[1]TPACK AND BUSINESS EDUCATION: A REVIEW OF LITERATURE (2008-2017)

TPACK E EDUCAÇÃO EM NEGÓCIOS: UMA REVISÃO DE LITERATURA (2008-2017)

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ABSTRACT

The objective was to conduct a literature review on TPACK in Business Education (BE) from 2008 to 2017 to provide a general scenario of the scientific studies on this topic. We used the search tools of six academic databases to identify studies that included TPACK and business terms. This search yielded a total of 389 studies, which only four were considered as belonging to the TPACK-BE area. Our results suggested that TPACK has not been much explored in BE and deserves more attention. The analysis of core aspects supported that TPACK can help to design courses, although teachers who are not familiar with technology and content would probably face stronger challenges in implementing it. The analysis of circumstantial aspects of the study indicated that they were TPACK-BE studies developed in different countries and published in technology-education thematic journals. Also, most of the studies employed surveys as a method.

Keywords: TPACK; Business education; Review of literature; Faculty; Technology.

RESUMO

O objetivo foi realizar uma revisão da literatura sobre o TPACK em Educação Empresarial (BE) de 2008 a 2017 para fornecer um cenário geral dos estudos científicos sobre esse tema. Utilizamos as ferramentas de busca de seis bancos de dados acadêmicos para identificar estudos que incluíam TPACK e termos de negócios. Essa busca resultou em um total de 389 estudos, dos quais apenas quatro foram considerados pertencentes à área TPACK-BE. Nossos resultados sugeriram que o TPACK não foi muito explorado na BE e merece mais atenção. A análise dos principais aspectos apoiou que o TPACK pode ajudar na criação de cursos, embora os professores que não estão familiarizados com a tecnologia e o conteúdo provavelmente enfrentem desafios mais fortes na sua implementação. A análise dos aspectos circunstanciais do estudo indicou que há pesquisas sobre a área TPACK-BE desenvolvidas em diferentes países e publicadas em revistas temáticas de educação tecnológica. Além disso, a maioria dos estudos empregou pesquisas como método.
Palavras-chave: TPACK; Educação em negócios; Revisão de literatura; Professor; Tecnologia.

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1. INTRODUCTION

Technology from a broad perspective has been utilized to support multiple educational processes. Online homework (JOHNSON et al., 2009), virtual learning environments (TODOROVA; MILLS, 2011), and massive open online courses (Freeman & Hancock, 2013) have all been used by educators. Additionally, some digital educational technologies have gotten more sophisticated over the last decades, including Plicker (HOWELL et al., 2017), Clicker (CHUI et al., 2013), video creation by students (Kaciuba, 2012), and computer tests (APOSTOLOU et al., 2009). They have the potential to bring higher interactivity to the classroom and promote an active learning environment.

With the variety of technologies that are being utilized in educational settings, we should step back and ask ourselves not if new technologies are available, but whether instructors have competencies to employ them appropriately. Particularly in business education (BE), there is evidence that instructors resist adopting new technologies because they do not want to spend time on training or redesigning their teaching methods. For instance, Watty et al. (2016) interviewed 13 academics and found that the time required to learn how to manage technology is one of the main obstacles to adopting technology reported by the respondents. Prior literature shows that others factors impact technology adoption too, for example, beliefs in technology (ERTMER et al., 2012; MUELLER et al., 2008), constructivism practices (OVERBAY et al., 2010), performance expectancy (ANDERSON et al., 2006) and others.

The implementation of technology into classrooms may necessitate that educators redesign their courses as well. In the case of Clicker, Sprague and Dahl (2010, p. 100) emphasize that "perhaps the most significant cost in implementing PRS clicker technology is the change required in the instructor teaching model", and not all educators are willing to modify their teaching style to incorporate technology into classes. Thus, while a significant number of empirical studies focus on the students, more effort is necessary to understand the use of technology by educators better.

An influential framework to assess a faculty's competencies in technology usage is the Technological Pedagogical Content Knowledge conceptual framework (TPACK). It elaborates on Shulman's (1986, 1987) constructs of Pedagogy and Content Knowledge (PCK) and has been improved over time, particularly by Mishra and Koehler (2006) and Koehler and Mishra (2008; 2009). Briefly, TPACK is a framework that takes into consideration the interactions between and among a teacher's body of knowledge regarding technology, pedagogy, and content (KOEHLER; MISHRA, 2009). Our objective is to provide a literature review on the TPACK framework in BE.

Teaching with technology has been perceived as challenging and difficult (MISHRA; KOEHLER, 2006; WATTY et al., 2016). For this reason, a consistent theoretical framework is needed to support technology integration into educational processes. TPACK has been demonstrating to be vital once it brings technology, pedagogy, and content subjects together, and shows how they interact to create new constructs and potentialize more contextual skills (e.g., the union of technology and pedagogy knowledge). It cooperates with teachers by supporting and showing ways to enable or deepen their abilities when it comes to teaching with technology.

Our study offers three main contributions. First, we review the literature about TPACK, a conceptual framework that lays out the bodies of knowledge instructors must have to use

technology effectively in educational processes (VOOGT et al., 2013). This review is meant to help business educators reflect upon their teaching methods as they relate to the use of technology under the TPACK conceptual framework. Second, in our review, we identify how technology has been employed in teaching practices and how this may inform the evolution of the TPACK framework. As technology advances, we need new conceptual frameworks that embrace the use of technology in teaching. Finally, in summarizing the accumulated knowledge yielded so far, we observe gaps in the prior literature and make suggestions for future studies on the topic. It is substantial to assure the continuing development of TPACK and its practical applications within BE.

The remainder of this paper is organized as follows: Sections 2 presents the TPACK framework and how it can contribute to BE. Section 3 describes the methodological procedures. Section 4 reports and debates the results and section 5 concludes and provides opportunities for future research.

2. THEORETICAL SUPPORT

2.1. Overview of TPACK Framework

New technologies have changed the nature of some classrooms, and have the potential to do so more broadly. It is critical to think first "How is the technology used?" instead of "What do teachers need to know?." For the successful integration of new technologies into educational processes, three core components are fundamental: content, pedagogy, and technology, and considering the interactions between these three components (Koehler & Mishra, 2008; Mishra & Koehler, 2006).

Matthew J. Koehler and Punya Mishra proposed the Technological Pedagogical Content Knowledge conceptual framework (initially the acronym “TPCK.” then Total PACKage “TPACK” - see THOMPSON; MISHRA, 2007) after several years working within a Research Program related to Teacher Professional Development and Faculty Development (KOEHLER; MISHRA, 2005, 2008, 2009; KOEHLER et al., 2004; MISHRA; KOEHLER, 2006).

The model is an extension of Lee Shulman's Pedagogical Content Knowledge (PCK) framework in which Content Knowledge (CK) and Pedagogic Knowledge (PK) are seen as correlated and simultaneous factors for teachers to be successful in the teaching and learning process (SHULMAN, 1986, 1987). With the rise of new technologies and their insertion in the educational process, Technological Knowledge was included in PCK Framework (KOEHLER; MISHRA, 2008; MISHRA; KOEHLER, 2006; VOOGT et al., 2013).

TPACK grouped integrated and complex bodies of knowledge about technology (T), content (C), and pedagogy (P). In this framework, the connections among these concepts are essential for teachers to understand when adopting new technologies in their classrooms (CHAI et al., 2013; KOEHLER; MISHRA, 2005, 2009; KOEHLER et al., 2007; MISHRA; KOEHLER, 2006). “The model considers how content, pedagogy, and technology dynamically coconstrain each other” (MISHRA; KOEHLER, 2006, p. 1046). Figure 1 shows how the interactions among the knowledge happen inside the model.

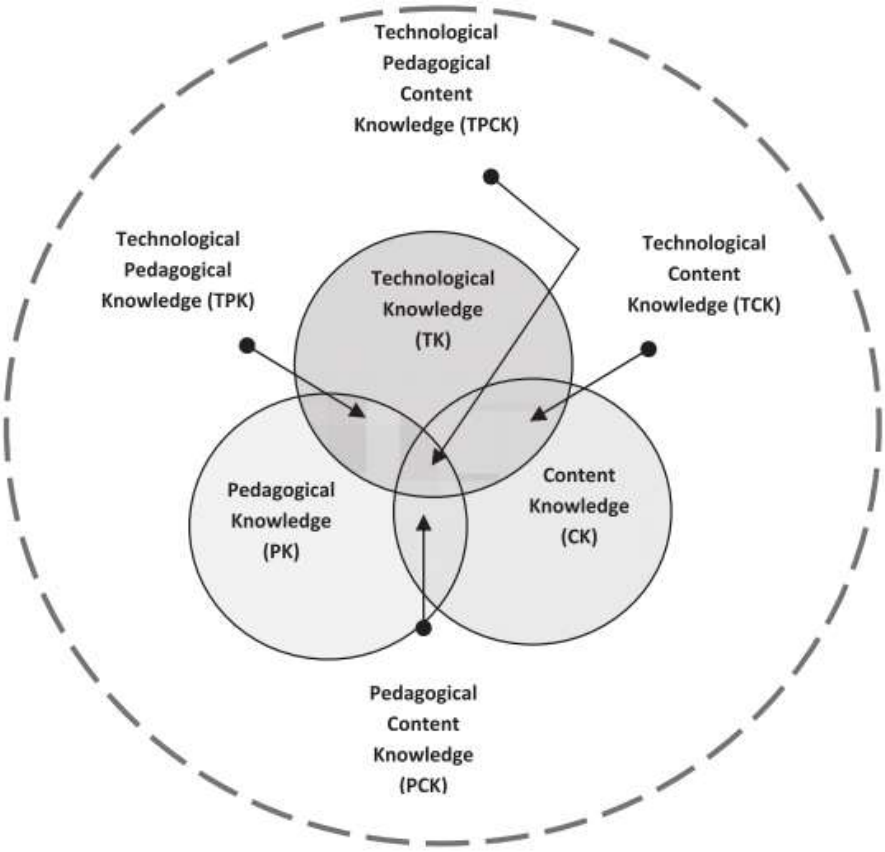

Figure 1 Technological pedagogical content knowledge framework
Source: Koehler and Mishra (2008).

TPACK framework presents three main knowledge categories: Content Knowledge (CK), Pedagogical Content (PK), and Technological Knowledge (TK). The interaction of these three basic forms of knowledge results in other four types of articulated knowledge: Pedagogical Content Knowledge (PCK), Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK) and, as the framework's name indicates, the Technological Pedagogical Content Knowledge (TPACK). Based on Shulman (1986, 1987), Koehler and Mishra (2005, 2009), Koehler et al. (2004), Koehler et al. (2007), and Mishra and Koehler (2006), the TPACK's concepts are presented below:

Content Knowledge (CK) is the knowledge teachers have about the content to be taught, considering the content which will be used on a specific course and that will be important to the development of a specific discussion or theme.

Pedagogical Content (PK) is the in-depth knowledge about processes, practices, and teaching methods presented by teachers. It is the knowledge that could be applied to the learning process, originated from fields such as Pedagogy, Curriculum, and Didactic.

Technological Knowledge (TK) is the ability to learn and adapt to technologies (standard and advanced technologies). The definition of this concept is complex, since it is in continuous evolution, especially when compared to the other knowledge domains (content and pedagogy).

Pedagogical Content Knowledge (PCK) is the form in which subject matter is transformed for teaching and refers to the ability to teach specific content properly, thus promoting interaction between pedagogy and content.

Technological Content Knowledge (TCK) is how technology could influence the content. In addition to domain-specific content, teachers also need to know how the use of technology can influence the subject matter.

Technological Pedagogical Knowledge (TPK) is related to how teaching and learning could be modified when technologies have been used. Also, TPK represents the integration of technology with pedagogical strategies. Finally, grouping all of these concepts:

> We argue that TP[A]CK is the basis of effective teaching with technology and requires an understanding of the representation of concepts using technologies; pedagogical techniques that use technologies in constructive ways to teach content; knowledge of what makes concepts difficulty or easy to learn and how technology can help redress some of the problems that students face; knowledge of students' prior knowledge of and theories of epistemology; and knowledge of how technologies can be used to build on existing knowledge and to develop new epistemologies or strengthen old ones (KOEHLER; MISHRA, 2008, p. 17).

Furthermore, learning how to use a particular technology isolatedly, ignoring the content or context, assumes that it will per se contribute to the success of the learning process. However, knowing how to use technology is not the same as knowing how to *teach with it*. The integration of new technologies into pedagogy processes could be difficult without considering the interaction of TPACK's three basic dimensions (CHAI et al., 2013; KOEHLER; MISHRA, 2005; MISHRA; KOEHLER, 2006).

2.2. TPACK and Business Education

TPACK has been providing vital contributions across different disciplines and at distinct levels of education. Tai et al. (2015), for instance, educators utilized the TPACK model in nursing education to design and implement an online collaborative writing training program in southern Taiwan. In turn, Reyes et al. (2017) conducted an exploratory analysis to verify how lecturers from an Australian regional university perceived the TPACK's impact on their teaching practice. In Turkey, Ay et al. (2015) administered the TPACK-Practical Scale with 296 teachers from 13 different schools (three high schools, four secondary schools, and six primary schools) to examine their perception about TPACK's constructs using structural equation modeling.

In a review of literature, Chai et al. (2013) indicated that the TPACK model had not been employed in some subject matters, such as Visual Arts, Music, Accounting, and Economics, arguing that more studies in these content areas are desirable. As TPACK seems relevant to a wide range of areas, BE is lagging when it comes to discussions about this framework.

Therefore, we present three main arguments why the analysis of TPACK within BE is essential. First, technological competency is progressively demanded by business practitioners as

technology becomes more sophisticated and a massive quantity of data is available today. Given that, recent studies discuss how Big Data will impact the business domain and how it can be incorporated into the curricula (JANVRIN; WATSON, 2017; LIU; BURNS, 2018; SLEDGIANOWSKI et al., 2017). Usage of both data analytics tools and electronic systems (e.g., information systems) in BE are more than pertinent to acquire technology competency, and faculty must have the necessary skills to teach students how to manage them. Second, a body of educational technology must increase to meet the new generation of students' expectations, and faculty cannot ignore this twist in the current education environment if they want to deliver content more effectively. Technology is one of the forces for change in higher education (PINCUS et al., 2017). Despite the resistance of some educators to adopt technology as reported by Watty et al. (2016), evidence supports that there are positive effects on student learning when it is adequately integrated into courses (MISHRA; KOEHLER, 2006; TAI et al., 2015), especially in post-secondary coursework (ESCUETA et al., 2017). Third, investigations about TPACK in distinct areas contribute to its generalizability. Chai et al. (2013) reinforce the need for more research on a broader range of fields. Thus, BE can benefit from existing TPACK studies conducted in other areas while contributing to expanding its theory and findings.

Some crucial implications for BE can be obtained from existing TPACK literature. First investigations on this framework focused on establishing its theoretical constructs, however, as a second step, researchers started dedicating efforts to measure and use it for both research and project purposes (TAI et al., 2015). This is the case of Archambault and Barnett's (2010), Ay et al.'s (2015), and Kopcha et al.'s (2014) studies in which distinct techniques were employed to analyze TPACK's validity as a construct. BE could use both TPACK as an instrument as well as a concept to guide and assess instructors' competencies and teaching profiles and match them with students' learning styles to make feasible a more involving learning process.

A second implication is the usage of the TPACK framework to design courses and programs (RIENTIES; TOWNSEND, 2012). Tai et al. (2015) developed an online English writing course for nursing students, and the results indicated a significant improvement in students' writing skills, as well as demonstrating TPACK's potential to develop courses. As the role of technology in educational settings becomes more prominent to reach distinct students at different places, technology-based courses with a solid theoretical structure are necessary to offer high-quality instruction. Then, BE and instructors can utilize TPACK for enhancing current and developing future courses, particularly because technology is present in business professionals' daily activities. More suggestions for improvements in business course design and teaching practices are discussed by Rienties and Townsend (2012).

TPACK studies have been developed at different levels of education and teachers. For example, Boschman et al. (2015) conducted an explorative case study with kindergarten teachers from three school districts to understand design talk in the collaborative design of technology-rich curriculum activities. The study was also carried out with high school, secondary school, and primary school teachers (AY et al., 2015), science teachers (JEN et al., 2016), business teachers (RIENTIES; TOWNSEND, 2012), and so forth. BE researchers could test TPACK uses at both undergraduate and graduate levels, as well as with teachers with different business backgrounds (e.g., Marketing, Accounting, Management)

Implications of the TPACK do not exhaust here, albeit we discussed only some of them. Despite that, its potential to positively collaborate with instructional methods and student learning constitutes, solely, a strong motivation to analyze this model in BE. The first step though is to offer an overview of accumulated knowledge about TPACK in BE to provide new research opportunities from the present scenario.

3. METHODOLOGICAL CONSIDERATIONS

To conduct our literature review of TPACK, we considered six academic databases over the 2008-2017 period, which are: (1) Elton B. Stephens Co. (EBSCO – all associated databases); (2) Education Resources Information Center (ERIC); (3) Institute for Scientific Information (ISI – Web of Science); (4) Proquest; (5) Science Direct; and (6) Scopus. We continue Voogt et al.'s (2013) discussion by reviewing three additional databases (EBSCO, Proquest, and Science Direct), although we did not take into consideration PsychINFO because our study has a particular interest in BE. We also review two complementary databases (Proquest and Science Direct) in comparison to Chai et al. (2013). Besides that, both Chai et al.'s (2013) and Voogt et al.'s (2013) literature reviews comprise published articles up to 2011. We then update the review of the literature about TPACK up to 2017, focusing on BE area though. For this study, we considered Accounting, Business, Economics, Finance, and Marketing as belonging to the "general" business area. We acknowledge that business can include more areas (e.g., Actuary) than those considered here, but we limited our research to analyze these five terms, which we consider reasonably representative of the "general" business area. Besides, because Thompson and Mishra (2007) proposed to change the acronym from TCPK to TPACK in 2007, our review of literature comprises the 2008-2017 period.

After defining the databases, we used their search tools to search for studies based on the following terms: "TPACK OR TPCK" AND "Accounting OR Business OR Economics OR Finance OR Marketing" in "ALL fields." This first search returned a total of 416 studies and was carried out on January 22, 2018. As 27 studies were in duplicity, they were excluded from the analysis, totalizing 389 studies.

Next, a minimum of two authors read each of the Abstracts to have an indication of whether the paper belonged to the TPACK-BE domain. As expected, a majority of studies were excluded, leaving 6 pertinent articles to be examined. Finally, we proceeded to the full reading of the remaining papers. We considered that four studies belonged to the TPACK-BE area, which constituted the data for the analysis. To organize and classify the studies we utilized an MS Excel® spreadsheet. Table 1 shows the procedures to reach the final group of articles.

Table 1 - Procedures employed to classify the studies

Procedures to classify the studies	Frequency	%
Initial search (based on the terms previously specified)	416	
(-) Studies that were retrieved from more than one database (duplicity)	(27)	
(=) Actual total number of studies	389	100,00

(-) A minimum of two authors read the Abstracts and agreed with their classification and excluded those that did not belong to the TPACK-BE area	(383)	(98,46)
(=) Subtotal	6	1,54
(-) A minimum of two authors read the relevant studies and excluded those that did not belong to TPACK-BE area	(2)	(0,51)
(=) Final group of studies	4	1,03

4. RESULTS

4.1. Databases

Table 2 shows the total number of studies retrieved from each database, as well as the number of studies excluded and selected for the analyses. Because we would not want to manipulate the relative frequency of the TPACK-BE studies by database, we chose to present all studies, including those in duplicity.

In absolute terms, all databases revealed a low number of studies, except for ISI and Science Direct, that presented no studies at all. SCOPUS was the one that has all the four studies that matched our criteria of selection. It means that if we had not considered SCOPUS, it would have impacted the TPACK-BE quantity of studies. The same cannot be said to the other databases though. In relative terms, ERIC obtained the highest frequency (10%), followed by Proquest (3%), and SCOPUS (2%) and EBSCO (2%). However, this is because ERIC was not able to retrieve a high number of studies in our initial search, inflating its relative frequency. It shows that the relative frequencies are very sensitive to any addition and/or exclusion of studies due to their low number.

Table 2 – Studies by database

Database	EBSCO		ERIC		ISI		Proquest		Science Direct		SCOPUS	
	F[b]	%	F[b]	%	F[b]	%	F[b]	%	F[b]	%	F[b]	%
Total # of studies[a]	42	100	10	100	7	100	37	100	91	100	229	100
# of studies excluded	41	98	9	90	7	100	36	97	91	100	225	98
# of studies selected	1	2	1	10	0	0	1	3	0	0	4	2

Database x studies	Tian et al. (2017)	George and Sanders (2017)	Swan and Hofer (2011)	Raman (2014)
EBSCO			X	
ERIC			X	
ISI				
Proquest			X	
Science Direct				
SCOPUS	X	X	X	X

[a]Studies in duplicity are included; [b]Absolute frequency.

This preliminary finding is consistent with Chai et al. (2013), who observe TPACK was not deeply explored in some domains, including Accounting and Economics. Therefore, we suggest BE researchers start to consider analyzing their work under the TPACK framework to complement prior literature. There are several opportunities to conduct both replicating and innovative studies in the context of the TPACK-BE area as few contributions were found. Next, we discuss these contributions.

4.2. Circumstantial and core aspects of studies

In this subsection, we analyze both circumstantial and core aspects we consider important to highlight the selected studies, starting with the former ones. Table 3 shows the studies' characteristics we considered as being circumstantial.

Although the low number of studies, we observe authors have distinct affiliations and citizenship, at least at the moment their articles were published. Authors were affiliated with education institutions located in China, South Africa, United States, and Malaysia. This diversity suggests that TPACK studies can be developed in a wide range of cultural contexts, improving its external validity. It encourages cross-culture research.

When we look at the academic journals in which the studies were published, we observe that all research is published in technology-education thematic journals, except for Raman's (2014), which is published in the Mediterranean Journal of Social Sciences. This result is expected once TPACK involves technology, pedagogy, and content knowledge. Regarding the number of citations, Swan and Hofer's (2011) research has received 33 citations according to the Google Scholar and ten according to SCOPUS thus far, followed by Raman's (2014) that was cited four times (Google Scholar) since its publication. Tian et al.'s (2017) and George and Sanders's (2017) studies have not been cited probably because they were recently published.

Table 3 - Circumstantial aspects of the studies

Circumstantial Aspects						
Study	Affiliations	Country	Journal	Citations		
				Google Scholar	Web of Knowledge	SCOPUS
Swan and Hofer (2011)	University of Kentucky, EUA / College of William and Mary, EUA	USA	Journal of Research on Technology in Education	33	NF	10
Raman (2014)	Universiti Utara Malaysia	Malaysia	Mediterranean Journal of Social Sciences	4	NF	0
George and Sanders (2017)	University of the Witwatersrand,	South Africa	Education and Information Technologies	0	0	0

Tian et al. (2017)	Johannesburg, South Africa Anhui Agricultural University, Hefei, China	China	International Journal of Emerging Technologies in Learning	0	0	0

Subsequently, we analyze the core aspects of the studies. First, we describe all the studies, and then we summarize their most crucial elements in Table 4. Swan and Hofer (2011) conducted a study exploring the instructional affordances and constraints of podcasting in the high school classroom, especially in teaching Economics. There was a particular interest in how teachers perceive the advantages provided by podcasting as they use it and the extent to which teachers showed the usage of TPACK as a base for their podcasting projects. The authors examined the implementation of the podcasting projects designed by eight ninth-grade teachers to teach Economics within the interdisciplinary social studies (ISS) course, through the following methods: introductory and pre-implementation surveys, project plans and post-implementation interviews, and observation notes. Podcasting allowed teachers to engage and stimulate their students to learn Economics. However, implementing a technology-enhanced learning activity may not produce improvements in student learning. Despite that, teachers think that podcasting adds value to the learning experiences, particularly to students' motivation and ways of expressing themselves in the classroom. Complementarily, podcasting can serve as an alternative form of student assessment. Finally, teachers with limited training and superficial curricula would have found it challenging to implement podcasting projects in the teaching of Economics. Although the teachers were able to connect the use of podcasting with curricula (TPK), the authors argued these connections did not demonstrate strong TCK (SWAN; HOFER, 2011).

Raman's (2014) research aimed to verify in pre-service teachers the (i) competence level of using Information and Communication Technologies (ICT) applications, (ii) confidence level of ICT usage, and (iii) TPACK confidence level. The survey was answered by 154 pre-service teachers in an Education Degree program with one of the following minors: Accounting, Moral, Business Management, or Information Technology (RAMAN, 2014). The results showed that pre-service teachers are skilled in using basic ICT. The teachers indicated the highest level of confidence in (in descending order) Email, Word processing, Web search, Web browser, Presentation software, web 2.0, and social networks. When analyzed the confidence level in using ICT in teaching and learning, 68.8% answered that they are confident or very confident. When examining the confidence level by gender, the results indicated that there is a significant difference, with women pre-service teachers showing much lower confidence compared to the male pre-service teachers. Lastly, the article examined TPACK confidence level differences

between males and females, and the results showed no difference concerning gender (RAMAN, 2014).

Based on the TPACK framework, literature about the acceptance of technologies and behavior, constructivism, and meaningful learning, George and Sanders (2017) sought to investigate teacher-designed technology-based tasks, evaluating their potential to use technology effectively and to promote meaningful learning. Also, the authors aimed to contribute to professional development actions, identifying aspects that could help teachers to design tasks with meaningful learning. Then, a case study was developed at one private secondary school in Johannesburg where the use of ICT is mandatory, with the following steps: (i) Analysis of 33 DigiDay tasks of 29 teachers; (ii) Four online questionnaires answered by the teachers over 18 months; (iii) Semi-structured interviews with the teachers. Qualitative data were analyzed through conventional open coding (GEORGE; SANDERS, 2017). The results indicated that only three of all tasks used technologies with a significant contribution to the quality of learning. Through the questionnaires and interviews, the authors found that two factors influence the use of computers to impact on meaningful learning: factor 1) the teachers' knowledge about technology-related matters for teaching their subject, and factor 2) the teachers' competency levels when applying their knowledge. Concerning the contributions for the professional teacher development initiatives, (i) the focus on TPK, TCK, and TK could be helpful, and professional development courses could utilize an analysis of the teachers' tasks to disclose possible areas for improvement (GEORGE; SANDERS, 2017).

Tian et al. (2017) developed a design model based on the TPACK framework to effectively integrate IT with teaching practices into practical curriculums of the economic management specialization program. Beyond the design curriculum model, the authors also designed a survey to verify the degree of satisfaction with the curriculum of 198 students. The construction of a curriculum model for the Enterprise Operation and Decision Simulation System (EODSS) course was carried out in four phases: First, the principles for the design and the development of the curriculum were defined based on the TPACK framework. Then, the analysis of demand and conditions for the curriculum model was conducted considering the three TPACK's main bodies of knowledge (technological, pedagogical, and content). The last two phases were the implementation of the curriculum and its evaluation. When questioned, the majority of students were satisfied with the teaching approach (content, methodology, effect, and testing method) of the new curriculum. After the descriptions, we present Table 4 as a summary of the core aspects.

Table 4 – Summary of the core aspects of the studies

	Core Aspects			
Study	**Objective**	**Method**	**Approach**	**Main Results**

Swan and Hofer (2011)	To explore the instructional affordances and constraints of podcasting in the high school classrooms, especially from a teachers' perspective. Also, there was a particular interest in observing how teachers used TPACK as a base for their podcasting projects.	Survey research, interviews, and observation	Consisted of implementing the podcasting projects designed by 8 ninth-grade teachers to teach economics. The authors gathered data from (i) introductory and pre-implementation surveys; (ii) project plans; post-implementation interviews; (iv) and observation notes.	Podcasting allowed teachers to engage and motivate their students to learn economics. Teachers think that podcasting adds value to learning experiences. However, teachers with limited training in economics would have found challenging such an implementation.
Raman (2014)	What is the 'competency/confidence/TPACK confidence' level of the pre-service teachers in the Universiti Utara Malaysia?	Electronic survey	Population=220 (and 154 response) pre-service teachers. All students were enrolled in the Education Degree program with one of the following minors: Accounting, Moral, Business Management, or Information Technology.	The pre-service teachers reported being skillful and confident at using basic ICT. But above 40% declared having limited confidence or no confidence at all synthesizing their knowledge, assessing themselves and society values critically, and understanding and getting involved in the changing knowledge economy.
George and Sanders (2017)	To investigate teacher-designed technology-based tasks to evaluate their potential to use technology effectively; To identify the factors affecting the task design.	Case study at a private education institution	The researchers conducted the following steps: 1) Analysis of 33 DigiDay tasks of 29 teachers; 2) Four on-line questionnaires answered by the teachers over 18 months; 3) Semi-structured interviews with the teachers.	Only a minority of the teachers had made effective use of computers to promote higher-order constructivist learning; Teachers' beliefs and attitudes affected their intentions to use ICT; The TPK, TCK, and TK should receive the focus, rather than the CK, PK, and PCK.

Tian et al. (2017)	Construction of a design model based on the TPACK framework to effectively integrate IT with teaching practices and contents into practical curriculums of the economic management specialization.	Design curriculum-based research method and survey research	The study designs and describes a curriculum model for economic management specialization under TPACK and then shows its application.	The new curriculum model had a positive impact on the mastering of knowledge and the majority of students were satisfied with the teaching aspects of the new curriculum.

4.3. Complimentary Analysis and General Observations

To initiate a complimentary analysis of the studies, we firstly examined the studies according to Voogt et al.'s (2013) categorization. Table 5 presents the theoretical and practical themes in which studies were classified.

Table 5 – Theoretical and practical themes

Theoretical and practical themes	Swan and Hofer (2011)	Raman (2014)	Tian et al. (2017)	George and Sanders (2017)
Theoretical themes				
Development of the concept			X	
Views on TK				
Development of TPACK as a concept in specific subject domains				
TPACK and teacher beliefs	X			X
Practical themes				
Measuring TPACK	X	X		X
Strategies for developing students' / teachers' TPACK			X	

The development of the TPACK framework as a concept needs to be related to the context of teaching as well as with the teacher's pedagogical and technological beliefs (VOOGT et al., 2013). According to our classification into the Voog et al.'s (2013) categories, there were no articles that develop the concept of the TPACK. They only reproduce the description of the constructs already defined by prior research.

The studies classified in the category "Views on TK" usually present different meanings of Technological Knowledge. Tian et al. (2007) refer to TK as technical knowledge, considering both basic (books, chalk box, blackboard) and advanced techniques (PPT, network teaching, video), and could also include specific skills demanded teacher-student interaction. Tian et al. (2017) also relate the constructs with business contents. There were no articles that presented new views on TK.

Regarding the "Development of TPACK as a concept in specific subject domains" category, Tian et al. (2017) advanced TPACK by using it to support the area of teaching of Economics. More precisely, Tian et al. (2017) used TPACK to design the EODSS curriculum, which in turn received contributions on how specific business subjects are related to each construct within the economic management area (e.g., Marketing Management belongs to CK concept). Other studies are either interdisciplinary or did not report any specific association between subjects and the TPACK constructs.

The category "TPACK and teacher beliefs", according to Verloop et al. (2001, p. 446), is pivotal because "in the mind of the teacher, components of knowledge, beliefs, conceptions, and intuitions are inextricably intertwined", and therefore both are often conceived as an inherent part of teacher knowledge (VOOGT et al., 2013). Swan and Hofer (2011) evaluate the way teachers have been used TPACK as a base for their podcasting projects, and the results demonstrate that podcasting allowed teachers to engage and motivate their students in the Economics subject, even though the teachers presented restricted knowledge about this discipline. George and Sanders (2017) worked with the analysis of technology-based tasks, and one of their findings pointed out that teachers' beliefs and attitudes affected their intentions to use ICT.

Three studies aimed to measure TPACK concepts. Swan and Hofer (2011) worked with open-ended questions and qualitative analysis for the results. Raman (2014) considered three different instruments for the analysis: (i) competency level of pre-service teachers in using ICT; (ii) confidence level of pre-service teachers in using ICT; (iii) TPACK Confidence Survey. 4-point Likert scale for the first two instruments and they used descriptive statistics for the analysis. Ultimately, George and Sanders (2017) utilized four online questionnaires and semi-structured interviews, but they did not provide additional information about the materials.

According to Voogt et al. (2013), the last category focuses on strategies to support students and teachers in their TPACK development, and their research presents active involvement in a technology-enhanced lesson or course design as major strategies. Our analysis classified only one study in this category (TIAN et al.'s. (2017)), which contributed to constructing a curriculum based on the TPACK framework for the economic management specialization program.

Analysis of the articles indicated that they had provided relevant contributions to the application of the TPACK framework in different areas and contexts. Results demonstrated that TPACK could improve student satisfaction (TIAN et al., 2017), student learning (SWAN; HOFER, 2011), and the quality of learning (GEORGE; SANDERS, 2017). Also, this framework increases the confidence level in teaching and learning (RAMAN, 2014). These results show the TPACK's potential to impact BE positively and how it can help educators redesign technology, pedagogy, and content knowledge in many business courses (RIENTIES; TOWNSEND, 2012). All works reviewed by this study considered TPACK as a whole, except for Swan and Hofer (2011), whose article concentrated only on TCK and TPK constructs. Despite these contributions, more research on both practical and theoretical themes are needed, particularly the last one, which has been receiving less attention.

All articles employed surveys as part of their methodological procedures, on which two articles were built on the context of K-12 education and the other two in Higher Education. BE

could advance by improving TPACK uses at both undergraduate and graduate levels. Graduate courses represent a continuing improvement of knowledge already acquired in undergraduate programs and if we assume that technology is substantial for undergraduate students, why would it lose importance at the graduate level in which more specialized knowledge is taught? Thus, we argue that the TPACK keeps being useful for graduate instructors as well.

Although the articles published about TPACK in BE increased in 2017, we are not able to observe a tendency due to the low number of studies analyzed. However, we encourage BE researchers to conduct studies considering TPACK. Finally, we emphasize that none of the four articles focused strictly on business programs or courses, but rather concentrated on multidisciplinary ones. We then suggest a more BE-focused study to understand the role of TPACK in this specific setting.

5. CONCLUDING REMARKS

This research aimed to provide a literature review on the TPACK framework in BE. We searched for studies in six academic databases and found 389 works that initially were detected as being related to the TPACK-BE area. However, after reading them, we confirmed only four studies (1.03%) belonging to this interdisciplinary field. This first result indicates the literature is scarce. Also, if we had not considered SCOPUS, the final number of studies would have been decreased considerably. It strengthens the Chai et al.'s (2013) proposition about the lack of articles using the TPACK framework in BE settings.

Regarding the results from the analysis of circumstantial aspects of the studies, we found that their authors are from multiple countries. It suggests that TPACK studies can be developed in a variety of contexts, increasing its external validity and applications. Also, the publication year is positively associated with the number of citations the studies have been received. Articles published in 2017 have no citations, while the older ones have at least four. About the core aspects, we observe that studies employed multiple research methods to achieve their goals (e.g., case study, survey, interviews, and observations), but experiment and ethnography can still be used to complement the evidence gathered so far, as well as other methods that researchers find relevant. We also emphasize the encouraging results of the studies. TPACK was used to design courses and to assist in integrating technology-based tools into classrooms successfully. BE instructors could take these examples when adopting educational technologies as well. Finally, additional analyses suggest that more studies could be conducted to enhance TPACK constructs or to shed light on new perspectives regarding its development because most of the studies have focused on measuring or validating its constructs empirically.

By reviewing TPACK in BE, we hope our study has value for education institutions, faculty, researchers, and students, as well as for teaching methods' and course design's discussions

in the context of BE. New research opportunities arise from the results, such as (i) research on the incorporation of technology into business classes and curricula under the TPACK framework at higher education level (both undergraduate and graduate), (ii) use of distinct and multiple research methods to address essential technology use issues in BE contexts, (iii) more research on both theoretical and practical themes, mainly focused on the first one, (iv) longitudinal studies about BE involving TPACK, (v) cross-culture/cross-country research involving the BE area, and (vi) comparative studies among theories or models that explain technology integration into education by instructors, particularly in BE (e.g., TPACK and Technology Acceptance Model).

As for the limitations of the present study, we only examined those journals that are indexed by the six databases considered here. Thus, there might be others that have published TPACK-BE studies. In this case, we are not able to provide any conclusion about these journals, even though our results suggest that would probably be a low number as well. Furthermore, we limited our study to five business-related keywords, which means that researchers can find other studies if they use more keywords. We leave it for future investigations.

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