

Research competences with ICT in PhD students

Competencias investigativas con el uso de las TIC en estudiantes de doctorado

<http://dx.doi.org/10.32870/Ap.v11n1.1387>

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ABSTRACT

Keywords

ICT, investigative skills,
e-skills, research,
doctorate studies

The research processes are part of the activities of PhD students; regardless of the focus of training or the educational modality of the program, the students will need to obtain, select, organize and analyze relevant information of various media, mainly Internet, as well as collaborate with their peers and socialize their findings in virtual media. The objective of this research is to analyze the research competences related to the use of ICT in PhD students from three Mexican universities. This is an exploratory and descriptive research with a mixed approach, it was used as a tool to retrieve information a questionnaire with Likert type scale items, multiple choice questions and open questions. The main findings identify that students frequently use technologies for communicative purposes and information search; however, they have areas of opportunity to determine the accuracy of the information they consult from the Internet, using digital tools to analysis the information in addition to participating in the dissemination of their knowledge using Internet platforms.

RESUMEN

Palabras clave

TIC, competencias
digitales, investigación,
estudios de doctorado

Los procesos de investigación forman parte de las actividades de los estudiantes que participan en programas educativos de doctorado. Independientemente del enfoque de formación o de la modalidad educativa del programa, existe la necesidad de obtener, seleccionar, organizar y analizar información relevante de diversos medios, sobre todo de internet, así como colaborar con los pares y socializar hallazgos en medios virtuales. El objetivo de este artículo es analizar las competencias investigativas relacionadas con el uso de las tecnologías de la información y la comunicación en estudiantes de doctorado de tres universidades mexicanas. El estudio es de tipo exploratorio-descriptivo, con un enfoque mixto; se utilizaron como instrumentos para recuperar información un cuestionario con ítems en escala tipo Likert, preguntas de opción múltiple y preguntas abiertas. Los hallazgos revelan que los estudiantes emplean con frecuencia las tecnologías con fines comunicativos y de búsqueda de información; sin embargo, tienen áreas de oportunidad en cuanto a determinar la veracidad de la información que recuperan de internet, emplear herramientas digitales diseñadas ex profeso para analizar la información, además de participar en la difusión de sus conocimientos a través de plataformas de internet.

Received: March 3, 2018
Accepted: July 13, 2018
Online Published:
March 30, 2019

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INTRODUCTION

The world is constantly changing in all scenarios, including teaching. At higher education, the substantive task of universities is to strengthen the incorporation of research as a fundamental part of their educational processes (Bolatovna, Zhayakovna, Ivanova, Murphy & Budanovna, 2016); hence, to do so, postgraduate students not only need to acquire disciplinary contents of their field of knowledge or the methodological bases for research but also know how to use technological tools efficiently to make it easier for them to search, select, organize and analyze the information necessary to structure their activities in generating knowledge.

The interest of this paper focuses on the following question: What use are the postgraduate students of three Mexican universities making of technologies to strengthen their research competences, more specifically in selecting, organizing and analyzing information as well as sharing and socializing their research findings? Therefore, we explored the students' perceptions on the use of technological resources to strengthen the necessary research competences and meet the objectives of their curricula.

This paper consists of five sections. In the first section, we address the importance of using technologies as essential tools to develop research competences. In the second, we retrieve the theoretical references regarding the concept of *research competences*. In the third we describe the methodological procedure. In the fourth, we examine the postgraduate students' technological and research competences, and in the fifth, we discuss the results and present conclusions.

TECHNOLOGICAL COMPETENCES

In the last decades, information and communication technologies (ICTs) have become a factor of change in all the arenas of human actions. In this regard Carneiro (2010) claims that “no other technology has caused such major mutations in society, culture and economy” (p. 15). Higher education has not been spared from this transformation. Table 1 shows a list of some forums in which the United Nations Educational, Scientific and Cultural Organization (UNESCO) has highlighted the relevance of ICTs.

Table 1. UNESCO declarations on the relevance of ICTs

Activity	Year	Declaration
Rome Symposium	1984	New technologies are leading the way to new educational strategies such as distance education
From Traditional to Virtual: The New Information Technologies Forum	1998	Acknowledgement of ITCs dominant position as an element of improvement in education, situation that was revalidated in the World Declaration on Higher Education in the 21 th Century
World Declaration on Higher Education in the 21 st Century	1998	Full use of ICTs potential for the renewal of higher education through the expansion and diversification of transmitting knowledge and making knowledge and information available to a wider public
World Conference on Higher Education	2009	ICTs have the ability of expanding the access to quality education and good academic achievements; hence, the call to strengthen the technological infrastructure as well as to invest in teacher and administrative staff training so they may assume the new roles society requires from them

Source: Self development.

In recent years, proposals of technological competences such as UNESCO ICT Competency Standards for Teachers (UNESCO 2008), ICT Competency Framework for Teachers (UNESCO 2011) and the ICT Standards and Competencies for Teachers from the Pedagogical Dimension (Valencia et al., 2016) have been outlined. The UNESCO position on the use of ICTs can be classified in two points that are described in Figure 1.

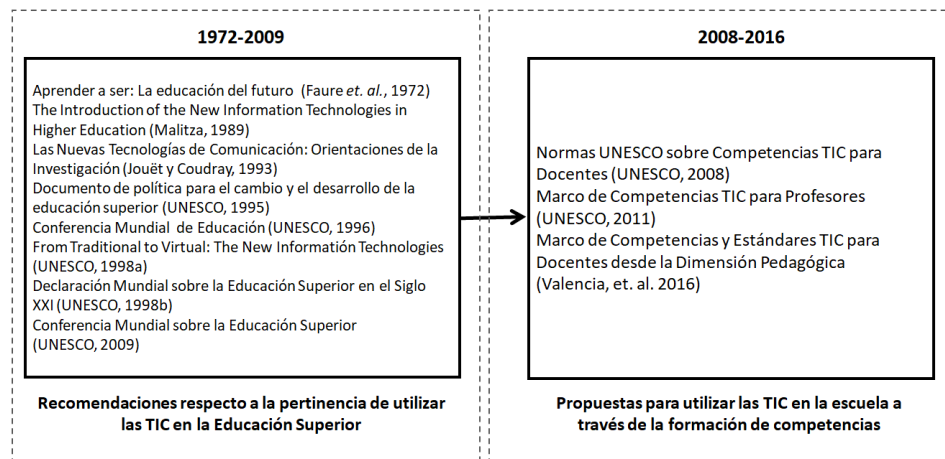


Figure 1. UNESCO Orientations and Proposals to Incorporate ICTs in Higher Education.

In Mexico, more specifically in postgraduate studies, the National Science and Technology Council (Conacyt, [Spanish acronym]) has pointed out the need for teachers and students to have the infrastructure and technological resources to carry out the teaching and research activities at this educational level (Conacyt, 2016).

Given the foregoing, it is undeniable that “technology is capable of guaranteeing better results and that it is more widespread in the social environment” (Torres, Ruiz and Meza, 2017, p. 8), even at the university level where it is essential that teachers and students be abreast in both the use of technological tools to carry out their teaching-learning activities and their knowledge on research strategies.

RESEARCH COMPETENCES

Strengthening this type of competences in students’ formation has an impact on their professional and social development (Zetina, 2017), as well as the economic development of every country, including that of a geographic region. Fostering these competences involves strengthening the activities related to the selection, order and analysis of information that leads to the generation and dissemination of knowledge.

Several authors have contributed to conceptualizing the term *research competences*. One of them is Londoño (2011), who claims that these competences comprise the set of practices that generate knowledge and allow students to develop attitudes, abilities and skills for and in research. These competences represent a construction of scientific knowledge for which students use their skills to solve problems they encounter in the research process during their academic formation.

Should the students achieve acquiring these competences, it would be easier for them to develop scientific works and they could disseminate the results of their research, participate in congresses and publish in scientific journals, activities that not only would contribute to their good academic achievement but also generate and update their knowledge in their field of study, in addition to consolidating research in the university (Campos and Ramírez, 2018).

Technological Research Competences

These competences represent the ability to seek, obtain, evaluate and manage information to transform it into knowledge (INTEF, 2016, p. 2). However, it is not sufficient to know how to retrieve information, it is also necessary to consolidate the competences of selecting, organizing and analyzing everything that the research may discover using technological resources; otherwise, they will find themselves buried in a sea of documents of different types and from multiple sources that will hardly be useful to generate knowledge.

Some researchers have studied technological research competences (TRC) from different approaches. Sánchez and Veytia (2015a) link them to activities such as browsing informatics networks to seek, locate, review and process information into digital format and, hence, corroborate the results of their research with other experts. On the other hand, Veytia (2013) conceptualizes the term *digital research competence* as a process that involves learning to know based on the analysis, reflection and evaluation of the information in addition to disseminating and sharing knowledge on collaborative networks.

For Jaik (2013), they are a set of knowledge, abilities and skills useful in a research work in which ICTs can provide the research with sufficient information to make sense of the study; while Mena and Lizenberg (2013) consider that they are related to the efficient management of ICTs in the processes of seeking, selecting and analyzing information as well as interactive work and networking with other researchers.

Skryabin, Zhang, Liu and Zhang (2015), Rodríguez and García (2013), Pérez (2017) and Camargo, Bonilla and Melo (2015) have analyzed technological competences and research competences in the teaching-learning processes in different settings and have found that there are difficulties in integrating both competences. The interactions between digital resources and the students' skills to conduct a research are scarce, hence, the research training process has not been strengthened with the use of ICTs, which represents an area of opportunity.

Therefore, addressing ICTs means knowing how to select the information adequately, to learn to organize it accurately, to consider digital tools to analyze it in a reliable manner, to collaborate in research communities to share information and knowledge, and to socialize the research findings or

results through virtual collaborative networks, congresses and scientific publications.

The foregoing coincide with the proposals of authors such as Reiban (2018), Veytia (2013, 2015a, 2015b), González (2011) and Hilarraza (2012), who include the abilities of selecting, evaluating, systemizing and socializing scientific information as ICTs elements; this involves a first step to mobilize cognitive processes directed to generating knowledge.

Under this review, we have considered the following as ICT dimensions: obtaining and selecting information, managing information, using tools to analyze information, socialize and publish the research results in digital media; and the advantages and disadvantages in using ICTs in research processes.

METHODOLOGICAL PROCESS

Sample Selection

We drew a purposive sampling of PhD students from the State of Hidalgo Autonomous University (UAEH, [Spanish acronym]), the Sonora University (Unison, [Spanish acronym]) and the Sonora College (Colson). The selection of who participated was direct and intentional (Cantoni, 2009) and was based on the fundamental criterion of student availability. The sample consisted of 39 participants: 20 men (51%) and 19 women (49%) aged 25-57 (M=34.38, DT=6.71) enrolled (See Table 2).

Table 2. Participant Distribution Sample

Institución	Programa educativo	Incorporado al PNPC Conacyt	Varones	Mujeres
Universidad de Sonora	Doctorado en Innovación Educativa	Sí	1	7
Colegio de Sonora	Doctorado en Ciencias Sociales	Sí	5	7
Universidad Autónoma del	Doctorado en Ciencias Computacionales	No	4	1

Institución	Programa educativo	Incorporado al PNPC Conacyt	Varones	Mujeres
Estado de Hidalgo	Doctorado en Ciencias de los Materiales	Sí	7	2
	Doctorado en Ciencias Sociales	Sí	3	2
Total			20	19

PNPC: National Quality Postgraduate Program.
Source: Self development.

Data Collection Strategies

In our research, we used the electronic consultation modality with students of selected academic programs from whom we requested they share their perceptions and experiences regarding the real situation in using technologies in the tasks related to the process of academic research. The questionnaire was provided through the automated Google Drive form application during February-June 2017.

Instrument Development and Validation

The questionnaire was designed with a Likert type scale since questionnaires developed through this type of scale have shown acceptable performance in research experiences (Blanco and Alvarado, 2005). Likewise, we included multiple-choice questions to know the students' preferences in some categories.

Subsequently, we subjected the instrument to expert validation which was used consistently in the fields of education and ICTs (Cabero and Infante, 2014). The four experts from different universities used the methodological strategy proposed by Cabrero (2014) and revisited by George and Trujillo (2017). As a result, two items were eliminated and the drafting of eight items was modified. The questionnaire consisted of a socio-demographic data section and a block of items on the use of technologies in research activities with established categories.

Data Processing

In order to process the retrieved data, we downloaded the Google Drive spreadsheet and migrated the data to the Microsoft Excel 2013 software.

We used two tools to treat the data, and the SPSS descriptive statistics software for quantitative data (items 1-9).

The qualitative data analysis (items 10-11) was conducted through the methodological approach of the Strauss and Corbin (2002) grounded theory. In order to seek coherences and contradictions, we based the codes of the students' discourse on the transcription of their responses. We kept the exact words of the individuals since these reflect their life experiences regarding the advantages and disadvantages of using technologies in their research activities.

RESULTS

This section presents the research results we interpreted after applying the methodological procedure to the instrument. This allowed us to identify the importance of promoting awareness in students in developing technological research competences that will help them strengthen the data selection, organization and analysis processes necessary for their doctoral studies.

General characteristics of the survey respondents

The digital devices preferred by the students of the three universities were the laptop with a total of 56.41%; second, the desktop computer with 30.77% and the remaining 12.82%, the tablet. Most of the survey students, i.e. 48.72%, are connected to the Internet on an average of five hours daily, datum consistent with the results collected by the Mexican Internet Association (AIMX, 2017 [Spanish acronym]) that points out that the average connection time in Mexico is eight hours daily; 28.21% are connected from three to four hours daily and 12.82%, from four to five hours daily and the remaining percentage are connected three or less hours daily.

Category: Data Collection and Selection

In this category, Table 3 shows that most of the students in the three universities always or almost always resort to scientific repositories (58.33% of the Colson; 52.94% of the UAEH; and 62.50% of the Unison); Google and known Internet sites are the second sources most mentioned, and lastly, Wikipedia.

Table 3. Results of the Data Collection and Selection Category

	Colson	UAEH	Unison	Promedio	Desviación típica
	1. Medios para buscar información				
Repositorios científicos	7	9	5	7.00	2.00
Googleo lo que quiero encontrar	2	5	1	2.67	2.08
Páginas de internet que conozco	2	4	1	2.33	1.53
Wikipedia	1	1	1	1.00	0.00
	2. Medios de donde se selecciona información				
Revistas electrónicas	7	13	5	8.33	4.16
Libros digitales	1	4	2	2.33	1.53
Libros físicos	4	2	1	2.33	1.53

Source: Self development.

According to Brookes (1980), data collection is subordinated to the users and their knowledge structure; hence, we infer that almost half of the students access scientific repositories since they consider them appropriate to be analyzed, classified and interpreted. However, it would be interesting to conduct a research that would bring students to seek information in Wikipedia, a data repository that has been traditionally classified as being unreliable.

Regarding the foregoing, we must mention that the content of the information exists only until the students read, it analyze, it, synthesize it and assimilate it in their body of knowledge (Hernández, 2013). Students prefer digital media whether journals or books, since this is where they can find the resources to construct desirable contents and achieve their research goals. The three universities concur with 66.67% in Colson, 89.47% in UAEH and 87.50% in Unison. This does not mean that physical books do not represent important resources; however, it seems that digital

media have surpassed traditional libraries as places of preference to collect and select data for research processes.

Category: Data Management

Knowing how to manage information represents an assimilation process in which the students, through the organization of retrieved sources, transform their knowledge structure (Belkin, 1975, quoted in Thellefsen, Sørensen and Thellefsen, 2014); hence, “the change of knowledge structure indicates [...] a more efficient assimilation of the information” (p. 7). Table 4 shows that 41.67% of the Colson students use Word to manage information, while 33.33% prefer Mendeley; at the UAEH, 31.58% use Word and the same percentage of students do not use any. At the Unison, Word and Mendeley represent the main information managers, both with 25%; meanwhile, 37.50% of this university does not exploit any of these information managers.

Table 4. Results of the Information Management Category

	Colson	UAEH	Unison	Promedio	Desviación típica
1. Uso de gestores de información					
Ninguno	0	6	3	3.00	3.00
Word	5	6	2	4.33	2.08
EndNote	2	4	1	2.33	1.53
Mendeley	4	3	2	3.00	1.00
Zotero	1	0	0	0.33	0.58
2. Uso de herramientas para almacenar información					
Gdrive	3	6	1	3.33	2.52
OneDrive	1	4	1	2.00	1.73
Dropbox	3	5	3	3.67	1.15
Ninguno, prefiero usar USB o disco duro	5	4	3	4.00	1.00

Source: Self development.

Regarding the storage of information, most Colson students (41.67%) did not manage any Cloud storage, but they did use storage devices such as USB or hard disc; 31.58% of UAEH students used Google Drive and 37.50% of the Unison students used Dropbox; however, the same percentage of students prefer physical storage.

Along these lines, there is an area of opportunity for students in using digital tools to organize and store their data since it seems that these management skills are not related to the exercise of having at their disposal the information they have retrieved from the sources consulted.

Category: Using Tools to Analyze Data

Using software to analyze data represents a bridge that the student establishes between the data analysis and its interpretation. To measure the competence of the data analysis, we present the students with different options for both the quantitative and qualitative analysis. Their responses are shown in Table 5.

Table 5. Results of the Data Analysis Category

	Colson	UAEH	Unison	Promedio	Desviación típica
1. Uso de herramientas para hacer análisis cuantitativos					
Excel	4	8	1	4.33	3.51
SPSS	3	4	3	3.33	0.58
R	1	4	1	2.00	1.73
No hago estos análisis	4	3	3	3.33	0.58
2. Uso de herramientas para hacer análisis cualitativos					
Nvivo	3	0	0	1.00	1.73
Atlas.Ti	3	8	6	5.67	2.52
Etnograph	0	1	1	0.67	0.58
No hago estos análisis	6	10	1	5.67	4.51

Source: Self development.

Regarding the quantitative analysis, the Colson students privileged the use of Excel with 33.33%, while an equal percentage asserted not conducting such type of analysis. At the UAEH, most students (42.11%) also stated using Excel and 15.79% did not carry out such type of analysis. Most of Unison students resorted to SPSS (37.50%) and the same percentage of students do not perform this type of analysis. As for the qualitative analysis, most Colson and UAEH students (50% and 52.63%, respectively), do not carry out this analysis. In the case of the Unison, Atlas.Ti was the software most mentioned, with 75%.

While given the nature of the curricula, some students do not require conducting quantitative and qualitative analyses; however, it is necessary to instill in student formation support strategies to use specialized software and highlight the importance of the meaning and interpretation of information (Dervin & Foreman, 2003).

Category: Socializing and Publishing Research Results in Digital Media

It is important to know what is being done with the information transformed into knowledge, i.e. with the activity in which “one processes information, constructs it and reasons it” (Todd, 1999, p. 855), which, in addition, is linked to the way it is used. Table 6 shows the results corresponding to the data socialization and knowledge competence.

Table 6. Socializing and Publishing Research Findings

	Colson	UAEH	Unison	Promedio	Desviación típica
	1. Participación en congresos mediante herramientas virtuales				
Sí, de dos a 5 veces	5	14	4	7.67	5.51
Sí, una vez	6	3	0	3.00	3.00
Nunca, pero me gustaría hacerlo	1	2	4	2.33	1.53
Nunca, no me gustaría hacerlo	0	0	0	0.00	0.00

	Colson	UAEH	Unison	Promedio	Desviación típica
2. Publicaciones científicas en medios digitales					
Sí, una vez	6	9	2	5.67	3.51
Sí, varias veces	3	6	3	4.00	1.73
No, no me interesa hacerlo	0	1	0	0.33	0.58
No, no sé cómo hacerlo	3	3	3	3.00	0.00
3. Membresía en redes de colaboración científicas					
Sí, en al menos una	5	9	4	6.00	2.65
No, no sé cómo hacerlo	0	4	0	1.33	2.31
No, no me interesa hacerlo	3	3	0	2.00	1.73
Sí, en varias	4	3	4	3.67	0.58

Source: Self development.

As for the participation in congresses through virtual tools, 50% of the Colson students have done so at least once and 41.67% from two to five times. At the UAEH, 73.68% have intervened two to five times and 15.79% at least once. In the case of the Unison, 50% have participated two to five times and the remaining 50% have never tried to do so but have said they would like to. In these three universities, none of the students pointed out not being interested in participating in congresses.

Publishing scientific papers through digital media is something that 50% of the Colson students have tried at least once; 25% several times and 25% do not know how to do so. As for the UAEH, 47.37% have done so once, 35.58% several times and 15.79% do not know how to do so. As for the Unison, we notice that 37.5% have published several times, at least once

and 37.5% do not know how to do so. Of all the students, 23.08% claimed not knowing how to publish scientific papers through digital media and only 12.56% comments not being interested in doing so.

Regarding the membership for scientific collaboration such as Academia.edu or ResearchGate, 41.67% of the Colson students participated at least once, 33.33% several times, and 25% were not interested in doing so. As for the UAEH, 47.37% are members of at least one and 21.05% do not know how to do so. At the Unison, 50% of the students participated at least in one and the other 50%, in several. Of all the students, 10.26% do not know how to use these tools and 15.38% lack interest.

For Jarkko (2007), the use of information “is what occurs after a person has transformed an information entity into knowledge” (p. 3). This research shows consistently the use students give to the information transformed into knowledge as “an active result of the information” (p. 4), since they have socialized it in scientific forums. However, we are concerned that some of the students show a lack of interest or ignorance in carrying on these activities.

Category: Advantages and Disadvantages of Using ICTs in Research Processes

This category was analyzed with the open, axial and selective encoding methodology (Strauss and Corbin, 2002), as of which interrelated subcategories were suggested such as the access to infrastructure (digital devices), the quality of the information on digital media, the volume of the information generated by a search as well as the context of the PhD academic formation, as shown in Figure 2 and Table 7.

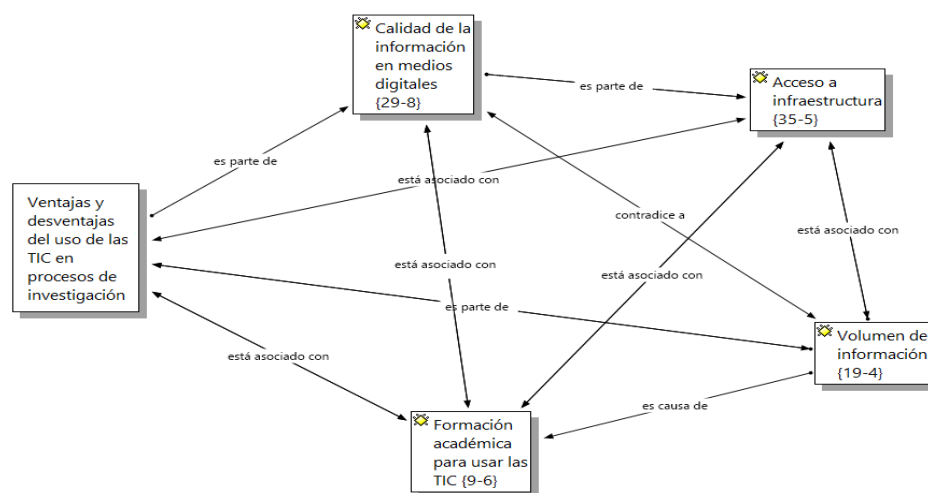


Figure 2. Interrelations between the categories found for the advantages and disadvantages of the use of ICTs in research processes. Source: Personal source.

Table 7. Emerging Subcategories

Category	Subcategories
Advantages and disadvantages in using ICTs in research processes	Access to technological infrastructure (digital equipment and software)
	Academic formation to use ICTs in research
	Volume of information available
	Quality of information in digital media

Source: Self development.

Access to Technological Infrastructure

This subcategory focused on the students' perception regarding the universities technological capacity as an advantage and disadvantage factor to generate technological research competences. In this research, the disadvantages show that ICTs are not part of the students' research processes, at least at the university level.

Advantages

“You can get applications on the Internet; some are free to conduct your research, more specifically for developing applications” (UAEH_DCC5).

Disadvantages

“You must do your research at home since the university Internet is slow and it is exasperating trying to seek information when many sites are not even accessible” (UAEH_DCM4).

“The laboratories do not have the necessary software such as Atlas.Ti, you must get it free because you cannot afford buying a license” (UAEH_DCS2).

“The wireless connectivity at my institution is slow” (Colson_DCS6).

Academic Training to Use ICTs for Research

During the research, perceptions emerged on the importance of incorporating technologies at the PhD formation level to carry out technological research competences. One of the disadvantages pointed out was the lack of use of the technologies by the faculty professors, while the advantages were seen in students of the PhD in Educational Innovation (Unison) and Computer Sciences (UAEH).

Advantages

“A PhD professor taught me how to use ResearchGate in order to connect with people from other countries to ask them for their research” (UNISON_DIE6).

“The doctorate itself trains you to use technologies. If it weren't for the Internet, it would be difficult to go forward in your thesis, you seek forums and whoever can guide you on the net” (UAEH_DCC3).

Disadvantages

“ICTs are not used at the doctorate level, at least not to do research. The PhD professors do not encourage their use” (UAEH_DCS5).

“Not all professors are digitalized. Your formation does not prepare you to use technologies to access information relevant to you” (Colson_DCS2).

“The academic formation at the doctoral level does not prepare you to use the Internet as a means to obtain reliable information” (Colson_DCS11).

Volume of Information Available

Students perceive differently the power to access multiple sources of information in digital format. Students of the PhD in Educational Innovation (Unison) and Computer Sciences (UAEH) are those who value most the advantages of using ICTs, while the most representative opinions regarding the disadvantages are given by PhD students in Social Sciences:

Advantages

“All the information is at hand and it's just a matter of understanding it and knowing how to look for it correctly” (UAEH_DCC1).

“Major sources of information, you find many updated references” (Unison_DIE4).

“There is more information available than in physical libraries” (UAEH_DCC3).

You can be distracted while searching through so much information for your research” (Colson_DCS1).

“There is an excess of information and it takes time to evaluate it since much of it does not contribute to the object of your study” (UAEH_DCS4).

“The Internet distraction factor, you are working and then there’s an e-mail, you open it and open a site and when you least expect it, you are watching a video” (Colson_DCS6).

“The vast sea of information can be confusing at times for those who are not so used in doing research with digital material” (Unison_DIE2).

Quality of the Information on Digital Media

Similarly to the previous opinions, some students claimed that, even though the Internet offers a considerable volume of information, it is important to evaluate the quality of said information and identify the platforms in which essential sources of consultation can be found according to the study interest:

Advantages

“The speed of access, the treatment and systematization of the information encountered on sites such as Redalyc” (Colson_DCC6).

You can find recent valuable research products and other historical products such as papers, books, presentations, on sites such as the ISSUE or in memoirs of congresses such as COMIE” (UAEH_DCS1).

“Valuable information is available within a click if you know where to look. They taught me how to use the digital library which is an invaluable source” (Unison_DIE6).

Disadvantages

“The disadvantage occurs when you do not know how to recognize if the material being consulted for your research is reliable” (UAEH_DCM2).

“On the Internet, one can access an enormous amount of “dubious quality” products that seem to be original when in reality, they are

invented, plagiarized, time-wasting studies, among other things” (Unison_DIE5).

“There is a lot of information that could be unreliable or false and if you do not know how to recognize it, you may use it unknowingly” (Unison_DIE6).

CONCLUSION

The PhD students who participated in the research coexist on a daily basis with technologies in their formation processes, including those related to the generation of research competences, since the characteristics of educational programs require so. However, these can be limited by two factors: the first has to do with the institution and its inadequacy in having an infrastructure such as the access to Internet and specialized software to carry out the tasks of seeking, selecting and analyzing information, as well as the idea that teachers do not incorporate technological tools in their teaching, hence the difficulty in achieving a synergy of the technological research competence.

On the other hand, students have found areas of opportunity by facing issues of research process in socializing the information and knowledge, since while some of them have participated in congresses and have made scientific publications, there are others that lack the knowledge or interest in doing so. Hence, the obligation to strengthen students’ scientific work so that, in a holistic manner, they generate technological research interactions and, with it, promote the necessary competences so technologies become part of the postgraduate research processes.

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