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TLK competencies of Colombian university teachers and students Confluences toward an integrated model of technologies in the curriculum

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Abstract

The implementation and management of technologies for learning and knowledge in the teaching and learning processes of educational actors and how their competencies are strengthened in higher education is a key element for the successful acquisition of knowledge. The study presents preliminary results of the project called "Atlas of TLK uses in higher education in Colombia" through the application of instruments designed and validated specifically for this research. A probabilistic sample of 172 teachers and 235 students of the University of Boyacá was obtained, who responded to the questionnaires. It is evident that most of the students and teachers are not familiar with the concept of ICT, however, they have great competencies regarding the use and knowledge of ICT, which marks a roadmap to work and generate proposals for a better understanding and acquisition of competences in the use of technologies for learning and knowledge.

Keywords: Technologies for learning and knowledge, Information and communication technologies, teaching competencies, integrated technology model, school curriculum.

Introduction

Information and Communication Technologies ICT have brought significant changes in education, taking into account the impact they have had at present, due to the pandemic, where social, educational, economic, political, and labor market interactions, among others, stand out; which allow transforming the environments in almost all processes.

In this aspect, ICT are classified according to the use that has been given to them in different environments, which is varied, mainly in the education sector, the communication facilities through Internet resources and services that can be accessed for free have revolutionized learning, knowledge production, creativity, and innovation.

According to Meléndez (2018), an innovative educational institution introduces novel factors that add value to improve its results. In others, they are those that transform scientific and technological advances into new products and processes. That is why, when talking about innovative university institutions, it is said that they are those that manage to adapt technological,

social, cultural, and other changes to the teaching and learning processes to achieve their goals and purposes.

It is for this reason that a few years ago the term "Technology of learning and knowledge TAC" was born, referring to the use of ICT as a training tool, focusing on didactics and methodology using technology within the educational projections to generate new learning and knowledge through pedagogical resources according to the specific competencies of each of the training areas.

Likewise, university education in the knowledge society demands an increase in scientific production, and for this, there must be motivated teachers and students who are researchers and innovators; together with this, education systems are according to the moment and time. From this arises the research question: How does the implementation and management of ICTs affect the teaching and learning processes of educational actors and how do they strengthen the competencies of students in higher education?

Therefore, "if the educational environment and the ways of educating are changing, so must the teaching methodologies and for this training is essential not only in the acquisition of investigative and digital skills focused on learning, research, the use of ICT tools, but in transforming them into Technologies for the development of Learning and Knowledge (TLK) to enhance the processes and develop skills in students, which implies that institutions and their teachers know how to educate from individualism to the social welfare of all" (Santos, 2020).

Moving on to another significant aspect, social networks loaded with symbolic interactionism appear, basically through Facebook, WhatsApp, Instagram and YouTube mainly, these should be considered in the academic field as technological phenomena of important application in all fields of know-how, know how to be and know how to live together (Pinto, 2015).

Therefore, the University of Boyacá, concerning knowledge, points out that there are personal conditions to know how to live together as integral citizens and transcendent human beings, capable of transforming and leading the community towards scenarios of freedom, justice, equality, peaceful coexistence, and sustainable socio-economic development, demonstrating the ability to manage the contexts of their profession and transversely competent to promote the integration and dialogue of knowledge and feelings as a way to objectively approach science and the service of society. Now, the professional conditions to recognize the knowledge to know and to do are developed together with the ICT and the learning and knowledge to identify and shape their mastery through the TLK.

Likewise, the role of TLK in the academic environment begins by identifying the domain that should be had concerning reading and writing skills through technologies, which are currently indispensable for the development of teaching and learning processes in the university environment and specifically in disciplinary training. Carlino (2020) defines academic literacy as "the set of notions and strategies necessary to participate in the discursive culture of the disciplines, as well as in the activities of production and analysis of texts required for learning at the university".

Therefore, reading and writing competencies are indispensable for the adequate development of teaching with the purpose that the university student has a satisfactory performance in disciplinary training. These competencies do not refer to basic information acquisition and communication skills but are linked to the construction of specific knowledge of a scientific community (Carlino, 2020).

However, the use of "TLKs" has been taking place for several decades, and the following are the significant experiences in Colombia. In the study entitled: "Learning and Knowledge Technologies as strategies in the training of teachers at the Escuela Normal Superior de Cúcuta, Colombia", it is noted that teachers stated that ICTs are tools that allow learning to learn in support of the pedagogical work of teachers (Díaz & Márquez, 2020). Another aspect raised in this study is that teachers should know how to use technologies, since they make classes more dynamic, guide decision making, and improve educational quality. The theoretical element resulting from the interpretation of the study was "The construction of knowledge in the teaching and learning process based on TLK strategies", where it is evident that

training by competencies for the consolidation of TLK is fundamental for the development of teaching quality. Another aspect is critical thinking and problem-based learning through the use of TLK strategies to reach the construction of knowledge in the teaching and learning process based on TLK strategies (Díaz & Márquez, 2020).

Another study conducted in Colombia focuses on: "Education for coexistence and culture of peace through TLK: a multi-case study in the context of Bogota" (Vargas, 2019). This research identifies that it is essential to generate transversal curricular plans toward coexistence and a culture of peace supported by TLKs and to consider expanding these studies in the Colombian context. It is concluded that the institutional commitment should facilitate the implementation of all types of experiences, on education for coexistence, culture, and peace supported by TLK, on different factors, administrative, time management, infrastructure, and training, as well as action (Vargas, 2019).

On the other hand, the experience of the Mareiwa seedbed and its relationship with the TAC is highlighted, which belongs to the Universidad Santo Tomás. This study shows that the seedbed has had an important formative value for students, mainly focused on strengthening research and personal skills, which has resulted in a high production, especially of audiovisual resources, constituting the TLK in a scenario of learning and exchange of knowledge, mainly through an accompaniment where horizontality prevails (Buitrago et al., 2020).

The study on pedagogical strategies mediated with ICT-TLKs as facilitators of meaningful and autonomous learning stands out, in this research it was sought to determine a set of pedagogical strategies, involving the mediation of ICTs, to facilitate meaningful and autonomous learning and the development of skills in digital native students of elementary school at the Fe y Alegría Educational Institution in Cartagena de Indias -Colombia-. In this study, limited use of ICT in the classroom was detected and it could be inferred that there was short pedagogical intentionality defined and agreed upon by the teaching staff. This led to the emergence of articulated institutional strategies to advance the development of student competencies, increasing didactic evidence in collaborative and b-learning scenarios, to build alternative forms of effective attention to the student's educational processes toward a self-regulated profile, which implies: more and better strategies mediated with ICTs, until they become TLKs in the classroom (Torres & Alberto, 2015).

Another relevant study was conducted at Los Andes School, Nuestra Señora de las Mercedes in Pasto, Colombia, where research was conducted on "TLK as tools for classroom work in the subject of English for 2nd and 3rd-grade students". To achieve the results obtained, methodologies such as the use of games, movement, an integral vision of the student, and the stimulation of learning were used, which made possible the significant learning that was manifested in the improvement of the level of basic English skills in all the students of the population under study (Delgado, 2019).

One of the experiences carried out in the Colombian software industry related to training in specific competencies, is an experience of the use of project-based learning. This study presents a methodological approach to competency-based training for the software industry sector through the application of a learning approach based on integrative pedagogical projects, to document the experience of training students in the area of information systems and present the objectives achieved in terms of projects carried out and companies impacted; the industry offers the possibility of project development in real execution environments. It ends with a technological proposal focused on a distributed application that allows the management of information, available to all actors in competency-based training (Plaza et al., 2015).

Another significant experience was the formulation of knowledge management models applied to the context of higher education institutions. This proposal was validated with information from the Fundación Universitaria Católica del Norte, Medellín-Colombia. The methodology is a route consisting of diagnosis, design, implementation, and validation of strategies. The dimensions and categories of the model were theoretically validated, as well as its applicability through interactive workshops, under the design thinking method. Among the main

results, the usefulness of carrying out a previous diagnosis to contextualize the intervention panorama and generate knowledge maps oriented to promote awareness of institutional procedures as a mechanism to make explicit and appropriate relevant knowledge (Acevedo et al., 2020).

It is also possible to find studies in the health area that allow evidence of the strengthening of the Safety Program and patient monitoring, through the implementation of ICT, TLK and PET, in the Medical Center Egeiro SAS in the city of Sogamoso, Boyacá - Colombia. In this sense, the integration of ICT, TLK, and PET technological tools facilitate the generation of knowledge sources, since they are tools considered emerging in the health sector because they impact the doctor-patient relationship and the provision of health services in general. Additionally, they are considered important resources to strengthen health systems, being, in turn, cost-effective and safe, facilitating the overcoming of barriers to access and coverage of health services (Soto, 2020).

Another example of what has been found in educational research reports is the "Design of a teaching and learning scenario based on the use of ICT and TLK from a neurodidactic perspective". The ICT-TLK tools, together with the didactic objectives and contents established by the teacher, determine what type of cognitive processes are worked on and stimulated in the students during the learning process, but for this, the teacher must know how to identify them to design activities for this purpose. These tools, together with the use of different active methodologies, constitute a support instrument for the teacher that allows him/her to develop the key competencies and skills of the 21st century (Navacerrada, 2019)

As can be seen, there is a large number of research reports that demonstrate the approach of ICTs at different educational levels, but especially in higher education, almost all of them have in common the conclusion that university students must have digital competencies that allow them not only to search, find, analyze, evaluate and effectively use the digital information present on the network but also to communicate, collaborate in the construction of knowledge and share their products through the use of technologies. The design of educational practices aimed at this objective must take as a premise the orientation of students towards the construction of meaningful learning through the use of technologies. It is then that such tools cease to be characterized as ICT and become TLK. In this context, technologies serve as a means and vehicle for university students to elaborate their knowledge through joint work with their peers (Ureta & Rossetti, 2020).

From the advantage offered by the different technologies of being in immediate contact with information, there is a change in the training needs of university students in the way of accessing and generating their knowledge. This also entails a greater commitment in their role as learners, since they must assume an autonomous and responsible role in their learning, developing competencies that allow them to direct and regulate their knowledge and make effective use of the various resources available. For the development of this process, students should not only receive the necessary guidance from their teachers but also work together with their colleagues, enriching themselves with the contribution of others and thus progressing in their knowledge (Ureta & Rossetti, 2020).

The development of digital competencies in higher education plays a fundamental role in the autonomous and self-regulated learning of students, who actively participate in the construction of their knowledge and the collaborative learning of others. These competencies enable them to perform a wide range of functions. Learning is aimed at people acquiring skills to consciously incorporate TLK in everyday life, in such a way as to generate cognitive independence in the student, using these technologies, promoting critical thinking, and encouraging innovation in the teaching-learning processes, which generates changes in different core aspects, such as the roles developed by the actors, the environments, resources, and the learning processes themselves.

To generate these critical and reflective spaces that open approaches to future scenarios for education, the use of ICTs has been involved in teaching, including multimedia resources, contributing to the development of competencies,

learning, knowledge, and values, since they have been contextualized in different environments: virtual and face-to-face, where students spend a great deal of time. The democratization of higher education with the appropriation of knowledge acquired by society is directly related to the right to have knowledge and access to learning processes. Among the important aspects that favor transformative practice are the following: "guaranteeing technological accessibility, rethinking development in the socio-cultural context, and arbitration in pursuit of a responsible use of the environment" (Neveada, 2013).

Teachers who have mastered TLK have been able to use methodologies oriented to collaborative learning and knowledge creation to motivate students to learn, "learning to select and use technologies appropriately to access information, process it and turn it into knowledge, as well as to consolidate, share and transfer it" (Valarezo Castro & Santos Jiménez, 2019).

The University is an entity of change, which has activities such as teaching, and research and for this, it must perform management tasks. In this management perspective, the University has what has been called the third mission, which is based on two main pillars: the institutional social responsibility of the university and the commitment to transform knowledge into economic value, "influencing competitiveness and facilitating innovation, creativity and cultural, scientific and technological development". While it is true that ICTs bring with them new social demands and training requirements, they also bring multiple benefits in management and transfer. It is therefore necessary to formulate changes for a flexible and open European university (Vilalta, 2013).

The prospective analyses that are being carried out at the organizational level have reached the management carried out in educational institutions, not only in their mission functions such as teaching, research, extension, and social projection but also in the tasks derived from administrative procedures. HEIs in their administrative tasks are involving processes of change, and globalization, which implies the use of technologies. It is there when university models emerge that integrate innovations in the training processes, which allow the adaptation to the changes and globalization mentioned so that they do not lag behind other institutions and, therefore, their academic programs. The increase in the offer of open universities in the world indicates the tendency to create new educational solutions.

Educational Innovation in the conceptual era through ICT, TLK, and PET: these are considered useful tools to make visible situations that individuals live in their daily lives from academic processes in their context and thus achieve actions to transform environments marked by inequity and backwardness, as is currently the case, through the implementation of innovative educational strategies, which are relevant to create awareness in young people, their families, and their community. All these are thanks to the resignification of the use of technology that empowers young people more aware of reality, who experience the better management they should have of it and of the media to disseminate it and give it greater visibility (Iglesias *et al.*, 2018).

Methodology

This paper presents the results obtained from the answers given by the teachers and students surveyed. It addresses the competencies in TLK that are essential for educational actors at the higher level in a scenario of change, so the level that each one of them considers they have in technological competencies is requested, as well as the value they give to them, as a key element to achieving a confluence towards an integrated model of technologies in the curriculum. The objectives of the study are:

- Describe teachers' and students' perceptions of the level of TLK competencies.
- To analyze the importance given by teachers and students to TLK competencies in their training and the university curriculum.

The present study is quantitative, descriptive, cross-sectional, and exploratory in scope (Hernández & Mendoza, 2018). First, 3 instruments were designed, one for managers, another for teachers, and the last one for students,

which were applied online using Google Forms, and the hyperlink was distributed by email to the entire population of the University of Boyacá. The instruments were elaborated based on the ICT and TLK competencies proposed in several studies.

Table 1

Research that served as the basis for constructing the scales and questionnaires that served as the basis for constructing the instruments

Authors	Dimension worked on
Grizzle, A., and Hamada, M. (2019).; Le-Voci-Sayad, A., and Lau, J. (2020).	Technological literacy of teachers
Wilson, C., Grizzle, A., Tuazon, R., Akyempong, K., and Cheung, C.K. (2011)	ICT teaching competencies
Frau-Meigs, (2006); Wilson, C., Grizzle, A., Tuazon, R., Akyempong, K., and Cheung, C.K. (2011).	Media education for teachers
Mishra, P., and Koehler, M.J. (2006).	TPACK Model (Technological Pedagogical Content Knowledge)
Fuller, (2020)	NETS-T Standards, of the ISTE (International Society for Technology in Education)
Gutiérrez-Martín and Tyner, (2012)	Edocumunication
Trejo-Quintana, (2016); and Koehler, M.J. (2006)	Media literacy in Latin America
Condeza-Dall'Orso, A., Herrada-Hidalgo, N., and Barros-Friz, C. (2019)	Teacher training in uncertainty
Paredes (2020)	Practices of ICT use in higher education.

Note: Information taken from book and journal databases.

1] Teachers: A version with 115 questions was generated and analyzed by 6 methodologists and technologists, doctors, and teachers in education who have extensive academic experience, in addition to being higher level teachers. A validity of .90 was obtained, making it a questionnaire with excellent validity. Thirty-eight items were eliminated due to their redundancy, leaving 77 questions in the final version.

To check reliability, the instrument was piloted with 7 teachers from various undergraduate and graduate careers at the University of Boyacá, which yielded a value of α=.98. On the other hand, a simple random sampling was used for the selection of the participants in the study, since, from the total universe of 564 teachers, only the first 172 who responded were taken into account and that was required for the study to be probabilistic.

2] Students: Finally, a questionnaire of 99 items was proposed, with the participation of 5 experts, who analyzed the relevance of the items, obtaining .92, so it is considered an instrument with excellent validity, even so, 25 items were eliminated because there was no consensus for its application and some items were modified to improve its comprehension, until a final version of 74 questions was obtained. Finally, Cronbach's Alpha was calculated; therefore, it was piloted with 7 university students, which yielded a value

of α=.96, showing high reliability. To select the participants in the research, simple random sampling was used, since out of the total universe of 5216 students, the first 235 who responded were taken into account. In all cases, it was verified that the criteria established for concluding were met, as well as the Kaiser-Meyer-Olkin measure of sampling adequacy and Bartlett's test of sphericity.

Table 2 shows the data of the original scales, as well as the deleted items and the final number of questions for each scale.

Table 2

Questionnaires for age groups, with the number of original, deleted, and final items[1]

Questionnaire for teachers	Number
Original scale	115
Items eliminated	38
Final scale	77
Student questionnaire	Número
Original scale	99
Deleted items	25
Final scale	74

Note: Information taken from the University's statistical data

Table 3 shows the data on the group of experts, pilots, the universe, and probabilistic sampling obtained, according to the universe of each age group to carry out the study. In all cases, the confidence level was 94%, with a margin of error of 6% and heterogeneity of 50%.

Table 3

Description of the piloting and selection of the probabilistic sample and the research.

	Experts	Control	Universe	Sample
Teachers	6	7	564	172
Students	5	7	5216	235

Note: Information calculated with an error of 6%.

The field work was carried out from March 9 to 31, 2022 with the application of the instruments previously described. The coordinators of undergraduate careers at the University of Boyacá were asked for their support so that the teachers and students assigned to their division, as well as themselves, would respond to the specific questionnaire that was designed. Since the sample was required to be probabilistic, the respective

[1] The complete analysis of the instruments, as well as their design and development can be found in: Correal (Coord.) (2022). Instruments to measure the level of uses and appropriation of technologies in Higher Education Institutions. University of La Serena. Chile. Available at: www.latinoamericanos.online/libros

formula was applied to determine the exact number of educational actors to be surveyed.

The results obtained were deposited in an Excel spreadsheet, which was used to design a frequency matrix and the various graphs presented below.

Results

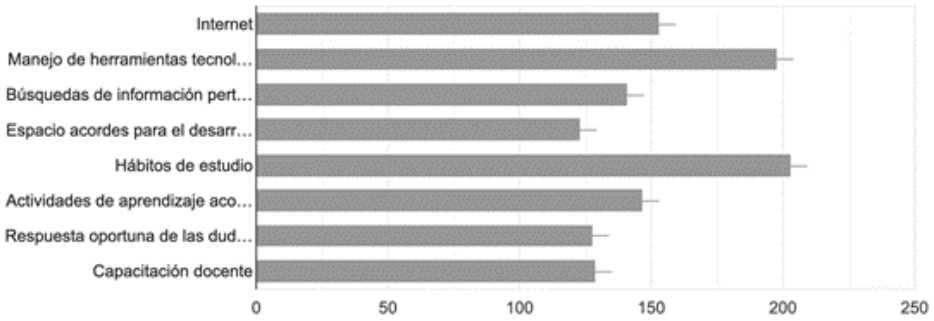
To respond to the objectives of this research, a descriptive analysis of the most representative items of the TLK dimension of the instruments was carried out. The information obtained provides evidence of the TLK competencies faced by educational actors at the higher education level.

The TLK competencies are the set of skills and knowledge that a student possesses concerning the mastery of different technological resources for learning and knowledge, from an ethical, safe, and responsible point of view.

In today's knowledge society, it is considered necessary for the individual to acquire new competencies to be able to respond to the demands required by technological changes and evolution. These competencies become essential elements of change in the new educational paradigm (Martínez & González, 2019).

Figure 1

Difficulties in TLK and ICT training that need to be improved



Note: The data were obtained from a group of 235 students

López and Silva (2016) show not only that a good number of researchers have managed to validate the improvement of learning processes through Mobile Learning, but also that this methodology has a pedagogical potential with transversal and interdisciplinary effects, which increase the interest of students and in turn promote collaborative work, creativity, knowledge transfer, accessibility to information and strengthen the use of this tool for professional performance.

With this affirmation, the students state that the greatest difficulties in training using ICTs and TLK are the lack of study habits, followed by the difficulty concerning the use of technological tools, access to the Internet, learning activities related to the development of competencies, and the search for pertinent information for the development of learning. The above is following the results related to the TLK competencies and the teaching of TLK in higher education, since once again the lack of knowledge in use to the development of professional skills and abilities is shown.

Likewise, the teacher must follow up on the different groups to support the development of learning, and guide students to establish tools that allow them to overcome these difficulties. The teacher evaluates the results, progress, and difficulties, and considers the students' perspectives. He/she transforms strategies, designs new forms, contents, and formats, and faces new difficulties (Romero et al., 2020).

Necuzzi (2013) points out that educational technologies have impacted other aspects of students such as motivation, digital literacy and transversal skills. Therefore, it is important to learn about these tools to use them in the classroom and thus modify the classroom dynamics. In other words, the existing paradigm should be broken and students should be allowed to make use of "ICT" and "TLK", both to learn and to generate knowledge. (Bárcenas & Morales, 2019).

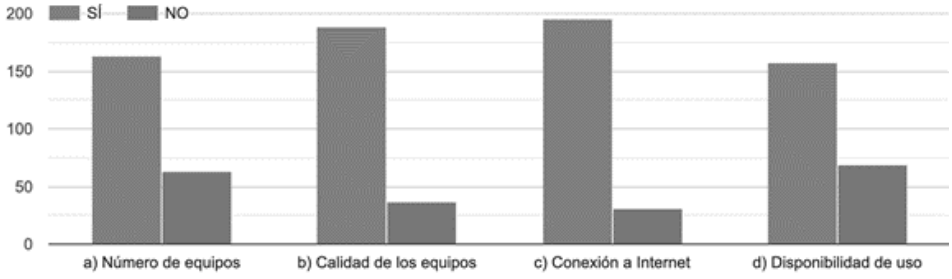
On this aspect, students state that they use in their personal and academic life: e-mail, chat, videoconferences, social networks, office tools, search tools, screen capture, image and video editors, Moodle platform, spaces to manage files, social bookmarks and use of audiovisual content platforms. Thus, indicating that they know their functionality, but there is a need to incorporate strategies for the creation of learning and knowledge scenarios.

From the above, it is possible to affirm that technological scientific development is an evident and real aspect of society so it is difficult to find a profession or a moment in their social life where new technologies do not exist, as well as constant changes in knowledge and technological development which forces the student to be directly involved in the learning of these technologies as part of their professional training (Font, 2018).

Reading practices, socialization practices through social networks, communication practices and even the generation and use of resources and teaching platforms have mutated rapidly. Thanks to digital technology, the ways of teaching and learning are different and contribute to building new ways of thinking, and new cultures (Alvarado et al., 2016).

Figure 2

Adequacy of infrastructure in the school environment



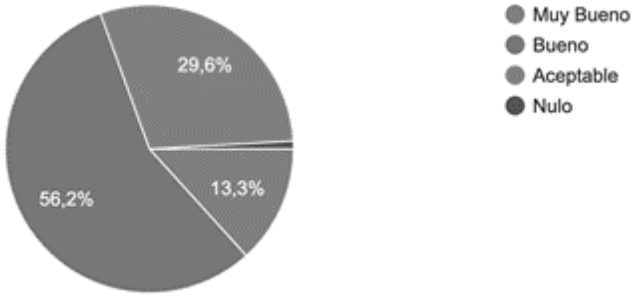
Note: The information was obtained from a group of 172 teachers surveyed

The results of this question are positive for the institution, since in most of the answers the YES option is the one that stands out, and by more than 50%. This answer is in line with Ruiz Velasco (2003:304), who tells that in many institutions it is believed that, because there is modern equipment, this results in technological appropriation, which in many cases is not always fulfilled and much less is seen as a problem for the institution.

The strengthening of technological infrastructure and its insertion in higher education began in the 1990s, without yet having in mind the so-called "information and knowledge societies". Later on, the need to create "policies and ways of incorporating innovative strategies to teaching and research processes mediated by the use of telecomputing artifacts" (Torres *et al.*, 2010).

Figure 3

Mastery of CAT for the pedagogical development of classes



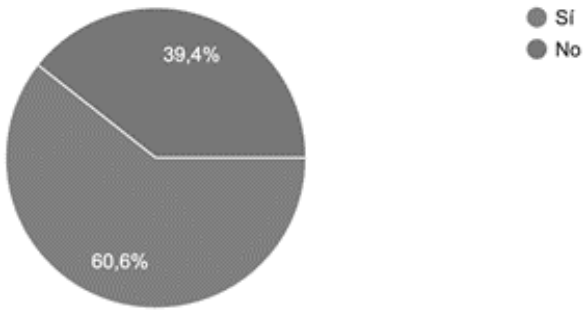
*Note*The information was obtained from a group of 172 teachers surveyed

The institution's teachers report having a good level of mastery of ICTs and TLK (56.2%), however, a low percentage is rated as very good (13.3%); it is noteworthy that only 0.9% report having no mastery of technology. According to these results, it can be stated that the University, and therefore the teachers, are aligned with the document published by the United Nations Educational, Scientific and Cultural Organization (United Nations Educational, Scientific and Cultural Organization, 2008), on standards of competencies in technology for teachers: indicating three approaches for the development of teaching competencies in ICT: (1) basic notions of these technologies, (2) deepening of knowledge and (3) generation of the same. Teachers must assume the commitment to teach and guide their students in the use of ICT and therefore, they acquire the responsibility to train themselves to use these same technologies to teach their knowledge and thematic content effectively.

There are educational institutions in which their teachers do not feel prepared for the use of ICT, generating an institutional problem since there is no generation of activities and teaching programs (Martínez, 2011). For this reason, teachers must be constantly updated on ICT advances, doing their part, both personally and professionally, to take on the challenge of using technological tools in their teaching activities.

Figure 4

Perception of teachers' pedagogical-technological competencies



Note: The information was obtained from a group of 172 teachers surveyed.

As seen in the course of the survey results, there is a favorable response, overcoming major drawbacks and stages such as the awareness period, which allows the motivation of teachers with experiences of their peers, technological training process to learn and use ICT tools and their incorporation into teaching activities, this can be seen in the 60.6% of teachers who have said they have pedagogical and didactic elements for ICT and TLK development in the classroom (Guzman Flores et al., 2011).

Karsenti & Lira (2016) state that in these times, people should no longer talk about "the need or not to make use of ICT in school", but in the way ICT are integrated to pedagogy, being this statement consistent with the thinking and practice of the surveyed teachers. The use of ICT in classrooms is a feature that allows proposing strategies that propitiate the construction of knowledge, being a great help in the teaching-learning process (Gómez, 2018).

Sometimes this ICT is not well used, generating results that are not adequate in the teaching-learning process, although it is true that "ICT is essential in the teaching-learning process: this perception by some teachers refers to their use without a prior analysis of their usefulness in the context of learning, sometimes teachers conceive the use of ICT as one more tool in higher education without making a due awareness of the advantages and disadvantages of the same" (Riascos et al., 2009).

The results of the survey show that teachers have a greater mastery of the Microsoft Office suite, with a special emphasis on the use of PowerPoint presentation software, followed by word processing and Excel in third place. This can be seen in the activities and functions that a teacher performs in his or her work.

It is striking that there is no use of tools associated with collaborative work and online tools, which coincides with the research carried out by Mercader & Gairín (2017) where it is stated that there is no use of technological tools that can be taken advantage of, such as social networks, forums, wikis, and blogs, "which have been integrated into the methodology and used to encourage student participation in the classroom". This result is even more noteworthy when the survey was conducted after confinement as a result of COVID and where greater use of tools that can be used virtually would be noted.

Conclusion and discussion

The analysis of the instruments applied to undergraduate university students where the emphasis was placed on TLK According to UNESCO (2017), the inclusion of TLK in the education sector in Latin America and the Caribbean had not reported positive effects on quality, this effect had its transformation in the educational process due to the Covid 19 pandemic. Nevertheless, students report having the skills to download files, organize folders, create and edit documents and surf the Internet. In other words, this phenomenon is significant, since there was a delay in relation to the knowledge of ICTs.

Students have acquired technological skills such as configuration and installation of hardware and software, browser management, spreadsheets, creating databases, and simple presentations, among others. For Cobo (2016), there is an appropriation of technologies if the use is oriented to the conformation and interconnection of spaces for creation and collaboration among users. An adequate level of appropriation will allow the use of these technological tools to stimulate learning and develop skills that contribute to the creation of new knowledge (Lion, 2019).

Regarding the experiences that students have observed concerning the integration of TLK in the educational environment, 67% of them state that they do not know any educational experience related to TLK because few pedagogical experiences are developed in the classroom for the development of learning through these technologies:

Student 1: "For the use of CTs, better training for teachers is recommended."

Student 2: "More Training in the student community to improve CT management".

Student 3: "I think that even though we went back to specialty we should not leave behind all the technological tools we used during the pandemic because it facilitates learning and organization in certain aspects. For example, when we students get sick and cannot attend class there should be a recording of the class we missed because simply disconnecting us from technology just because we went back to the classroom does not seem to me to be the most accurate thing to do based on the fact that technology makes life easier for us in many things and therefore, we should use it to our advantage."

Apparently, as it happens in other countries of the world, the problem is no longer the equipment or facilities, since in some way the administrations and institutions have been providing the infrastructure resources for this purpose; the problem lies in how to apply these technologies to the educational process, where the Internet plays an influential role in improving the training of students and teachers, giving access in a fast way to information sources and providing a highly efficient communication and interrelation process with greater effectiveness and productivity (Malagón, 2018).

Finally, students recognize that ICTs are part of the teaching process to generate and demonstrate learning that generates knowledge to solve problems. One aspect to highlight is that 67% of the participants state that they do not know authoring tools, Netbook, Wikis, and Webquest. Therefore, it is necessary to know what weaknesses the academic community has in the use of these technological resources since it is important to be convinced that in the professional future and as teachers the uses of all these tools are very useful (Orús et al., 2015).

TLK has made inroads in education as an opportunity to provoke an evolution in educational systems and meet the need for professionals capable of driving rapid and complex transformations that the development of science and technology demand (Moriya & Schlünzen, 2016). The presence of TLK in the teaching-learning processes has redefined learning towards "constructivist models, which focus the active process on the students, giving a new conception to the functions of the teacher, who takes on the role of a facilitator" (Viñals-Blanco & Cuenca Amigo, 2016).

Constructivism is defined as a theory "the set of epistemological and practical elaborations that start from considering knowledge as the result of a dynamic and interactive process through which external information is interpreted and reinterpreted, recreated by the mind of the learner who progressively builds increasingly complex explanatory models of reality, which are constantly created and modified, always susceptible to be improved as a result of the process of knowledge construction itself (Fundación Chile, 2014). This theory is supported by active methods (concept maps, heuristic conversation, investigative method, collaborative work, among others), and adding technologies, presenting the information to the student so that he/she can manage it and analyze it to turn it into knowledge, increasing previous knowledge.

The appropriate use of technologies as a didactic resource generates the development of autonomous learning as an antecedent of solid knowledge; as long as its practice and advice have favorable methods for its use (Valarezo Castro & Santos Jiménez, 2019). The student must progress from the use of ICT to the use of TLK: from user to creator of information and knowledge, which is a consequence of the change in educational thinking, and conceptions of learning, among others, to generate the aforementioned innovation and interest in new technologies and in general for the unknown and current. To create scenarios that favor learning management, it is necessary to adequately use TLK and for this, it is necessary to design, implement and evaluate methodologies to develop digital competencies through the construction of knowledge (Medina *et al.*, 2015).

Institutional strategic planning should promote the management of change or adjustment of academic policies to a University-Society correlation, since it should be the fundamental objective of any university in the world, i.e., the university should be an entity that generates knowledge for the benefit of its community, thus making it become the epicenter of social solutions (Arce, 2019). In

addition, Sahraoui (2009) mentions that universities present obstacles in the management of ICT since they do not have prospective strategic planning that directs this process and that could be remedied by "creating a sustainable ICT governance structure", through flexibility in learning modalities, reconciling academic, administrative and technical-financial perspectives; this situation is especially present in developing countries, as is the case of the research presented in this investigation.

The current times, in which society demands a productive use of knowledge, originate challenges, opportunities and threats, among others. In order to face these challenges, organizations must create policies in which their employees work as a team, making the best use of responsibilities, knowledge and information technology (García Peñalvo). This technology allows transforming education and its academic-administrative management, to give way to a global, denationalized and de-personalized education (World Bank, 2004)

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