

TPACK PUBLICATIONS IN BRAZIL BETWEEN 2018 AND 2021

*PUBLICAÇÕES SOBRE TPACK NO BRASIL ENTRE 2018 E 2021*

*PUBLICACIONES SOBRE TPACK EN BRASIL ENTRE 2018 Y 2021*



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**ABSTRACT:** The pandemic of Covid-19 caused modifications in the Brazilian educational processes, therefore, teachers in training were faced with difficulties about the pedagogical approach of Digital Information and Communication Technologies (ICT). Thus, discussions about the Technological Pedagogical Content Knowledge (TPACK), focus of research in Brazil since 2009, intensify, mainly, regarding the initial and continuing education of teachers, teaching and learning with the integration of ICT. Thus, the objective of this study is to analyze the publications on TPACK, in Brazil from 2018 to 2021, seeking to answer: which studies and/or reviews published and their typology on the theme? which year has the largest number of publications? The corpus of analysis consisted of 45 works (articles, dissertations, and theses) found in open access databases. The research also presents previous bibliographic reviews, performing a cross-referencing of data and discussions.

**KEYWORDS:** Teaching knowledge base. Education. Teaching knowledge. Shulman.

**RESUMO:** *A pandemia da Covid-19 ocasionou modificações nos processos educacionais brasileiros, logo, professores e professoras em formação depararam-se com dificuldades sobre a abordagem pedagógica das Tecnologias Digitais da Informação e Comunicação (TDIC). Dessa forma, discussões sobre o Conhecimento Tecnológico e Pedagógico do Conteúdo (Technological Pedagogical Content Knowledge - TPACK), foco de pesquisas no Brasil desde 2009, intensificam-se, principalmente, quanto à formação inicial e continuada de professores, o ensino e aprendizagem com a integração das TDIC. Assim, o objetivo deste estudo é analisar as publicações sobre o TPACK, no Brasil de 2018 a 2021, procurando responder: quais estudos e/ou revisões publicados e sua tipologia sobre o tema? qual o ano com maior número de publicações? O corpus de análise constituiu-se de 45 trabalhos (artigos, dissertações e teses) encontrados nas bases de dados de acesso aberto. A pesquisa apresenta ainda, revisões bibliográficas anteriores realizando um cruzamento de dados e discussões.*

**PALAVRAS-CHAVE:** *Base do conhecimento de ensino. Educação. Saberes docentes. Shulman.*

**RESUMEN:** *La pandemia del Covid-19 provocó modificaciones en los procesos educativos brasileños, por lo que los profesores en formación se enfrentaron a dificultades sobre el enfoque pedagógico de las Tecnologías Digitales de la Información y la Comunicación (TDIC). De este modo, se intensifican las discusiones sobre el Conocimiento Tecnológico Pedagógico del Contenido (TPACK), foco de investigaciones en Brasil desde 2009, principalmente, sobre la formación inicial y continuada de los profesores, la enseñanza y el aprendizaje con la integración de la TDIC. Así, el objetivo de este estudio es analizar las publicaciones sobre TPACK, en Brasil de 2018 a 2021, buscando responder: ¿qué estudios y/o revisiones publicaron y su tipología sobre el tema? qué año tiene el mayor número de publicaciones? El corpus de análisis consistió en 45 trabajos (artículos, disertaciones y tesis) encontrados en bases de datos de acceso abierto. La investigación también presenta revisiones bibliográficas previas realizando un cruce de datos y discusiones.*

**PALABRAS CLAVE:** *Base de conocimientos de la enseñanza. Educación. Conocimiento del profesor. Shulman.*

## Introduction

The COVID-19 pandemic has had an impact on life in society in different ways, in which education has been affected by the suspension of face-to-face school activities, and as a result of this preventive measure, institutions have implemented emergency remote teaching (ERE), blended learning and other educational actions that did not exist prior to the pandemic. These types of teaching created the need for professional teacher improvement, especially when pedagogical and technological relationships are established in the development of content. Therefore, appropriating TDIC in the teaching and learning processes is fundamental in the current educational context (RICARDO, 2020). For the National Union of Municipal Councils of Education (UNCME), the pandemic period exposed the lack of experience of teachers with Information and Communication Technologies (ICT) and the impossibility of access by students to the internet and ICT (UNCME, 2020).

In view of this, teachers need pedagogical knowledge that encompasses technologies, so that they transcend the mere vision of a tool to that of a cultural instrument, which constitutes another perspective of work, referring to the Technological Pedagogical Content Knowledge (TPACK) – a framework that highlights the relationships of the triad technology, pedagogical knowledge and interrelated content (MISHRA; KOEHLER, 2006). The TPACK proposed by Mishra and Koehler (2006) is based on the Pedagogical Content Knowledge (PCK), composed of Content Knowledge (CK) and by Pedagogical Knowledge (PK) proposed by Shulman (1986).

Shulman, continuing his studies, seeks to include new knowledge in its base, comparing them with the Periodic Chart, in which new elements are added as studies are carried out; In this way, we can say that A Knowledge Base for teaching is not fixed and definitive, and in it we have the Knowledge of Students (CA) and their characteristics and the Knowledge of Educational Contexts (KCE). CA is the teacher's knowledge of how their students learn and the relationships established with the contents; the CCE refers to educational contexts, school management and the community in which the school is inserted (SHULMAN, 2014).

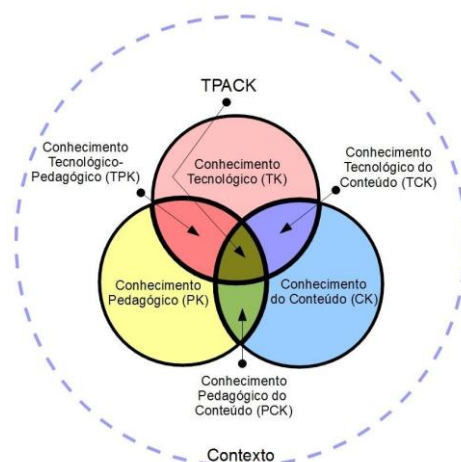
CK relates to the teacher's discipline, understandings, concepts, processes and procedures in a specific area; the PK with teaching practices or methods, learning processes, values, objectives, development and management of actions in the classroom, planning and student assessment (SHULMAN, 1986). The PCK constitutes skills, competences and knowledge necessary for teacher training, that is, it is the knowledge of the didactics of the

content, of how to teach the subject, of how to interpret and find ways to work a specific subject in a specific content (SHULMAN, 1986).

With the advances in technology, Mishra and Koehler (2006), based on the knowledge proposed by Shulman (1986), originated the TPACK including the Technology Knowledge (TK) component, which discusses the knowledge necessary for teachers to use technologies in their teaching and learning processes, resulting in: Technological Content Knowledge (TCK); Pedagogical Knowledge of Technology (TPK) and TPACK. Thus, TPACK makes it possible to understand the context in which the technology is inserted to consider the use of pedagogical knowledge and the best way to adapt the reality that is being experienced, as well as the content to be studied. Shulman 's knowledge relations (TK, PK and CK) originate four different domains (FIGURE 1).

It is important to emphasize that TPACK is essential for the teaching and learning processes involving technologies, however, it is not enough to promote changes in teaching and learning proposed by teachers. This knowledge is a way for teachers to appropriate technologies with the intention and objective of seeking to understand how technologies can contribute to the development of content and student learning (CIBOTTO; OLIVEIRA, 2017). It is the combination of content, pedagogical and technological knowledge with professional teaching integration, so that teachers feel comfortable in developing their practices combined with technologies in their knowledge set, with a critical proposition of contents (RIBEIRO; PIETY, 2021).

**Figure 1 – TPACK and knowledge components**



Source: Adapted from Koehler and Mishra (2009, p. 63)

TPACK is the interactions between Knowledge, Technology and Pedagogy so that technologies in the teaching and learning processes are constitutive and not just tools to make a different class. Therefore, professors need to be prepared and qualified to use ICT as cultural instruments, which articulate the production of new understandings of themes and contents to be taught and learned. Therefore, the knowledge of TPACK (CHART 1) is important in professional teacher training.

**Chart 1** – Summary of TPACK knowledge

<b>PCK</b>	It's teaching with art and science; it's mastering the content and knowing how to conduct it.
<b>TCK</b>	It is evaluating the best technology that relates to the content.
<b>TPK</b>	It is to evaluate the most adequate DICT for the intended teaching and learning strategy.
<b>TPACK</b>	It means mastering pedagogical teaching methods that use digital technologies in constructive ways to develop content.

Source: Nise Furtado *et al.* (2021)

In this sense, this investigation is relevant for approaching and presenting the research on TPACK, starting with the literature reviews already carried out between the period from 2011 to 2018, and in continuity extends the searches until June 2021. Maneira and Gomes (2016) and Bervian (2019). Therefore, this investigation proceeds because the use of technology in teaching is not trivial, especially when situations such as the COVID-19 pandemic arise, demanding other reflections on teaching with technologies from teachers.

## Methodology

This research has a qualitative approach, with a systematic review of published studies on TPACK available in open access databases with the phases: i) need for revision; ii) identification and selection of the studies that make up the review; iii) presentation and analysis of the results (KITCHENHAM, 2004). To assist in the review of TPACK in Brazil, the following questions were defined: (i) what are the published studies and/or reviews on the subject? (ii) what is the year with the highest number of publications on TPACK in Brazil in the period 2018-2021? What is the typology of publications on the subject in Brazil?

The open access databases used were: (i) Catalog of Theses and Dissertations of the Coordination for the Improvement of Higher Education Personnel (CAPES); (ii) CAPES journals; (iii) Scientific Electronic Library Online (SciELO). The descriptor “TPACK” was used in the search for studies published in Brazil, the data period was not delimited, and the collection took place in July 2021, limiting works and studies found until this date. Inclusion

criteria are: (i) empirical scientific work, in the form of an article, master's dissertation or doctoral thesis; (ii) carried out in Brazil; (iii) open access. For the exclusion criteria, we eliminated the publications: i) repeated; ii) unrelated to the “TPACK” descriptor in its title or abstract. A total of 45 works were found, distributed in Chart 2, with the number of publications found and the period in each database.

**Chart 2** – Corpus of the bibliographic review

Data base	Number of publications found	Period of publications
CAPES Theses and Dissertations Catalog	27	2018-2020
CAPES periodicals	15	2018-2021
SciELO	03	2019
<b>Total</b>	<b>45</b>	<b>2018-2021</b>

Source: Survey data (2022)

In the CAPES Catalog of Theses and Dissertations, there were 27 works, from 2018 to 2020; in SciELO, articles were found only in the year 2019.

### Systematic reviews of publications prior to 2018

Trying to answer the first question, about studies and/or literature reviews carried out on TPACK in Brazil, Chart 3 shows: authors, year of publication, review period and number of publications.

**Chart 3** – Systematic literature reviews on TPACK in Brazil

Authors And Year	Review Period	Publications searched/found
NOGUEIRA; PESSOA; GALLEGO, 2015	2006-2015	29 <sup>3</sup>
MANEIRA; GOMES, 2016	2006-2015	08
BERVIAN, 2019	2011-2018	20
NISE FURTADO <i>et al.</i> , 2021	2015-2020	20
<b>Total</b>	<b>2006-2020</b>	<b>77</b>

Source: Survey data (2022)

The first literature review found was by Nogueira, Pessoa and Gallego (2015), with research on studies from Portugal, Brazil and Spain on the subject, in which publications between 2006 and the first half of 2015 were evaluated. The terms used in the search for

<sup>3</sup>The results of the survey from Brazil were presented to compare the other reviews. The study also included the analysis of 33 articles in Portugal and 30 in Spain (NOGUEIRA; PESSOA; GALLEGO, 2015).

systematic literature reviews on TPACK were: “Systematic literature review”, “TPACK”, with the Boolean operator “e”.

The second review by Maneira and Gomes (2016) established the timeline between 2006 and November 2015, with studies related to interventions/actions and operationalization of TPACK. The review by Bervian (2019) from 2011 to 2018 showed the publications of the National Meeting of Research in Science Education, World Congress of Learning Styles, International Conference on Information and Communication Technologies in Education, in the CAPES journal portal and in Google Scholar. In the fourth review, Nise Furtado *et al.* (2021), with a review from 2015 to the first half of 2020, in Google Scholar, SciELO and the Brazilian Digital Library of Theses and Dissertations, present the studies found.

Considering Chart 3, it can be seen that the first review of TPACK was carried out in 2015, and that the proposed framework, which was published internationally in 2006, took a few years to be disseminated in Brazil. Another factor that may have influenced this systematization refers to the fact that, in 2015, the internet reached households (about 50%) in Brazil, according to research by the Center for Studies on ICT. Until then, about 14% of the population did not use cell phones (GOMES, 2015). These factors may have contributed directly to discussions on Digital Information and Communication Technologies (TDIC), at school and in teacher training, still being incipient and with few studies, since accessibility to computers, cell phones and the internet was not yet fully available, and/or was a priority.

In order to present the typology of the corpus of previous reviews on TPACK, we tried to organize Chart 4, with the authors/year of reviews, the number of dissertations, theses, book chapters and monographs.

**Chart 4** – Typology of the corpus of systematic literature reviews on TPACK

Authors And Year	Articles In Journals	Dissertations	Theses	Book Chapter	Monography
NOGUEIRA; PESSOA; GALLEGO, 2015	15	11	03	00	00
MANEIRA; GOMES, 2016	04	03	00	01	00
BERVIAN, 2019	19	00	00	01	00
NISE FURTADO <i>et al.</i> , 2021	11	06	02	00	01
Total	49	20	05	02	01

Source: Survey data (2022)

Most productions focus on articles (49): only one monograph on TPACK was identified in this period. In this sense, it seems that TPACK does not arouse interest in undergraduate course completion research, in the periods covered by the studies cited in Chart 4. It was not

possible to find directly linked factors that could justify such lack of interest. Indirectly, it can be proposed that society was and is experiencing great technological advances, but TDIC seem to remain apart from schools and education. G1 Portal (2012) demonstrates that TDIC did not find its way to school and routine activities with lectures remain the reality. Thus, research in Higher Education depends on studies in Basic Education.

Finally, to provide an overview of the research found in systematic reviews of the literature already published, Chart 5 was prepared with the division of studies by year, in which the study by Nogueira, Pessoa and Gallego (2015) did not indicate the distribution of publications by year and for this reason are not described.

**Chart 5 – Year of systematic literature reviews on TPACK**

Year	NOGUEIRA; PESSOA; GALLEGO, 2015	MANEIRA; GOMES, 2016	BERVIAN, 2019	NISE FURTADO <i>et al.</i> , 2021	Total
2006	The authors did not specify the number of works per year	-	-	-	-
2007		-	-	-	-
2008		-	-	-	-
2009		01	-	-	01
2010		01	-	-	01
2011		02	02	-	04
2012		00	01	-	01
2013		01	03	-	04
2014		02	01	-	03
2015		01	05	02	08
2016		-	-	03	02
2017	-	-	03	07	10
2018	-	-	02	02	04
2019	-	-	-	05	05
2020	-	-	-	02	02

Source: Survey data (2022)

Chart 5 shows that TPACK began to be researched in Brazil in 2009 with a master's thesis and, in the following year (2010), there was only one study with an academic article. These factors may show that data from the Ponto BR Information and Coordination Center (NIC.br), in 2009, which together with the Center for Studies on Information and Communication Technologies (CETIC.br) carried out research on the use of computers and internet access, point to a percentage of growth. Still in 2009, 36% of Brazilian households had computers and 27% had access to the Internet, triggering the beginning of discussions on DICT in schools (CETIC.br, 2009).

If we ignore the data not presented in the study by Nogueira, Pessoa and Gallego (2015), but analyze the other reviews presented, it can be mentioned that, in 2017, there was the highest



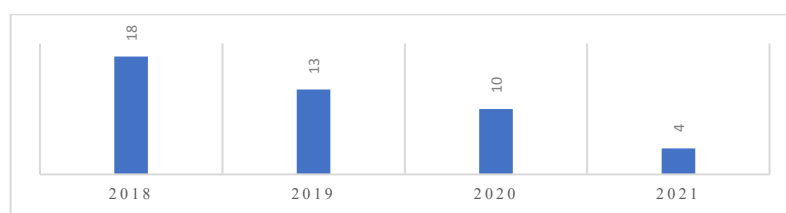
number of publications regarding TPACK. This factor can be explained with the arguments of Gomes (2018), who presents the growth in the use of technologies in Brazil, from 2017, and with the perspective of expansion and growth of these in the school universe.

Another factor that may have contributed to this growth of research on TPACK in Brazil is the increased use of the internet by the population that attends basic education (access of 77% of the school population to the network), as well as the access of teachers to technologies through smartphones (15% in 2011 to 96% in 2016) (CAMPOLI, 2017). Thus, these numbers may suggest greater interest on the part of professors in technologies and their pedagogical use, producing demands for further research on the subject in Brazil, since, in teaching, professors are challenged at all times in relation to TDIC. Students have profiles increasingly integrated with technologies, demanding other approaches from teaching and learning methods, as proposed by Mishra and Koehler (2006) in TPACK: knowledge that articulates technologies, pedagogical and content knowledge to favor student learning. Still, it is possible to recognize ICT as cultural instruments that promote cognitive development in a different way.

### **Systematic review of TPACK in Brazil: publications between 2018 and 2021**

Regarding the publications found on TPACK between the period 2018 and June 2021, we sought to elucidate the second question of this review, presenting the number of publications per year on TPACK in Graph 1, in the described period.

**Graph 1 – Year of publication of the TPACK studies**



Source: Survey data (2022)

As can be inferred from the literature reviews, the number of studies on TPACK shows an increase from the year 2017, consolidating with our research in 2018. It should be noted that one of the possible justifications for this increase in publications is related to the implementation of the National Common Curricular Base (BNCC) with a normative character for Basic Education, developed to present essential learning to students through skills to be developed.

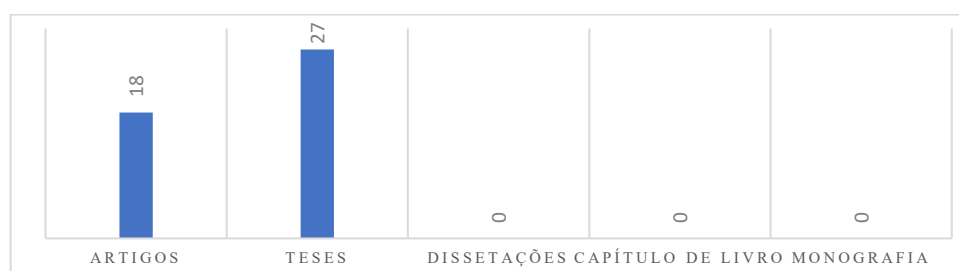
Among the essential competences, we have competence 5, which links TDIC as essential in the teaching and learning path of students, both inside and outside school:

Understand, use and create digital information and communication technologies in a critical, meaningful, reflective and ethical way in the various social practices (including school ones) to communicate, access and disseminate information, produce knowledge, solve problems and exercise protagonism and authorship in personal and collective life (BRASIL, 2018, p. 9, our translation).

Thus, the increase in the number of works related to TPACK, in 2018, may be related to the implementation of the BNCC and the intention of in-service and in-service teachers to delve deeper into TDIC, as there is a need and intention to study technology and teaching and learning issues, thus rethinking the initial and continuing training of teachers. Although 2020 shows a decrease compared to previous years, there is a tendency to believe that the number of publications may have been affected due to the COVID-19 pandemic, as an atypical moment in society, with different consequences for researchers, professors and students: from education systems never adopted before to research resources being affected.

The low number for 2021 can be explained by the fact that the collection period takes place in the middle of the current year, when research could still be published in the second half, and the fact that some platforms require a period of between three and eight months to carry out the publication, thus causing delay in access to these researches. It is also believed that research regarding TPACK will tend to, in the future, show a growth rate due to the factors of the COVID-19 Pandemic and the different forms of teaching such as ERE, blended learning and distance learning, involving the technologies that the teacher, both in Basic Education and in Higher Education, sought to adapt in a short period of time, resulting in discussions about pedagogical and content knowledge involving TDIC.

Regarding the typology of publications found on TPACK, Graph 2 expresses the distribution by typology: articles, master's dissertations, doctoral theses, book chapters and monographs.

**Graph 2 – Typology of studies on TPACK**

Source: Survey data (2022)

The typology of publications links 27 texts to theses on TPACK, perhaps as a continuation of studies developed in dissertations, present in reviews prior to 2018. In relation to this typology, one can see the absence of monographs or course completion works on the theme of TPACK, which shows the little consideration of technological and pedagogical knowledge of content in the constitution of teachers in their initial training.

The research by Teodoro do Prado *et al.* (2020) with Physics undergraduates on perceptions of technological, pedagogical and content aspects in physics teaching brought data that may contribute to the typology not found, such as the neutral and instrumental view of DICT. Higher education students surveyed agree with Lima *et al.* (2012) regarding teachers in training and technologies, treating DICT as tools to help and facilitate academic and student life, without reflections, with an instrumental view not integrated with pedagogical and content knowledge.

That said, it corroborates with Lima *et al.* (2012), considering that the pedagogical use of TDIC needs to be rethought and discussed in the initial training of teachers, so that they are not understood only as resources that contribute to traditional teaching methodologies. In this sense, it is inevitable that discussions about TPACK begin to integrate the initial training of teachers, so that, in the future, they can be the subject of monographs and course conclusion works.

To present the themes of each work, research and/or study found in this review, Chart 6 was organized with a summary of each research.

**Chart 6 - Summary of themes on TPACK**

<b>ID</b>	<b>Summary/theme involving TPACK</b>
T1	It presents and proposes a literature teaching methodology using audiobooks as a way to enhance reading skills, demonstrating its benefits in the acquisition of TPACK.
T2	It investigates how teachers' knowledge of working with TDIC is integrated with specific content knowledge and pedagogical knowledge.
T3	The articulation of TPACK knowledge can be developed in continuing education activities for teaching the Multiplicative Field with support in Digital Technologies.
T4	It addresses accessible music education for visually impaired students through ICT in a school specialized in teaching and rehabilitation of these people in the city of Limeira-SP .
T5	degree courses in distance education at the State University of Maranhão and concepts about knowledge related to TPACK.
T6	It investigates the conceptions and perceptions of the teaching staff composed of tutors and teachers of a Mathematics Degree course or other areas regarding the use of learning objects in the distance learning modality, supported by the TPACK methodology.
T7	TPACK and the analysis of the pedagogical project of the degree course with qualification in pedagogy.
T8	Investigates the training needs of unlicensed teachers in higher technological education: the paths of continuing education.
T9	It investigates the applicability of the TPACK base for meaningful, critical and collaborative continuous learning.
T10	It investigates the understandings of Science teachers, in initial and continuing training, on the constitution of TPACK in interactive research-training-action processes with ICT.
T11	semi- pedagogical and technological training course for the educational use of infographics aimed at Spanish teachers who teach in public basic education, especially in the high school segment.
T12	It investigates the understanding of how learning in/from digital teaching, integrated to the perspective of B-Learning, can promote new pedagogies in teacher training for the integration of ICT, in a Federal Institute of Education, in times of Culture of Digital and Technological Convergence.
T13	Investigate what knowledge (knowledge, skills and abilities) teachers use when there is integration between face-to-face and online teaching, which is essential to identify the demands in relation to the teacher training process.
T14	It presents a case study with the reconfiguration of the remote experimentation laboratory at UFSC in Araranguá/SC, to become Makerspace.
T15	It proposes a lesson plan model that can help teachers in the preparation of classes mediated by ICT.
T16	It investigates the conceptions of teacher trainers about the role of digital technologies in education, to understand whether they favor or limit the stages of pedagogical integration of digital technologies; identify the extent to which operational knowledge of ICT favors the process of pedagogical integration of digital technologies within the scope of Degree courses.
T17	Evaluate the level of integration between the internet, pedagogical approaches and science content that undergraduate students are able to achieve in the construction of teaching strategies based on the proposal of Harris and Hoffer (2009) in an undergraduate course for the use of educational technologies.
T18	It investigates ICT as a support for the conductor, which contribute to their training and to the development of adult choral practice, as well as surveying and describing activities with possible uses of digital technologies in choral practice.
T19	It developed, applied and presented the results of a strategy for teacher training that would allow the integration of ICT in the teaching and learning processes of Basic Education teachers.
T20	It analyzed the changes and continuities of conceptions about Interdisciplinary Teaching in Science and the use of ICT by high school teachers.
T21	Proposition and evaluation of a methodological approach for the insertion of ICT aiming at the Digital Literacy of future Science and Biology teachers.
T22	It investigated the perception of bachelor professors about the teaching knowledge base, specifically, the TPACK to teach classes in the Information Systems course at a university in the south of Minas Gerais.
T23	It investigated the contributions of PIBID to the initial training of Mathematics teachers, with the use of TDIC in the actions carried out by the Mathematics subprojects of the Brazilian Federal Universities.
T24	It identified the knowledge mobilized/constructed by the High School Mathematics teacher, particularly the TPACK during a continuing education whose theme was the teaching of Polyhedrons involving exploratory-investigative tasks, with the use of digital technological resources.
T25	Study on hybrid active teaching and implementation methodologies in a private school in São Paulo.

T26	Elaboration and integrated planning of TPACK and Bloom's Digital Taxonomy, which are achieved with the use of digital tools in the different learning levels of students' cognitive development.
T27	Proposition of an educational product called “mobile technologies: Didactic Sequences for the teaching and learning of Mathematics”, aiming to help teachers in the integration of mobile technologies.
S1	Proposition and improvement of a model through the use of systems of structural equations based on TPACK.
S2	It presents an approach to knowledge and teaching practices around TPACK in university classrooms of humanistic careers in an Argentine university.
S3	It analyzes the design and use of the Web Application in Conditional Probability in the educational process considering the TPACK model, data science and machine learning.
A1	Identifies the pedagogical practices in Distance Learning considered adequate to the areas of knowledge, considering the point of view of teachers, students and mediators.
A2	It explores a sample of in-service teachers' knowledge about using Braille to teach pre-reading skills to visually impaired grade R students.
A3	Investigates Saudi teachers' knowledge of the three essential components of TPACK.
A4	It analyzes the processes of practice and construction of the TPACK of novice teachers in secondary education in nursing.
A5	Blackboard learning management system (LMS), used at the Autonomous University of the State of Hidalgo (EAU).
A6	It presents results of an action-research carried out in an English Language discipline in the Languages course at a federal university in the Emergency Remote Teaching modality.
A7	It sets out professional perspectives of technology-based teaching and learning (TBTL) in the Foundation Phase from the point of view of two district officials from the Gauteng Department of Education .
A8	It analyzes, through interviews, the didactic strategies involved in the use of ICT by three professors of the chemistry degree course at a federal university in Brazil.
A9	Explores the use of tablets to improve English reading among 5th grade primary school students.
A10	It proposes a theoretical and analytical framework for mapping the historical-cultural trajectory of the South African Early Knowledge curriculum.
A11	It presents and discusses the visions of future teachers regarding the integration of digital technologies in Mathematics teaching and teacher training.
A12	It describes the content validation process of a Virtual Learning Object to support the teaching of nursing care systematization to nursing technicians.
A13	We present the e- learning ecosystem (EeL) model, which can be applied to any higher education context, and which takes into account all inhabitants and their interrelationships, not just the components, of the e-learning food chain .
A14	It investigates the levels of development of Technological and Pedagogical Content Knowledge – TPACK of Mathematics teachers.
A15	Discloses the characteristics and construction phases of structural equation models, a useful statistical methodology to study causal relationships through non-experimental information, specifically when the relationships are of the linear type.

Source: Survey data (2022)

The work summarized in Chart 6 focuses on teacher training, whether initial or continuous, on pedagogical and content actions with technologies, focusing mostly (37) on investigating teachers' knowledge regarding TPACK. Thus, it is understood that teacher training and TPACK present the experienced reality, in which teachers and undergraduate students, according to the themes and research summaries, demonstrate the need to relate and investigate how education and TDIC are presented in basic education and in higher education.

Therefore, this systematic literature review presents TPACK studies, structures, propositions and interventions published in Brazil from 2018 to 2021, taking into account that TPACK constitutes pedagogical practices with TDIC. The reading of these studies and research

is relevant to produce evidence that TPACK is seen as a driver of knowledge in pedagogical intervention with the use of TDIC.

It is also corroborated that, with the Covid-19 pandemic, educational reinvention through remote and hybrid teaching tends to present an increase in investigations on TPACK, seeking to assimilate the adaptations of the teaching networks and initial and continuing training offered to Brazilian teachers. However, it is expected that, in addition to expanding research, actions will be carried out for teaching and learning with the use of TDIC as cultural instruments and not mere tools, in the light of TPACK.

### **Final remarks**

The objective of this research was to identify the literature reviews carried out on TPACK in Brazil and to carry out a systematic literature review from 2018 to 2021, investigating the largest number of publications on TPACK and the typology of these publications. Thus, the four literature reviews since 2015 demonstrate that research and studies related to interventions/actions involving the operationalization of TPACK in Brazil are recent. In total, the reviews totaled 77 works, the majority (49) coming from scientific articles.

About these selected literature reviews, it was found that, since 2017, there has been an increase in the number of publications, which may be the result of facilitations and access to DICT by the Brazilian population, leading to the need for pedagogical investigations on the use of technologies in the school environment and, consequently, in the initial and continuing training of teachers. Investigating the open databases, 45 works were found distributed between 2018-2021, which certify the growth that started in 2017 and continues in 2018. The typology of studies shows the significant growth of theses on TPACK.

Among the results, it is worth highlighting the little access to technologies by Brazilians, despite the ease in using smartphones and the internet, unavailable to many people, as demonstrated in the pandemic. The other possibilities of use seem to have expanded studies and research on TPACK, especially regarding teacher training and articulation between content, pedagogical and technological knowledge. It is also noticed that, as a response to the Covid-19 pandemic, studies, from the year 2021, tend to increase with the need for other systematizations to understand the evolution and appropriation of TPACK by teachers.

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