools on the net is a waste of time. The response trends to the questions posed in a negative way suggest that teachers perceive positively the use of technology in their practice, since they invest resources in preparing themselves to adopt it in their teaching work; in this regard, they agree that the investment required is considerable but that it brings benefits. Similarly, it was found that neither stress nor online training represent a limitation in the work of teachers regarding technological adoption; perhaps the frank and daily contact with the devices generates a habit that is incorporated into the teaching practice because, although gradually, the need to use these tools is created indistinctly.

In this sense, the positive appreciation of IT is in line with the theory of reasoned action, insofar as the perceived usefulness and attitude towards the use of technology facilitate its acceptance and adoption and influence the intention to use it. It is perceived in the frequencies of responses a self-regulated way of assuming technology in their teaching work, which can be related to what has been happening worldwide for some years: teachers have been forced to continue their training online and, now, to become part of an “emergency non-attendance teaching” (Castellanos, Escott and Guzmán, 2021), which has made them acquire certain digital skills and competences. Based on the above, the profiles of early adopters and early majority of Rogers' (1983) typology were distinguished.

As a final reflection, it remains to think of strategies that strongly support the overcoming of extrinsic barriers and some that influence the intrinsic ones. Although in this specific case the intrinsic factors do not seem to be a limiting factor for the adoption of TI, it is necessary to carry out studies in other groups of teachers at different educational levels, as well as to include responses in the instrument that do not allow a neutral positioning. Finally, a qualitative analysis could be carried out, which would make it possible to delve deeper into other motivational elements among teachers.

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