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ARTICLE

DIGITAL TEACHING COMPETENCE MODEL: BIBLIOMETRICS AND LITERATURE REVIEW

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ABSTRACT: Digital teaching competence is a recent subject in Brazilian scientific debates. This expanding theme is related to the use of digital technologies in education, especially in remote teaching after the coronavirus pandemic. Therefore, this article aims to identify in the literature which digital skills are needed for teaching. We discuss the theme from the international literature with a mixed approach of quantitative aspects, using bibliometric analysis, and qualitative ones, with content analysis. We selected 120 articles from the Web of Science, Scopus and Science Direct databases, using the search terms 'digital teaching competence' and the time frame from 2015 to 2020. We identified terms used to express the integration of digital technology into education and represent digital competence. Content analysis indicated six categories of digital competence in teaching, involving the handling of digital tools, information and communication skills, knowledge and skills to teach or pedagogical skills, to self-develop and to deal with issues sociocultural aspects that permeate the teaching work. We conclude that the identified categories constitute a still unexplored model of digital teaching skills.

Keywords: Digital teaching competence, technology, education, teacher training.

MODELO DE COMPETÊNCIA DOCENTE DIGITAL: REVISÃO BIBLIOMÉTRICA E DE LITERATURA

RESUMO: A competência docente digital é assunto recente nos debates científicos no Brasil. Essa temática encontra-se em expansão e está relacionada à utilização das tecnologias digitais na educação, especialmente no ensino remoto após o período de pandemia do coronavírus. Por isso, este artigo tem o objetivo de identificar na literatura quais são as competências digitais necessárias ao trabalho docente. O tema é discutido a partir da literatura internacional, com abordagem mista, ou seja, possui aspectos quantitativos, que utiliza método de análise bibliométrica, e qualitativos, com análise de conteúdo. Para isso, foram selecionados 120 artigos das bases Web of Science, Scopus e Science Direct, com busca realizada com o termo competência docente digital e com filtro temporal de 2015 a 2020. Foram identificados termos que são utilizados para expressar a integração da tecnologia digital à educação e

representam a competência digital. A análise de conteúdo indica que, na profissão docente, são identificadas seis categorias de competência digital, que envolvem o manuseio de ferramentas digitais, habilidades de informação e comunicação, conhecimentos e habilidades para ensinar ou competências pedagógicas para autodesenvolver-se e para tratar das questões socioculturais que permeiam o trabalho docente. Conclui-se que as categorias identificadas constituem um modelo ainda inexplorado de competências docentes digitais.

Palavras-chave: Competência docente digital, tecnologia, educação, formação de professores.

MODELO DE COMPETENCIA DOCENTE DIGITAL: REVISIÓN BIBLIOMÉTRICA Y DE LITERATURA

RESUMEN: La competencia digital docente es un tema reciente en los debates científicos en Brasil. El tema está en expansión y está relacionado con el uso de las tecnologías digitales en la educación, especialmente en la enseñanza a distancia después del período de pandemia del Coronavirus. Por ello, el artículo pretende identificar en la literatura qué competencias digitales son necesarias para el trabajo docente. El tema es discutido a partir de la literatura internacional, con un enfoque mixto, o sea, tiene aspectos cuantitativos, que utilizan un método de análisis bibliométrico, y cualitativo, con análisis de contenido. Para ello, fueron seleccionados 120 artículos de las bases de datos Web of Science, Scopus y Science Direct, con una búsqueda realizada con el término competencia digital docente y con un filtro temporal de 2015 a 2020. Fueron identificados términos que son utilizados para expresar la integración de la tecnología digital en la educación y que representan la competencia digital. El análisis de contenido indica que en la profesión docente se identifican seis categorías de competencia digital, que involucran el manejo de herramientas digitales, habilidades de información y comunicación, conocimientos y habilidades para enseñar o habilidades pedagógicas, para el autodesarrollo y para tratar aspectos socioculturales que están relacionados al trabajo docente. Resulta que las categorías identificadas constituyen un modelo aún inexplorado de competencias docentes digitales.

Palabras clave: Competencia docente digital, tecnología, educación, formación de profesores.

INTRODUCTION

Transformations in the 21st- century society, driven by technological development, communication, and information networks, modify the interactions between people and establish new forms of human relations in the social, cultural, and professional training contexts. Furthermore, the global scenario presents a connected but unequal society, which faced a global pandemic caused by the Sars-CoV-2 virus (MINISTÉRIO-DA-SAÚDE, 2020).

In this scenario, students and teachers came across remote teaching and had to adapt to digital tools and changes in learning and teaching. It was a fast change, so teachers could not prepare for this new reality. However, education in emergency contexts has a protective role by offering life-saving knowledge, skills, and psychosocial support to those affected by the crisis. It also seeks to develop skills to prevent disasters, conflicts, and diseases in children, young people and adults, aiming at a sustainable future (UNESCO, 2015). Thus, the need arises to synchronize education and the current technological and sociocultural context. This factor is essential for professional development, which requires digital skills compatible with jobs in synch with innovations, new teaching methodologies, and teaching practices that include people connected by networks (CASTELLS, 1999; PRETTO; PASSOS, 2017).

This situation reinforces the debate on the subject of Digital Teaching Skills (DTS) related to teachers' continuing education. It also reinforces its insertion in international and local programs and policies and its historical-legal framework regarding teacher-training educational policies in Brazilian K-12 Education (TOURÓN et al., 2018; GILIOLI; MELO; DIAS-TRINDADE, 2019). Thus, DTS is discussed as the mastery of Digital Technologies (DT), understanding that this concept is under construction. The definition used in this study is close to the constructivist concept, which understands that human beings mobilize internal resources that cooperate, articulate, and complement each other to develop competences (PERRENOUD, 2000; ZARIFIAN , 2001; BOTERF, 2016).

Regarding Digital Literacy (DL), Cervera and Cantabrana (2015) state that the term is associated with basic knowledge about access, evaluation and information management, and learning processes. The authors also highlight that the word is associated with identifying training needs, accessing information in digital environments, and using ECT tools (educational and communication technologies) to manage, interpret, represent, evaluate, and transmit information. According to them, DL goes beyond the technical ability to use digital devices but comprises a combination of techniques, cognitive procedures, and skills needed for socio-emotional life, learning, and working in a digital society.

Perrenoud (2000) proposes the constructivist concept of competence as a set of knowledge, skills, values, and attitudes or a global grasp of a situation, able to operate specific issues or schemes that guide mental and concrete operations, which can become resources to several competencies. To teach, a teacher depends not only on global cognitive resources combined and articulated in synergy but on the mobilization of specific competences, independent from each other, to solve aspects of a problem. In this sense, skills are procedural knowledge, i.e., resources at the service of global competencies (PERRENOUD, 2000; BOTERF, 2016). In this concept, digital competence involves skills related to accessing information, processing and using communication, creating content, pedagogical activities using Digital Information and Communication Technologies (DICT), the values related to security and problem-solving, both in formal and informal contexts (PERRENOUD, 2000; PERRENOUD et al., 2002; INTEF-ESPAÑA, 2017).

In the same perspective, Ferrari (2013), Instefjord (2015), and Tourón et al. (2018) understand digital competence as the set of knowledge, skills, and attitudes, thus, including skills, strategies, values, and awareness needed to use ICT means to perform tasks, solve problems, communicate, manage information, collaborate, create and share content, build knowledge effectively and efficiently, appropriately, critically, creatively, autonomously, flexibly and ethically, reflectively for work, leisure, participation, learning, socialization, consumption, and training. That is, being digitally competent is more than having technical skills and knowing how to use specific tools, as these are just two aspects of digital competence. This perspective considers the use of DT, including the technical, cognitive, and socio-emotional learning issues.

The terms media literacy, information literacy, or ICT literacy are specific terms included in the different frameworks but with similar meanings. In the context of 21st-century competencies or skills, these terms are conceptualized as digital literacy or new literacies and represent a wide range of competencies that coincide with the use of DICT. However, a workable definition of digital literacy has yet to be developed. Therefore, the implications for teachers are unclear (OUDEWEETERING; VOOGT, 2018). Other authors consider digital competence a developing concept and claim that there are already generalizations about the term, used by researchers in European countries, the United States and Japan (KARTASHOVA; BAKHMAT; PLISH, 2018; HAZAR, 2019). More specifically, DL is defined as people's awareness, attitude and ability to properly use digital tools to identify, access, manage, integrate, evaluate, analyze, and synthesize digital resources, create new knowledge, express themselves through multimedia resources and communicate with others in any specific context of life (ESCOBAR ZÚÑIGA; SÁNCHEZ VALENCIA, 2018).

When dealing with DL in information security, Tomczyk (2019a) understands it as skills and knowledge regarding the fluent use of digital media and the mechanisms that challenge digital security in its technical and social aspects. DL also involves anticipating threats, understanding the social mechanisms mediated by the Internet and digital technologies, discerning the positive and negative consequences of the digital world, and critically evaluating online content. Knowing how to check the reliability and credibility of online information is as important as any other communication means.

Regarding teacher training, DL covers four areas: a) competencies within a subject, the awareness of opportunities to involve ICT when teaching a given subject; b) methodical competencies, which are the awareness related to students, their needs and capabilities toward complete operational objectives through ICT; c) technical skills, which refer to the ability to use devices, programs, and the Internet; and d) skills related to personal and professional development through interactions with digital media (TOMCZYK, 2019b).

Hrytsenchuk et al. (2018) define digital competence as the conscious and critical use of digital technologies. In teaching, digital competence also includes educating citizens to use digital technologies as a natural part of their daily lives, promoting student learning and contributing to the construction of knowledge (TOURON et al., 2018; CANTABRANA; RODRÍGUEZ ; CERVERA, 2019). In the context of information society development, the concept of DL is subject to constant transformations

triggered by new circumstances, mainly the intensification of negative phenomena related to new technologies, the emergence of new electronic threats, and the development of the Information Technology industry (DZHURYLO; SHPAYK, 2019). We understand that, in the information society, "technological transformation expands exponentially due to its ability to create an interface between technological fields through a common digital language, in which information is generated, stored, retrieved, processed and transmitted" (CASTELLS, 1999, p. 68). Society becomes digital when the need for teaching mediated by technology arises.

The term ICT literacy is associated with knowing what a personal computer is, its software products, roles and capabilities, as well as knowledge about the existence of computer networks. Thus, a teacher needs a) training and positive motivation to use ICT; b) ideas about computer handling and ICT didactic resources; and c) mastery of methodological fundaments for visual and didactic materials (DZHURYLO; SHPAYK, 2019).

The terms digital literacy and digital competence have different connotations. The competence discourse revolves around digital literacy, schools and teacher education, but the term has no clear and precise definition. It is not a stable term; for some, it is more related to ICT's technical use. Although related, digital competence and digital literacy are not the same concepts (CERVERA; CANTABRANA, 2015; ABIO, 2017; GUDMUNDSDOTTIR; HATLEVIK, 2018; PETTERSSON, 2018; ENGEN, 2019). This article intends to explore the definitions of digital competence applied to teaching, organizing digital teaching competence into categories to understand the concept used by different authors who discuss the subject. We synthesize the concepts and propose an expanded model for the term.

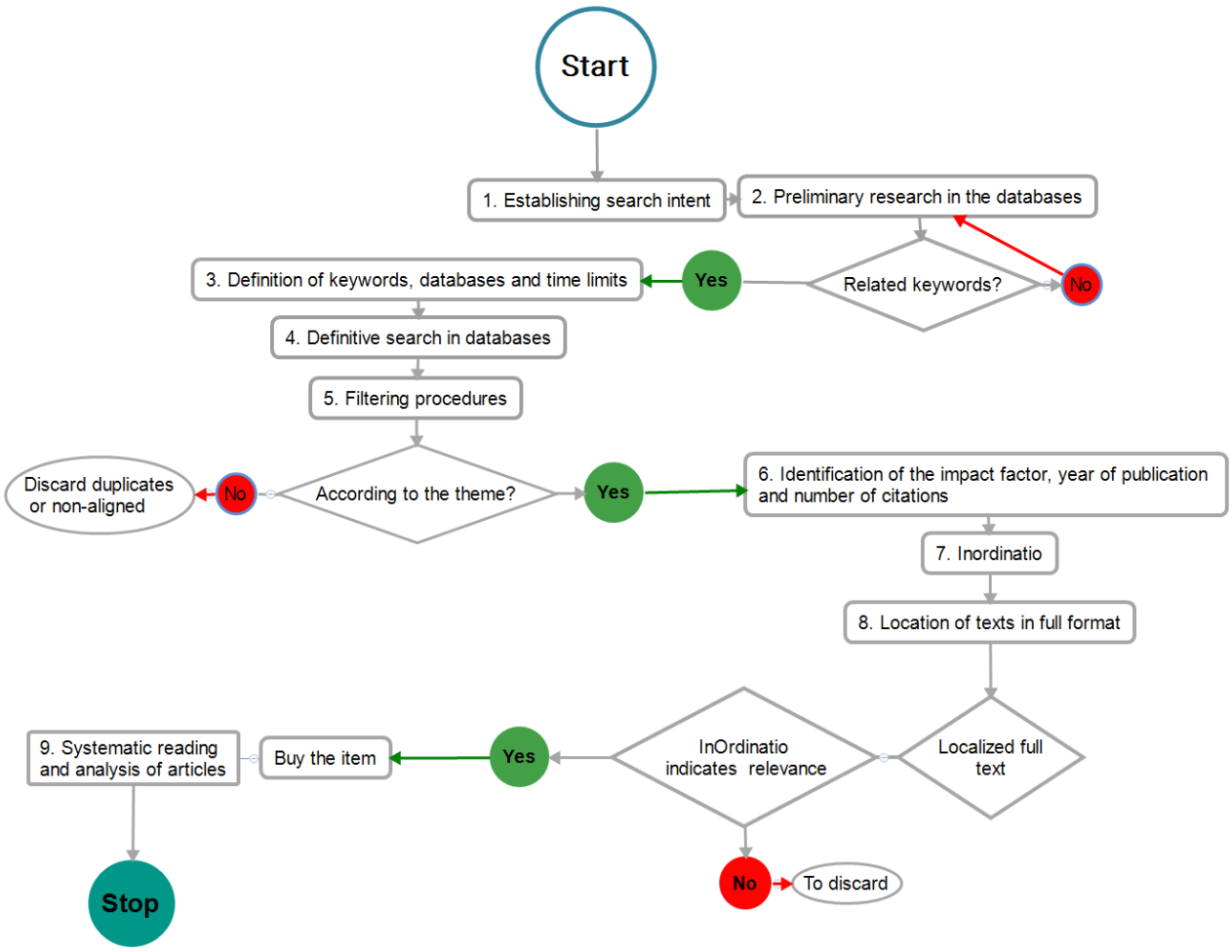
METHOD

The research is descriptive with a mixed approach, using qualitative content analysis and quantitative bibliometric methods to identify relevant authors and articles to the theme. The study aims to categorize the elements that constitute the digital teaching competence proposed in this article. To build a bibliographic portfolio, we systematically reviewed Scopus, Web of Science, and Science Direct databases

. We used: a) a quantitative approach based on the Methodi Ordinatio, developed by Pagani, Kovaleski and Resende (2015); b) a qualitative approach based on content analysis and categorization (BARDIN, 2011); c) a search delimitation of articles through the journal portal of Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) and in the Web of Science, Scopus, and Science Direct databases.

The study followed a research protocol following these criteria: how the articles are found, their inclusion and exclusion criteria, the definition of focused outcomes, verification of results accuracy, determination of studies quality and analysis used. The protocol follows the Methodi Ordinatio (Figure 1) proposal and includes nine research steps to systematize the search and data treatment.

Figure 1 – Methodi Ordinatio



Source: The authors (2023) translated and adapted from Pagani, Kovaleski e Resende (2017).

Using InOrdinatio (IO) to classify the most relevant articles, we can have a) a portfolio of articles that contemplate the research theoretical framework; b) the Web Of Science, Scopus and Science Direct as databases that present journals with an impact factor – Journal Citation Report (JCR) and Scientific Journal Rankings (SJR)- to the scientific community; c) keywords aligned with the research theme; and d) authors that stand out in the area.

We can find elements that identify the article's relevance in the method described. Therefore, we used InOrdinatio to select the portfolio of articles for the review (PAGANI; KOVALESKI; RESENDE, 2015, 2017), following these steps: 1) Establishment of the research intention: What scientific works deal with digital skills and teacher training in K-12 education?; 2) Preliminary exploratory research with keywords in the databases. We combined the terms competence, teacher, and digital, in English, Spanish, and Portuguese, in the databases Web Of Science, Scopus, and Science Direct ; 3) Definition and combinations of terms and databases: competenc* AND "teacher OR professor OR professor" AND digit* NOT higher education NOT university; 4) Final search in the databases using the Mendeley bibliography manager; 5) Filtering procedures- selection criteria: i. from the bibliometric analysis of the articles, select the articles of the most relevant authors, based on the InOrdinatio coefficient; ii. select only scientific articles; iii. reading the available full-text articles. Exclusion criteria: i. exclude articles about professional skills – other jobs; ii. exclude articles dealing with teaching skills in higher education; iii. articles that only address information technology and not skills. 4. Articles dealing with students' digital skills; 6) Identification of the ISSN, impact factor, year, and the number of citations: convert and merge into a single file those with the extension .txt from Web Of Science and Science Direct and .csv from Scopus and eliminate repeated articles; 7) Ordering of articles using InOrdinatio: calculate the IO in an Excel spreadsheet (PAGANI; KOVALESKI; RESENDE, 2017). In the absence of the Web of Science JCR, we considered the Impact Factor (IF) of the Elsevier SJR ; 8) Location of

articles in full format (PDF) using the software Mendeley. We selected a total of 120 articles with IO greater than or equal to 80 to compose the research portfolio; 9) Reading and systematic analysis of the articles according to the criteria: i. the investigation should discuss educational contexts, preferably from K-12 education (kindergarten to high school). As it is an extensive topic, we focused on K-12 education because it is the first author's field of experience; ii. the research should address pedagogical or digital competence management aspects needed for actors working in educational contexts; iii. studies involving technology integration into education; iv. research should focus on professional development or teacher training with digital technologies; v. research should not focus on students' digital skills.

The IO calculation allows us to rank the best articles using the following criteria: impact factor of the journal in which it was published; number of citations; and year of publication (PAGANI; KOVALESKI; RESENDE, 2017):

InOrdinatio = (Fi / 1000) + α* [10 - (AnoPesq – AnoPub)] + (Σ Ci)

Where:

α = importance ratio established by the researcher (0 to 1, where 1 is the most important and 0 is not important, or 1 to 10, where 1 is the least important and 10 the most important).

Fi = Impact factor, as defined by the Journal Citation Report (JCR);

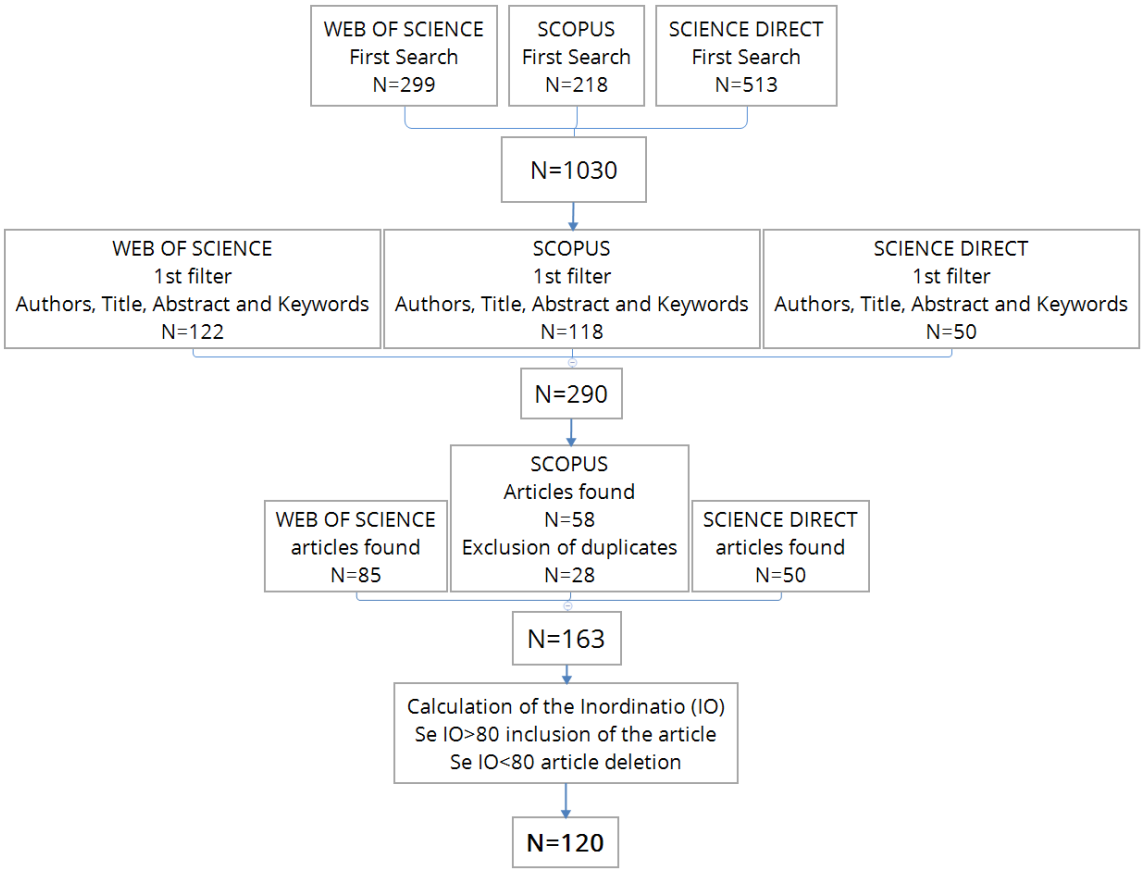
AnoPesq = Year the research was carried out;

AnoPub = Year the article was published;

Σ Ci = total citations of the article;

For this research, the value assigned to α was 10, considering that the articles are relevant. In Figure 2, we present the number of papers in our research portfolio after applying the Methodi Ordinatio to select them.

Figure 2 - Number of articles found in the research process phases



Source: The authors (2023).

To identify the categories of digital teaching skills, we conducted a content analysis based on a list of 120 articles from the international literature on the subject, from 2015 to 2020, excluding articles outside the issue and those with IO under 80. We opted to do this to reduce the number of papers to be

read without compromising the research relevance and topicality. We conducted the content analysis in NVivo 12 with the readings coded in nodes according to the article themes and based on the classification defined by Rangel Baca (2015), identifying six categories of digital teaching skills, presented below.

RESULTS AND DISCUSSION

We identified the terms related to digital competence by reading the 120 selected articles and using NVivo 12 as an aid for categorization. The term digital competence has different connotations according to each author. In the literature analyzed, we identified the terms digital literacy (literacy), digital information, literacy in information and communication technologies, digital literacy, professional digital competence, and didactic technological competence (Chart 1 below).

Chart 1 – Terms associated with digital competence

Term	Concept Associated	Authors	Country
Digital Literacy *Literacia digital*	The term most commonly used as a synonym for digital competence, though with different connotations.	Abio (2017); Cervera amd Cantabrana (2015)	Brazil; Spain
Digital Information *Informação Digital*	Synonymous with Digital Competence, which represents the human ability to use ICT in life, to learn, work, and continually update oneself throughout life.	Hrytsenchuk *et al.* (2018)	Ukraine
ICT Competence *Competência em TIC*	Teacher knowledge for professional life or pedagogical-level tasks.	Dzhurylo e Shparyk (2019)	Ukraine
ICT Literacy *Alfabetização em TIC* *Alfabetização Informacional* *Alfabetização midiática*	Knowledge of ICT tools.	Dzhurylo and Shpayk (2019) Oudeweetering and Voogt (2018)	Ukraine
Professional Digital Competence *Competência Digital Profissional*	The discourse around the digital competence in schools and teacher training. Currently, there is no clear and precise definition of the term.	Engen (2019); Gudmundsdottir and Hatlevik (2018)	Noruega; Holanda
Didactic Technological Competence *Competência Tecnológica Didática*	Professional digital literacy skills to use digital teaching tools and their applications in the actual practice of the subject taught.	Záhorec, Hašková and Munk (2019)	United Kingdom
Digital Competence *Competência Digital*	Set of knowledge, attitudes, and skills for using Digital Technologies, including technical, cognitive, and socio-emotional learning perspectives.	Ferrari (2013); Instefjord (2015); Tourón *et al.* (2018)	Romania; Norway

Source: The authors (2023).

Besides the articles related to digital competence, other references with different research focuses were also part of the portfolio. We found several systematizations around the theme. In this text, we decided to group the concepts brought in the articles based on the definitions presented by Rangel Baca (2015) and discussed by the authors of the analyzed articles: technological competence (discussed by three authors), information competence (six authors), communication competence (four authors), pedagogical competence (five authors), and axiological competence (three authors). In addition to the five competencies identified by Rangel Baca (2015), We propose a sixth competence, called sociocultural in this research, as a DTS category, representing an aspect of competence related to sociocultural factors in the use of technology. We identified four authors who present this idea.

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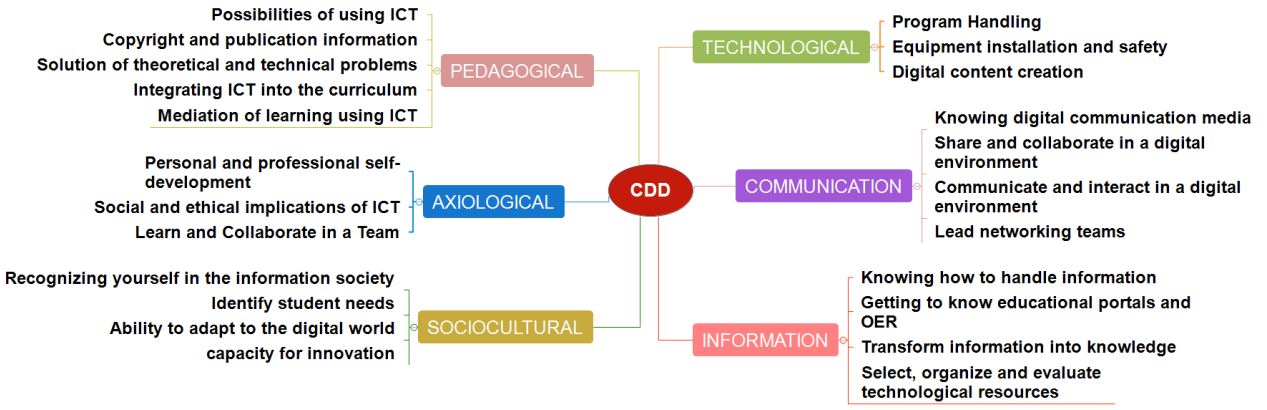
In the literature, we notice that researchers use categorization to delimit a field of study and allow them to identify the DTS. Therefore, considering the approaches to the concept of digital competence discussed, its main elements were gathered and organized into six categories. These competence categories emerge from the literature on the subject and constitute an unprecedented model of digital teaching competencies proposed from the systematization shown in Figure 3.

Figure 3 – Digital Teaching Competency Categories



Source: The authors (2023).

The consulted literature presents studies that contemplate DTS in different interrelated areas. Thus, digital teaching competence is formed by a set of categories discussed in this article. The proposed model represents an expanded definition of DTS. We present below the characteristics of each type.

Technological Competence

Ungar et al.'s (2018) findings point out that teachers who have developed pedagogical competence and to-be-developed technological competence have difficulty applying innovative methodologies, presenting gaps between their conceptual approach and their ability to implement it. In addition, teachers with this profile do not allow their students to take control of their learning, as they do not feel safe. The authors identify the importance of teachers' mastery of technological knowledge to implement an innovative pedagogy and integrate ICT in the classroom.

A consensus among researchers is that technical literacy, or technological competence, is important for teachers to develop DTS. Teachers with developed technological competence can successfully perform their professional roles and integrate ICT into teaching to promote changes in teaching methodology by using various techniques, devices, and Internet resources with their students (DZHURYLO e SHPAYK, 2019; HATLEVIK e HATLEVIK , 2018).

Teacher technological competence includes digital literacy skills, selecting and using software and internet resources as teaching materials to achieve standard curriculum objectives, using ICT to develop and control individual or group plans for students, and designing manuals and ICT lessons. Furthermore, this competence also involves the capacity to use ICT to develop students' knowledge and critical thinking, to support the constant process of thinking, to receive information and communicate with external experts if necessary, and to analyze or find solutions to specific problems. (DZHURYLO e SHPAYK, 2019).

Information Literacy

Information literacy is a vital teaching competency for professional development in teacher education and work success. Information and communication are two concepts that cannot be isolatedly studied, as information can only be conceived when communicated. Likewise, communication is a process in which content is the information (BONDARUK, 2017; ARAÚJO, 2018).

In Bondaruk's (2017) study, teachers had an average level of digital competence concerning the informational area, corroborating previous research that identified a lack of competence in this area. Based on Ferrari's(2013)studies, the author defines information literacy as a set of knowledge, skills and attitudes essential to perform tasks, solve problems, communicate, manage information, collaborate, create, and share content. They also generate adequate and efficient knowledge appropriately, critically,

creatively, autonomously, flexibly, ethically, and reflectively for work, leisure, participation, learning, socialization, consumption and training (BONDARUK, 2017).

Information literacy is one of the skills needed for lifelong learning. It is often defined as basic ICT competence, i.e. knowledge required to use computers and to retrieve, evaluate, store, produce, present and exchange information, and communicate. (BONDARUK, 2017; EUROPEAN COMMISSION, 2018). We can find other terms expressing the same idea, such as "information technology competence", "information competence", "information competence", or "information and communication competence" (ARAÚJO, 2018; DZHURYLO; SHPAYK, 2019; HAZAR, 2019).

Dzhurylo and Shpayk (2019) conclude that the teacher's information and communication competence can be interpreted as the combination of teachers' professional knowledge, skills and experience expressed in their ability to solve pedagogical tasks through modern information and communication technologies. It means knowing how to work beyond problem-solving and selecting the appropriate software. Teachers must be able to use network resources to help students collaborate, receive information and communicate with external experts, if necessary, to analyze or find solutions to specific problems.

López-Belmonte et al. (2019) identify information literacy as part of DTS, which brings together skills for navigation, research, access, filtering, management, storage, organization, processing, retrieval, analysis, evaluation, comparison, and data interpretation. With these skills, one can generate new, valuable, and helpful information that facilitates critical decision-making and acts in teachers' effective strategic action to improve the quality of teaching and learning processes. In the research, López-Belmonte et al. (2019) determined the level of skills in each dimension (D) of information literacy. D1 is related to browsing, searching, and filtering information, data, and digital content. D2 refers to the evaluation of information, data and digital content. D3 is connected to storing and retrieving information, data and digital content.

In Brazil, Vitorino and Piantola (2009, 2011), pioneers in the study of information competence, discuss this category of competence under the dimensions of technique, aesthetics, ethics, and politics. The technical dimension is related to the skills and tools needed to find, evaluate, and appropriately use the information. The aesthetic dimension originates from the subjectivity implicit in the reception and transmission of informational content. Data production, dissemination, and use are closely linked to individuals' involvement in a community; these processes invariably assume an ethical and political character.

Information is a constituent element of a group's culture and must relate to politics and ethics. As a political activity, it assumes a pedagogical role when it transforms men/women into citizens. In addition to access to informational content, this competence also develops the ability to interpret reality and build individual and collective meanings. Hence, the authors argue that information competence restricted to the technical sense, disconnected from other dimensions, is impoverished. Therefore, it must be tied to its ethical and political characteristics (VITORINO; PIANTOLA, 2011).

Competence in Communication

Despite having different evidence, information literacy is related to communication competency, also called communicative or communicational competency (ARAÚJO, 2018). When educational policies and schools promote online communication with teachers, students and parents, they assist in developing the e-communication or communication competence of teachers and students (BLAU; SHAMIR-INBAL, 2017). One form of communication competence is related to the concept of digital citizenship, which Xu et al. (2019) define it as ethical concerns or behavioral norms associated with the use of technology, which describe the integration of technology in society.

Competence in interpersonal communication indicates the teacher's ability to convey information and interpret the non-verbal cues that demonstrate students' opinions and understandings. With the increasing frequency of technology use, new inappropriate behaviors of digital citizenship also appear in communication mediated by ICTs that sometimes conflict with established rules, such as cyberbullying, which represents the irrational or abusive use of ICTs (Xu et al. al., 2019).

Many interpersonal and communication skills were highlighted as essential for success in 21st-century economies, such as the importance of complex communication tasks that technology cannot accomplish alone. However, aspects of this century's digital skills are not clearly defined. The survey results indicate that individuals with higher levels of interpersonal communication skills also have higher or adequate levels of digital citizenship. Empirical data also reveal that the four interpersonal communication competence skills (environmental control, empathy, interaction management and proximity) are most influential for the digital citizenship of pre-service teachers (Xu et al., 2019).

Adequate communication is understood as positive between communicators and such adequacy may vary between individuals or different environments. Digital environments present new complexities in which individuals are more widely interconnected. The authors test hypotheses of the relationships between digital citizenship and competence in interpersonal communication, made up of 10 skills: self-disclosure, empathy, social relaxation, assertiveness, alterocentrism, interaction management, expressiveness, support, immediacy, and environmental control (Xu et al., 2019).

Helleve, Grov Almås and Bjørkelo (2019) study teachers' digital skills for communicating with students using social networks. They conclude that becoming a professional teacher in a digital world includes more than being able to design pedagogical learning activities supported by technology. It is necessary to consider how technologies interfere with professional practices and use them according to the characteristics of each school discipline. Awareness of how to handle your students' communication is also needed.

Pedagogical Competence

Pedagogical competencies characterize a DTS category that articulates DICT with the curriculum focused on teaching activities. In a case study based on the integration of ICT in the classroom, taking into account teachers' perceptions about digital competence and media education, Rivallo and Martín (2017) state that the difference between the didactic and educational dimensions is not well established. Their research with technically competent teachers identified that teachers generally prepare some digital material for their classes but do not usually share their work as open educational resources (OER) in digital environments and/or virtual communities for collaboration in teaching. Teachers, the objects and the subjects of the study, do not believe they have the digital skills needed to adapt their methodology and teaching practice to the demands of society and teaching systems. However, they think that, in the educational dimension, the didactic dimension and the use of ICT can be included in the teaching-learning processes.

Abio (2017) uses the term semi-pedagogical competence to express teachers' awareness of the semiotic possibilities or potentials offered by technological means and the skills needed to prepare appropriate tasks mediated by ICT. The author also reports three primary skills the teacher must show: evaluation of the available means of communication, evaluation of methods (modes), and task design (ABIO, 2017, p. 43). Hrytsenchuk et al. (2018) identify teachers' characteristics of ICT competencies when they can assess the use of ICT and link skills and educational content, pedagogical approaches, teaching methods and technologies.

Dzhurylo and Shpayk (2019) comment that trends for ICT skills are characterized by a shift in emphasis from technological-level tasks (related to learning specific tools and specific software products) to pedagogical-level tasks. The teacher must be aware of the professional requirements, implement ICT in the education process, create their methodology, and develop research and professional-pedagogical training throughout life. In addition, teachers must analyze pedagogical situations to identify problems when formulating teaching tasks and find the best ways to solve them, with the maximum use of ICT opportunities. These characteristics are grouped into two skill patterns: a) those related to the development of knowledge, skills and competencies in the field of ICT; b) those teachers need when preparing students to live in an information society.

Teachers with a high level of ICT competence are prepared to create content using them to develop their professional activities and expand the informational environment of the learning process. That is, organizing the learning process in a way that combines information and new pedagogical

technologies for activities that involve emotion and information, besides promoting educational cooperation and collaboration among students (DZHURYLO e SHPAYK, 2019).

The teacher's level of ICT competence involves the ability to: a) find, assess, select, and display information from digital educational resources (e.g., use of materials from e-books and other digital and Internet guides) according to the educational tasks; b) install programs on a demonstration computer, use projection techniques, develop methods to create their electronic didactic material; c) effectively modify and present information to solve educational tasks, compile their teaching material from accessible sources, generalize, compare, contrast, update large volumes of data; d) select and use software (text and table editors, handouts, websites, presentation software such as Power Point and Flash) to better demonstrate the different materials needed for the learning process (lesson materials, thematic planning, monitoring, various reports, etc); e) effectively apply student educational activity organization tools (test programs, electronic workbooks, student class activity organization systems, etc.); f) form a digital and a paper portfolio; g) choose how to provide information to competently students, parents, colleagues, and school administration (school network, email, social network, website/section of the website, forum, etc.); and h) organize students' work within the framework of network communication projects (contests, competitions, quizzes), supporting the educational process remotely, if necessary (DZHURYLO e SHPAYK, 2019).

Olofsson, Fransson and Lindberg (2019) discuss pedagogical competence to understand the notion of "adequate digital competence". Digital resources used in teaching must be appropriate and result in the effective use of technology. In addition to access to digital tools, teachers must also be competent in choosing the correct method and tools and know how to use them. Still, using digital learning resources can contribute to students' knowledge acquisition. Digital learning resources must be of high pedagogical, interactive, visual and scientific quality, meeting the stated availability requirements.

Axiological Competence

Another category identified in the literature refers to the self-efficacy of ICT for instructional purposes. This concept was measured with questions about how teachers could better perform specific tasks using ICT related to their teaching practice (monitoring students' progress, preparing lessons using ICT and assessing their learning). The results show that collaboration between teachers positively affects ICT use in their teaching practice (HATLEVIK; HATLEVIK, 2018). The perceptions of newly graduated teachers are also seen at the beginning of their profession. The collaboration process depends on the will and predisposition to learn and develop. This question is linked to values and represents the axiological competence related to self-efficacy (GUDMUNDSDOTTIR; HATLEVIK, 2018).

On teachers' intentionality and predisposition to develop digitally, Tomczyk (2019a) comments that the challenge for teachers to transform and/or improve their digital literacy is permanent. A passive attitude prevents them from understanding young people's reality and producing educational activities using ICT. The author considers teachers' use of ICT associated with information processing, self-education (axiological), and communication.

The author also classifies teachers according to their attitudes towards the electronic medium: techno-optimists (accepting all ICT solutions openly and uncritically); techno-ignorant (not interested in new media, considering the analogue didactic media and solutions sufficient); techno-pessimists (who see the implementation of ICT in the educational process as a disturbance in effective teaching and learning); and techno-realists (the ideal attitude of a balanced assessment of the positive and negative consequences of the ICT implementation in the education process). The ideal is to have more teachers in this last group (TOMCZYK, 2019b).

According to Engen (2019), there is a consensus in the research community and among policymakers that teachers' digital competence refers to their skills, knowledge, and attitudes towards digital technology. These questions are essential for understanding how technology is adapted and used in schools. Furthermore, a teacher's competence in translating digital technology across different contexts also considers digital technology's social and cultural aspects.

Sociocultural competence

Advantages and criticisms are identified concerning ICT integration in teaching and teacher training, especially in studies that refer to society. The critical factors that interfere with the use of technology for the development of 21st-century skills are: a) inadequate education, teacher training and resources; b) limited teachers' awareness and self-confidence; c) limited content coverage; and d) longer preparation time. Teachers' skills are knowing how to design a program, model, or strategies to improve student's quality of learning and developing skills based on the vision and objectives of social studies, based on the philosophical and pedagogical foundations of constructivism (FARISI, 2016).

This competence also considers that society is undergoing a profound socio-cultural change and technological evolution. In the discourse around knowledge, skills, and digitization, education plays an entirely new role in the "knowledge society", different from the previous industrial society. The context of the knowledge society presented by Engen (2019), p. 10) refers to the changes and innovations of a society "characterized by a profound sociocultural change, not just a technological change. In the discourse around knowledge, skills and digitization, education is highlighted as one of the most important premises for the development of society" (ENGEN, 2019, p. 10). The author considers the ideological foundations that understand knowledge as a productive force, which has, on the one hand, rationalization and, on the other, innovation, new products, new services and new cultures. Therefore, to understand social structures, whether at a micro level with the use of digital technology in the classroom, or a macro level in the global economy or political and cultural institutions, digital competence plays an important role, including a political one, reflecting the beliefs and assumptions about the types of skills needed by societies (ENGEN, 2019).

Schools or educational institutions are expected to adapt and use technology at the same pace they are introduced to the consumer market, which always entails a cultural delay. Therefore, technology design and implementation encompasses organizational, political, economic, and cultural factors. Literacy areas cannot be separated from the social and educational needs to which the educational system must respond (CERVERA e CANTABRANA, 2015; ENGEN, 2019). In this context, professional digital skills require practical abilities to use digital tools for teaching, which requires transferring them from the personal level to the professional practice, i.e., the ability to transfer technologies to different domains (ENGEN, 2019).

Hence, Engen (2019) states that DC, understood as knowledge and skills, is not suitable for all situations without a reference to a specific domain or context. The term "professional digital competence" must be closely linked to concrete situations and uses. It is no longer possible to speak of just one type of digital competence but several interconnected digital competencies. Developing teachers' professional DC is much more than developing competencies based on instrumental skills. It is to expand the conceptual knowledge of social and cultural aspects of digital technologies' role and transformative potential in modern society. The social role of technology comprises becoming aware of how to use technology in the classroom and its context, differing from neoliberal notions or the perspective of knowledge and skills as commodities in the job market (ENGEN, 2019).

In their research, Serafín, Depešová and Bánesz (2019) used five groups to determine the level of digital competence, including areas such as technical skills, media and information literacy, engagement, critical attitude and their influences on literacy levels, as well as the relationships between some variables, as media relations, Internet use, globalization and psychological problems. The results show a positive correlation between Internet use and levels of digital culture and confirm that variables such as the use of technology and Internet users' self-confidence can provide the necessary skills to move in the virtual world. Therefore, these are skills needed to guide students in this world, using online networking, communication, collaboration, and critical views of both the positive and negative phenomena associated with the Internet.

In a sociocultural approach, learning is an interactive process between the subject and the context to understand social and cultural aspects. This approach, introduced by the European Framework of Reference – DigCompEdu, promotes the transfer of digital competencies from teacher to student. Through social interaction, the teacher can create the ideal scenario for technological learning.

Accordingly, the teacher becomes critical to developing students' digital skills (COLÁS-BRAVO; CONDE-JIMÉNEZ; REYES-DE-CÓZAR, 2019).

To identify DC in a sociocultural approach, the authors define the instrumental and strategic levels and appropriation of digital culture. At the instrumental level, teachers need to include, in their teaching activities, practices that allow their students to use digital tools at a basic and technical standard. The strategic and operational level, connected to the activation of digital competence for problem-solving, includes the development of skills and strategies that can establish new uses, spaces, and practices through ICT. It promotes the transfer of cultural artifacts from one context to another and can expand individual and social capital through technologies, generating social impact (COLÁS-BRAVO; CONDE-JIMÉNEZ; REYES-DE-CÓZAR, 2019).

Thus, at the level of appropriation of digital culture, people assume the rules, identify the characteristics and are part of this digital society. Therefore, there is a need for skills that show peoples' interpretation of reality through ICT, to build meanings and internalize narratives. In this context, teachers must ensure that students take ownership of digital culture, providing spaces and scenarios that include digital technologies and positive emotional aspects for their use in the learning environment (COLÁS-BRAVO et. Al., 2019). Colás-Bravo, Conde-Jiménez and Reyes-De-Cózar's (2019) study presents the sociocultural approach as a theoretical perspective that serves as a basis for generating innovative models for the development of teachers' digital skills due to the potential for transfer and operationalization of its constructions.

FINAL REMARKS

To arrive at a definition of digital teaching competence, We identified the various terminologies associated with the term, including digital literacy, competence in ICT, and literacy in ICT, among others. Despite being related to the concept of competence, digital literacy and ICT competence are one of six categories of digital teaching competence, connected to mastering digital technology. Digital competence is broader, not limited to the ability to use technology, but comprises knowledge and skills beyond digital literacy.

Digital teaching competence is understood as a set of knowledge, skills, attitudes and values that promote the ability to use personal, social and methodological skills in work, study, and personal and professional development. In addition, teachers develop this knowledge, skills, attitudes, and values for the intended, safe, and critical use of Digital Information and Communication Technologies in teaching and learning activities.

The literature consulted, which includes articles from different countries, allows us to identify that teachers have digital competence when they develop their technological, communicational, informational, pedagogical, axiological, and sociological competencies. However, the concept of Digital Teaching Competence is still under construction. We attempted here to present a proposal for systematizing the concept. Nonetheless, we were limited to research published on three scientific bases, Scopus, Web Of Science and Science Direct. Other scientific bases can be searched for a complete literature review. New studies correlating the categories of competence are needed to identify its potential in promoting teachers' professional development.

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Author 1 – Conceptualization, data curation, formal analysis, investigation, methodology, project administration, original writing, revision and editing of final writing.
Author 2 – Supervision of the planning and execution of the research project, visualization, revision and editing of the final writing.
Author 3 – Validation and verification of the quality and potential for replication, visualization, revision and editing of the final writing.

CONFLICT OF INTEREST DECLARATION

The authors declare that there is no conflict of interest with this article.
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