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Teacher Training for Distance Learning: an Analysis Considering the Knowledge Domains of the TPACK Model

Formação de Professores para EAD: uma Análise Considerando os Domínios de Conhecimento do Modelo TPACK

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Abstract

The Technological Pedagogical Content Knowledge framework seeks to understand the knowledge base necessary for teachers to properly integrate technologies into their practices.

Therefore, this research investigates the contributions of TPACK as a theoretical framework for teacher training programs in the area of Distance Education (DE). The impact of a specialization course focused on teaching in distance education, offered by a Brazilian public higher education institution, was verified in the self-assessment of the TPACK knowledge of course participants, postgraduate students from one of the public universities associated with this institution, in the integration of Information and Communication Technologies (ICT) in their teaching practices. A quantitative approach was chosen, with the application of a questionnaire with 41 items, built and validated exclusively for the study. The results show that the participants (1) consider the training obtained as satisfactory; (2) show the highest levels of confidence in the content knowledge construct and its intersections; (3) feel more comfortable using the technology to do science rather than teaching and (4) have their ages as the only sociodemographic data that influences TPACK significantly.

Keywords: Distance education. Information and communication technologies. Technological pedagogical content knowledge. TPACK.

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Resumo

O quadro Conhecimento Tecnológico Pedagógico do Conteúdo, do inglês Technological Pedagogical Content Knowledge - TPACK, procura compreender a base de conhecimentos necessária aos professores para que integrem adequadamente as tecnologias em suas práticas. Assim sendo, esta pesquisa investiga as contribuições do TPACK como referencial teórico para programas de formação de professores na área da Educação a Distância (EaD). Verificou-se o impacto de um curso de especialização voltado para a docência em EaD, ofertado por uma instituição pública de ensino superior brasileira (IES), na autoavaliação do conhecimento TPACK dos cursistas, pós-graduandos de uma das universidades públicas conveniadas a esta IES, na integração das Tecnologias de Informação e Comunicação (TIC) em suas práticas docentes. Optou-se por uma abordagem quantitativa, com a aplicação de um questionário com 41 itens, construído e validado exclusivamente para o estudo. Os resultados evidenciam que os participantes (1) consideram a formação obtida como satisfatória; (2) apresentam os maiores níveis de confiança no domínio de conhecimento do conteúdo e suas intersecções; (3) sentem-se mais confortáveis em usar a tecnologia para fazer ciência do que para ensinar e (4) possuem a idade como único dado sociodemográfico que influencia o TPACK. A partir destes resultados, foi possível detectar as demandas formativas dos participantes e vislumbrar futuros redirecionamentos acerca da matriz curricular do curso em análise..

***Palavras-chave**: Educação a distância. Tecnologias de informação e comunicação. Conhecimento tecnológico pedagógico do conteúdo. TPACK.*

1. Introduction

Due to the possibility of democratizing access to education and the advancement of information and communication technology, Online Learning has received more and more attention in recent years. Despite the growth in the number of students in this modality, there is a lack of teachers specifically trained to work in online education (MILL, 2015) and, at the same time, there is little investment by educational institutions in training these professionals (LEYENDECKER; SILVA, 2017).

These shortcomings have led teachers to transpose teaching between the face-to-face and on-line modalities according to their professional experience, the so-called “learning by doing” or “knowing how to teach” (MILL, 2015; TARDIF, 2014). As important as face-to-face teaching experience is in building the foundations of teaching practice, distance learning has certain particularities. In face-to-face higher education, for example, there are one or two teachers responsible for the entire subject; in distance education, on the other hand, in addition to the temporal and physical distance, multidisciplinary teams work alongside the teacher in the planning, production and delivery phases of a lesson, in order to make it feasible and fulfill the proposed learning objectives (KENSKI, 2020).

As a result of the construction of this new teacher profile and the demands brought about by cyberculture and the job market, there are two questions: (i) What are the main skills/knowledge/knowledge required of this professional? and (ii) How should teacher training projects be designed to take into account these specificities?

According to Silva (2009), teacher training for distance education must digitally include the teacher in the context of cyberculture and then guide them to do the same with their students. The author believes that understanding a new communicational logic, based on the dynamics of hypertext, the articulation of mass media with digital media and interactivity, as well as enhancing teaching with the appropriate use of internet interfaces, are essential for good training.

From the perspective of distance tutors (also considered virtual teachers in this article), Mattar et al. (2020) carried out a systematic review to identify empirical research on the core competencies and functions of online tutors in order to contribute to training programs for these professionals. As a result, six core competencies/functions were found, defined as shown in Table 1.

Table 1: Model of on-line tutor competencies and functions

	Skills/Functions	Definition
1	Skills and functions	Carrying out organized activities
2	Know-how	Tutor specialized in the subject
3	Know-how and pedagogical functions	Skill that enable on-line mediation
4	Communication	To receive and transmit information clearly
5	Social-affective skills	Bond building and conflict resolution
6	Technological skills	Digital fluency of the online tutor

Source: Adapted from Mattar *et al.* (2020).

Looking at the competencies and functions listed, the authors highlight the diversity and complexity of the requirements for tutoring and teaching in distance education, as issues of different natures need to be addressed in their training process. As Tardif (2014) describes, teaching knowledge is different and comes from a variety of sources, making the instructional strategy for training courses complex, especially with the inclusion of the technology factor inherent in virtual teaching.

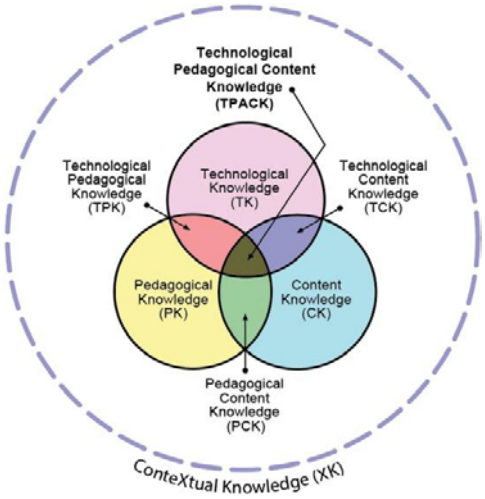
Thus, it is understood that on-line teaching, with different educational technologies at its disposal, requires an understanding of the dynamics of content, pedagogy and technology and their relationship, leading teachers to question their own pedagogy, something that teachers may not have done for a long time (PERUSKI; MISHRA, 2004). In other words, the introduction of a new technology can impact both the way a concept is represented and the methodology used to teach it. Thus, discussing the TPACK model seems fundamental in order to not only create a framework of competencies for on-line teaching, but also to produce a training model that favors a new didactic approach to virtual teaching (HENRIQUES et al., 2017).

Mishra and Koehler (2006), creators of TPACK, propose that in order to teach educational technologies in a transformative way, it is not enough for teachers to know various digital tools that will soon become outdated, but rather to learn about the subtleties and relationships that exist between tools, actors and contexts.

According to the TPACK framework, the intersection between Technological Knowledge (TK), Pedagogical Knowledge (PK) and Content Knowledge (CK) gives rise to four different domains: Technological Peda-

gogical Knowledge (TPK); Technological Content Knowledge (TCK); Pedagogical Content Knowledge (PCK); and the central intersection, the so-called TPACK Knowledge. In the end, the seven domains generated make up Contextual Knowledge (XK), as shown in Figure 1.

Figura 1: Os domínios do conhecimento TPACK



Source: Diagram revised by Mishra (2019).

[Audio description of figure 1: Illustration. Three overlapping circles, surrounded by dotted lines. The central intersection is TPACK Knowledge].

TPACK Model in Teacher Training

It is hoped that with professional development based on TPACK, teachers will be able to create innovative teaching strategies using technology to help students understand the content, taking into account their particularities and those of the educational environment. However, despite the possibilities arising from this training model, and the great diversity of studies published on TPACK in recent years, especially with an emphasis on the curricular planning of training programs and the development of evaluation instruments, in the area of Distance Education (RIBEIRO; PIEDADE, 2021) and in works in the Portuguese language, the same is not verified (NOGUEIRA, et al. 2015; ROLANDO, et al., 2015; RIBEIRO; PIEDADE, 2021).

Based on the TPACK framework, Rolando et al. (2015), for example, carried out an analysis of publications on the integration of technologies, from its emergence in 2006 to 2014 in Portugal. The authors selected 60 articles. From this selection, only four articles analyzed the teachers' knowledge base, while the others remained in the theoretical/conceptual sphere. No articles were found that mentioned training strategies or courses with this theoretical framework. According to Nogueira, Pessoa and Gallego (2015), studies applying TPACK have contributed more to highlighting paradigm shifts and demonstrating the model's suitability than to validating the model and measuring its results. Furtado et al. (2021) also highlight the importance of field studies where data is collected directly from participants in the teaching and learning process.

Recently, Ribeiro and Piedade (2021), in a systematic review on the use of the TPACK model in the design of teacher training courses, in a Brazilian and Portuguese context, found only 28 publications from 2013 to 2020. In these publications, ongoing training courses prevailed (more than 70% of the publications), in

the curriculum area of Mathematics (64.3%), with approaches aimed at developing the TPK domain of the course participants to the detriment of the others. There is a trend towards an increase in the number of publications on this subject, but it is still in its early stages (Rolando, et al. 2021) and in some specific areas, such as Mathematics, for example.

Considering this model of training, this study aimed at verifying the impact of a training course aimed at teaching in distance education on the self-assessment of TPACK knowledge by the course participants and on the integration of Information and Communication Technologies into their teaching practices.

To do so, it aims to answer the following questions: (i) What levels of knowledge in the seven domains of TPACK did the course participants perceive after completing the training course? (ii) What correlations can be established between levels of confidence in the seven TPACK domains?; (iii) Is there a relationship between levels of confidence in the seven domains of the TPACK and attendance at courses in the area of digital technologies aimed at undergraduate education? (iv) Is there a relationship between the levels of confidence in the seven domains of the TPACK and the sociodemographic profile of the students on the training course?; and, to finish, (v) What relationship can be established between the use of TPACK and the understanding of technology integration in the context of teacher training for distance learning?

2. Methodology

The research was based on a quantitative approach, but of a descriptive, exploratory and correlational nature, in order to understand and describe the results of the participants' responses. The aim is to examine the relationships between variables to answer research questions, through strictly controlled surveys and experiments, ensuring measurements or observations to test a theory (Creswell, 2007).

Research Context

This research employed the TPACK framework as a theoretical model to collect, analyze and interpret student data during the Lato Sensu Specialization course in Didactic-Pedagogical Processes for Distance Learning Courses, offered by a Brazilian public higher education institution, which is exclusively dedicated to distance learning. The aim of the course is to prepare teachers for distance learning based on Information and Communication Technologies.

To apply for a place on the course, you must be a Master's student or PhD student at a partner university, as well as having an academic degree in one of the following: Computer Science, Computer Engineering, Production Engineering, Public Management, Degree in Languages, Degree in Mathematics or Pedagogy. You should also be available for twelve hours a week to carry out theoretical and practical activities.

The theoretical activities consist of accessing the virtual learning environment and carrying out the tasks in the five modules of the specialization's curriculum. The modules are as follows: 1- Pedagogical Mediation in Distance Education; 2 - Collaborative Teaching and Learning in Distance Education; 3 - Resources for Teaching and Learning in Distance Education; 4- Didactic Design for Distance Education and 5- Course Conclusion Work (TCC). There are also practical activities, which consist of tasks carried out with undergraduate students, for example: synchronous and asynchronous communication; checking assessment activities and providing qualitative feedback; monitoring the academic calendar and reflecting on practice by preparing quarterly activity reports.

Data Collection Tool

The data collection instrument chosen was the construction, validation and subsequent application of a self-report questionnaire with closed answers, which is a trend for measuring participants' TPACK (SCHMID; BRIANZA; PETKO, 2021). The aim of the questionnaire is to identify the sociodemographic profile of the study participants and their confidence levels in relation to the TPACK domains (PK, TK, CK, TCK, PCK, TPK, TPACK). In addition, we also considered the TPACK.xs Scale by Schmid, Brianza and Petko (2021) and the TPACK Survey by Archambault and Crippen (2009), both of whom were contacted to grant permission for the translation and validation of the instruments used in their studies.

With the authorization of the authors, the questionnaires were translated from English and revised by a translation specialist. From these instruments, the first version of the scale was constructed, with 6 questions on the participants' personal and professional data, and 41 items on TPACK knowledge, with questions adapted from the selected articles and original questions. Based on the responses, the statistical tests needed to assess the instrument's metric quality were developed. These are: sensitivity analysis, internal consistency and validity. A sensitivity analysis eliminated one of the items which had very high asymmetry and kurtosis values. After this change, a high internal consistency index was obtained (α=0.93). Finally, the factor analysis revealed that the seven dimensions explain 63.4% of the scale's variability.

The following table shows the overall structure of the questionnaire and example items for each of the dimensions. The full version of the questionnaire can be found in Ribeiro's work (2022).

Table 2 : Groups of questions in the questionnaire.

#	Group	Example
I	**Personal and professional data:** sought to characterize the study population on a personal and professional level. Items 1 to 6.	4. Area of knowledge related to your training
II	**Pedagogical Knowledge (PK):** sought to identify the participants' level of confidence in their mastery of pedagogical knowledge. Items: pk1 to pk7.	pk5. I can adjust teaching methodologies based on student performance and feedback
III	**Technological Knowledge (TK):** sought to identify the participants' level of confidence regarding their mastery of technological knowledge. Items: tk1 to tk10.	tk5. I can create a basic presentation using PowerPoint or a similar program
IV	**Content Knowledge (CK):** sought to identify the participants' level of confidence in mastering content knowledge. Items: ck1 to ck5.	ck2. I can use concepts, ideas and methods specific to my field of knowledge
V	**Technological Content Knowledge (TCK):** sought to identify the participants' level of confidence with regard to their mastery of technological content knowledge. Items: tck1 to tck5.	tck3. I am able to use various learning platforms to deliver instruction (e.g. Blackboard, Canvas, Teams, Zoom)
VI	**Pedagogical Content Knowledge (PCK):** sought to identify the participants' level of confidence in their mastery of pedagogical content knowledge. Items: pck1 to pck5.	pck3. I am able to develop appropriate tasks to promote students' complex thinking in the subject I teach
VII	**Technological Pedagogical Knowledge (TPK):** sought to identify the participants' level of confidence with regard to their mastery of technological pedagogical knowledge. Items: tpk1 to tpk5.	pck3. I am able to develop appropriate tasks to promote students' complex thinking in the subject I teach

VIII	**Technological Pedagogical Content Knowledge (TPACK):** sought to identify the participants' level of confidence with regard to their mastery of technological pedagogical content knowledge. Items: tpack1 to tpack5.	tpack2. I am able to use technology to predict students' understanding and ability on a specific topic

The form was constructed using Google Forms, with answers organized on a 5-point Likert scale of agreement, ranging from 1 - Strongly disagree to 5 - Strongly agree.

By March 2021, there were 1110 students enrolled in this specialization. As we wanted to verify the impact of completing this training, we considered the 572 students enrolled in the last module, the Course Conclusion Work, as the population. The voluntary participation of 100 students was obtained, which corresponds to a response rate of 17.48%. Based on the data, the appropriate statistical tests were carried out using the Statistical Package for the Social Sciences - SPSS, version 26.

3. Results and Discussion

The results will be presented and discussed according to the research questions presented previously, complemented with results from previous studies.

(i) What levels of knowledge in the seven domains of TPACK do the course participants perceive after completing the training course?

For each of the seven TPACK domains, the average, standard deviation, skewness and kurtosis of the scores given by the participants were calculated, with a minimum value of 0 and a maximum value of 5. The results shown in Table 1 indicate a high level of self-efficacy among the participants in all the TPACK domains, ranging from 3.85 (PK domain) to 4.59 (CK domain), with an overall average value of 4.14. For the sake of comparison, in the study carried out by Archambault and Crippen (2009), which was used in this study to construct the TPACK scale, the overall average level of self-efficacy in all seven domains was 3.81 (SD = 0.93), in a range of 1 to 5 values.

Table 1: Mean values, standard deviation, asymmetry and kurtosis of the scale

Dimension	Average	Standard deviation	Asymmetry	kurtosis
PK	3,85	0,65	-0,41	0,4
TK	4,04	0,64	-0,39	-0,7
CK	4,59	0,47	-1,35	2,14
TCK	4,45	0,54	-0,75	-0,19
PCK	4,19	0,64	-0,67	-0,05
TPK	3,95	0,64	-0,25	-0,03
TPACK	4,16	0,65	-0,78	0,93
Escore	4,14	0,43	-0,29	0,04

As for the average scores obtained in each TPACK domain, the highest values are found in the Content Knowledge (CK) domain, followed by Technological Content Knowledge (TCK) and Pedagogical Content Knowledge (PCK). This means that the participants consider that they have a good knowledge of the concepts related to their area of training, that they have mastered the use of emerging technologies to repre-

sent them and, finally, that they know how to use pedagogical strategies to facilitate the students' learning of these concepts. It can be seen that CK plays a central role in the confidence of the survey participants, given that its intersections with PK and TK are among the domains with the highest averages of self-reported knowledge.

Regarding the domains with the "technology" component, the higher level of self-efficacy in TCK and the lower level in TPK indicate that the study participants feel more comfortable with their ability to use technology to do science than to teaching (GRAHAM et al. 2009). Given the characteristics of the study population, it is expected that the development of their research at university will provide greater confidence when using technologies for this purpose. Considering the influence of the university environment on confidence in the TPACK domains, Cox and Graham (2009) also found a stronger level of confidence in TCK in university teachers, and stronger TPK and less evident TCK in elementary school teachers.

Curiously, Pedagogical Knowledge (PK) showed the lowest level of self-reported confidence (M = 3.85). In this regard, it is relevant to consider the different context in which the participants are inserted, the context of on-line distance education. According to Corry and Stella (2018), when teachers make the transition from face-to-face teaching to distance learning, they may not feel comfortable with the pedagogy of online teaching, which requires teaching strategies adapted to this new environment.

(i) What correlations can be established between levels of confidence in the seven TPACK domains?

In order to understand the degree of correlation between the TPACK dimensions, Pearson's correlation coefficient (r) was calculated. Table 2 shows that practically all the dimensions correlate significantly, with moderate intensity, ranging from $0.215 < r < 0.673$; $p < 0.01$, with the exception of the TK and CK (0.56) and CK and TCK (0.19) dimensions.

Table 2: Pearson's correlation coefficients.

	PK	TK	CK	TCK	PCK	TPK	TPACK
PK		.304**	.242*	.246*	.468**	.510**	.489**
TK			.056	.646**	.311**	.525**	.381**
CK				.196	.387**	.215*	.413**
TCK					.374**	.594**	.487**
PCK						.552**	.673**
TPK							.626**

Note: * significant for α = 0,05. ** significant for α = 0,01.

The low correlations found between TK/PK (0.304) and TK/CK (0.056) are in line with Archambault and Crippen (2009), who described the low relationships between the technology-pedagogy and technology--content domains as expected, as they are markedly different from each other. In their study on biology teachers' perceptions of TPACK, Rolando et al. (2021) found this same trend, as well as pointing out the strong positive correlation found between the domains and the technology component. However, for Archambault and Crippen (2009), high correlations raise a discussion that has existed since the creation of the PCK model proposed by Shulman (1986, 1987), about the limits of each domain. In fact, Scherer, Tondeur and Siddiq (2017) analyzed the self-efficacy of 665 trainee teachers from 18 higher education institutions and similarly found a high correlation between the domains and the technology component (p. > 0.80), with the exception of TK. Based on this data, the authors questioned whether trainee teachers were able to distinguish the boundaries between the TCK, TPK and TPACK domains or even whether these domains exist in practice (OLIVEIRA, 2017).

In contrast to this discussion, Angeli, Valanides and Christodoulou (2016) suggest investigating the contribution of each component to the constitution of TPACK as a body of knowledge, and how they influence each other and also influence teaching practice (ROLANDO, et al. 2018). Ribeiro and Piedade (2021) address this issue by presenting the theoretical structure of the TPACK model, which is conceptualized as either integrative, when the domains of knowledge are unique and distinct from each other, or transformative, when they are analyzed holistically; in addition, there is the discussion about inclusion of new domains in the theoretical framework (ESQUINCALHA; ABA, 2016). Portanto, no sentido de investigar quais domínios contribuem para a maior confiança dos participantes em TPACK, verificou-se que os domínios Conhecimento Pedagógico do Conteúdo (PCK) e o Conhecimento Pedagógico Tecnológico (TPK) são os mais altamente relacionados à TPACK. Como PCK é a base de conhecimento precursora do modelo TPACK, é esperado que este domínio afete diretamente o desenvolvimento de TPACK (PAMUK et al., 2015); quanto a TPK, sua influência sobre TPACK é comumente relatada em conjunto com TCK, como os dois domínios de maior influência sobre TPACK (SALVADOR; ROLANDO; ROLANDO, 2010; PAMUK et al., 2015).

Content Knowledge (CK), despite being the domain with the highest level of self-reported confidence, was not correlated with the TK and TCK domains and was only weakly correlated with the other domains. The low correlation of CK was also reported in the study by Rolando et al. (2021), especially in relation to the domains with the technology component; the authors found a correlation of CK only with PCK.

Considering the curriculum matrix of the training course under study, none of the modules addressed CK, which was only evident in the practical component of the course, where participants had to use it to monitor the subjects of undergraduate students. A similar situation was found in the systematic review by Moore-Adams, Jones and Cohen (2016) which sought to structure the knowledge and skills for teaching on-line, using the TPACK model. The authors reviewed 26 articles on initial and continuing teacher training and, in all the training programs, content knowledge was absent. Thus, all the CK applied came from their academic training and/or from studying the material made available in the subject itself, which points to the disconnection between theoretical and practical training activities.

(i) Is there a relationship between levels of confidence in the seven domains of TPACK and attendance at subjects in the area of digital technologies aimed at undergraduate education?

A significant difference was found only in the PK domain (sig = 0.02), where the average value for those who had taken ICT courses was 4.16 (SD = 0.56) compared to an average of 3.77 (SD = 0.66) for those who had not. This means that these participants (19% of the total) feel more confident about applying teaching strategies that go beyond the subject or are independent of the subject being taught, such as active or collaborative learning strategies (GRAHAM; BORUP; SMITH, 2012). It is noteworthy that the PK domain had the lowest average self-confidence score among all the participants, raising the hypothesis that taking these subjects during initial training could have a significant impact on the PK confidence of the 81% of participants who had no previous contact with this content.

(i) Is there a relationship between the levels of confidence in the seven domains of the TPACK and the sociodemographic profile of the students on the training courses?

Regarding the gender variable, a relatively balanced sample was obtained in terms of average scores, but with no statistically significant differences. It can be concluded that gender is not a variable that influences self-efficacy scores in the TPACK domains. This result is in line with those found in the literature (GARRETT, 2014; SCHMID; BRIANZA; PETKO, 2021). With regard to age, the overall analysis of self-confidence levels showed that younger people were more insecure in relation to the TPACK domains. The opposite can be observed among older people, precisely in the 46 to 55 age group, where the greatest confidence was found in all domains.

Although the group with a master's degree in progress had the highest means in all domains and there

was a significant difference in the TPACK domain between the "master's degree in progress" and "doctorate in progress" groups, it was not possible to identify academic training as a differentiating factor, given the small size of the two samples. If we look specifically at the areas of knowledge, seven areas were listed among the participants, resulting in a very stratified sample. Even so, there was a significant difference in TK, where participants from the Computing area showed greater confidence than those from the Education area (sig = 0.045). Schmid, Brianza and Petko (2021) point out that Computer Science students are expected to have higher TK, due to the more frequent use of digital technologies inherent in their academic training.

As for teaching experience, no significant differences were found between the groups, contrary to the results obtained in similar studies (CORRY; STELLA, 2018; SALVADOR; ROLANDO; ROLANDO, 2010). In Garrett's (2014) study, for example, full professors with longer teaching experience reported a stronger perception of their KP compared to assistant professors and non-full professors. This could be an indication that immersion in professional practice favors increased self-confidence in the use of pedagogical strategies. In contrast, for the participants in this study, there was no influence of teaching experience on TPACK.

Therefore, with regard to the participants' sociodemographic data, there were no major trends that would support the development of different courses or modules between groups, making the TPACK model ideal for forming heterogeneous groups of participants, without harming learning.

(i) What relationship can be established between the use of TPACK and the understanding of technology integration in the context of teacher training for distance learning?

When it comes to evaluating the integration of technologies into teaching, it is common to consider the first-order (external) and second-order (internal) factors of the teacher as obstacles, the latter being the most decisive in the process (COSTA; RODRIGUEZ; FRADÃO, 2012; PIEDADE, 2017). For Porras-Hernández and Salinas-Amescua (2013), the "context" component, or, more recently, "Contextual Knowledge - XK" (MISHRA, 2019), would be responsible for bringing the discussion on these issues into the TPACK framework.

Based on the answers to the questionnaire, it was possible to identify the integration of technologies from the perspective of their relationship with pedagogical and conceptual knowledge. However, it is difficult to conceptually separate the teacher from their context (PORRAS-HERNÁNDEZ; SALINAS-AMESCUA, 2013), which directly influences the "effectiveness and success of any TPACK development, or a teacher's attempts at technological integration" (MISHRA, 2019, p. 76).

For the purposes of expecting effective incorporation with pedagogical intent, only confidence in the ability to use technologies that influence the way technology is integrated was considered (PORRAS-HERNÁNDEZ; SALINAS-AMESCUA, 2013). In this way, the high levels of TPACK knowledge indicate the predisposition of teachers in training to use information and communication technologies in the service of learning. Furthermore, once the trainees are confident with information and communication technologies, the essential skills for teaching in an online environment, such as listening and giving feedback, managing discussions, building relationships, motivating students and monitoring the course, find a favorable environment in which to develop holistically (ARCHAMBAULT, 2008).

4. Conclusion

This study sought to analyze the impact of a specialization course for teaching in distance education on students' self-reported knowledge and integration of information and communication technologies, using confidence in the TPACK domains as a measure. Based on the results found, the participants consider the training they received to be satisfactory, guaranteeing a good level of confidence for future practices in

online education. By mapping the level of knowledge in each domain, it was also possible to detect the training demands of the participants and glimpse future redirections regarding the curriculum matrix of the course under analysis.

The higher confidence in the PK domain of participants who took Information and Communication Technology subjects during their undergraduate studies, for example, reinforces the discussion about the importance of initial training that introduces educational technologies to future teachers, guaranteeing a more solid knowledge base to be improved during continuing training.

Given that there was direct interference from the context of higher education and distance learning in the composition of the participants' TPACK knowledge, it is suggested that the teachers' working context, whatever it may be, be considered when designing a training program that uses this model.

In conclusion, to consolidate the research findings into guidelines for on-line teacher training courses based on TPACK, it is recommended to start with a clear definition of the role of a teacher in distance education and what competencies are required. teaching role in distance education and what skills are required. It is then recommended that the students' level of TPACK knowledge be assessed at the start of the course, with the aim of identifying the knowledge base they already have, and then creating additional dynamics that address the lower value domains. It is also suggested that the course contain a theoretical part that includes Content Knowledge (CK), to facilitate understanding of its relationship with the other domains, and Pedagogical Knowledge (PK) of online teaching, and a practical part, as a way of reflecting on and applying theory to the integration of technologies, focusing on the context in which the future teacher will work.

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