# Insights on Innovation in Education: A TPACK Experience in Continuing Teacher Education in Southern Brazil

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**Abstract**
Pedagogical practices at different levels of education, especially in basic education, demand proposals capable of developing autonomy and innovation skills. Considering the Latin-American scenario, especially in Brazil, the (post) pandemic context has contributed for information and communication technologies to move from supporting to protagonists in the pedagogical process, with their limitations and potential being the object of investigation in different spheres. In this regard, it is essential to consider the teaching role and, more than pointing out gaps in pre-service teacher education, or teachers' lack of technological knowledge, it is crucial to establish dialogues and proposals resulting from understandings involving a teaching and learning process with, through and about technologies, which still seems to be far from pedagogical practices in the Brazilian context. To this end, we conducted a survey with forty K-12 teachers from southern Brazil engaged in continuing education course on educational technologies based on the TPACK framework. A questionnaire was used in order to evaluate their self-perception regarding content, pedagogical and technological knowledge. Results suggest important variations in understanding among different areas of knowledge, especially regarding technological integration and awareness of teachers' practice, with impact on research and curriculum proposals. The results also show that the participants are uncertain about their knowledge involving the use of technologies in an integrated way for educational purposes. If there is, on the one hand, greater confidence in solving technical problems, on the other hand, there seem to be limitations regarding technological experimentation and metacognition involving their teaching role.

Keywords: TPACK, Continuing Teacher Education, Teacher's Knowledge

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## Introduction

Pedagogical practices at different levels of education, especially in basic education, demand proposals capable of developing autonomy and innovation skills with working teachers and their students. From this perspective, the Brazilian educational context has shown a certain shyness with regard to theoretically based practices around Information and Communication Technologies (ICT) that, in fact, translate the potential of these instruments in dialogue with the historical-cultural context with the which students interact.

However, it is clear that, often, there is some resistance and/or difficulty in understanding the presence and true role of ICT in education, be it distance, blended, or even face-to-face teaching, both on the part of basic education educators, as well as by teacher trainers in degree courses. This movement has generated consequences that involve the so-called learning "deficit", which can and should be urgently addressed and based on academic research in partnership with basic education, as we seek to develop through the project entitled "Smart Schools: exploring possibilities for innovation in the pedagogical process in a blended context" (Fapergs/Sebrae Funding Call).

The issue has proven to be urgent, to the point that UNESCO (UN Brazil, 2020) has pointed out some of the systemic repercussions in this regard, which involve numerous aspects beyond education itself and which demand collective and collaborative efforts between governments, the private sector and civil society. But, more than pointing out gaps in initial teacher training or even theoretical and methodological lack of knowledge when it comes to educational technologies, it is crucial that partnerships be established in order to establish dialogues, training, and methodological proposals regarding their practice in the classroom with with a view to feeding public policies in line with current demands.

There are, indeed, weaknesses in initial teacher training, as we could see in recent studies, in which the purely instrumental character involving ICT and education, that is, the emphasis only on the use and on "teaching about ICT" as something divorced from the process Pedagogical training in all areas is a reality arising from the initial teacher training itself, with very significant consequences for the performance of these professionals in basic education.

Thus, "learning with" ICT, in a transversal way and integrated with social practices and current demands in the 21st century, with a strong theoretical basis regarding its character as a cultural instrument that alters the flow of human actions, remains quite latent in the investigative scenario academic in the educational area in Brazil, as our studies have pointed out for a long time (Kurtz et al, 2020; 2021; 2022; Silva et al, 2020).

Therefore, concepts and frameworks typical of the technological sphere have been almost "naturally" associated with the perspective of innovation in education in several areas. The dimensions involving Artificial Intelligence (AI) in education (LUCKIN et al, 2016), Computational Thinking (CP) (Wing, 2006; 2014; Bower and Lister, 2015; Duncan et al, 2017) and TPACK (Technological Pedagogical Content Knowledge) (Mishra and Koehler, 2006) are dimensions that have been gaining ground in the national literature, not only linked to the scope of innovation, but the knowledge necessary for all teachers, in all areas of knowledge (Leone et al, 2022; Ferreira et al, 2022).

Therefore, as ICT are human creations, we consider their role in enhancing students' thinking to be crucial. They are not tools that are only at the service of the population or teachers, but

"intellectual partners" that help subjects to position themselves and act in the world. Thus, the objective of the research carried out was to propose a methodological parameter that would guide teaching in different areas in basic education, based on the continuous training process of teachers so that they qualify and, ultimately, revolutionize their immediate practices in the classroom.

This objective was built keeping in mind the fact that the so-called 21st century skills make the role of the teacher stand out. One cannot think about the pedagogical process without associating it with technological fluency, whether of the teacher or the student. Thinking, from this perspective, is no longer limited to a self-absorbed activity, but a collective one. The computer, if understood as a cognitive tool, amplifies certain skills, like any other cultural tool, from the Vygotskian historical-cultural perspective. Following this perspective, both cognitive processes and human actions are oriented, directed or "molded" by cultural instruments used by subjects.

## Research Methods

This is an applied research that involves an analytical dimension in a theoretical-conceptual scope and also an empirical one - qualitatively and quantitatively -, in the sense of investigating teachers' perceptions regarding the role of technologies in teaching, in different areas, as well as degrees of involvement, adhesion, resistance, teaching knowledge around technological competences in an educational perspective. These dimensions are combined with the participatory action-research process.

As for the qualitative and quantitative dimensions of the research, we adopted, in the first one, the Discourse Textual Analysis (DTA) proposed by Moraes and Galiazzi (2011), considering that this qualitative approach provides the content analysis articulated to the discourse analysis, being the data from the descriptive research. In this way, we seek the so-called data triangulation from the theoretical and empirical dimensions. The qualitative dimension manifested itself in the conceptual analysis of the publications compiled and analyzed regarding the topics investigated around innovation in education through technology according to experiences in several countries, as well as teaching methodologies adopted in these studies that are considered innovative.

After this stage, perceptions, prior knowledge, experiences and degree of adherence to innovative technologies and methodologies were mapped with the teachers (elementary and high school in public and private schools) participating in the research by requesting a response to a questionnaire. Through DTA, both the theoretical-conceptual and empirical material (interview responses) were analyzed in search of points of contact and conceptual divergence regarding the way in which experiences involving ICT and education are presented and based on which concepts, as well as as well as to the meaning processes of these elements as aggregators to the educational area as innovation. The Atlas.ti qualitative analysis software was fundamental for this.

The quantitative dimension is related to the analysis of the questionnaire used to investigate perceptions, prior knowledge, contact, etc. of participating teachers involving educational technologies. The analysis was performed based on descriptive statistics from the Likert school adopted.

Unlike an action-research, participatory action-research starts from a dense analysis of the context involved – either in the literature or in the investigative field, together with a preliminary analysis of the context and the needs of the participants. Hence the relevance of a preliminary, investigative, quali-quantitative mapping, as presented through mapping through questionnaires and interviews.

The cycle foreseen in the action-research predicted changes in the practices in question, within the scope of its joint and collaborative planning – between researchers and participants, and also the change in practice when it was implemented throughout the project, which actually happened. As the beginning of the participatory action-research cycle, after the composition of the group of participants (teachers-schools) the collective and collaborative planning of the planned activities (agenda, tasks, etc.), follow-up process, elaboration and implementation of Objects of Learning designed by teachers. The proposal carried out involved eight theoretical and methodological training meetings carried out remotely with the participants and the availability of tutorial videos.

The course involved the following themes: Cyberculture, Multimodality and Education, Practice and implementation of TPACK, Development of Computational Thinking in Basic Education, Experiences and possibilities involving AI in basic education, Gamification and use of applications for mobile devices in basic education, among which MathGo and PortGo applications, developed by the project team, Blended teaching methodologies in basic education. It also involved making tutorial videos available on Scratch, PortGo and MathGo applications, Augmented Reality/Metaverse, Appinventor and Curriki.

Throughout the period of formation and (preliminary) implementation of the proposed methodology, guided by a process of reflection-in-action about the pedagogical process in the perspective of innovation throughout the entire cycle of the research, a systematic movement of evaluation and mapping of potentialities, limitations and contributions of the proposal for future movements with the schools and classes of participating teachers, considering the return/feedback of the participants. After the training cycle, the developed learning objects were shared with the group, as well as reports of experiences regarding their elaboration and implementation, which will also be materialized in an e-book of the project.

Thus, the research had 45 basic education teachers, who effectively participated in the continuing education course with remote meetings held monthly between April and December 2022, always on the last Saturday of each month, and, of these, 22 participants concluded the course. The participation of teachers in remote meetings, when this was not possible, could be validated by their written evaluation, delivered at the end of the course, in December, in a hybrid meeting (face-to-face and remote). However, many showed difficulty in following the course due to the high number of activities and personal commitments, which meant that we had a small number of graduates.

Among the 45 participants, 93% are female and mostly aged between 40 and 50 years old (58%) and 30 and 40 years old (29%). The least representative age groups were 20 to 30 years old (11%) and over 51 years old (1%). They are linked to the areas of Literature (31%), Mathematics (15%), History (8%), Pedagogy (7%), Chemistry and Biology, both with 6% of the participants. Among the participants, 44% reported having a postgraduate degree, 24% an Academic Masters, and 11% a Doctorate. The remaining 21% reported that they did not have a graduate degree.

We report below elements verified both in the conceptual and empirical dimensions throughout the research, without dwelling on the punctual analysis of the instruments in order to enable a general look at the research and the evidence arising from it.

## Results and Discussion

After carrying out the research, we were able to develop an outline of parameters that can help implement proposals aligned with the field of educational technologies and that consider the teacher's knowledge as based on the content, pedagogical and technological dimensions based on the TPACK.

Such parameters, still in the design phase, involve:

- Consider teaching in all areas from an effective interdisciplinary process in effective dialogue with the multimodal context with which subjects - and the school - interact on a daily basis. For this reason, the context and hybrid teaching are envisaged as a scenario for implementation and redefinition in methodological terms in a strong association between theory and practice.

- To develop the effective exercise of interdisciplinarity, with the expansion of the work from a “discipline” to a “pedagogical program”, involving conceptions of a conceptual and methodological nature of the areas of knowledge in their points of approximation, giving them an effective process of “ change in pedagogical behavior” based on solving real problems in an integrated way with ICT. A kind of active methodology, even if it has already been systematized, which considers contextual variables directing the dialogue between disciplines, naturally, towards each other.

- Incorporate and feed new public policies in effective harmony between the agents of the school institution - such as principals, pedagogical coordinators, teachers, etc., in a perspective of mediation regarding what the legal documents provide and how the areas of knowledge, sciences and disciplines are materialized in school knowledge.

- Implement proposals based on the TPACK in a spiral, that is, start its integration into the curriculum from elementary school with simpler technologies that teachers and their students are more familiar with, followed by more elaborate applications over the years until the end of the high school. The content to be worked on should not be defined by ICT - the content - based on an interdisciplinary basis - associated with pedagogical knowledge should be a parameter for choosing a particular technology to be worked on, enhancing student learning, in favor of solving real problems/authentic situations.

- Validate proposals and activities developed in the educational context through digital learning objects (DLO) to be systematically publicized inside and outside the school.

It is also important to highlight that, through activities carried out with primary, secondary and youth and adult education classes reported by the concluding participants, it was evident, in the textual analysis carried out in the reports, the category The continuing education course contributed to the re-signification of teaching practice and the role of ICT for pedagogical purposes. The units of meaning that make up this category relate to how much the course challenged them to effectively rethink the role of technologies in their lives and that of their students.

Final data from the analyzes carried out suggest that the participants began to develop more consolidated understandings with regard to the integration between technology and content. We were also able to verify responses regarding gaps in their initial training regarding the pedagogical processes associated with the technological context, beyond the instrumental sphere, of use, suggesting that teachers perceive the lack of opportunity for reflection and critical thinking in this regard in their initial training , as well as uncertainties about the selection of technological resources “at the service” of the object or teaching methodology adopted.

With this proposal, we believe that ICT will no longer be underused at school (and even in undergraduate courses), simply because of fear or lack of knowledge on the part of teachers. Computers arrive at homes and institutions equipped with programs and applications that are examples of cognitive tools, allowing them to be used transversely in curricula, and not in one or another discipline, becoming, even more, an element that does not require large amounts of effort. financial investments, considering that most schools and degree courses have computer labs, many of which are not used by all areas in the same way.

In a context in which network computing has been understood as “cloud computing” for some time, it seems evident that these concepts should be part of the list of discussions in undergraduate courses and teaching in general, something still somewhat distant from the reality of many Brazilian teachers.

## Conclusion

The research carried out enables an understanding that technologies and education must be conceived far beyond a utilitarian logic or in a fragmented way in their formation, whether in teacher training courses or in basic education. They should, however, be considered in an integral and transversal way in curricula from a critical perspective of empowerment and social inclusion.

Aspects verified are still linked to the metacognition process as a strategy for the development of computational thinking, as xx points out, which is the basis for sustaining concepts and practices supported by an epistemological field that distances the educator's gaze from extremist and quantitative positions, such as the neo-Vygotskian Wertsch (1985; 2002) already highlighted, moving to a qualitative understanding, that is, what changes and why it changes in the educational process from the introduction of these new cultural instruments in the flow of human actions. It is, then, a process of cognitive education in which metacognition enhances the pedagogical process by enabling processes that stimulate and produce meanings that facilitate the meaning carried out by the subjects, which, according to Vygotskian theory, contributes to conceptual elaboration. It is, therefore, a condition for debate in undergraduate and continuing education courses in basic education.

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