SYSTEMATIC REVIEW: THE CONTRIBUTIONS OF DIGITAL INFORMATION AND COMMUNICATION TECHNOLOGIES TO THE DEVELOPMENT OF THE SUPERIOR PSYCHOLOGICAL FUNCTIONS OF UNIVERSITY STUDENTS

REVISÃO SISTEMÁTICA: AS CONTRIBUIÇÕES DAS TECNOLOGIAS DIGITAIS DA INFORMAÇÃO E COMUNICAÇÃO PARA O DESENVOLVIMENTO DAS FUNÇÕES PSICOLÓGICAS SUPERIORES DE ESTUDANTES UNIVERSITÁRIOS

REVISIÓN SISTEMÁTICA: LAS CONTRIBUCIONES DE LAS TECNOLOGÍAS DE INFORMACIÓN Y COMUNICACIÓN DIGITAL AL DESARROLLO DE LAS FUNCIONES PSICOLÓGICAS SUPERIORES DE LOS ESTUDIANTES UNIVERSITARIOS

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ABSTRACT: This systematic review aimed to identify how the scientific literature from 2015 to 2019 describes the use of Digital Information and Communication Technologies (DICTs) to promote the development of Higher Psychological Functions (HPF), using PRISMA protocol, Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). Articles were standardized and analyzed from Electronic Journals in Psychology (PePSIC) portal, Scientific Electronic Library Online (SciELO) and Latin American Database of Bibliographic Information in Health Sciences (LILACS), which constitute the Virtual Health Library - VHL Health. This review measures which areas of knowledge employ academically DICTs as a mediated teaching practice, as well as highlighting the skills that are used by professionals in the 21st century. It happens when a new technological (re)evolution occurs in teaching spaces, with the emergence of applications, virtual environments, mobile technology, and other digital resources that are being rethought. They are invading Higher Education Institutions, and they bring some concepts and practices that enhance and develop HPF of university students.

KEYWORDS: Human development. Autonomy. Teaching. Learning.

RESUMO: *Esta revisão sistemática se propôs a identificar como a literatura científica do período de 2015 a 2019 descreve o uso das Tecnologias Digitais da Informação e Comunicação (TDICs) para fomentar o desenvolvimento das Funções Psicológicas Superiores (FPS). Empregou-se o protocolo Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). Foram parametrizados e analisados artigos a partir do portal de Periódicos Eletrônicos em Psicologia (PePSIC), da biblioteca eletrônica da Scientific*

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Electronic Library Online (SciELO) e da base de dados Latino-Americana de Informação Bibliográfica em Ciências da Saúde (LILACS), que constituem a Biblioteca Virtual em Saúde - BVS Saúde. Esta revisão mensura quais áreas de conhecimento empregam academicamente as TDICs como prática de ensino mediada, assim como realça as habilidades necessárias ao profissional do século XXI, ocasião em que ocorre uma nova (re)evolução tecnológica nos espaços de ensinagem, com o despontar de aplicativos, ambientes virtuais, tecnologias móveis e demais recursos digitais que estão sendo repensados à medida em que máquinas, redes eletrônicas e tecnologias móveis invadem as Instituições de Educação Superior, fazendo emergir conceitos e práticas que potencializam e o desenvolvimento das FPS dos estudantes universitários.

***PALAVRAS-CHAVE**: Desenvolvimento humano. Autonomia. Ensino. Aprendizagem.*

***RESUMEN**: Esta revisión sistemática tuvo como objetivo identificar cómo la literatura científica de 2015 a 2019 describe el uso de las Tecnologías de la Información y la Comunicación Digitales (TDIC) para promover el desarrollo de Funciones Psicológicas Superiores (FPS), utilizando el protocolo Preferred Reporting Items for Systematic Reviews y Meta- Análisis (PRISMA). Se parametrizan y analizaron artículos del portal de Revistas Electrónicas en Psicología (PePSIC), la biblioteca electrónica Scientific Electronic Library Online (SciELO) y la Base de Datos Latinoamericana de Información Bibliográfica en Ciencias de la Salud (LILACS), que constituyen la Biblioteca Virtual en Salud - BVS Health. Esta revisión mide qué áreas de conocimiento emplean académicamente los TDIC como práctica docente mediada, además de destacar las habilidades que necesitan los profesionales en el siglo XXI, cuando se produce una nueva (re) evolución tecnológica en los espacios docentes, con la aparición de aplicaciones, entornos virtuales, tecnologías móviles y otros recursos digitales que se están repensando como máquinas, redes electrónicas y tecnologías móviles invaden las Instituciones de Educación Superior, dando lugar a conceptos y prácticas que potencian y desarrollan los FPS de los estudiantes universitarios.*

***PALABRAS CLAVE**: Desarrollo humano. Autonomía. Enseño. Aprendizaje.*

Introduction

The Internet in Brazil emerged in the academic environment around 1980, when some Brazilian researchers began to organize themselves and dialogue with government institutions in order to propose a network that would interconnect all universities. Representatives from civil society and other research institutions showed interest and highlighted the need to connect through TCP/IP[3]. Thus, the Internet was instituted when the São Paulo State Research

[3] TCP/IP symbolize a set of protocols for communication between networked computers. TCP stands for Transmission Control Protocol. It is intended to ensure that the data is fully transmitted, in the sending sequence, to the correct destination hosts. The sent data is broken into smaller pieces of information, the datagrams, and recomposed at the destination host. IP is the Internet Protocol (internet or interconnection protocol), which defines the mechanics of transmitting datagrams. It is responsible for communication between hosts on a network, managing the transport of a message from the source host to the destination host. Available at: https://ead.catolica.edu.br/blog/tcp-ip-para-que-servem.

Foundation (Fapesp) and the National Laboratory for Scientific Computing (a research unit of the Ministry of Science, Technology and Innovation, located in Rio de Janeiro) connected to research institutions in the United States of America (USA).

In 1989 the National Research Network (RNP) was officially launched by the Ministry of Science and Technology (MCT), which was funded by the National Research Council (CNPq), currently the National Council for Scientific and Technological Development, with support from the United Nations Development Program (UNDP), which aimed to implement the first national backbone[4], to disseminate Internet technology and train human resources in the area of networks (BRAZIL, 1989).

In 1995 the Ministries of Communications and Science and Technology launched a project to implant a global network in the country, covering different areas that went beyond the academic universe. For this reason, the structure of the National Research Network was amplified and totally reconfigured. In this way, the functioning of the Internet was commercially established and reported in the media.

At that time, the Brazilian Telecommunications Company (EMBRATEL), still a state-owned company, was beginning tests with the Internet. At the same time, the Brazilian government established the Internet Steering Committee to coordinate decisions regarding the implementation, administration and use of the Internet in the country. Officially, on May 31, 1995, the inter-ministerial decree 147 established the Brazilian Internet Steering Committee (CGI.br) (BRAZIL, 1989), which is a multisectoral entity with the purpose of preventing the national Internet from being monitored exclusively by governmental agencies, the private sector, or researchers. It is thus a model of diversified governance.

With the Civil Rights Framework for the Internet in Brazil, Law No. 12,965/2014 (BRAZIL, 2014), principles, guarantees, rights and duties for those who use the network were regulated, as well as guidelines for state action in national territory, especially to ensure freedom of expression, access to information and knowledge.

It is in this context that this systematic review was carried out, considering the studies available in the journals of the Virtual Health Library. [5] (VHL). This platform was chosen due to the trajectory that ensures the integrity of the data, as well as presents relevant scientific

[4]Known as the "backbone", it is responsible for sending and receiving data between different locations, inside or outside a country. It is divided into smaller parts for the purpose of preventing slow data transmission. Available at: https://canaltech.com.br/telecom/o-que-e-backbone/.

[5] The Virtual Health Library - VHL MS, available on the internet at: www.bvs-psi.org.br since 2001, is a division of the Library of the Ministry of Health and international bodies, responsible for publishing the VHL MS website, in which Bibliographic information is published, as well as general information in the area of health sciences.

publications at national and international level regarding the area of health and technologies in the field of Psychology.

In this way, this investigation aims to systematically review how the scientific literature from 2015 to 2019 reports the use of Digital Information and Communication Technologies (DICTs) for the development of Higher Psychological Functions (HPF) of university students.

For this, it is necessary to remember that the superior psychological functions come from the social and cultural transformations that occur assiduously in the perspective of human development. They are qualitatively conceived, arising from internal and external factors that result in interactivity and, therefore, in the appropriation and internalization of new signs and instruments. Psychological functions are named superior, as they are human psychic functions, "[...] complex forms of mental activity, such as perception, memory, attention, language and thinking, reading, writing and calculation, were formed during historical development. and, therefore, they are social in their genesis" (LEONTIEV, 1978; LURIA, 1981; VYGOTSKY, 1993). Vygotsky (2000) emphasizes that the higher psychological functions have as their main characteristic the self-generated stimulation, which is based on the creation and use of artificial stimuli, which are modified and transformed into behavior.

Method

For the elaboration of this systematic review, the protocol Preferred Reporting Items for Systematic Reviews and Meta-Analyses, PRISMA [6]. PRISMA was adopted because it establishes effective norms to support trials, reporting of systematic reviews, meta-analyses, randomized clinical trials, as well as other types of research of an evaluative and interventional nature. With the PRISMA guidelines (LIBERATI; ALTMAN; TETZLAFF *et al*., 2009) outlined, articles were parameterized and analyzed from the portal of Electronic Journals in Psychology (PePSIC), from the electronic library of the Scientific Electronic Library Online (SciELO) and from the database of Latin American Bibliographic Information on Health Sciences (LILACS), which constitute the Virtual Health Library - VHL Health.

A priori the following steps were established: (1) studies available at MEDLINE [7] (Medical Literature Analysis and Retrieval System Online) and LILACS[8] (Latin American and

[6] PRISMA (2015) consists of a 27-item checklist (Table 1; see also Table S1 for a Word template available for use by researchers) and a four-step flowchart (Figure 1; see also Figure S1 for a Word template available for use by researchers) of researchers).
[7] Created in 1946, covering the international literature of all medical specialties.
[8] Created in 1982, initially as an extension and evolution of the IMLA (Index Medicus Latino-Americano).

Caribbean System on Health Sciences Information), that were exclusively in Portuguese, English and Spanish; (2) use descriptors; (3) analysis of results; (4) PRISMA checklist; (5) selection of articles; (6) appreciation of the information provided in the articles; (7) evaluation, synthesis and interpretation of emerging data.

In this review, the following eligibility criteria were adopted: publication of articles in the period from 2015 to 2019; be available in MEDLINE and LILACS databases; as well as using the descriptors "autonomy and technology", "digital information and communication technologies", "digital technologies", "technology", "autonomy" and/or their respective abbreviations, "TIC", "TDIC" and "TDICs" .

Thus, with the design and eligibility criteria defined, the bibliographic base indexed by the VHL was exported, launched in an Excel spreadsheet, so that the respective queries and informative filters were parameterized according to PRISMA. After examining titles and abstracts, the articles had the following variables excluded: (1) that were not in Portuguese, English and Spanish, (2) absence of descriptors, (3) absence of results or (4) outside the proposed publication period.

Results

During the first stage of the screening, using the respective research areas as a parameter, 1816 scientific publications were located in the bibliographic databases indexed by the VHL. Of these, 1723 were contained in MEDLINE and LILACS.

In the bibliographic databases indexed by the VHL, Brazil stands out as one of the countries that has investigated the most on the subject, followed by the United States of America, Argentina and Cuba.

The arrangement of this result is detailed in Table 1:

Table 1 – Frequency and number of publications

Year of publication	**Frequency**
2015	2
2016	4
2017	1
2018	4
2019	6

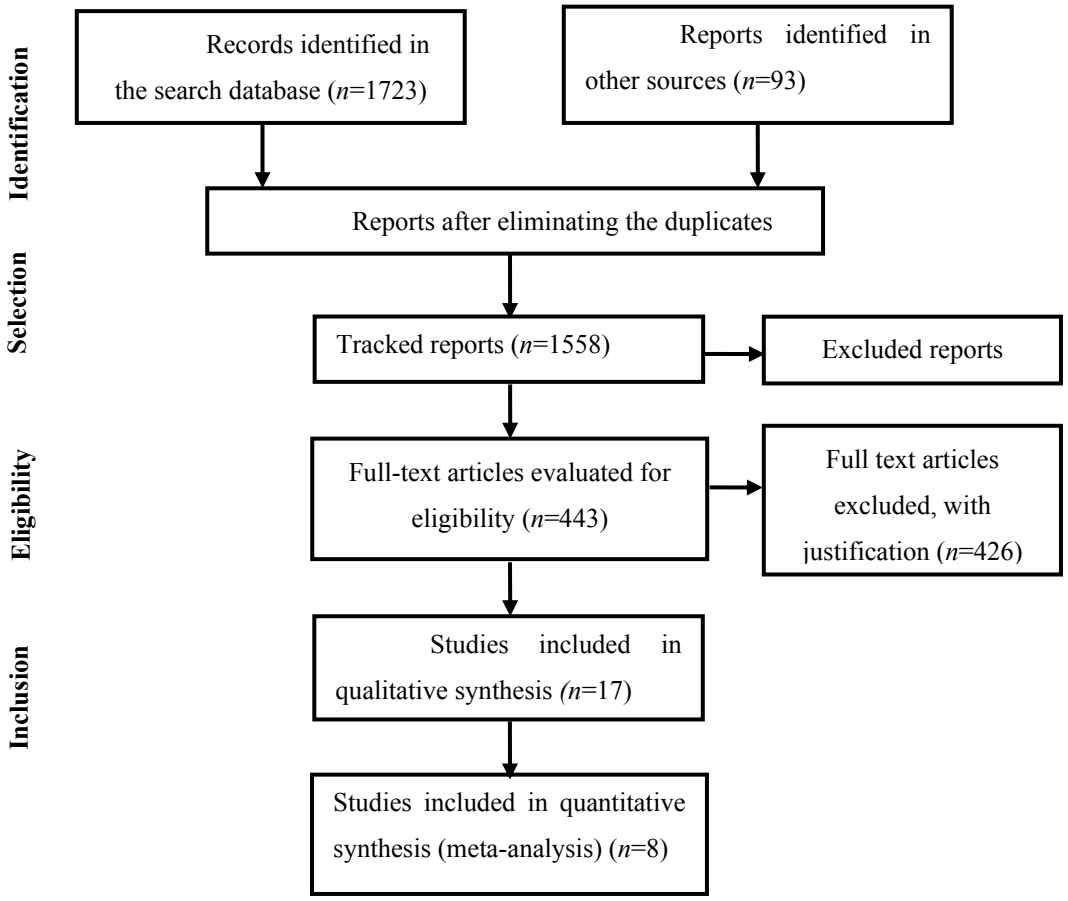
Researchers' country	Number of publications
Argentina	1
Brazil	13
Cuba	1
USA	2

Source: Prepared by the authors

Considering the period investigated, from 2015 to 2019, Table 1 clarifies that, over the years, the theme Digital Information and Communication Technologies becomes relevant, with a considerable increase in the number of publications on the subject. Just as emotion runs through human behavior and thinking, it is clear that TDICs can impel actions and bring about changes, and should be understood as a (re)action to the circumstances of human learning and development, and consequently in the development of higher psychological functions. of students.

With the sample defined, the descriptors and keywords indexed by the VHL were evaluated, making it possible to examine and assess the articles that fit the inclusion criteria proposed by the PRISMA checklist, as the flowchart elucidates:

Figure 1 – Flowchart of the Article Review Process



Source: Prepared by the authors

Through the records cataloged in the database, 1723 articles were located. 165 duplicate reports were excluded, constituting a total of 1558 articles screened. There are 9 articles in Spanish, 394 in English and 40 in Portuguese, totaling 443 publications for eligibility in the period from 2015 to 2019.

When using the descriptors "autonomy and technology", "digital information and communication technologies", "digital technologies", "technology", "autonomy" and/or their respective abbreviations, "TIC", "TDIC" arrives at the number of 17 scientific publications screened.

Discussion

Initially, the articles described in Chart 1, from the Virtual Health Library, in the period from 2015 to 2019, provide the titles of the scientific publications, authors, related journal, country of origin:

Chart 1 – Scientific publications

N	TITLE	AUTHOR(S)	JOURNAL	COUNTRY
1.	Digital health information technologies: reviewing metadata standards with a focus on interoperability	Sales, Odete Máyra Mesquita; Pinto, Virginia Bentes	RECIIS (Online);13(1): 208-221, jan./mar. 2019.	BR
2.	Physical Education teachers' training and digital technologies of information and communication (TDIC)/media: a possible relationship? Analysis of the curriculum proposals of Brazilian federal universities	Silveira, Juliano; Brüggemann, Ângelo Luiz; Bianchi, Paula	Motrivivência (Florianópolis);31(57): e55308, mar. 2019.	BR
3.	Tecnologías de la información y la comunicación en educación universitaria/ Information and communication technologies in university education	Sagol, Cecilia	Rev. Asoc. Odontol. Argent;107(1): 1-4, ene./mar. 2019.	AR
4.	Pedagogical theories that support learning with the use of Information and Communication Technologies.	Montoya Acosta, Luis Alberto; Parra Castellanos, María del Rosario; Lescay Arias, Michel; Cabello Alcivar, Oscar Andrés; Coloma Ronquillo, Grabiella Michelle	Rev. inf. cient;98(2): 241-255, 2019.	CU
5.	Digital information and communication technologies as a support to the Internship in Dentistry	Barros, Myrna Maria Arcanjo Frota; Borges Neto, Hermínio; Sousa, Maria do Socorro de; Silva, Paulo Goberlanio de Barros; Teixeira, Cinthia Nara Gadelha; Almeida, Maria Eneide Leitão de	Rev. ABENO;19(2): 117-126, 2019.	BR
6.	Relational, information and communication technologies (TRIC) as tools for social inclusion	Bernal-Meneses, Lara; Gabelas-Barroso, José Antonio; Marta-Lazo, Carmen	Interface (Botucatu, Online);23: e180149, 2019.	BR
7.	Teaching in health: time for new information and communication technologies	Wanderley, Tatiana Peres Santana Porto	RECIIS (Online);12(4): 488-501, out./dez. 2018.	BR

8.	Digital information and communication technologies in undergraduate nursing: report of a pedagogical activity	Franzoi, Mariana André Honorato; Silveira, Aline Oliveria	REME rev. min. enferm;22: e-1145, 2018.	BR
9.	Learning Design and Technologies: Creating Collaborative Environments for Learning	Assis, Maria Paulina de; Almeida, Maria Elizabeth Bianconcini de	Psicol. Educ. (Online);44: 47-56, jun. 2017.	BR
10.	Indicators on the adoption of information and communication technologies (ICT) in health	Barbosa, Alexandre F; Senne, Fabio	J. health inform;8(4): [I-II], out./dez. 2016.	BR
11.	School Physical Education and digital information and communication technologies in the Common National Curricular Base... How does it connect!!!?	Ferreira Júnio, José Ribamar; Oliveira, Marcio Romeu	Motrivivência (Florianópolis);28(48): 150-167, set. 2016.	BR
12.	Too old for technology? How new information and communication technologies affect social relationships of older people in Portugal	Azevedo, Celiana	Estud. interdiscip. envelhec;21(2): 27-46, ago. 2016.	BR
13.	Adolescence and knowledge in the context of digital technologies: is transmission possible?	Lima, Nádia Laguárdia; Viola, Daniela Teixeira Dutra; Nobre, Márcio Rimet; Lisita, Helena Greco; Kelles, Natália Fernandes	aSEPHallus;11(21): 42-65, nov. 2015-abr. 2016.	BR
14.	Digital technologies as mediating tools in the learning of digital natives	Costa, Sandra Regina Santana; Duqueviz, Barbara Cristina; Pedroza, Regina Lúcia Sucupira	Psicol. esc. educ;19(3): 603-610, set./dez. 2015.	BR
15.	Information and Communication Technology in Nursing Audit	Grossi, Luciane Mandia; Pisa, Ivan Torres; Marin, Heimar De Fatima	J. health inform;7(1)jan./mar. 2015.	BR
16.	The Ethics of Smart Pills and Self-Acting Devices: Autonomy, Truth-Telling, and Trust at the Dawn of Digital Medicine	Klugman, Craig M; Dunn, Laura B; Schwartz, Jack; Cohen, I Glenn	Am J Bioeth;18(9): 38-47, 2018.	US
17.	Should Artificial Intelligence Augment Medical Decision Making? The Case for an Autonomy Algorithm	Lamanna, Camillo; Byrne, Lauren	AMA J Ethics;20(9): E902-910, 2018.	US

Source: Prepared by the authors

Finally, the articles were catalogued and analyzed, considering, besides the methods and results, the psycho-pedagogical theories that elucidate the students' learning through the DTICs, as well as describe the pedagogical mediations performed within each context, resulting in eight publications, as described in Chart 2:

Chart 2 - Selected publications

N	TITLES	COUNTRY
1.	Information and communication technologies in university education.	AR
2.	Pedagogical theories that support learning with the use of Information and Communication Technologies.	CU
3.	Digital information and communication technologies as a support to the Internship in Dentistry	BR
4.	Teaching in health: time of new information and communication technologies	BR
5.	Digital information and communication technologies in nursing undergraduate: report of a pedagogical activity	BR
6.	Learning Design and Technologies: Criação De Ambientes Colaborativos para a Aprendizagem/ Learning Design and Technologies: Creating Collaborative Environments for the Learning Process/ Learning Design y Tecnologías: Creación de Ambientes Colaborativos para el Aprendizaje	BR
7.	Indicators on the adoption of Information and communication technologies (ICT) in health	BR
8.	Digital technologies as mediating tools of digital natives learning/ Digital technologies as herramientas mediadoras de aprendizaje de los nativos digitales	BR

Source: Prepared by the authors

After analytical reading of the respective articles, we arrive at the number of eight publications that meet the requirements established by PRISMA. The scientific publications are from the American continent: 1 from Argentina, 1 from Cuba and 6 from Brazil. They present emerging information related to the teaching-learning processes.

Thus, to meet the objectives proposed in this review, three categories were established that prioritized aspects related to the development of higher psychological functions of university students, considering the potential of ICTs for autonomy, the description of the proposed pedagogical mediation and the mapping of the ICTs used. To consolidate this analysis, it is important to elucidate some aspects:

A. Potential of the DTICs for autonomy: map the contributions of the analyzed productions regarding the potential of the Digital Information and Communication Technologies for the development of the students' autonomy in the Institutions of Higher Education;

B. Describe the pedagogical mediation: identify the actions that corroborated with the pedagogical mediation and the promotion of the students' autonomy, provoking the exercise of potentialities, fomenting the critical and analytical capacity, the knowledge to think and other abilities necessary to the professional of the 21st century.

C. Describe the ICTs used: identify and report which ICTs were used and relate them to interactive actions and their respective contributions to the development of higher psychic functions.

Table 3 explains the design:

Chart 3 – Delineation performed

N	TITLE	POTENTIAL FOR AUTONOMY	PEDAGOGICAL MEDIATION	USE OF ICTs
1.	Information and communication technologies in university education.	Encouragement of diverse spaces for the exercise of research; Democratization of knowledge; Encouragement and promotion of continuing education.	Performed by teachers accompanying the student from the interventional practices in the VLE and the DTICs	Platforms, Media, videos and games, and online classes.
2.	Pedagogical theories that support learning with the use of Information and Communication Technologies.	Collaborative work, interaction; Democratization of knowledge through forums; Encouraging and promoting continuing education.	Use of Social Networks mediated by teachers; Application of new didactics; Conscious exercise of pedagogical theories.	Discussion forum and the logbook.
3.	Digital information and communication technologies as a support to the Internship in Dentistry	Elaboration of a portfolio of activities via the educational platform Virtual Teaching Environment - VTE	Conducted using the VTE synchronously and asynchronously, providing content and accompanying the university student to disseminate the digital culture. The adequacy of teaching methodologies by teachers, allowed improvements in performance and autonomy of students, stimulating the process of continuing education, facilitating the teaching-learning process in Internship in Dentistry	The ICTs have contributed to the improvement of the undergraduate dental course, involving students and professors more intensely, integrating them to the communication strategies, and learning available in VTE.
4.	Teaching in health: time of new information and communication technologies	The DTIC used in the educational context can enhance learning, developing learning environments, improving and	It is a narrative review. It reports on the use of Moodle and other features of the platform itself	The Moodle platform, educational chat and the discussion forum were the most used.

		modernizing teaching practices. Encouraging and promoting continuing education.		
5.	Digital information and communication technologies in nursing undergraduate: report of a pedagogical activity	With the creation of digital spaces, expansion of digital culture, socialization and collaborative spaces, students from another educational institution and the external community asked questions and made comments about the themes especially on the pages created by the nursing course students on social networks	Describes an experience considering the use of different digital information technologies to foster scientific learning. The proposal was developed in an undergraduate discipline of the Nursing course of a public higher education institution.	Technological communication resources were used, such as videos, blogs, social network pages, and a digital booklet.
6.	Learning Design and Technologies: Creating Collaborative Environments for the Learning Process	Encouraged the creation of collaborative digital learning environments for teachers to exchange and share teaching and learning methods, strategies, and resources in order to foster innovation within the concept of learning design	Presents the synthesis of a research conducted in the United Kingdom based on the sharing of methods, techniques, and didactic resources among teachers, using collaborative tools to enhance pedagogical practice for teacher autonomy.	Use of virtual learning environments with a view to fostering innovation, within a learning design concept.
7.	Indicators on the adoption of Information and communication technologies (ICT) in health	Presented as an editorial on Indicators and the adoption of information and communication technologies (ICT) in health. Contact was made with the author, but no response was received.	It does not present.	It does not present.
8.	Digital technologies as mediating tools of digital natives learning	Site (PDF) unavailable for analysis. Contact was made with the author, but no response was received.	It does not present.	It does not present.

Source: Prepared by the authors

It is known that, with the advent of technologies, the instruments and signs, in the Vygotskyian sense, help and stimulate human beings in the exercise of their transformative function, as they ensure the development of new skills.

Most human perceptions, learning, and understanding are conscious, coming from the environment: it is a matter here of apprehending from an objective situation, based on actions, accompanied by social representations and experiences (VYGOTSKY; LURIA; LEONTIEV, 1988). It is then highlighted the sociocultural origin of higher psychological processes, which are indispensable implications to understand the functioning of perception in the Vygotskyan conception.

From the dialogue, interactivity, and social relations established between the subject, its historicity, and the instruments available in its reality, it is possible to mediate learning in different dimensions of society, especially in education. According to Lalueza, Crespo and Camps (2010, p. 49):

> [...] both the almost unlimited access to texts through the Internet and the use of telematic communication (electronic mail, forums, chat or SMS) have a high potential for the transformation of individuals, since they promote daily practices that decisively mediate their socialization.

Thus, the articles analyzed make explicit the changes in the behavior of the teacher, who needs to foster contextualized initiatives for the undergraduate, as well as in the behavior of the student, who appropriates new didactic strategies to learn.

There is a permanent use of higher psychological instruments that provoke analytical thinking, the use of new languages, exploring the symbolic nature of technologies, allowing the integration of semiotic systems, reworking, processing, transmitting and sharing large amounts of information (COLL; MONEREO, 2010; KOZULIN, 2000).

The potential of ICTs, from planned and mediated actions, can occur as described in the excerpts:

> It is noteworthy that the groups that chose to disseminate information and knowledge on social networks through the Facebook and Instagram pages stimulated interaction with the target audience, because professionals, students and families from different locations asked questions and made comments about the published themes. Considering this interactivity of social networks, the products developed by other groups, such as videos and digital booklet, were also disseminated on these pages, in order to contribute to the dissemination of information related to the health of the newborn in general (FRANZOI; SILVEIRA, 2018, p. 04, our translation).

It can be seen that the process of internalization of new languages implies a true reconstruction of what in principle was manifested externally. Social networks provoke actions of interactivity and intercommunication. In this way, the higher psychological functions express the new sociocultural and symbolic relations established and expressed in contemporary society:

> In educational processes mediated by ICT, it is up to the teacher to organize and guide learning with autonomy and proactivity of the student, mobilizing the diverse knowledge, acting as a team, establishing creativity and learning while teaching. However, for the insertion of ICT, before restructuring/informatizing schools and training teachers to handle them, we need a new pedagogical method, a teaching that promotes criticality and new cognitive skills of the student (WANDERLEY *et al*., 2018, p. 491).

The mediated actions express that learning is personal and non-transferable, since the pedagogical practice used is characterized by being challenging and participatory. Pacheco (1996) evidences that learning how to learn is the most ambitious and at the same time irrenounceable goal of education, and is equivalent to being able to perform significant learning by oneself, in a wide range of situations and circumstances, provoking global and continuous development.

> The trainees' perception of the preceptor as a stimulator of the EVA activity was relevant, because the effective involvement of the preceptor is of fundamental importance, and he/she should be a motivator and encourager of the teaching-learning process. Without the participation and stimulus of the preceptor, the success of a distance learning course decreases considerably (18,21). A training process is necessary for preceptors involved in internships to realize their importance in encouraging their trainees to participate in distance activities (BARROS *et al*., 2019, p. 124).

Thus, by analyzing the excerpts and the categories established, it can be seen that, in contemporary times, there are several mediating didactic strategies that ensure the development of higher psychological functions in college students, especially from the use of digital technologies, which, with the relevant interventions, establish and boost the outbreak of learning processes, both in social and internal contexts, fostering new opportunities for the exercise of protagonism and autonomy.

Final remarks

This systematic review makes explicit that the scientific literature from the period 2015 to 2019 describes the profuse use of Digital Information and Communication Technologies to foster the development of the Higher Psychological Functions of university students and, in many cases, subliminally.

The results of the analysis reveal that, the digital revolution in recent decades, the voracity of information production, the use of digital technologies in education and in the academic-scientific universe, as well as the broad transformations of society arising from the expansion and evolution of ICTs, caused the development of Higher Psychological Functions, responding to new stimuli, contributing significantly to the formation of human conduct, given that the development of behavior originates from the processes constituted by the current historical and cultural conditions.

The study also measures which areas of knowledge academically employ the DTICs as a mediated teaching practice, as well as highlight the skills needed for the professional of the 21st century, causing a new technological (re)evolution in teaching spaces, given the emergence of applications, virtual environments, mobile technologies and other digital resources, which are being rethought as machines, electronic networks, software and artificial intelligence invade the Institutions of Higher Education, bringing out concepts and practices that enhance the development of the SPF of college students.

The fact is that the processes of human development in the perspective of autonomous learning need to occur in a consolidated way. To this end, it is fundamental to go beyond concepts related to the role of the teacher and the student, to break with the paradigm based on the Cartesian model, proposed by banking education, since being autonomous requires knowing how to manage processes, adversities, and concrete existential situations.

The teacher must play an indispensable role in articulating, suggesting, encouraging collective intelligence, mediating and promoting social interactionist actions, encouraging the development of activities, being active, articulating, and interactive in the face of the teaching and learning processes proposed to the students. Thus, it will enable new learning styles, whether personalized or networked, promoting a new culture to learn, based on contemporary languages, on communication, committing to the management of scientific knowledge, interacting, sharing and, consequently, valuing hybrid experiences, innovative and contextualized pedagogical practices and disruptive for the exercise of protagonism and student autonomy.

REFERENCES

BARROS, M. M. A. F. *et al*. Tecnologias digitais de informação e comunicação como suporte ao Estágio em Odontologia. **Revista da Abeno**, v. 19, n. 2, p. 117-126, 2019. Available at: https://revabeno.emnuvens.com.br/revabeno/article/view/670. Accessed on: 03 Dec. 2020.

BRAZIL. Ministério da Ciência e Tecnologia. **A RNP e a história da internet brasileira.** Rio de Janeiro: RNP, MCT, 1989. Available at: https://memoria.rnp.br/noticias/imprensa/2002/not-imp-marco2002.html. Accessed on: 05 Aug. 2019.

BRAZIL. **Lei n. 12965, de 23 de abril de 2014.** Marco Civil da Internet. 1. ed. Brasília, DF: Presidência da República, 2014. Available at: http://www.planalto.gov.br/ccivil_03/_ato2011-2014/2014/lei/l12965.htm. Accessed on: 19 July. 2019.

COLL, C.; MONEREO, C. (org.). **Psicologia da Educação Virtual**: Aprender e Ensinar com as Tecnologias da Informação e da Comunicação. Porto Alegre: Artmed, 2010.

FRANZOI, M. A. H.; SILVEIRA, A. O. Digital Information and Communication Technologies in nursing undergraduate: report of a pedagogical activity. Reme: **Revista Mineira de Enfermagem**, v. 22, e-1145, p. 01-06, 2018. Available at: https://cdn.publisher.gn1.link/reme.org.br/pdf/e1145.pdf. Accessed on: 03 Jan. 2021.

KOZULIN, A. **Instrumentos psicológicos**: la educación desde una perspectiva sociocultural. Barcelona: Paidós, 2000.

LALUEZA, J. L.; CRESPO, I.; CAMPS, S. As tecnologias da informação e da comunicação e os processos de desenvolvimento e socialização. *In:* COLL, C.; MONEREO, C. (org.). **Psicologia da Educação Virtual:** aprender e ensinar com as Tecnologias da Informação e da Comunicação. Porto Alegre: Artmed, 2010.

LEONTIEV, A. **O desenvolvimento do psiquismo**. Lisboa: Livros Horizonte, 1978.

LURIA, A. R. **Fundamentos de neuropsicologia**. São Paulo: Edusp, 1981.

PACHECO, J. A. **Currículo**: Teoria e Práxis. Portugal: Porto, 1996.

PRISMA. **Preferred Reporting Items for Systematic Reviews and Meta-Analyses**. University of Ottawa/Oxford University, 2015. Available at: http://www.prisma-statement.org/PRISMAStatement/. Accessed on: 02 Apr. 2018.

VYGOTSKY, L. S.; LURIA, A. R.; LEONTIEV, A. **Linguagem, Desenvolvimento e Aprendizagem**. São Paulo: Ícone, 1988.

VYGOTSKY, L. S. **Pensamento e linguagem**. São Paulo: Martins Fontes, 1993.

VYGOTSKY, L. S. **Formação social da mente**. São Paulo: Martins Fontes, 2000.

WANDERLEY, T. P. S. P. *et al*. Docência em saúde: tempo de novas tecnologias da informação e comunicação. **Revista Eletrônica de Comunicação, Informação e Inovação**

em Saúde, Rio de Janeiro, v. 12, n. 4, p. 488-501, dez. 2018. Available at: https://doi.org/10.29397/reciis.v12i4.1522. Accessed on: 03 Jan. 2021.

How to reference this article

SILVA, C. C. F.; FREITAS, L. G. Systematic review: The contributions of digital information and communication technologies to the development of the superior psychological functions of university students. **Revista Ibero-Americana de Estudos em Educação**, Araraquara, v. 17, n. 2, p. 1246-1262, Apr./June. 2022. e-ISSN: 1982-5587. DOI: https://doi.org/10.21723/riaee.v17i2.14734

Submitted: 03/02/2021
Revisions required: 08/12/2021
Approved: 09/02/2022
Published: 01/04/2022

Management of translations and versions: Editora Ibero-Americana de Educação
Translator: Thiago Faquim Bittencourt
Translation reviewer: Alexander Vinícius Leite da Silva