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The Necessary Knowledge for Online Education: Teaching and Learning to Produce Knowledge

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ABSTRACT

This article presents qualitative research of a case study type, carried out with a group of 27 educators who were strengthening their knowledge of online education to a greater depth. Online education requires pedagogical mediation and the skills and competencies to work with technological resources which promote interaction, collaboration, and co-learning. From this perspective, the following research question was posed: what is the knowledge needed for educators to work in online education in order to promote knowledge production? The data collected was analysed according to Bardin (2011) and the assistance of Atlas Ti software. Based on the research findings it was possible to identify three main knowledge areas for mediating teaching and learning processes designed to produce knowledge, essential for teaching online.

Keywords: online competencies and skills, distance education, online education, knowledge production, teaching

INTRODUCTION

The strong influence that the information and the knowledge society exert in social contexts is a consequence of the rapid technological progress and evolution of the networked society; consequently, this influence has greatly affected education, especially the way to communicate and propose methodologies that foster meaningful learning. However, the use of just information and communication technologies (ICT) in education does not guarantee innovation and effective learning for students. As such, we begin this paper with the premise that pedagogical knowledge allied with technological knowledge is essential for teachers who work or intend to work with online education.

Online education can refer to completely virtual lessons, meaning there is no physical contact involved, but it can also include blended courses that mix face-to-face and virtual meetings, such as face-to-face courses with complementary activities performed on the Internet outside the classroom, which are common today. In online education, there is an integration of "face-to-face classes with virtual classes and activities", as Moran explains, "making time and space more flexible, extending the teaching and learning spaces that were until now practically confined to the classroom[1]" (Moran, 2006, p. 42). Online education offered by means of the Internet surpasses the conservative vision of distance education (DE), in which courses are delivered by post and are designed to reach people who live in distant places.

As a result of the social changes of the 21st century and the strong presence of ICTs, contemporary society requires professionals who are prepared to employ technological resources from a critical and ethical perspective. This approach means that methodologies capable of accommodating these technological innovations must be offered and, for this, teachers must use them with discernment in the teaching and learning process. The university,

[1] All quotes in this paper were translated into English from the source in Portuguese or Spanish by the authors.

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Contribution of this paper to the literature

- The methodological process, data and findings of the qualitative research are analysed in a well-grounded and original way.
- Research findings identified the necessary knowledge for online teaching.
- The study can have both a pedagogical, practical and technological impact on teacher training courses and can directly influence online teaching and teachers.

among other educational institutions, also becomes responsible for responding to this demand to prepare professionals, but teachers must be aware and ready to respond to this demand.

In Brazil and around the world, there have been several changes in teaching and learning methods in institutions of higher education that offer distance learning courses (Torres & Siqueira, 2012). Some of these changes include the growing number of: (a) students enrolling in distance learning courses; (b) courses being offered online; (c) universities adopting this modality; (d) governmental regulations and (e) marketing actions. Besides, several of these programs are being internationalised. These developments have reflected on face-to-face teaching activities, with an increasing number of *online* episodes being incorporated into curriculums and into teachers' planning (Siqueira, Hilu, & Torres, 2015).

Initial and continuing teachers' education has seen a significant growth in the last decade in Brazil, which has even disproved the theory that these courses would be of less value in education. It is believed that the reason this education is now so popular is because Article 62 of Brazil's own National Education Guidelines Law - LDBEN 9394/96, clearly states that initial and continuing teachers' education can be accomplished through the use of DE resources and technologies. Article 80 highlights that "Public power will encourage the development and delivery of DE programs at all levels and modalities of education and continuing education" (Brasil, 1996). The effects of this law could be felt from 2009 with a significant increase in the number of enrolments for distance courses.

DE presents different forms of teaching and learning that carry specific terminologies such as *online learning*, *e-learning*, *blended learning*, *mobile learning*, and *MOOC*. Online education is a form of DE which involves the Internet, and is usually accessed through a number of devices, such as a computer, tablet, or smartphone. Through interaction and communication in synchronous or asynchronous ways, online education can overcome the feeling of isolation, typical of many distance courses, by allowing students to experience a sense of belonging to a virtual class (Torres, 2004).

From this perspective of online education, this article will discuss the findings presented by educators involved in research on the use of online education in the process of teaching and learning. Qualitative research, of the case-study type, was conducted on a group of 27 master's and doctoral students who work at different levels of education and who were attending meetings of the research group Pedagogical Practice in Teaching and Learning with Educational Technologies (PRAPETEC) at the Catholic University of Paraná (PUCPR), in Brazil.

In the research group, students discussed and reflected on issues related to online education and teaching practices, deepening their understanding, exchanging and producing knowledge in debates that were conducted in person and online. Online activities were performed in the Eureka virtual learning environment (VLE). In the face-to-face meetings, researchers reflected on topics, raised questions from the assigned readings and elaborated synthesis of the relevant points covered by the research group. From the readings and the syntheses performed, they created concept maps to organise and represent knowledge and to find possible solutions to the problem being researched. Concept mapping was used in order to promote meaningful learning as the creation of concept maps can significantly contribute to promote a shift from rote-mode learning to meaningful learning, encouraging analysis, synthesis, and critical thinking (Marriott & Torres, 2014). In the online meetings, the researchers developed activities in the VLE and established discussion forums on the subject. The research group held 15 meetings during the first half of 2016 and eight online activities, one of which concerned a discussion forum about online education.

The discussions and reflections presented in this article were extracted from the thematic forum on online education hosted on Eureka in which the following research question was posed: what is the knowledge necessary for educators to work in online education in order to promote knowledge production? The objective of the research was to analyse course participants' perceptions of online education in regard to the related teaching and learning processes focused on the production of knowledge.

ONLINE EDUCATION

Online education has democratised information and communication, bringing knowledge and learning to students who are geographically separated from the teacher, thus allowing knowledge to overcome physical distances. Among many existing technologies, videoconferencing, teleconferencing, and VLEs can be highlighted as the most used didactic resources in online education. It is in these online teaching and learning circumstances

that many training processes occur across Brazil, and this ensures the education and professional development of many teachers who seek to strengthen their pedagogical practice. The cultural and technological reality of Brazil is vast and much differentiated, and online education must be provided in a meaningful, innovative, and qualitative manner.

Online education has been assisting "the teacher who works in online courses, where new teaching temporalities need to be considered so that he/she can plan, develop and execute the planned classes" (Kenski, 2013, p. 119). Nevertheless, online teachers are being faced with a new paradigm in which the students, mediated by their teachers, produce their knowledge in an autonomous way and are able to 'learn how to learn' and to learn collaboratively. As such, for teachers to act in an emerging context based on virtuality and interactivity, both pedagogical and technological knowledge is necessary, but are only these two types of knowledge enough?

KNOWLEDGE NEEDED FOR ONLINE EDUCATION

Given the new educational paradigm in which today's students enjoy the connectivity and the sharing of information, the different modalities of education bring challenges to pedagogical practice and encourage teachers to seek professional development so that they can work in online education with relevance, quality, and commitment. In this sense, there is a need to determine the necessary knowledge that enables teachers to work with online education in a competent way in relation to the process of teaching and learning.

Teachers' academic education is influenced by the paradigms of education and, as a result, educational practice is determined according to the paradigm that the teacher establishes in his/her teaching. According to Behrens (2005), educational paradigms may be defined as conservative or innovative/emerging. The complexity presented by Morin (2000) appears as an innovative paradigm that proposes a reform of conventional thinking, and this has been much discussed in education, mainly in regard to its relation with technology.

Moreover, the complexity paradigm brings us a model of circularity that "is favoured by the possibilities of effective self-organising and self-creative processes that information and communication technologies can provide, more specifically by Web 2.0, the collaborative web." Online education with the support of ICT based on collaboration allows co-creation and co-learning that "privileges circularity and feedback inherent to a complex approach" (Torres & Hilu, 2017, p. 28).

Just as in face-to-face teaching, in which the teacher uses technology, mainly a VLE, as a resource to store *slides* of classroom lessons, the complexity approach seeks to overcome conservative actions in online education. The complexity view is essential for pedagogical mediation in online education, as it allows the teacher to transcend complex knowledge relating to online education without dismissing the need to overcome the contradictions and difficulties found in this type of teaching modality. On the other hand, the teacher cannot simply adopt the technological resources in a conservative way and be a mere instructor or someone only passing on contents because, in order to boost the production of knowledge, the teacher must acquire a form of knowledge that, in Tardif's vision (2010, p. 10), is called "professional practice":

An online education teacher must explore and use all of the technological possibilities related to the process of teaching and learning, and have a clear understanding of the knowledge embedded in this network. Therefore, when using technological resources, the teacher must clearly understand that these resources are designed to foster learning, in the same way that ICT fosters socialisation and collaboration in the production of knowledge. However, it is necessary that the teacher masters the technologies used in DE, especially in online education. The technological knowledge of a teacher is related to his/her technical knowledge, his ability to interact with and adopt technologies as resources in his/her teaching activity.

Online education enables various technological resources to be used to explore a wide range of information and knowledge. It is important to highlight that learning in online education can happen in any time and circumstance, depending on the technology and pedagogical proposal used.

It is also imperative to draw attention to a knowledge-related skill that must be constantly applied in conjunction with the knowledge required for online education: the skill of learning throughout life and from new scenarios that are presented from the different relations created through working with this type of education. This skill prioritises new methods of autonomous learning, collaborative learning, interactivity, and connectivity, all of which arise in the complex role of being a teacher of online education.

METHODOLOGICAL RESEARCH APPROACH

The objective of this research was to analyse educators' perceptions about online education in regard to teaching and learning processes focused on producing knowledge. The developed research presents a qualitative approach of a case-study type and of an interpretive nature. Qualitative research allows the researcher to interpret the phenomena of education in relation to their environment. From this perspective, the researcher is able to establish

a true interpretation of occurrences and educational facts in the search to understand the complexity of the education and the educational processes.

The research in question is of the case-study type, as this format allows researching a case in detail, specifically linking the thematic to the theory and pedagogical practice of teachers' education proposed by the PRAPETEC research group. Case-study research allows the researcher to delve deeper into details of specific situations. According to Bogdan and Biklen (1994, p. 89) "[...] the case study consists of the detailed observation of a context or individual, of a single source of documents or of a specific event."

The sample used to conduct the research and apply the data collection methods was made up of 27 educators who were masters or doctoral students belonging to the research group PRAPETEC. They were mainly women over the age of thirty who work at different levels of education (from kindergarten to higher education). Of the 27 subjects, 23 had experience in DE, 25 were female (15 pedagogues and 10 with another teaching degree[2]) and two were male (one pedagogue and one with another teaching degree).

All subjects of the research participated in several of the online forums; however, for this article, only the discussion forum concerning online education was investigated because, in this forum, the educators could discuss online education and the essential knowledge teachers required to be able to work in this model of teaching.

The data collection was performed based on the contributions in the online discussion forum, which enabled the participants' responses to be surveyed. Two questions about online education were presented and these generated discussion in the VLE. The subjects remained anonymous during all phases of data collection and data analysis. Free and informed consent forms were made available to the research subjects during the research group's face-to-face meetings. All educators involved were over the age of 18 and freely agreed to participate in the study. The research developed in this article was approved by the Research Ethics Committee at the Pontifical Catholic University of Parana (PUCPR) under the legal number 852.829.

The responses made in the forum were copied from the VLE and pasted into a Microsoft Word document; this was in order to enable content analysis and to maintain research ethics standards. The answers that the educators gave in the forum were coded as follows:

- The acronym "RFD" stands for a Response in the Discussion forum.
- The letter "E" next to a numeric expression such as "01" corresponds to the identification number for each Educator who participated in the research.

Combining this information creates a specific code; for example, "RFDE01," which has the following meaning: "Response in the Discussion Forum from Educator 01." A code with this information was created for each forum response. After forum responses were assigned identifying codes in the text of the Word document, the responses were entered into Atlas Ti qualitative-data-analysis software (the Mac version of this software) in order to begin performing the content analysis process recommended by Bardin (2011). This process of identification and coding was performed for the 27 responses in the discussion forum provided by the research subjects.

BARDIN'S CONTENT ANALYSES PERSPECTIVE

Data analysis is a very important part of research, as it allows the researcher to organise and interpret the data collected. At this stage, the researcher seeks to organise and structure the data in order to discern meanings that can be used as research evidence. The qualitative approach to data analysis is dynamic and varied; the researcher may choose to perform different types of data analysis in order to obtain a better answer to his research problem. The researcher, while performing the data analysis, must possess theoretical knowledge about the analysis technique that will be performed. Currently, there are different techniques for organising and analysing qualitative data; in this article, the content analysis method recommended by Bardin (2011) was employed to the responses of the discussion forum that was held on Eureka.

Content analysis as a qualitative analysis technique can be performed on various text materials from any source. To Bardin (2011, p. 37), content analysis "[...] is a set of communication analysis techniques. It is not a tool, but a range of implements; or, more precisely, it can be described as a single instrument, but one that allows for a great disparity of forms and is adaptable to a very wide field of application [...]." Content analysis can also be performed on images and sounds and it can be conducted in different ways; there is no rule to be followed to complete an analysis process. Considering the many ways of performing content analysis, the technique proposed by Bardin (2011) was used as a guide. From Bardin's perspective, the stages of content analysis are the following: pre-analysis,

[2] In Brazil, the holder of a teaching degree is entitled to be a teacher in kindergarten, elementary, secondary and high schools in the area of knowledge the degree was taken, such as: biology, mathematics, physics, chemistry, languages, history, philosophy, pedagogy, social sciences, arts, and physical education.

Figure 1. Stages of the content analysis process, which was performed with the help of Atlas Ti software on the discussion forum responses

material exploration, and treatment of results. The first stage, the pre-analysis, corresponds to the organisation of the collected material.

The objective of the **pre-analysis** is to organise the data; to choose the documents that will be part of the data analysis, to create code indicators to facilitate the analysis. At this stage of the content analysis, the responses from the discussion forum were organised and a code was created to identify each response made by the educators in the discussion forum. For the *corpus* (the set of documents used) of the content analysis, all of the answers posted on the discussion forum were used. The **exploration** stage of the material is the moment in which the researcher performs the content analysis: a systematic application of the analysis technique. In this stage, coding was performed, which concerns the reading of the responses given and the creation of codes to differentiate them in the data-collection instrument. Coding involves the systematic organisation of data for later classification and categorisation. Therefore, after coding, the next step is categorisation which, according to Bardin (2011, p. 133) "[...] corresponds to a transformation - made according to precise rules - of the raw text data, which is processed by clipping, aggregation and enumeration, and achieves a representation of the content or its expression, which is likely to clarify to the analyst the characteristics of the text." Categorisation is presented as a process that allows codes to be grouped, segregated, or regrouped with the purpose of consolidating a meaning.

At the **treatment of results** stage, according to Bardin (2011, p. 131), "[...] the raw results are treated in such a way as to become meaningful and valid [...] and the researcher [...] having at his/her disposal meaningful and trustworthy results, can then propose inferences and interpretations in advance towards the intended objectives - or that concern other unexpected discoveries."

We now present the analysis of data collected in this investigation following Bardin's perspective.

ANALYSIS PROCESS FOR THE COLLECTED DATA

In our research, the content analysis of the discussion forum responses was performed using the Atlas Ti software, which allows the researcher to perform qualitative analysis of the collected data. According to Gibbs (2009), qualitative data analysis software provide ease-of-use and advantages for organising and analysing data, making it easier and more accurate; however, the software itself does not perform data analysis, this is done by the researcher, along with the job of establishing its relationship with the object of study. Atlas Ti is a qualitative data analysis software tool widely used for research in the field of education; it affords the management, organisation, grouping, and regrouping of data.

To clarify the steps of the content analysis performed on the discussion forum responses using Atlas Ti software, **Figure 1** is presented, illustrating the steps of the data-analysis process and providing an explanation for each.

Step 1. Pre-analysis - Data Organisation: **At this first stage,** the data entered into the software was sourced from the discussion forum that was held on Eureka, which had the objective of discussing online education and the knowledge necessary for its teaching. The 27 answers given by the educators in the discussion forum were entered into the software.

Step 2. Use of the Atlas Ti Software: **At the second stage, t**he answers from the discussion forum were identified by a code that followed the following format: "RFDE01" – "Response on the Discussion Forum from Educator 01," where educator 01 represents one of the subjects who participated in the Eureka activity. For example, the code "RFDE13" means that the following is a response on the discussion forum from educator 13. The coded discussion forum responses were saved in Word format and inserted into the Atlas Ti software to begin the analysis process.

Step 3. Material Exploration: In the material exploration stage, the answers from the discussion forum followed two stages: coding and categorisation; these steps correspond to the analysis of the answers made by the educators involved in the research. A code was created for each questionnaire response.

Step 3.1 Coding: The coding stage was performed by creating codes for later categorisation. The codes represent a system of symbols that allow the representation of information. The codes were created chronologically as the reading of the responses in the discussion forum was being performed. For each response, a code was created, and identical or similar responses received the same previously created code.

Step 3.2 Categorisation: **At this stage,** we placed codes in a set in regard to occurrence or similarity. This allowed the researcher to group the data to consolidate a meaning. The codes that were grouped by similarity and occurrence gave rise to the categories of analysis.

After the coding was completed, the code that presented the highest occurrence and similarity of responses was visualised in Atlas Ti. All codes with high rates of occurrence and similarity of responses were analysed by the researchers. The analysis of the code was conducted as follows: 1 - Careful reading of the answers of the participants; 2- Reflection by the researchers on each response; 3- The identification and creation of groups with points of convergence between the answers in order to consolidate a meaning; 4- The creation of categories from the educators' answers.

Step 4. Treatment of Results: **We then reached the last stage.** After the educators' responses were learnt, they became indicators for creating categories. In order to create the categories, the researchers sought the meaning of the educators' answers and, as they were also interested in discerning the intensity of logical semantic meanings, they decided to quantify the absolute and relative frequencies of the answers. For content analysis to be performed in the responses of the discussion forum, a table was drawn to present the created categories and some of their indicators (answers). The table below presents three responses that were used as examples for the creation of categories and the total responses for each category. The question asked in the discussion forum on Eureka was as follows:

Problematization presented in the discussion forum: (1) What is the importance of online education for contemporary education? And (2) What knowledge is essential in order for an educator to work in this type of education before beginning the process of teaching and learning to produce knowledge?

For the first question on the discussion forum, the answer that had the highest rate of occurrence (21) was that online education is important to education because it allows collaboration. The questionnaire was designed to identify the relevance of online education today. **Table 1** presents the categories that were created from the participants' answers:

Table 1. Some reasons highlighted by the surveyed educators to justify the importance of collaboration in online Education

Answers	Teachers
(CATEGORY) - In Collaboration to obtain Knowledge	**Total of answers: 6**
"Online education allows students to learn more and more about using technology, social networks, etc. I use social networks a lot to collaborate in regard to information and learning [...]."	RFDE03
"In this type of DE, online education allows interaction between teachers and students and, in particular, collaboration conducted through various technologies in regard to information and knowledge that can contribute to the education of many people. In online education I try to collaborate with all involved, as this affords better interaction."	RFDE19
"In online education, we have the possibility to interact, integrate and collaborate with all those involved, disseminating information and knowledge."	RFDE25
(CATEGORY) - In Learning	**Total of answers: 15**
"Online education enables a collaboration of the teacher and student's knowledge, both interacting and exchanging information and knowledge mediated by information and communication technologies. Online education allows learning to be shared openly and dynamically."	RFDE08
"Online education offers a wide range of resources for teachers, allowing them to be more closely integrated with students, thus breaking the physical barriers of the classroom and allowing learning to be mediated by technologies. The interaction between teachers and students allows collaboration; in my point of view, this is very important, but the collaboration of all involved in the process allows, without a doubt, a form of learning in which there is exchange and sharing, something that many times does not occur in face-to-face teaching."	RFDE022
"[...] collaboration is of great relevance in online education, the teacher and the student share knowledge and life experiences. Collaboration, when done by everyone online, promotes collaborative learning."	RFDE13

Source: table built from data collected

In **Table 1**, it is possible to verify that 15 educators mentioned that the existing collaboration in online education assists learning. Given the educators' responses, the relationship between collaboration and learning becomes evident. In this study, the researchers understand that collaboration in online education is fundamental to learning, making it necessary knowledge for online teaching. In this sense, "Online learning is a social and individual activity at the same time. Social skills are an important aspect of Internet interaction, especially when they involve collaboration" (Kearsley, 2011, p. 66). The collaboration that occurs in this type of education, also called collaborative learning, is generated in learning situations in which students, in pairs or groups, not only assist each other but also share goals and meaningful exchanges amongst themselves and the teacher (Torres & Irala, 2014).

In online education, collaborative learning can occur in interfaces such as forums, messenger applications, e-mails, and social media, among others. According to Okada, Mikroyannidis, Meister, and Little (2012), social media provides co-learning, open, and collaborative learning. The co-learning used in online education can provide increased opportunities for co-authoring, the creation of open-education resources (OER), the promotion and exchange of *feedback* and comments, motivation for users to share their productions and their learning processes, contributions to disseminate knowledge, practices and paths for co-learning, instant answers and editing, availability for any web user to contribute, ease of communication; and low costs (Okada et al., 2012).

Considering the analysis made, it is important for online education teachers to plan and offer to students methodologies that allow collaboration, which will give them opportunities to discuss, argue, present points of view, collaborate, and share and produce knowledge, both individually and collectively. This can be performed through existing collaboration in online education, using technology to disseminate knowledge in a collaborative and open way. This can become a recurring practice in education, especially in teachers' education and, in the case of online education, in its pedagogical mediation.

In relation to the second question asked on the discussion forum, the answer that had the highest occurrence (23) was that the essential knowledge required for teachers to work in online education before beginning the process of teaching and learning is for the teachers themselves to have already been educated in online education. The question in the forum aimed to identify the knowledge required for online teaching. We agree with this research evidence, because it is very important for teachers who work in this modality of education to have specific training. In many educational institutions, in the start of teachers' education there is no subject which addresses online teaching, a type of education that is becoming more popular every day and one which from which many teachers graduate from in Brazil. In relation to DE, Brazilian undergraduate teaching courses have seen a significant increase in this type of education. **Table 2** shows the categories that were created based on participants' answers:

Table 2. Some reasons highlighted by the surveyed educators to justify the importance of training to build essential knowledge for teaching in online education courses

Answers	**Teachers**
(CATEGORY) - Technological knowledge	**Total of answers: 05**
"[...] one type of knowledge is related to technological knowledge, and concerns the ability to use and mediate online education. I believe that this knowledge must be provided through specific education in this modality of teaching."	RFDE01
"It is important for the teacher to receive training in online education. [...] a type of knowledge that I consider essential is the technological knowledge of the teacher. It is fundamental, and without it, the teacher cannot teach online education."	RFDE12
"I believe that in order to obtain knowledge about online education, it is necessary to have a good training in this modality of DE. Therefore, I believe that many types of knowledge are essential, such as ICT-related knowledge."	RFDE11
(CATEGORY) - Practical Knowledge	**Total of answers: 6**
"I am a teacher of several distance-learning courses, but I have never had any training in this modality of teaching. I think it is very pertinent that universities provide teachers with education related to DE. I did not learn to be a DE teacher at university; I became a teacher in this modality of teaching through practice, employing trial and error in regard to the process of teaching and learning in online education."	RFDE27
"Training to work in online education is fundamental, whether it is initial or continuing. My experience as a teacher in DE is completely practical, as I obtained no theoretical knowledge from my initial formation."	RFDE07
"Teacher education is essential for online education. I have become a teacher of DE due to hands-on experience. I used to clarify doubts with colleagues who work in online education" [...]	RFDE19
(CATEGORY) - Pedagogical Knowledge	**Total of answers: 12**
"Teacher education is essential to those who want to work with teaching. Pedagogical knowledge is paramount for the teacher to teach in both face-to-face and distance learning."	RFDE03
"[...] Tardif mentions vocational knowledge as one of the skills that is part of teachers' education. Online education is no different, the teacher needs to have training about online education; knowledge of this type of DE is required to teach and learn and, thus, produce knowledge. The knowledge acquired from teachers' education is essential."	RFDE24
"Having solid education to work in online education helps the process of teaching and learning in this context; without this, the teacher will not be able to deliver quality work to produce knowledge."	RFDE15

Source: Table built from data collected

In **Table 2**, it is possible to verify that 12 educators mentioned that the knowledge required to teach online must be acquired from teacher education, with pedagogical knowledge being central for online teaching. Given the evidence gained from the analysis conducted, it can be agreed that pedagogical knowledge related to the teaching and learning process is essential for online education, as well as for any educational principle.

Teaching knowledge is built through the professionalisation and professional development of teachers. It is a "plural knowledge, formed of diverse knowledge types from training institutions, vocational training, curriculums and daily practice." (Tardif, 2010, p. 54) The necessary knowledge required for a teacher to work in online education must stem from the same premise expressed by Tardif; however, it is believed that the necessary knowledge for the online education teacher should be given during education, whether it is initial or continuing.

Considering the categories created from the teachers' responses, it was possible to identify the different types of knowledge required by the online education teacher, among which are: technological knowledge; professional practical knowledge; and pedagogical knowledge, such as essential knowledge to mediate the process of teaching and learning.

FINAL CONSIDERATIONS

This research on the importance of online education and the essential knowledge that teachers require to work in this modality of education presents an advancement that needs to be considered in regard to the teaching and learning process to produce knowledge. However, it is necessary to consider that the findings of this case study research originated from a group of educators doing their master's or doctoral studies on a post-graduate Education program. The collaboration of the research participants and the deepening of the theoretical research made it possible to see that, in the online modality, the types of knowledge required include major fields of pedagogical, practical, and technological dimensions. In a true network that generates learning, this alliance between these forms of knowledge compose a weave, each one with its own importance, but all forms of knowledge need to manifest

themselves in the educational process, in particular by generating methodologies that embrace different procedures, such as the much needed problematization and contextualisation required to produce knowledge.

Once the relevance of each dimension is safeguarded, the *pedagogical* knowledge becomes directly linked to an epistemological view, as it portrays one's teaching choice, which is linked to one's approach to humanity, society, and the world. At this moment, the overcoming of the conservative view points towards the new complexity paradigm (Morin, 2000) which implies considering the student as an entity, that is, as a whole. So, in order to learn, it is necessary to consider multiple factors, like reason, but also to consider emotions, subjectivity, and lovingness, among others. In this respect, *pedagogical* knowledge offers methodological processes that involve both interactivity and collaboration, as indicated by the participants of this research. Such care becomes relevant and essential for bringing teachers and students increasingly closer together in regard to the expressive use of sharing and collaborative interfaces in the search to produce knowledge.

Practical knowledge involves considering the experiences of teachers, which they acquired throughout their lives as students and were further enhanced when they chose to become professionals in education. *Practical* knowledge is produced from experience as a teacher and from critical reflection from daily work in the classroom. *Practical* knowledge also depends on epistemological views allied with pedagogical knowledge, which is essential in the initial and continuing teacher education and involves choosing a conception or approach that ensures the ability to teach and to learn. Teaching methodologies, in some cases called active methodologies, have been widely discussed in an effort to meet new demands, including procedures that embrace interaction and collaboration in peer learning and involve the use of virtual resources.

In the alliance between pedagogical knowledge and practical knowledge, *technological* knowledge is added by those educators who wish to develop skills and competences in online or face-to-face teaching. *Technological* knowledge is knowledge that the teacher must apply in the use and adoption of virtual environments, their resources, and their interfaces. In this online network, participants are senders, receivers, and knowledge producers and, in this process, students must access information and resources to develop collaborative activities, engage in dialogue with each other, and establish connections. Students can enter new information or take it over in order to transform it in something new. The new complexity paradigm requires more than memorising contents. It concerns the addressing of real problems, leading to the search and elaboration of information to transform it into knowledge and in this process produce meaningful knowledge that encourages learning for life and not only learning to pass a test. The idea is to educate students and teachers as conscious, critical beings, capable of managing the available information and transforming it into relevant knowledge.

Pedagogical, *practical*, and *technological* knowledge, among others, involve performing the necessary research, analysis, preparation, reflection, and actions to form critical and thinking citizens required for this century, fostering a networked and interconnected circulation of thoughts, stimulating information not merely for communication's sake, but also to solve possible problems that humanity is facing.

REFERENCES

Bardin, L. (2011). *Análise de Conteúdo* [*Content Analysis*]. São Paulo: Edições 70.

Behrens, M. A. (2005). *O Paradigma Emergente e a Prática Pedagógica* [*The Emerging Paradigma and Teaching Practice*]. Petrópolis, RJ: Vozes.

Bogdan, R. C., & Biklen, S. K. (1994). *Investigação Qualitativa em Educação* **[***Qualitative Investigation in Education***]**. Porto: Editora Porto.

Brasil. (1996). Lei de Diretrizes e Bases da Educação Nacional. Lei no 9.394, de 20 de Dezembro de 1996. Estabelece as diretrizes e bases da educação nacional [National Brazilian Guidelines for Education]. *Diário Oficial da União*, Brasília, DF, 23 dez.

Gibbs, G. (2009). *Análise de dados Qualitativos* **[***Analysis of Qualitative Data***]**. Porto Alegre: Artmed.

Kearsley, G. (2011). *Educação Online*: *aprendendo e ensinando* [*Online education; learning and teaching*]. São Paulo: Cengage Learning.

Kenski, V. M. (2013). *Tecnologias e Tempo Docente* **[***Technologies and teachers' time***]**. Campinas, SP: Papirus.

Marriott, R. de C. V., & Torres, P. L. (2014). Mapas Conceituais uma ferramenta para a construção de uma cartografia do conhecimento [Concept maps – a tool for the construction of knowledge cartography]. In: Torres, Patricia (Ed.) *Complexidade – Redes e Conexões na Produção do Conhecimento*. Curitiba: SENAR-PR. P. 173-221.

Moran, J. M. (2006). Contribuições para uma pedagogia da educação on-line [Contributions for online pedagogy] In M. Silva *Educação Online: teorias, práticas, legislação, formação corporativa* (2nd Ed.), São Paulo: Loyola. p. 41-53.

Morin, E. (2000). *Os sete saberes necessários à Educação do Futuro* **[***The seven necessary knowledges for future education***]** (2. ed.), São Paulo: Cortez; Brasília, DF: UNESCO.

Okada, A., Mikroyannidis, A., Meister, I., & Little, S. (2012). Coaprendizagem através de REA e Redes Sociais [Colearning via OER and Social Networks]. In: Okada, Alexandra. *Open Educational Resources and Social Networks: Co-Learning and Professional Development*. London: Scholio Educational Research & Publishing.

Siqueira, L. M. M., Hilu, L., & Torres, P. L. (2015). Formando professores universitários para o uso de redes sociais na aprendizagem [Education university teachers to use social networks for learning]. In: Miguel, Maria Elisabeth Blanck; Ferreira, Jacques de Lima. (Eds.). *Formação de professores: história, políticas educacionais e práticas pedagógicas* **(**1 ed.), Curitiba: Appris, v. 1, p. 281-295.

Tardif, M. (2010). *Saberes docentes e formação profissional* **[***Teaching knowledge and professional education***]**. Petrópolis: Vozes.

Torres, P. L. (2004). *Laboratório on line de aprendizagem: uma proposta crítica de aprendizagem colaborativa para a educação* **[***Online learning lab: a critical proposal of collaborative learning for education***]**. Tubarão: Editora Unisul.

Torres, P. L., & Hilu, L. (2017). O paradigma da complexidade e o desafio da virtualização e da transformação da educação [The complexity paradigme and the challenge of vistualization and the transformation of education]. In: Núñez, María Elena Chan e Rama, Claudio (Eds.). *Futuro de los sistemas y ambientes educativos mediados por TIC*. Guadalajara: Ed. Universidad de Guadalajara. p. 25-39.

Torres, P. L., & Irala, E. (2014). Aprendizagem Colaborativa: teoria e prática [Collaborative learning: theory and practice]. In: Torres, Patrícia Lupion (Ed.). *Complexidade: redes e conexões na produção do conhecimento*. Curitiba: SENAR - PR, p. 61-94.

Torres, P., & Siqueira, L. (2012). Educação virtual nas universidades: as contribuições da aprendizagem Colaborativa **[**Virtual education in universities: the contribution of collaborative learning]. *Revista da história da educação latino-americana*, *14*(19), 175-204. https://doi.org/10.19053/01227238.1991