

## USE OF DIGITAL TECHNOLOGIES IN THE TEACHING OF CARTOGRAPHY IN THE MILITARY COLLEGE SYSTEM IN BRAZIL

### *USO DE TECNOLOGIAS DIGITAIS NO ENSINO DE CARTOGRAFIA NO SISTEMA COLÉGIO MILITAR DO BRASIL*

### *USO DE TECNOLOGÍAS DIGITALES EN LA ENSEÑANZA DE CARTOGRAFÍA EN EL SISTEMA COLEGIO MILITAR DE BRASIL*

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**ABSTRACT:** This article presents a study carried out with the purpose of identifying the teaching practices of cartography with digital technologies, characterizing the way in which digital technologies are used by teachers working in geography in the schools of Military College System of Brazil. Based on bibliographical research in scientific databases, practices in the use of digital technologies considered relevant in the teaching of cartography were identified. From the results of this research and with a view to its exploration, semi-directive interviews were carried out with high school teachers. It was found that the interviewed teachers take advantage of the possibilities of digital technologies through different practices and strategies in their use in the teaching of cartography. It is noteworthy that, in addition to fulfilling the educational objectives contained in the curriculum documents, the view of teachers reveals their concern with meaningful learning for their students.

**KEYWORDS:** Digital technologies. Pedagogical practices. Cartography teaching. Military College System of Brazil. High School.

**RESUMO:** Neste artigo apresenta-se um estudo realizado com o propósito de identificar as práticas de ensino de cartografia com tecnologias digitais, caracterizando o modo como são usadas as tecnologias digitais pelos professores atuantes na disciplina de Geografia nos colégios do Sistema Colégio Militar do Brasil. Com base em pesquisa bibliográfica em bancos de dados científicos foram identificadas práticas de uso de tecnologias digitais consideradas relevantes no ensino da cartografia. A partir dos resultados dessa pesquisa e com vista à sua exploração, realizaram-se entrevistas semidirectivas a professores atuantes no 1º ano do Ensino Médio. Verificou-se que os professores entrevistados tiram partido das possibilidades das tecnologias digitais através de diversas práticas e estratégias no seu uso no ensino da cartografia. Destaca-se que além do cumprimento dos objetivos educacionais contidos nos documentos curriculares, a visão dos professores revela a preocupação com uma aprendizagem significativa dos seus alunos.

**PALAVRAS-CHAVE:** Tecnologias digitais. Práticas pedagógicas. Ensino de cartografia. Sistema Colégio Militar do Brasil. Ensino Médio.

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**RESUMEN:** Este artículo presenta un estudio realizado con propósito de identificar las prácticas de enseñanza de cartografía con tecnologías digitales, caracterizando la forma en que las tecnologías digitales son utilizadas por los docentes que enseñan en la disciplina de geografía en las escuelas del sistema Colégio Militar de Brasil. A partir de la investigación bibliográfica en bases de datos científicas, se identificaron prácticas en el uso de tecnologías digitales consideradas relevantes en la enseñanza de cartografía. A partir de los resultados de esta investigación y con miras a su exploración, se llevaron a cabo entrevistas semidirectivas con docentes que enseñan en 1º año de la educación secundaria. Se verificó que los docentes entrevistados aprovechan las posibilidades de las tecnologías digitales a través de diferentes prácticas y estrategias en su uso en la enseñanza de cartografía. Es de destacar que, además de cumplir con los objetivos educativos contenidos en los documentos curriculares, la mirada de los docentes revela su preocupación por un aprendizaje significativo para sus alumnos.

**PALABRAS CLAVE:** Tecnologías digitales. Prácticas pedagógicas. Enseñanza de cartografía. Sistema de Colegios Militares de Brasil. Educación Secundaria.

## Introduction

In recent years, with the advent of the Internet and its potentialities, the world has experienced a profound revolution in communication and socialization processes, and the educational use of networked digital technologies is also no different, the latter being an object of great relevance in the field of educational research (COSTA *et al.*, 2012). The impact that technologies have on learning depends on how and for what they are used (COSTA *et al.*, 2012).

Digital technologies have a high potential from a pedagogical point of view (COSTA *et al.*, 2012; COSTA *et al.*, 2017), and from a learning point of view they can be used as tools for the student's work, assisting and actively involving him/her as a protagonist in the construction of his/her knowledge (e.g. JONASSEN, 2000; PAPERT, 2008). According to Jonassen (2000, p. 21), technologies enhance student learning when they allow "accessing desired information, simulating problems and situations, articulating and representing what students know, reflecting on what they have learned and how they have done it."

The present study focuses on the use of digital technologies in the teaching of cartography in the Brazilian Military College System (SCMB in the Portuguese acronym), starting from the following problematizing question: "How do Geography teachers take advantage of the potential that digital technologies have for the teaching of cartography in Basic Education in Military College System in Brazil?"

As a strategy to answer the central question, the following research questions were defined: i) which practices with the use of digital technologies are considered relevant in the

area of cartography teaching?, ii) what are the teachers' perceptions about the use of digital technologies in cartography teaching?, and iii) what is the teachers' vision about the potential of digital technologies in cartography teaching in relation to traditional technologies? This is a qualitative study (AMADO, 2013), whose methodological design was built and defined in two moments, using different techniques for data collection and analysis: i) documentary analysis of studies found in bibliographic research conducted according to the systematic literature review technique, and ii) interviews with high school teachers from the Military College System in Brazil.

In this article we present the practices of cartography teaching with digital technologies developed in Basic Education, characterizing how they are used for cartography teaching by teachers working in the Geography subject in the SCMB schools, identifying strategies and activities developed, contents worked and digital tools used, focusing on the transforming pedagogical potential (COSTA, 2008) that digital technologies can exert in the teaching-learning process. In the search for what the interviewed teachers had to say, immersed in the context of the Covid-19 pandemic, we also tried to identify possible changes in teaching practices in this period.

### **Use of digital technologies in Cartography Teaching**

Cartographic production is an activity that was and is present in all phases of humanity, since prehistoric times, with the records made in caves by primitive people (IBGE, 2020), until the most recent times, with the use of a wide range of technological resources that facilitate its production and dissemination. According to Capel (1981), the importance of cartography can be settled in the historical context of the Franco-Prussian war (1870), when the French after being defeated by the Germans found that there was a scarce level of knowledge in Geography and in living languages within the high schools, which eventually awakened to a need for reform in education, and Geography was clearly favored in this process of renewal. They promoted changes since primary education, making it mandatory to take geographical excursions, also called "topographical walks", as well as the elaboration of sketches and the previous study of maps and plans. Francischett (2004) states that cartographic language has its importance recognized in the teaching of Geography, because besides being developed the skills related to the understanding of maps, it provides the ability to represent the geographic space.

Simielli (1999) structures the main methodological acquisitions (simple, medium and complex) that students between 11 and 17 years of age should acquire when developing cartographic activities (Chart 1).

**Chart 1** – Methodological acquisitions in cartography

Simple Acquisitions	Average Acquisitions	Complex Acquisitions
<ul style="list-style-type: none"> <li>- Know the cardinal points.</li> <li>- Know how to orientate yourself with a map.</li> <li>- Finding a point on a map with the coordinates or with the index.</li> <li>- Finding the coordinates of a point.</li> <li>- To know how to drive with a simple plan.</li> <li>- To extract from simple a single series of facts.</li> <li>- Know how to calculate altitude and distance.</li> <li>- Know how to drive with a road map or topographic chart.</li> </ul>	<ul style="list-style-type: none"> <li>- Measure a distance on a map with a numerical scale.</li> <li>- Estimate a point on the hypsometric curve.</li> <li>- Analyze the arrangement of topographic shapes.</li> <li>- To analyze a thematic chart representing a single phenomenon (population density, landform, etc.).</li> <li>- Recognize and locate the forms of relief and land use.</li> <li>- Know how to differentiate between slopes.</li> <li>- Know how to recognize and locate types of climate, air masses, vegetation formations, population distribution, industrial and urban centers and others.</li> </ul>	<ul style="list-style-type: none"> <li>- Estimate an altitude between two hypsometric curves.</li> <li>- Know how to use a compass.</li> <li>- Correlate two simple charts.</li> <li>- Read a simple regional chart.</li> <li>- Explaining the location of a phenomenon by correlation between two charts.</li> <li>- To create a simple chart from a complex chart.</li> <li>- Draw a regional map with the precise symbols.</li> <li>- Know how to draw a simple regional sketch (with legend provided by the teacher).</li> <li>- Know how to make real hypotheses about the origin of a landscape.</li> <li>- Be able to analyze a thematic map that presents several phenomena.</li> <li>- Know how to extract the fundamental elements of a complex map.</li> </ul>

Source: Adapted from Hugonie (1992 apud SIMIELLI, 1999, p. 93-108)

The teaching of cartography enables the student "to think significantly the knowledge of geographic space through the reading and understanding of cartographic representations [...]" (FRANCISCHETT, 2007, p. 1). Di Maio (2004, p. 13) highlights that "[...] Cartography, in the discipline of Geography, can assume a role of tool or instrument that awakens skills and competences, stimulating in the classroom the students' intelligences". For Canto (2011, p. 29), the digital language applied to cartography allows "map users the possibility of navigating through different forms of expression of geographic contents and select, within a range of predefined options, the information they want to visualize cartographically".

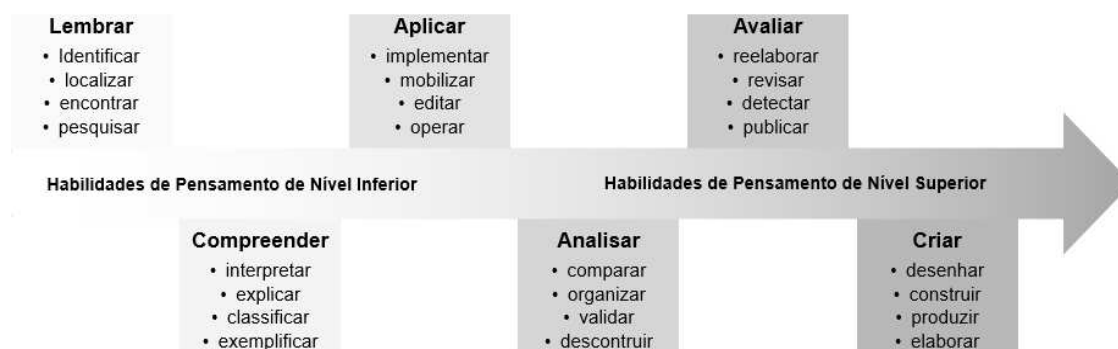
Regarding the role of digital technologies, Costa *et al.* (2012) emphasize that these should be instruments to assist the student in learning, actively involving him as a protagonist in the construction of his knowledge (COSTA *et al.*, 2012). For Jonassen (2000, p. 26), "when students use computers as partners, they offload some of the burden of non-productive memorization tasks onto the computer, which allows them to think more productively." Jonassen (2000) proposes that we should replace the idea of learning from computers or about

computers with learning with computers, because while learning from computers and learning about computers mean using computers as merely productive tools, learning with computers means "using the computer as a tool with which to learn" (JONASSEN, 2000, p. 28), that is, computers as cognitive tools. Cognitive tools require students to have critical thinking, because when using computer applications they do so in a meaningful way and representing what they know (JONASSEN, 2000).

When reflecting on the learning process, we must take into consideration its complexity. According to Benjamin Bloom (1956), learning occurs under three areas or domains: affective, cognitive, and psychomotor. Bloom's taxonomy (1956) is a tool for understanding the learning process, which orders and classifies the levels of learning, ranging from the least complex to the most complex, and each category is described from a noun (CHURCHES, 2009).

Bloom's taxonomy underwent a first revision by Anderson and Krathwohl (2001, apud CHURCHES, 2009). When analyzing how the revised Bloom's taxonomy could be applied to the context of ICT integration, Churches (2009) found that the verbs used no longer meet the goals, processes and actions that are present in this new context, both for teachers, students, as well as almost all the activities we perform daily, and therefore, the need arose for another revision, this time, for a digital version: Bloom's digital taxonomy (Figure 1).

**Figure 1 – Bloom's Digital Taxonomy - cognitive area<sup>3</sup>**



Source: Adapted from Churches (2009)

It is worth noting that Bloom's digital taxonomy is not focused on the digital tools and technologies, but rather on the use of the tools as a means to achieve the learning objectives

<sup>3</sup> Lembrar, Aplicar, Avaliar, Compreender, Analisar, Criar = Remember, Implement, Evaluate, Understand, Analyze, Create; Habilidades de pensamento de nível inferior = Lower-level thinking skills; Habilidades de pensamento de nível superior = Higher-level thinking skills

(remember, understand, apply, analyze, evaluate, and create, for the cognitive domain) (CHURCHES, 2009).

Pereira, Kuenzer and Teixeira (2019, p. 4) conclude that the use of digital technologies in the teaching of Geography in High School, in addition to providing greater student engagement with the content, encourages youth protagonism and "re-signifies the act of learning and the process of knowledge construction due to the possibilities provided".

In the following sections, the context in which the study was carried out, the methodology used, and the sociodemographic characterization of the interviewed teachers will be presented. Subsequently, the results are presented and discussed, culminating with some considerations in the form of conclusions.

### **Background of the study**

The study carried out is located in the Brazilian Military College Teaching System. The Military Colleges are considered Military Organizations (MO) that function as public educational institutions belonging to the Brazilian Army (BA), directly subordinated to the Directorate of Preparatory and Assistential Education (DEPA in the Portuguese acronym) and are intended to provide basic education in the final years of elementary school (6th to 9th grades) and all of high school (1st to 3rd grades). The central purpose is to train students for entry into military institutions and civilian institutions of higher education (BRAZIL, 2008, 2014). Currently, the colleges are present in fourteen Brazilian cities, in the five regions of the country, in eleven states, and in the Federal District.

In the context of the SCMB, the curriculum is materialized as follows:

[...]The curriculum is materialized by the Plans of Teaching Sequences (PSD) and is composed of a reference matrix, by cognitive axes, by the philosophical proposals of the Area and of the Disciplines, by the objects of knowledge designated for the school years and by the discursive competence. In the current pedagogical proposal the conception that guides the use of the curriculum is that of an open and flexible perspective, that is, the curriculum can be adjusted and updated [...] (DEPA, 2016, p. 19).

The curriculum should be seen as an essential document in the planning, focused on the development of the contents within a didactic sequence, and should be organized according to the objectives intended by the teacher, regarding the learning of their students, as learning activities and assessment (DEPA, 2016).

Based on the Didactic Sequence Plan - PSD (DEPA, 2012), the guiding curriculum for teaching in the Teaching System in question, cartography is an object of knowledge planned

for the 1st year of high school. Because cartography is one of the ten objects of knowledge provided for the 1st year of high school geography, corresponding to about 10% of what is taught in this grade, we chose to identify what is pertinent to the teaching of cartography. The reading of the PSD regarding the teaching of cartography in the 1st year of Geography is summarized in table 2, with the content topics and their respective details (table 2).

It is observed that the teaching of cartography proposed in this curriculum emphasizes the need to master the scale (geographical and cartographic), in order to make a more accurate analysis of geographical phenomena, whether at local, regional, or even global level. The PSD (DEPA, 2012) highlights the reading, interpretation, and making of maps as one of the textual genres necessary for the development of discursive competence, further reinforcing the importance that cartographic documents have in all areas of knowledge.

**Chart 2** – Geography 1st Year High School Didactic Sequences Plan Summary

Topic	Detailing
Philosophical Proposal of the Discipline	It is a multidisciplinary science, as it combines the knowledge of multiple disciplines with the methodology of reading and interpreting texts and maps (...). (...) it develops in the student skills and competencies for locating and understanding geographic phenomena (...).
Aspects raised about the methodology and didactics of the discipline	prepare the student to understand and act in the complex world, problematize, formulate propositions, think and act critically in their reality, promoting students' spatial literacy (...). The mastery of the scale of analysis, as well as the scale of representation, is an important criterion in the study of Geography, and it is essential to always consider its various levels (local, regional and global), so as not to incur in simplistic interpretations of reality. Competences related to the interpretation of cartographic documents will be common to all objects of knowledge.
Learning Strategies	The mastery of cartographic reading and interpretation is an indispensable condition for the analysis of the phenomena that are distributed in the geographic space.
Procedural	Understand the mapping process through the spatialization of different themes, elaborate topographic profiles, perform distance and area calculations and identify the geographic coordinates, elaborate conceptual maps, elaborate organizational charts (...).
Textual Genres	Maps, charts, infographics (...)
Discursive Skills	Students should have opportunities, based on their reading of texts, to correctly use and understand words and phrases that describe contexts such as: location, geography, landscape, place, territory, region, scale, cartography, among others.

Skills	<p>GSE1 - Reading, analysing and interpreting the specific codes of Geography (maps, graphs, tables etc.), considering them as elements for representing spatial or spatialised facts and phenomena.</p> <p>GS2 - Recognize and apply the use of cartographic and geographical scales as ways of organizing and knowing the location, distribution and frequency of natural and human phenomena.</p> <p>GS5 - Reflect, compare and use the data recorded through graphs, tables and maps.</p> <p>GS6 - Knowing the fundamentals of scale and above all knowing how to use it appropriately, both for the preparation of documents - maps, tables and graphs - and for the analysis of geographical space.</p>
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Source: Adapted from DEPA (2012)

## Methodology

The methodology, of qualitative approach, used for this study was based, in a first moment, on i) documentary analysis of publications obtained in the literature search on practices of cartography teaching with use of digital technologies, using the systematic literature review, and, in a second moment, in ii) characterization of the perceptions of teachers who work in secondary education in military colleges on the use of digital technologies in cartography teaching, obtained through semi-directive interviews. According to Cohen, Manion and Morrison (2006, apud AMADO, 2013, p. 212), "the combination of research methods allows us to judge the coherence or incoherence of the results".

In the interviews, we sought to confront the data obtained in the documentary analysis, trying to find out what teachers had to say, using the semi-directive interview technique in the auscultation of Geography teachers who work in the 1st year of high school.

In the bibliographic research, we sought to identify documents that dealt with the integration of digital technologies in the teaching of cartography in order to build a representative framework that would allow a rigorous analysis of the practices of cartography teaching with the use of digital technologies and, consequently, to establish a relationship between the documents produced about the theme and the objectives of the Geography curriculum of the 1st year of High School at the SCMB. For the development of the bibliographic research, we opted for the literature search and review indicated by Gil (2008), identifying, locating, analyzing and including in this work the documents researched from the pre-established criteria in chart 3.



**Chart 3 – Search criteria in scientific databases**

Database	Criteria		Search Expression	Publication period
	Searched fields	Types of Sources		
Brazilian Digital Library of Theses and Dissertations Open Access Scientific Repository of Portugal Institutional repository of the University of Lisbon Academic Search Complete EducationSource SciELO	Abstract	Articles, dissertations and theses	(teaching) AND (cartography OR geography) AND (technologies)	2010 to 2020

Source: Prepared by the authors (2022)

During the search in the databases, 232 documents were found (articles, dissertations and theses). Concomitant to the survey, the abstracts were read in order to confirm the relevance and clarity regarding the object of study, and 222 documents were excluded for not meeting the intended requirements, i.e., publications that did not refer to the teaching of cartography in basic education, specifically in Secondary Education.

At the end of the screening stage it was possible to obtain complete access to 10 documents published over the various years of the decade considered, 5 articles, 4 master's dissertations and 1 doctoral thesis, according to chart 4.

**Chart 4 – Documents from the literature search<sup>4</sup>**

Nº	Author(s)	Year	Title	Type	Country
1	Batista, N. L.	2019	Cartografia escolar, multimodalidade e multiletramentos para o ensino de geografia na contemporaneidade	Theses	Brazil
2	Junior, L. M. & Martins, R. E. M. W. & Frozza, M. V. C.	2020	Potencialidades da ferramenta Google My Maps para o ensino de geografia em Portugal	Article	Portugal

<sup>4</sup> Translator's note: We have chosen to keep the original name of the Brazilian Portuguese language researches

3	Lôbo, R. N. B.	2011	O uso da cartografia digital como ferramenta didática na disciplina Geografia no ensino médio		Dissertation	Brazil
4	Louro, D. F. dos S.	2016	A utilização das Tecnologias de Informação e Comunicação como ferramenta didática no ensino da História e da Geografia		Dissertation	Portugal
5	Medeiros, J. L.	2016	Tecnologias Digitais e Geografia: um relato de experiência.		Article	Brazil
6	Nogueira, R. E.	2012	Tecnologias da Informação e Comunicação (TICs), inclusão e cartografia escolar		Article	Brazil
7	Oliveira, E. A. & Oliveira, R. C. S.	2019	O Uso do Aplicativo LandscapAR Como Recurso Pedagógico Para o Ensino de Geografia		Article	Brazil
8	Santos, A. M. F.	2018	(WEB) Cartografia e Realidade Aumentada: Novos Caminhos para o Uso das Tecnologias Digitais no Ensino da Geografia		Article	Brasil
9	Silva, A. P. A. d.	2013	Potencial pedagógico do sensoriamento remoto nas escolas de educação básica da região metropolitana de Feira de Santana - Bahia		Dissertation	Brasil
10	Silva, F. G.	2012	Geotecnologias no ensino de geografia: Livros didáticos e práticas educativas para o ensino médio em Feira de Santana, BA		Dissertation	Brasil

Source: Prepared by the authors (2021)

To conduct the interviews, a script was built, "a fundamental instrument for the correct and useful conduct of the interview" (AMADO, 2013, p. 215). Sources from the literature review regarding the object of study were used, in addition to the results from the documentary analysis of the bibliographic research conducted in the previous step, as provided by Amado (2013).

The interviews with teachers aimed to characterize the perceptions of teachers about the use of digital technologies in cartography teaching; describe the practices that teachers say they adopt when using digital technologies in cartography teaching, highlighting the activities, strategies, content covered and digital tools used in the classes; and, finally, identify the teachers' vision about the potential of digital technologies in cartography teaching in relation to traditional technologies. Given the conjuncture of the covid-19 pandemic, which was indisputably present in all sectors of society, including education, there was a need to identify possible changes that occurred in the pedagogical practices of teachers during this period.

The interviews were carried out with Geography teachers who teach cartography in the 1st year of High School at the Military Colleges. The interviewed teachers teach in one of the schools in the North, Northeast and South regions of Brazil.

The interviews with the teachers took place in July 2020 by videoconference, using the Zoom and Google Meet applications, and only the audio of the interviews was recorded, after authorization from the interviewees. It is worth mentioning that ethical principles and guidelines were respected and complied with during the research, having the favorable opinion of the Ethics Committee of the Institute of Education of the University of Lisbon (no. 545 of February 3, 2010) for this research. The protection and privacy of participants were ensured, maintaining the confidentiality of information.

For data analysis, the categorical analysis technique was used (BARDIN, 2016). For the analysis of the documents that resulted from the literature search, we proceeded to identify elements in common in all studies that were organized into a system of categories of their own, while considering the qualities of mutual exclusion, homogeneity, relevance, objectivity, fidelity and productivity (BARDIN, 2016). We sought to identify the elements that described the practices of cartography teaching with the use of digital technologies and, subsidized by the theoretical contribution, the following categories were defined: strategies, activities, content and digital tools.

For the process of content analysis of the interviews, we chose the closed procedure (AMADO, 2013), proceeding to the categorization of the elements that describe the teaching practices with technologies adopted by teachers, from a system of previous categories.

### **Sociodemographic characterization of the interviewed teachers**

In terms of academic background, all the interviewed teachers have a degree in Geography and at least one specialization and/or master's degree. Two male teachers and one female teacher were interviewed, all belonging to the military teaching staff. The teachers have a level of experience ranging between 8 and 33 years teaching Geography.

### **Presentation and discussion of results**

In this section we will present the results based on the comparative analysis of the results of the analysis of the publications obtained in the literature search and the interviews for each of the dimensions and categories.

## Use of digital technologies in teaching

According to the perceptions of the interviewed teachers, technologies provide approximation for the student in his relationship with reality, as well as in the student-teacher relationship. Regarding the perceptions about the contributions of digital technologies to learning, it can be observed that teachers highlight the speed of access to information and the achievement of results when technologies are used for learning, in addition to the possibility of using technologies as a reinforcement to what is taught in the classroom, reinforcing that technologies should be a tool to assist the student in learning, actively involving him as a protagonist in the construction of his knowledge (COSTA *et al.*, 2012).

## Use of digital technologies in teaching cartography

Regarding the view on the use of digital technologies in the teaching of cartography, teachers see digital technologies as essential for cartography and consider that they facilitate the understanding of cartographic representations by students. These results corroborate what Silva, Antunes, and Painho (1996, apud DI MAIO, 2004, p. 44) advocate when they describe that geotechnologies:

They contribute to the development of knowledge in Geography and of graphic skills, since they enable the location of geographical elements, the perception of scale changes and their reflection in a problem, through multiple spatial representations of the phenomena (SILVA; ANTUNES; PAINHO, 1996 apud DI MAIO, 2004, p. 44).

Regarding the teaching-learning practices with digital technologies for the teaching of cartography, in which we seek to characterize how digital technologies are used by teachers, we present the results organized into six subcategories, namely: (i) activities performed by students with digital technologies to learn cartography, (ii) cartography contents worked with the use of digital technologies, (iii) digital tools used, (iv) strategies used in the teaching-learning of cartography with digital technologies, (v) forms of social organization of students in the activities with the use of digital technologies to work the knowledge of cartography, and (vi) use of digital technologies in the evaluation of learning in cartography.

Among the activities performed, teachers highlight the measurement of distance from a scale and the location of phenomena in geographic space through geographic coordinates as the activities most performed by students. In the documents surveyed, it was observed that measuring distance from a scale was the activity with the highest occurrence (N=4). The

activities of exploration of satellite images and localization of phenomena in geographic space through geographic coordinates had the same number of occurrence (N=3) each. The activities performed promote learning through the acquisition of knowledge at different levels of complexity ranging from understanding, application of acquired knowledge, analysis, to creation/elaboration (CHURCHES, 2009). In this sense, it is observed a higher occurrence of activities related to the application/mobilization of knowledge considered of medium complexity, according to Bloom's digital taxonomy (CHURCHES, 2009).

Regarding the content, the location of phenomena in geographic space through geographic coordinates is the content most worked by teachers. Then, the reading and interpretation of cartographic documents and notions of scale were the most addressed contents. In the surveyed documents, it was observed a higher occurrence of reading and interpretation of cartographic documents (N=5). Four studies emphasize the teaching of notions of scale. Next was the localization of phenomena in geographic space by means of geographic coordinates (N=3), then the elaboration of cartographic documents (N=2) and the representation of the landform (N=2). The contents identified in the results are consistent with critical reading skills and conscious mapping for a high school student and are in accordance with the methodological acquisitions that the age group should acquire in cartography, as described by Simielli (1999). The complex acquisitions represent most of the surveyed contents, while the medium acquisitions and the simple acquisitions represent the contents identified by the teachers.

As for the digital tools used, it is observed that only two tools were indicated by the teachers. Google Earth is used by two teachers and Google Maps is used by one teacher. In the surveyed documents, Google Earth is the most used tool (N=5). This is followed by the Google Maps tool (N=3), then the "LabTate Portal" tool (N=1), the LandsacpAR tool (N=1) and QGIS (N=1). Meneguete (2014, p. 25) highlights that Google Geo products constitute a "powerful set of educational tools" because they are easy to use and share. These tools are technologies called "webcartography" (OLIVEIRA; NASCIMENTO, 2017). According to Tsou (2011, p. 250), webcartography "is the new medium of maps, changing cartographic representation from paper and desktop GIS to distributed, user-centered, mobile, and real-time geospatial information services"<sup>5</sup>. Webcartography tools present several criteria, such as computer-based tools, available applications, affordability, knowledge construction, generalization, critical thinking, transferable learning, simple and powerful formalism, and

<sup>5</sup> Webcartography is a new way of representing maps, no longer as traditional as printed maps, but as user-centered, real-time representations of geospatial information.

easy to learn which, according to Jonassen (2000), serve as indicators to evaluate whether an application can be classified as a cognitive tool. For Jonassen (2000, p. 33), cognitive tools are "knowledge representation tools that use computer application" and should be regarded as "intellectual partners that facilitate knowledge construction and reflection by students."

As for the strategies used in the teaching-learning of cartography with digital technologies, it is observed that two teachers organize their classes starting with an expository moment and, in the second moment, with the realization of practical activities. The third teacher is different from the others, for besides starting with an expository-dialogical class, he uses the laboratory to perform the practical activity. In the researched documents, in half of the reported studies (N=4), the classes start with the presentation of the topic, the key concepts and the specificities of each of the digital tools that are later used in the practical activity. The introduction activity to the theme, through the expositive and dialogical class technique, approaching and discussing the key concepts in a dialogical way, values the students' participation (N=2). Regarding practical activities, half of the studies analyzed (N=5) chose to perform practical activities using the computer lab. In two studies practical activities were carried out with the use of a smartphone in the classroom.

Regarding the forms of social organization of students in activities using digital technologies to work with cartographic knowledge, it was observed that two of the three teachers prioritized organizing students in group and/or pair activities and one teacher prioritized individual activities. It is also observed that in seven studies analyzed were reported that the suggested activities were performed in groups.

### **Potentialities of digital technologies in teaching cartography**

It can be observed that teachers present different visions, ranging from the instantaneity and speed that digital technologies provide when working different levels of cartographic and geographic analysis, to the potential that technologies have in helping the student to search for more in-depth cartographic information, to the potential of the practice of cartographic production when digital technologies are used. These visions demonstrate the potential of digital technologies for the teaching of cartography. The different views of teachers converge on the role of technology in teaching and in the classroom, allowing students to "think more productively" (JONASSEN, 2000, p. 26).

## **Teaching in the Context of the COVID-19 Pandemic**

Regarding the identified changes in teaching practices caused by the pandemic of COVID-19 compared to teaching-learning practices in previous years, all teachers reported that there were changes caused by the pandemic. One teacher started to record video lessons to present the contents. Another teacher reported that she started to hold synchronous classes and that they have been very productive. A third teacher pointed out that there was a decrease in student-teacher interaction, because with the implementation of the virtual learning environment as a teaching platform during the closing of the school, many students were unable to interact in this environment.

Regarding the changes identified in the teaching-learning practices of cartography with digital technologies, we observed different reports from the teachers. One teacher taught cartography classes before the pandemic, so he reported that there was no change. Another teacher emphasized that the pandemic affected teaching and learning, considering that the planning of the classes was prior to the pandemic and the exemplification of the activities that were previously thought and planned to be face-to-face, needed to be adapted to the remote mode. A third teacher emphasized that in the context of the pandemic there was a deepening of the cartography contents, since the students were immersed in the remote teaching context with the use of digital technologies, and therefore researched more about the subjects.

## **Conclusions**

In the search for the answer to the central question "How do Geography teachers take advantage of the potential that digital technologies have for the teaching of cartography in Basic Education in Military Education System in Brazil?" and its specific questions, some final considerations are presented in the form of conclusions, based on the theoretical framework and the results found, both from the analysis of the documents referring to the studies carried out in this field between 2010 and 2020, and in the interviews made to the teachers.

The practices of teaching cartography with digital technologies identified in the results of studies carried out in this area and described by the interviewed teachers proved to be quite diverse. With regard to the activities developed in the teaching of cartography with digital technologies, we highlight the activities of measuring distance from a scale and the location of phenomena in geographic space through geographic coordinates. These are in the list of activities of medium complexity belonging to the levels 'apply' and 'analyze', according to the

approach of Bloom's Digital Taxonomy applied to the context of ICT integration proposed by Churches (2009). Activities of lower cognitive complexity and activities of higher complexity were also identified. The identification of activities at different levels of cognition demonstrates the teachers' concern in the choice of activities that promote intellectual development and critical thinking, noting that the theoretical perspective underlying the teaching practices tends to be constructivist (e.g. COSTA, 2008; JONASSEN, 2000; PAPERT, 2008; PRENSKY, 2010).

As for the contents addressed in the teaching of cartography with digital technologies, it is verified that the location of phenomena in geographic space through geographic coordinates and the reading and interpretation of cartographic documents are the contents most present in the interviewees' speech and in the researched documents, respectively. It is observed that the notions of scale and the representation of relief were also identified in the speeches of the interviewed teachers. It is worth noting that the contents addressed are provided for in the SCMB's 1st year High School Geography PSD, a guiding document for the development of the contents and objectives intended by the teacher (DEPA, 2016).

As for the digital tools used in cartography teaching, it is verified that Google Earth and Google Maps, also called webcartography (OLIVEIRA; NASCIMENTO, 2017), are the most used tools. Di Maio (2013, p. 80) highlights that these tools "encourage new forms of knowledge and actions and their inclusion provides positive impacts on school teaching practices, including in favor of citizenship, in view of the large amount of data available with free access on the web".

As for the strategies adopted in the teaching of cartography with digital technologies, we conclude that the expositive lessons for the introduction of the theme and the practical activities with the use of cell phones and/or the use of the computer lab are the most used strategies. It is also noteworthy that the organization of the students usually occurs in groups.

Regarding the teachers' perceptions of the use of digital technologies in cartography teaching, it is possible to conclude that digital technologies facilitate, primarily, the understanding of cartographic representations by students, giving new meaning to "the act of learning and the process of knowledge construction due to the possibilities provided" (PEREIRA; KUENZER; TEIXEIRA, 2019, p. 4). It is verified that teachers have a very favorable view about digital technologies, highlighting their role as support in the teaching-learning process of the students themselves, making them more critical and productive in the construction of knowledge (COSTA *et al.* 2012; JONASSEN, 2000; PRENSKY, 2010).



In relation to the teaching-learning practices of cartography with digital technologies, it was found that the context of remote teaching allowed a deepening of the contents, due to the use of technologies as a research resource by the students while performing the activities. With the development of the study, it was verified that the interviewed teachers take advantage of the potential of digital technologies from diversified practices, denoting willingness and motivation for the use of digital technologies in the teaching of cartography. As a suggestion for future studies, it is proposed to continue the research with teachers from regions not covered in this study, as well as the direct observation of classroom practices.

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