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DIGITAL SKILLS IN POST-GRADUATE TRAINING IN EDUCATION

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Abstract: In this study, we aim to analyze the training offered in *Stricto Sensu* Postgraduate Studies in Education for the development of digital skills. For this purpose, documentary research was carried out through the Sucupira Platform and institutional websites whose curriculum matrices presented evidence of discussions about technologies. The data were analyzed based on the interaction model of different teaching knowledge (pedagogical, specific and technological) called Technological Pedagogical Content Knowledge. We found that digital skills are treated in different dimensions, but it is still incipient in the curricular organization.
Keywords: Digital technologies. Postgraduate in Education. Digital Skills. TPCAK. Theory Grounded in Data.

INTRODUCTION

Over the past two years, the Covid-19 pandemic has triggered a global crisis that has profoundly impacted society in all aspects, including education. The educational sector was abruptly forced to adapt to the digital environment, giving rise to Emergency Remote Studies (ERE). In this process, teachers and students had to migrate to online teaching, requiring the rapid acquisition of digital skills. Digital Communication and Information Technologies (DICT) have become the central focus of discussions and concerns, going beyond a select group of educators. In addition to accessibility and infrastructure issues, the development of digital skills has become an urgent need. This implied the search for Open Educational Resources (REAs), online interaction and assessment tools. This situation highlighted the lack of technological preparation in education, both in conceptual and technical terms, leading to an intense effort to acquire these skills.

The understanding of the digital skills that we bring to this discussion is based on international guidelines, such as those of the International Society for Technology in Education (ISTE), the European Commission and the Organization for Economic Co-operation and Development (OECD) Program, which go beyond the technical dimension. This includes collaboration, communication, creativity, innovation and critical thinking skills, meeting the demands of the 21st century. The term "digital skills" encompasses the ability to investigate, process information, use tools to produce, understand complex information and use technologies to support critical thinking and creativity (European Commission, 2013).

Previous studies (Arruda, 2018) revealed the scarcity of initiatives related to the technological training of future researchers and university professors, finding that only 2% of undergraduate course curricula addressed TDIC in the educational context. Other more recent research (Arruda, 2020) suggested that these gaps can be attributed to generic curricular matrices that neglect digital technologies as a transversal training axis.

When we examine the integration of TDIC into professional training in Education, we observe that this issue has been widely debated in basic education and initial training, but has received little attention in postgraduate studies, which is the training environment for researchers and teachers. The training deficiencies in these programs are highlighted in previous studies (Pimenta and Anastasiou, 2010; Almeida, 2012) due to the lack of approach to the pedagogical dimension of teaching in higher education, resulting in the lack of concern with the interconnection between specific, pedagogical and technological knowledge.

Although discussions about the incorporation of Digital Information and Communication Technologies (DIT) in

Education and their pedagogical potential have expanded recently, there is still a notable absence of these issues in teacher training programs. This creates gaps at all educational levels, as illustrated in Figure 1.

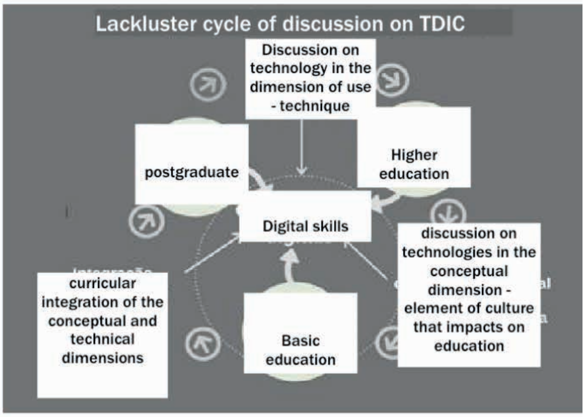

Figure 1 - Gap cycle of discussion about TDIC

Source: Written by the author

In view of the above, we ask: does the postgraduate curricular organization offer opportunities for the development of technological skills in the dimensions of specific knowledge of a content with the pedagogical knowledge associated with this content and technological knowledge? Are there curricular components that address the educational use of TDIC in the curricula of postgraduate programs? What are the concepts present in these components?

To answer these questions, qualitative research was developed, with the aim of analyzing the training offered in postgraduate programs in education (PPGE) for the development of digital skills (CD). This research proposal is justified by the need to answer such questions, seeking possible multiplier effects arising from training that articulates specific, pedagogical and technological knowledge, intrinsic and necessary to teaching and educational processes.

METHODOLOGICAL COURSE

We started with documentary research, focusing on master's and doctoral programs in the area of Education. This data collection initially took place through the Sucupira Platform, run by the Coordination for the Improvement of Higher Education Personnel (CAPES)[1]; We then turned to institutional websites in search of curricular matrices to identify the pedagogical components that include discussions about TDIC offered by the programs. We analyzed the titles and syllabi using the following keywords: technology - TDIC - cyberculture - digital media - pedagogical innovations - hybrid learning - virtual learning environments - digital culture, digital skills.

This exercise allowed us to identify, in addition to the presence or absence of discussions about technology and education, the number of curricular components with these discussions offered in each program, classifying them as mandatory, elective or optional. From this mapping we made the first selection of our sample: the programs whose curricular matrices presented evidence of discussions about technologies, resulting in a universe of 78 programs and 206 curricular components. A second cut was made through the adhesion of the programs, using different communication strategies (e-mail, telephone call, social networks) that aimed to guarantee the largest possible number of participants. We closed the process with 14 participating Higher Education Institutions and 39 curricular components to be analyzed.

Given the need to deal with a large volume of written textual data, generated by the syllabi, we find in the principles and foundations of the Theory Grounded in Data GT (Strauss and Corbin, 2008; Charmaz, 2009), more specifically the related guidelines

1 It consists of a reference base of the National Postgraduate System (SNPG) which makes available in real time the information, processes and procedures that CAPES carry out in the SNPG for the entire academic community.

and techniques data coding.

The research process guided by Grounded Theory (TF) involves a flexible and interactive approach to collecting and analyzing information, with the aim of building theories based on the data itself (CHARMAZ, 2009, p. 14). From the constructivist perspective of TFD, the following key positions stand out:

- The research process is continuous and adaptable.
- Initial methodological choices are influenced by the research problem.
- Researchers are an integral part of the object of study.
- The GT analysis guides the conceptual development of the study, which can lead to the adoption of different data collection methods and the carrying out of research in multiple locations (CHARMAZ, 2009, p. 239).

The assumptions of this theory constitute the link that helped us attribute meanings to emerging codes and categories, and are best described in Cruz (2021).

We defined as a theoretical basis for data analysis the interaction model of different teaching knowledge (pedagogical, specific and technological) called Technological Pedagogical Content Knowledge (TPACK) (Mishra; Koehler, 2006).

TPACK is the balanced mix of knowledge at the scientific level, or content, at the pedagogical level and also at the technological level. The proposal, in this case, combines the relationships between knowledge of the topic that will be worked on in class; practices, processes, strategies, methods for teaching and the use of computers, Internet, digital video, among other technologies (Cruz, 2016).

This construct is based on the most accepted and recurrent contributions in the area of teacher training: Pedagogical Content Knowledge (PCK) proposed by Schulman (1987), according to which to teach, teachers need to have developed an integrated knowledge structure, which incorporates knowledge about the content, the students, the pedagogy, the curriculum and the school, that is, they need pedagogical knowledge of the content.

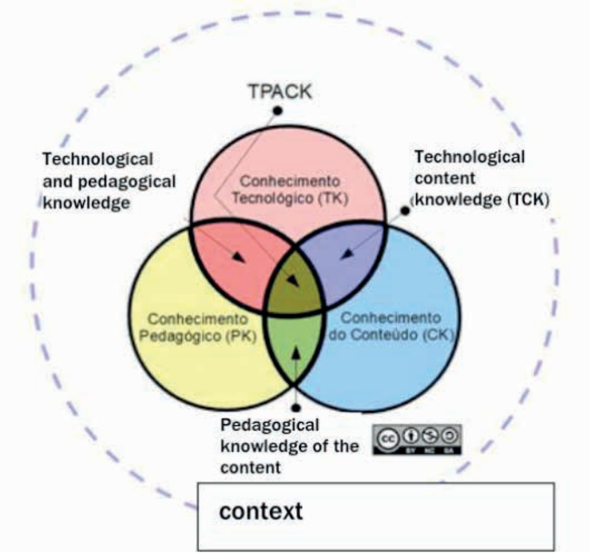

Figure 2 - Schematic representation of TPACK

Source: Adapted from Misha and Koeller (2006).

The TPACK framework has proven to be appropriate to support the discussion of integrating technologies into initial and postgraduate training curricula, in order to develop the digital skills necessary to make the qualitative leap towards innovation in educational processes.

Based on the studies cited, we used TPACK in this research to articulate three perspectives: i) recognizing it as the interaction between three domains of knowledge and their intersections (Figure 2), ii) as a distinct body (Angelis; Valanides, 2009), represented by the domains: Content Knowledge (CK), Technological Knowledge (TK), Pedagogical Knowledge (PK) and by the subdomains: Pedagogical Content Knowledge (PCK), Technological Content Knowledge (TCK), Pedagogical Technology Knowledge (TPK) and iii) adapted to the specific context of this research as described in Table 1:

Definition of TPACK subdomains in the research context		
Acronym	**Domains and subdomains**	**Description**
C.K.	CONTENT KNOWLEDGE	Theoretical-conceptual reflections on technology, on the relationship between TDIC and education, curriculum and its impacts on today's society
P.K.	PEDAGOGICAL KNOWLEDGE	Knowledge about the processes and practices or teaching methods.
T.K.	TECHNOLOGICAL KNOWLEDGE	Understanding how basic and advanced technologies work
PCK	PEDAGOGICAL CONTENT KNOWLEDGE	Discussions about methodological and pedagogical approaches that fit into different learning situations using technologies
TCK	TECHNOLOGICAL KNOWLEDGE OF CONTENT	Development of skills to identify strategies for selecting the most appropriate technological resources for a given curricular content
TPK	TECHNOLOGICAL PEDAGOGICAL KNOWLEDGE	Analysis of proposals for using digital resources and tools in teaching and learning situations

Table 1; Definition of TPACK subdomains in the research context

Source: Prepared by the author based on Mishra and Koehler (2006)

Once this is done, we proceed to analyze the syllabuses of the curricular components with discussions about technologies - CCODT, in an attempt to identify the concepts present and verify their similarities with our theoretical framework.

DISCUSSION OF RESULTS

CURRICULAR COMPONENTS, TECHNOLOGIES AND EDUCATION: WHAT DOES THE DATA FROM THE SUCUPIRA PLATFORM TELL US?

The data obtained from the survey on the Sucupira platform and the first foray into the IES websites resulted in a mapping of all programs offered by the IES, with their respective area of concentration, level, concept, location, starting year, evaluation concept, coordinators of the program, in addition to informing the electronic address of the websites of each of them.

Of the 177 programs mapped, 78 had between one and seven curricular components with the occurrence of TDIC; 56 did not present any CCODT and in 11 it was not possible to locate the curricular proposal or it is available in a generalist way, stating only the name of a set of curricular components without the respective syllabi.

Despite the numerous difficulties encountered on institutional websites in locating the complete matrices (weaknesses in the availability of data, lack of updating, not always clear ways of arranging information and the absence of important data) with the respective syllabi, we found 206 curricular components, evidence of discussion about TDIC with different dimensions and approaches. Of these, 71.3% present incomplete information, that is, they do not describe the syllabus, do not present bibliographic references or do not inform the elective or mandatory nature.

CURRICULAR COMPONENTS, TECHNOLOGIES AND EDUCATION: WHAT DO THE DATA FROM THE PROGRAMS' CURRICULAR MATRICES TELL US?

In relation to the classification of the curricular components offered, the PPGE curricula are organized into curricular components in areas of concentration and lines of research that are generally classified as mandatory, elective and optional[2].

We carried out a search on the CNPQ platform, which is a Directory of Research Groups in Brazil, constituting an inventory of scientific and technological research groups active in the country. The crossing of data from this directory with programs where there is a presence of Discussions about technologies allowed us to verify that the curricular components offered are probably justified by the presence of research groups in the area.

Regarding working hours, it is observed that the majority work between 30 and 45 hours. The curricular structures of master's and doctoral degrees have a very similar organization, so that each student must complete around 24 credits for a master's degree and 48 for a doctorate, combining mandatory curricular components with various activities - optional curricular components, special topics, guided studies, activities research, teaching internship and publications.

Considering that each student builds their educational trajectory aiming to expand the conceptual theoretical repertoire focused on their research topic, I infer that the CCODT include a small portion of the graduates of each program. Briefly, the study involved analyzing the syllabuses of 14 programs, identifying recurring categories, relating them to curricular components and seeking connections with the knowledge domains of the TPACK structure, resulting in 14 categories as shown in Figure 3

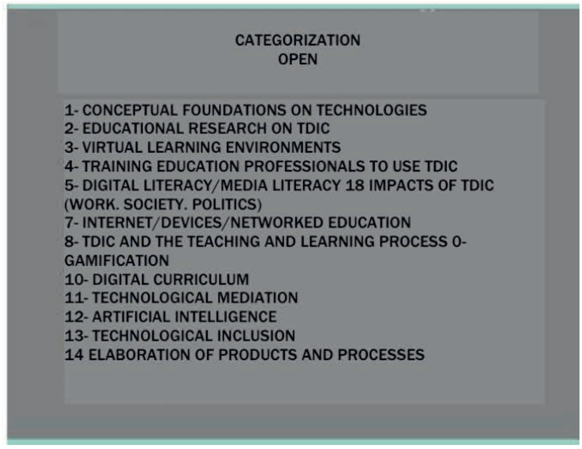

Figure 2 - Open categorization

Source: Elaborated by the author

Through comparative analysis of the 14 categories, we verified that there were dualities, inconsistencies and possible gaps in the language expressed by the menus, reflecting individual perspectives and conceptions of their proponents. Even so, this categorization exercise allows us to group the categories into 3 axes:

Axis 1 - categories 1, 2, 4, 5, 6, 10, 11, 12 and 13 where explicit and implicit theoretical-conceptual dimensions prevail in the terminologies, in the concepts covered where the teachers, authors of the syllabi, seem to propose discussions in that technologies reflect a set of processes used in interaction between people and that change social and pedagogical relationships. In other words, the discussion of teaching tools and equipment is not restricted, corroborating studies by Castañeda and Selwyn (2018), presenting the concern present in productions in the area beyond instrumental issues, turning our attention to conceptual issues and, consequently, recognizing the need for epistemological contributions that support in-depth and

2 Mandatory curricular components: are those that convey essential and indispensable knowledge for carrying out research in the Program's line of research and concentration area, and must be taken with approval by all regular students enrolled in a given course. Elective curricular components: are those that address content linked to specific themes, being chosen by students from a list of curricular components offered by the program. Optional curricular components: are those of the student's free choice, which can be offered by other programs to compose their curricula in order to provide a more personalized training for the professional being trained.

critical reflection on the relationships between learning and technology.

Axis 2 - categories 7, 9, 14 point to technical and/or practical dimensions indicating a conception of educational technology related to use. This approach meets the ideas of Kenski (2016), presenting TDIC as tools that complement human relationships and that allow new cultural configurations, treating them as facilitators of interaction and communication. "[...] thus becoming a tool for expanding memory and communication" (Kenski, 2016).

Axis 3 – in this third axis, categories 3 and 8 point to the articulation between the two dimensions presented: technique and practice. They are among the most recurrent categories and were identified in 8 of the 14 programs analyzed.

In this last axis, we identify conceptions that refer us to the innovative character of technologies from the perspective of Castañeda and Selwyn (2018) where the focus is on the development of skills and competencies for the integration of TDIC into teaching and learning processes. The following excerpts exemplify this perspective:

- changes in the daily teaching and learning mediated by technologies (CC3P3) [3];
- ways of knowing/learning and thinking and organizing educational processes (D1P4);
- the different approaches and techniques for using digital resources in pedagogical practice (CC1P5);
- challenges in teacher training for practices in computerized learning environments (CC3P2);
- technical, didactic, cognitive and epistemological aspects of technological learning environments (CC1P8).

There is an understanding of technology as a means and material source for teaching and learning processes. Following Sancho (2006), the use of technologies as educational resources implies understanding them together with new educational perspectives that involve social context (educational demands, value system, educational policies, initial and continuing training plans, legal aspects), school culture (physical and symbolic structure of the school, curriculum, communication system) and educational projects (aims and object of education, concepts about teaching and learning, learning environments, assessment).

INTEGRATING THE DATA: WHAT CAN WE SAY ABOUT PPGE?

Considering the recurrence of the categories in axes 1,2 and 3, related to the data obtained through the graduates' questionnaires, led us to group the PPGE into 3 groups:

Group 1 - P1; P3; P7; P11 - Group 1 is made up of four master's and doctoral programs in Education, with an emphasis on predominant theoretical-conceptual aspects. One public program has a grade of 7, while the three private programs have a rating of 5. The P3 and P7 programs are older, more consolidated and have lines of research on technologies, including related elective courses. P1 is recent, created in 2013, and P11 in 2004, without specific lines of research. P3 stands out for its vast production in the area, covering most of the Axis 1 categories. P7 focuses on conceptual and pedagogical discussions, while P11 offers only conceptual foundations in its curriculum.

Group 2 – P2; P10 - In Group 2, there are two programs that have in common the emphasis on Axis 2, addressing technical and/or practical aspects. Program 2, from a private institution, offers a master's and doctorate in School Education and Teaching Profession, with a line of research and three

3 These are the codes used to identify the curricular components and programs as described in Cruz (2021)

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elective courses related to technology. The syllabi cover six categories, with "Virtual learning environments" prevailing in all courses, suggesting the development of digital skills. P10, a professional master's degree in Rural Education from a federal institution, introduces a 14th category, "Elaboration of products and processes", indicating the emphasis on strategies for selecting technological resources for specific teaching contexts.

Group 3- P4; P5; P6; P8; P9. P12; P13 - In Group 3, made up of professional master's programs, there are common characteristics, including the nature of the offer and the objectives that emphasize teacher training and teaching in basic education. Most programs mention specific areas of concentration, such as school education and new technologies, with the exception of two that only state "Education", suggesting that these programs may not address the specificities of the training offered. They balance the categories of axes 1, 2 and 3 in their menus, reflecting a concern to integrate conceptual and practical discussions, meeting the training needs in digital skills. All have lines of research, bringing the curriculum closer to the most recent discussions and guidelines. The analysis with TPACK subdomains reveals that the curricular components allow theoretical reflections on technology, its impact on education and methodological and pedagogical approaches aligned with different learning situations, covering the TK, TCK and TPK subdomains.

From the categorization and organization of programs by axes, the predominance of the CK domain was identified. The adapted analysis of the TPACK domains indicated that the curricular proposals considered both individual knowledge (CK, PK, TK) and pairs of knowledge (PCK, TPK, TCK) in an inferential way. However, the discussion about TDIC in the curricular components reached only a small portion of graduates, indicating that the introduction of these contents as CC does not effectively address the training needs in digital competence.

The literature on the TPACK concept emphasizes the need to expand training in digital skills in teacher training programs, overcoming isolated approaches between technology and educational theories. This implies more integrative perspectives that consider the articulation between TPACK components. Studies such as Sampaio and Coutinho (2013), Angeli and Valanides (2009), Niess (2005, 2008, 2013) demonstrate that technology has been treated as something separate from educational theories, that is, discussions are generally isolated from a context, sometimes privileging the conceptual dimension, sometimes the technical dimension. The analysis of the three axes resulting from the categorization of the syllabi and the characterization of the programs revealed similarities, differences and limitations in the formation of digital skills in postgraduate studies in Education.

FINAL CONSIDERATIONS

In the context of this study, we assume the definitions of international guidelines, translating digital skills as the capacity for action that integrates tools, resources, interfaces and technological, pedagogical and theoretical knowledge in planning, practice and reflection on practice. Emphasis was placed on the development of knowledge related to the appropriation and use of TDIC as an essential condition for success in studies, work and life in today's society.

Through an exercise of analytical construction and deconstruction, the TPACK framework allowed us to create parameters to identify the knowledge present in the categorization of menus in dialogue with the adopted references. We agree with the studies on TPACK, which despite presenting its complexity and multifaceted characteristics, consider it as a potential theoretical lens to anchor research related to the use of TDIC in education. Therefore, it presents itself as a promising path to guide training trajectories that allow the development of digital skills in favor of teaching and learning (content + technology + pedagogy) and collaborate in the (re) construction of teacher training curricula, including post- graduation.

TPACK domains and subdomains were found diluted in all programs. However, professional master's programs showed better coordination between them. There are discussions that emphasize the relationship between TDIC and learning, that is, they are not restricted to the use of tools and equipment.

The analysis of the characteristics of the programs grouped in (G3) indicated that the curricular organization stands out for offering opportunities for the development of technological skills in the dimensions of specific knowledge of a content with pedagogical knowledge, associated with this content and technological knowledge. These programs directly contribute to improving the training of basic education teachers.

The categorization revealed different approaches to technologies, covering theoretical-conceptual and technical/practical aspects. The lack of training in digital skills is not only due to the presence or absence of discussions about technology, but to the curricular organization with predominantly elective or optional components, making it difficult to incorporate these topics. The most prevalent domain is content knowledge (CK), indicating theoretical reflections on TDIC and its relationships with education. This emphasis can be a starting point for critical and pedagogical teaching of technologies, as long as it is integrated with practical and conceptual dimensions, articulating with other curricular contents.

It is also worth highlighting the valuable contributions of choosing Data-Based Theory (TF) as the methodological reference for this study, which allowed us to maintain a constant dialogue between data and theoretical references, resulting in the conceptual order presented here. Such data-based theorizations allowed us to reveal curricular strengths and weaknesses, bringing to light reflection that is still little considered in research, especially in the Brazilian context. We hope to have contributed to the necessary search for efficient ways to develop digital skills and the future creation of conceptual contributions aimed at the formation of such skills within the scope of teacher and researcher training.

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