






Teacher knowledge: insights for continuing education in Southern Brazil

Conocimiento docente: perspectivas para la formación permanente en el sur de Brasil

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Abstract

The pandemic caused by Covid-19 has caused education, on a global scale, to face increasing challenges in considerable aspects, from the social and economic inequality of students and teachers to the so-called learning deficit at all levels. Considering the essential dialogue between the university, through its teacher education courses and the basic education school, an applied research project was developed (participatory action research) whose theme presupposes technological innovation from a double perspective, as a means and an end. Means, through the proposed teaching methodology, integrated with technology with a view to changes and innovation in the work processes of basic education teachers when implemented. End, considering the pedagogical products generated after implementing the methodology, digital learning objects that, by nature, encompass different technologies for learning purposes. Furthermore, through the effective participation of teachers linked to the action research proposal, the results suggest the effectiveness of teaching resignification, made possible by continuing education, regarding their role as mediators and curators of the pedagogical process, aware that their knowledge of teacher involves the content, pedagogical and technological dimensions, as well as the role of information and communication technologies as an integral part of their pedagogical work.

Keywords: ICT, TPACK, Participatory action research, Technological innovation, mediation, cultural tools.

Resumen

La pandemia causada por el Covid-19 ha provocado que la educación a nivel mundial se enfrente a desafíos cada vez mayores en numerosos aspectos, desde la desigualdad social y económica entre estudiantes y docentes hasta el llamado déficit de aprendizaje en todos los niveles. Considerando el imprescindible diálogo entre las universidades, a través de sus cursos de formación docente y las escuelas de educación básica, se llevó a cabo un proyecto de investigación aplicada (investigación acción participativa) cuya temática presupone la innovación tecnológica en una doble perspectiva, como medio y como fin. Medio, por la metodología de enseñanza propuesta, integrada con la tecnología, con miras a cambios e innovación en los procesos de trabajo de docentes de educación básica al implementarlos. Fin, considerando los productos pedagógicos generados tras la implementación de la metodología propuesta, objetos de aprendizaje digitales que, naturalmente, abarcan diferentes tecnologías con fines de aprendizaje. Además, a través de la participación efectiva de los docentes vinculados a la propuesta de investigación-acción, los resultados sugieren una efectiva redefinición de la enseñanza, posibilitada por la formación continua, en cuanto a su rol como mediadores y curadores del proceso pedagógico, conscientes de que su conocimiento como docente evoluciona los contenidos, dimensiones pedagógicas y tecnológicas, así como el papel de las tecnologías de la información y la comunicación como parte integral de la enseñanza.

Palabras clave: TIC, TPACK, Investigación acción participativa, Innovación tecnológica, mediación, herramientas culturales.

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1. Introduction

Pedagogical practices at different levels of education, especially in basic education, demand proposals capable of developing autonomy and innovation skills with teachers and their students. From this perspective, the Brazilian educational context has not been fierce regarding the 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 which students interact.

However, there is some resistance to understanding the presence and role of ICT in education, be it face-to-face, e-learning or even blended, both on the part of basic education educators and teacher trainers. This movement has generated consequences that involve, today, in a post-pandemic scenario, the so-called learning “deficit”, which can and should be urgently addressed and based on academic research in partnership with basic education. UNESCO (UN Brazil, 2020) has pointed out systemic repercussions in this regard, which involves numerous aspects beyond education itself, and which requires collective and collaborative efforts between governments, the private sector and civil society.

Specifically, it is essential to pay attention to the teaching role in this context of qualification and resolution of problems related to education in an adverse context like this one. More than pointing out gaps in their initial training or even lack of theoretical and methodological knowledge when it comes to educational technologies, it is crucial to have partnerships in order to establish dialogues, training, and methodological proposals regarding teaching practice.

In this sense, recent studies conducted by “Mongaba: education, languages and technology” Research Group have shown that the purely instrumental character involving ICT and education, i.e., the emphasis only on the use and on “teaching about ICT” as something separated from the pedagogical process is a reality arising from initial teacher education, with very significant consequences in the performance of these professionals in basic education.

Thus, “learning with, through and about” technologies 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 academic investigative scenario in the educational area in Brazil, as the studies have pointed out (Kurtz et al., 2021; Kurtz et al., 2022; Kurtz & Silva, 2023; Kurtz, 2023; Silva, 2020).

In this way, concepts and frameworks typical of the technological sphere have been almost “naturally” associated with the perspective of innovation in education in several areas. For some time now, the dimensions involving Artificial Intelligence (AI) in education (Luckin et al., 2016) and Computational Thinking (Wing, 2006; 2014; Bower & Lister, 2015; Duncan et al., 2017) and frameworks such as TPACK (Technological Pedagogical Content Knowledge) (Mishra & Koehler, 2006) have been gaining ground in the Brazilian literature, even if timidly, not only linked to the scope of innovation, but of knowledge necessary for all teachers and their students, in all areas of knowledge.

In this perspective, it is assumed in this research that continuing education is the most viable way to set a perennial process so that teachers can develop their skills and competences. It is considered the importance of continuous teacher education and the need for constant reflection on pedagogical practice, as well as critically reflecting on its performance. The exchange of experiences between educators and the collective construction of knowledge are crucial, aspects that were also verified in the scope of the research reported.

In the same way, the principles of Schön’s “Reflective Teacher” (Schön, 1992; 2000) are considered as one constantly engaged in the critical analysis of his/her pedagogical practice, seeking to improve his/her teaching strategies, understand the students’ needs and adapt his/her performance to the demands of the contemporary world. The continuing education of the reflective teacher provides a space for reflection and theoretical deepening, allowing the educator to be updated on the new approaches, methodologies and educational resources available. Ultimately, the process contributes to filling gaps in their initial education, expanding their practices and promoting a more dynamic and contextualized education.

Initiatives that consider the scenario of gaps in pedagogical terms with regard to the role and use of ICT in basic education need to consider both the blended context and the different applications and

technological environments that not only enable meaningful pedagogical practices, but also qualify and potentialize them in a context permeated and transformed by technologies. ICT are, therefore, cultural instruments, starting from the ideas of Vygotsky (2007; 2008), which, once inserted in human social and cultural systems, alter these practices as well as human cognitive functioning. Ideas from “neo-Vygotskian” researchers (Wertsch, 1988; 2002) are fundamental in the sense of relating historical-cultural studies to the understanding of the mind and human learning, in the sense that subjects learn and, therefore, develop.

Given this scenario, the main purpose of the research is to verify how teachers in basic education conceive the role of technologies for pedagogical purposes before and after taking a continuing education course based on the previous epistemological assumptions. This objective is 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 (Jonassen, 2007), amplifies certain skills, like any other cultural tool, from the sociocultural perspective. Following this perspective, both cognitive processes and human actions are guided by cultural instruments used by subjects. New cultural conditions require new cognitive competences (composed, in turn, of a range of skills that constitute them). These conditions are effectively carried out in everyday life, since children and adolescents manipulate ICT in a very intimate way, often unlike their parents and teachers. On the other hand, this common sense does not produce an awareness of the new concepts, skills and abilities intertwined in the pedagogical scope, since it is necessary to enhance the development of theoretical knowledge of this new cultural condition

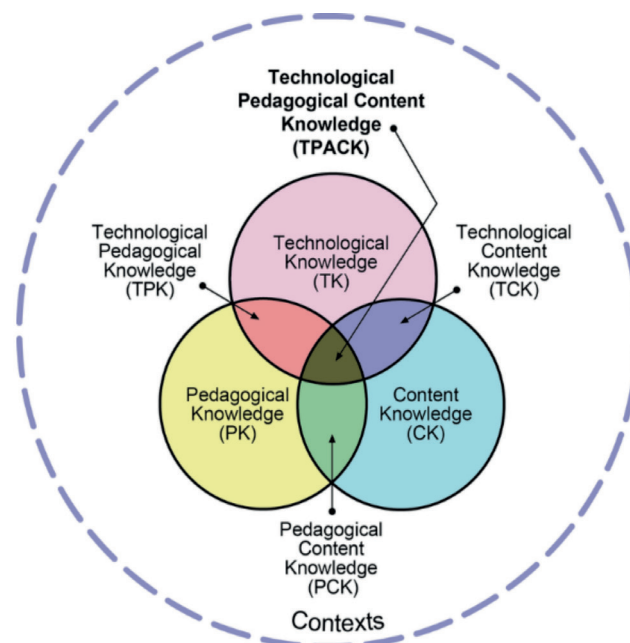
that even changes the human biological functioning, under the Vygotskian perspective.

Thus, this report presents results from an umbrella project that investigates teacher education in different contexts, both in the south and northeast of Brazil. Specifically, it presents results based on research conducted in the southern region of the country, Rio Grande do Sul State, involving basic education teachers’ self-perception of what constitutes teachers’ knowledge, using the TPACK framework (Mishra & Koehler, 2006) as a basis. The research was selected and received funding from a public call by a Rio Grande do Sul Funding Agency (FAPERGS) in partnership with the National Funding Agency (SEBRAE/RS), for projects involving innovation in education in hybrid contexts (Proedu/2021 Call).

2. Rethinking initial and continuing education with, on, and through educational technologies

The context presented above demands an understanding that the changes necessary for education reach the classroom, as it is there that the process of effective construction of engaged, competent and socially empowered citizens takes place. School is guided by structures created in another historical context, visible in the means it uses and the objectives it aims at, which until recently made it impossible to make proposals that go beyond the so-called *status quo*.

Among these changes is the constitution of competences that associate the pedagogical dimension of content to the technological dimension, following the conceptual proposal of TPACK or “Technological Pedagogical Content Knowledge” (Figure 1), which expands Shulman’s work (Shulman, 1986; 1987; 2004) from the proposal of North American researchers Punya Mishra and Matthew J. Koehler, from Michigan State University in 2006.

Figure 2. TPACK (Mishra and Koehler, 2006)

If we are – and this is not new in the educational sphere – in a new paradigm provoked by changes and drastic ruptures in the processes of human development and learning – obviously, new references guide the forms of interaction and social practices of the subjects. Therefore, new “pedagogical models” (teaching and learning relationships supported by learning theories) that, at their core, carry certain teaching methodologies, need to be developed.

Despite being investigated and disseminated in several countries for almost two decades, TPACK has shown itself in Brazil as something far from curricula and teaching methodologies, both in basic education and in initial teacher education. &, in a context/paradigm no longer characterized by the traditional and now outdated separation between “presence” and “distance” in social practices and education, in which “blended” becomes the protagonist, it is essential that these models are aligned with such context.

It is important to highlight that when it comes to articulating teaching and technology, for many educators the first movement is that of distancing, often linked to a concern of a technical and instrumental nature, something far from reflections articulated to theories and concepts that permeate and constitute the teaching profession itself. In many cases, there is a concern to reflect on aspects considered proper to “being a teacher of...”, but when

it comes to the role attributed to ICT in education, the subject becomes restricted to the “domain of...”, as if these “orbited” instruments were external to the pedagogical process.

Based on these understandings, the need for “reflective practice” emerges (Schön, 2000). The reflection is linked to teacher education as an educational principle necessary for the innovation of knowledge that qualifies and questions what is taught, enhancing the transformation of pedagogical practices. It is important to assume that reflective practice provides teachers with means for their professional development, making them more aware and helping them gradually to distance themselves from impulsive and routine conduct. In this way, teachers can act intentionally, differentiating themselves as informed human beings, which is a characteristic of intelligent action (Dorigon & Romanowski, 2008).

It seems urgent to deconstruct the instrumental and technical conception of mere “use” of technologies in teaching, specially in preservice teachers’ dimension, emphasizing the need for a pedagogical process that encompasses social and political aspects of ICT in the historical-social context and the role of the teacher in the midst of this scenario. Future teachers cannot be conceived from a paternalistic perspective, whose formation is merely technical, but rather as individuals capable of reflecting on the

world in which they critically and creatively live. The starting point for such a discussion should also involve the sociological and psychological prism regarding the use of ICT in the current context, in a transversal way, and not in one discipline or another, as our studies have shown (Kurtz & Silva, 2018; 2020; Kurtz et al., 2021). It is a pedagogical assumption that situates teaching and learning processes with, on and through technologies.

If models emerge at the core of new paradigms, and in education the so-called “pedagogical models” are associated with learning theories, such as Vygotsky’s socio-interactionist, it is essential to pay attention to what configures teaching methodology in a blended context, considering scientifically supported proposals that combine numerous experiences in the field of education (García-Lázaro & Martin-Neto, 2023; Maureira-Cabrera et al., 2020; Daniels, 2016; van Huizen et al., 2005). The management or curatorship of the teaching process becomes the teacher’s focus in the midst of this innovative scenario. The so-called “pedagogical distance” comes to be understood as the student’s “cognitive presence”.

However, can such skills and abilities be developed? Considering the Vygotskian historical-cultural approach, the issue of “being aware” of practices that already exist in the social context can be carried out, or the meaning of knowledge constituted about what to teach and by what means (Daniels, 2016). This confirms the importance of these questions being part of the preservice teacher’s process. In this way, teachers will lead other teachers to integrate ICT in their practice, as the teacher cannot share experiences he/she does not have or point out ways that he/she has never experienced.

3. Methodology

Considering the “problem” of the research carried out - the theoretical and methodological gap with regard to the effective association between technologies and basic education -, we verified significant possibilities to fill it and, in fact, seek a leap in quality in the education of young students and education as a whole. With a view to achieving the research purpose, a continuing education course based on applied action-research was developed. Data collection involved theoretical and empirical scope, in the sense of investigating teachers’ percep-

tions regarding the role of technologies in teaching in different areas, as well as degrees of involvement and resistance around technological competences in an educational perspective.

The participatory action-research started from a dense analysis of the context involved. The cycle foreseen predicted changes in teachers’ practices within the scope of their joint and collaborative planning and future implementation within schools. After organizing the group of participants, the planning dimension took place involving elaboration and future implementation of digital learning objects. After that, a theoretical and methodological cycle started, holding eight training meetings carried out remotely with the participants and providing video tutorials recorded by the researchers on key concepts of the project. A portfolio was organized and displayed at the project’s webpage (<https://sites.google.com/unijui.edu.br/escolasinteligentes/p%C3%A1gina-inicial?authuser=0>) and youtube channel (https://www.youtube.com/playlist?list=PLdDk-tqvuzA_aKO42Se40tEYei4ec_WDuc).

The research had 45 participants. They effectively participated in the course, which featured remote meetings held monthly between April and December 2022, always on the last Saturday of each month. The themes of the remote meetings were Cyberculture, Multimodality and Education, Practice and implementation of TPACK, Development of Computational Thinking in Basic Education, Experiences and possibilities involving Artificial Intelligence (AI) in basic education, Gamification and use of applications for mobile devices in basic education, and Blended teaching methodologies, based on team’s and teachers’ suggestions.

Among the 45 participants, 93% are female and the majority are between 30 and 50 years old. They are linked to the areas of Literature and languages, Physical Education, Literacy, History, Geography, Mathematics, Physics, Biology, and Chemistry. 50% have a *lato sensu* postgraduate degree, 25% a Master’s degree and 11% a PhD. Others do not have postgraduate degrees.

In terms of data gathering, participants were asked to answer a questionnaire (adapted from Schmidt et al., 2009 apud Herring et al., 2016), which seeks to ascertain their self-perception regarding their TPACK before taking the course. Data analysis was developed with a five-point Likert scale to assess

participants' attitudes towards the use of technology in education, followed by a descriptive analysis to summarize and interpret data, identifying patterns and trends at this stage.

After the course, a qualitative dimension regarding participants' reports was conducted based on Discourse Textual Analysis (DTA) (Moraes and Galiuzzi, 2020), and this is the dimension highlighted in this report. Specifically, the oral reports from the participants during the last meeting were recorded and transcripts were analyzed with the use of the qualitative software Atlas. ti. Considering DTA, the transcript was analyzed starting with the "fragmenting", or "unitarization" stage. In this phase, the text was examined in detail to be fragmented in meaning units. These were later interpreted and organized into a broader category, constituting the second DTA stage - the "categorization" process. Finally, the last stage, with the so-called "Metatext" was produced, i.e., the analytical textual production was carried out in which the categories were presented and interpreted from the perspective of the constructed theoretical framework, on a recurring basis: theory informs and is informed by the data and categories emerging from them, as it is presented in the following Results section.

4. Results and Discussion

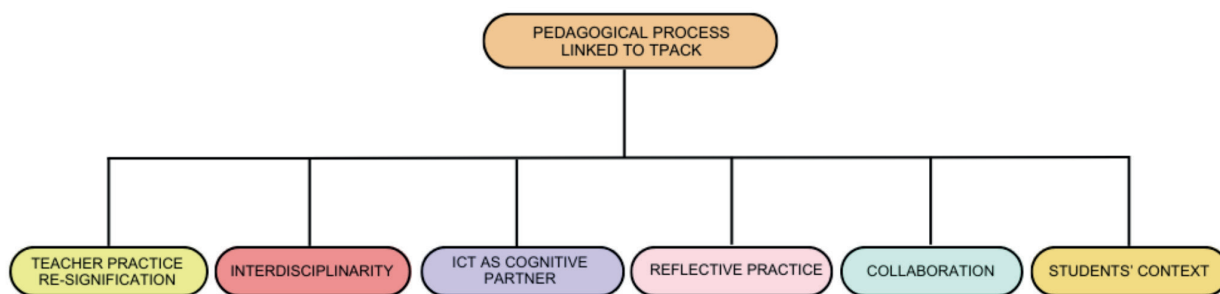
For the purpose of preliminary mapping about their view on educational technologies and self-perception involving technological pedagogical content knowledge (TPACK), the questionnaire proposed and validated by Schmidt et al. (2009) apud Herring et al. (2016) was adapted, and the 46 questions were "labeled" according to the grouping associated with a type of knowledge linked to TPACK.

In general terms, we observed that teachers had limited familiarity with educational technologies, often using them in isolation without holistic integration into their pedagogical practice. Teachers demonstrated a solid understanding of pedagogical strategies and underlying theories but faced challenges in assessing student performance and adapting teaching approaches to student needs.

Hence, before taking the course, participants recognized the interaction between technology and content in their pedagogical practices, but faced difficulties with thinking critically about the integration of technology in teaching and its impact on learning, with challenges in both preservice and effective inservice teaching practice. There were uncertainties involving elements regarding the habit, knowledge and technical skills for using ICT, as well as the approximation with technologies on the one hand; and on the other hand, greater confidence about solving technical problems. Gaps in their initial training regarding the pedagogical processes associated with the technological context, beyond the instrumental sphere of use, were clear in their opinion, suggesting that teachers perceive the lack of opportunity for reflection and critical thinking in their initial training.

However, after taking the course, experiences' reports showed significant changes in terms of participants' understanding and reflection-in-action regarding the role of ICT within their pedagogical practice. The analysis carried out on the transcripts of the recordings showed an interdisciplinary work on the part of the professors, who, through different didactic and technological resources, explored the themes discussed throughout the course, as Figure 2 illustrates.

Figure 2. Main concepts from textual discourse analysis (DTA)



Considering DTA, teachers' experience reports transcript was analyzed starting with the "fragmenting", or "unitarization" stage. In this phase, the text was examined and fragmented into 65 meaning units. These can be summarized as Figure 2 illustrates, regarding concepts that emerged from teachers' voices. These units were later interpreted and organized into an emergent category: "The continuing education course contributed to the re-signification of teaching practice and the role of ICT for pedagogical purposes".

In order to portray these dimensions, 4 excerpts are given in this results section. They are qualitatively representative of the 45 participants in the sense that the meaning units that make up this category related to how much the course challenged participants to effectively rethink the role of technologies in their lives and that of their students, as participating teachers' excerpts (named as P1, P2, P3, P4) illustrate.

From the work with cyberbully and corporeality, teacher P1 reported that students' engagement in "gamified" activities with unplugged computing simulations was much greater, enabling integration between theory and practice with students - with and without the presence of technologies. According to her:

So ...the first one that I developed for the sixth year, the theme was bullying in the life project I worked on and then first it was working, then the conversation through the titles of bullying ,, the consequences ... purpose of the law ... videos we worked on ... And then I presented these more theoretical questions I wanted to know about the subject and I integrated the physical education that I was working with them on the games ... board games ... so they created the games and they did it in parallel ... Because of the two disciplines ... I worked on the types of board games ... how it was built and everything ... history ... and then they created a board game about bullying with constructions and questions, drawing scores of each game. For this, they used the material available ...(...), there were times when I worked from technology to face-to-face and other face-to-face to technology so there I started from the discussion of it to later use it within the technological environment ... so they used sheets ... they created their own board games ... and played between them... they created each one with their questions ... And then they socialized with each other ...

they exchanged the games they created on the topic. (P1)

The cyberbully topic was developed by the teacher with other students involving specific technological tools, evidencing her conscious and integrative work of her content, pedagogical and technological knowledge. P1 effectively sought to develop not only activities with one or another digital resource, but integrated ones, transcending the instrumental focus as Jonassen (2007) and Kurtz and Silva (2018) observe, raising students' awareness about their technological knowledge for educational purposes (Zeng et al., 2022). Just like her, teachers argued having to adapt and develop different activities in different grades of elementary school. According to P1:

So this was one of the activities carried out for the sixth year, another activity that I did during the year, also culminating in the Smart Schools project. It was the 8th year and the theme was then divided, so it was the use of technology for education, for one of their objectives... It was to learn about online game site applications, so that technology could also be used for knowledge because they have this access to technology much more or just for social networking, right, they don't have ... sometimes they don't even know how to search for correct information, right ... so the objective was more in that sense ... life project and I was at the same time working with the Smart Schools project ... and then the concepts of different developments ... (P1)

Like P1, the participating teacher P2, who developed activities associating computational thinking and statistics through collaborative work, stated that the practical activity mediated by technologies was not only much more meaningful for students, but also fed the link between teacher and student and between students, considering their contextual needs. According to P2:

The teacher's place within the process...that student in my point of view had a very significant speech....the other ways I worked with that student... I had no connection with him, and from the moment I involved him in a technological practical activity, he managed to express himself, he managed to say what he knew... (P2)

According to P2, it seems possible to perceive that the effective participation of the student was not possible through “traditional paths”. According to her, the work gave the student a “voice”, and through the continuing education course she was able to reflect on this process as a whole, considering Tardif (1991; 2010; 2013) and Schön (1992; 2000) theoretical assumptions on reflective teacher and teacher knowledge.

In addition, P3 expresses surprise with the course taken, deconstructing myths involving continuing education in the field of technology, in a metacognitive process of teacher reframing (Daniels, 2016; Ouyang et al., 2021; Popandopulo et al., 2021), i.e., a process in which teachers and students gradually become aware of the cognitive processes used in the act of teaching and learning. This conception reiterates Daniels' (2016) finding that most individuals have the capacity for reflection, which allows them to develop more original and enlightened ideas, as long as they are explicitly and intentionally mediated.

According to P3, the tools and applications explored in the course, in association with theoretical and epistemological reflections, made meaningful experiences possible for her and her students. According to P3,

... then when I started to participate in this project I thought I started to rethink some things... Mainly in the sense that I could include the technology part within this project... We visited a sanitary landfill, a collection cooperative that also ... make money with our garbage, with our waste that can be recycled in reality, just like this school in the students' homes ... In this context of need to know the reality of the person who really does not have the conditions to live literally from the garbage that we don't use so it was really cool we had this visit and they assembled the material using the Canvas platform, google tools, PowerPoint as a tool that was the first moment where they used technology ... I was thinking about the question, what do students know at school in terms of proper waste disposal? (...)

The scope of the project and training cycle was quite significant, as the excerpt from P3's speech illustrates. Environmental awareness was disseminated throughout the school and beyond, suggesting that technological mediation effectively enables a greater range of actions such as the one provoked by the teacher and her classes.

Another report that shows a significant change in understanding the role of technologies in the teaching and learning process is brought by P4, when she highlights the challenge to teachers and students regarding the creativity and reflection that can be introduced in pedagogical proposals mediated by technologies, such as reported by this teacher:

The project exceeded my expectations and I believe of my colleagues as well because we had a space for reflection, systematization of doubts and support... There were several meetings outside our work shift and it was a learning moment and will also awaken in the teacher more and more the desire to continue working and to continue using these resources ... And this will also awaken in the students this interest and this desire to learn in a different way and of course we will not limit only the use of technology with the electronic means but also the awakening to those ludic practical activities that are also technological tools that will improve the contact with the student and help to understand the themes that we have to present... to complement our work with new technologies bringing different activities...challenges for us and also for the students because just as we do not have mastery of a large part of the technologies that can be used in the classroom, the students are also unaware of it... challenge... I started to use a tool called Kahoot ... and it was really cool ... it was challenging even initially ... I tested it at home with the family, right to learn not to embarrass myself, but it was really cool ... It was very challenging at the beginning of this project ...in the meetings we discovered that we have a group in common so we decided to think of an interdisciplinary activity and put this activity into practice...

Thus, P4's report illustrates results verified in continuing education regarding the significant change in understanding, on the part of the participating teachers, regarding the role, limitations and potential of ICT in the educational context. From mere tools to be used, they became cultural instruments created by man to “solve human problems”, with changes brought about from different perspectives, some positive, others not so much.

According to this teacher report, and this was also shared by the participants, there is praise and recognition that the continuing education course was, in fact, a space for reflection, where tea-

chers were able to discuss their doubts and support each other, in an environment of collaboration and continuous learning between teachers. This space awakened a desire to dare and explore technological resources in their teaching practice, and, consequently, the interest and desire to learn differently in students. The diversity of activities, playfulness, games, and other issues based on the scope of the project made it possible to understand that innovation is possible regardless of the use of one technology or another, but is enhanced by an articulated use of these resources, especially in an interdisciplinary way, as recent literature has pointed out (García et al., 2020; Reyes-Cabrera, 2022; Martín-Párraga et al., 2022; Silva et al., 2024).

Thus, we realized that the methodology triggered from TPACK, through tools and applications, from the simplest to the most elaborate can effectively be implemented in schools, in deep conceptual association, as it is not enough to deal with new methodologies if the conceptual and epistemological basis of the teaching, research, teaching role and instruments or mediation means are not sufficiently clear.

Teacher knowledge (Tardif, 1991; 2010; 2013) thus became effectively meaningful and experiential for the participating teachers as they comprehended the knowledge they have and use in their daily pedagogical practice. By recognizing not only the importance of integrating technology into their practice but also actually experiencing study situations and methodological possibilities grounded in a strong epistemological framework, they demonstrated deep reflection regarding their teacher knowledge concerning the curriculum and experiential knowledge as originally proposed by Tardif in 1991.

5. Final considerations

In the realm of cloud computing, blended learning, and especially after the spread of programs based on generative Artificial Intelligence (AI), a field where machines are becoming increasingly proficient at creating content and simulating human-like behavior, it seems possible to state that concepts explored in this research should be integrated into undergraduate and teaching curricula, either into preservice and inservice teachers' programs. This is especially relevant because many educators, inclu-

ding those in Brazil, are still somewhat apart from critical and reflective practices regarding this digital and technological scenario.

Through research investigation and the completion of the continuing education program, it was collectively and collaboratively realized that ICT will no longer be underused in educational contexts due to teachers' fears or lack of knowledge. We have successfully bridged the gap between academia and the classroom, facilitating teachers' efforts in an educational landscape that is increasingly mediated and transformed by technology.

Certainly, we encountered challenges along the way, such as the drop-out rate among enrolled professors, which can be attributed to various factors like time constraints and health issues. Nonetheless, our experience with conducting a distance learning course with monthly synchronous meetings has been positive. This approach enabled participation from educators across various cities without the need for traveling, reducing the associated costs and inconveniences.

Furthermore, our collaborative efforts have resulted in mutual learning and strengthened partnerships, not only within the education sector but also in the broader academic community. We have been actively sharing our findings and insights nationally and internationally. This collaboration between researchers in education and computer science underscores the critical importance of interdisciplinary initiatives like ours.

Finally, in light of the Sustainable Development Goals (SDGs), it is evident that the initiatives undertaken and the strengthened partnerships mentioned play a pivotal role in striving for a more sustainable and equitable future. By integrating these global principles into our collaborative efforts, we are not only empowering educators and enhancing the quality of education but also actively contributing to the achievement of the SDGs, particularly those pertaining to quality education, sustainable development partnerships, and technological innovation.

Our next step follows the recent research conducted by Wang et al. (2023), focusing on mapping research to the SDGs, which aligns closely with the principles and objectives of the 2030 Agenda for Sustainable Development. Considering the authors' work, the University of Auckland's SDG Keywords Dictionary Project aims to enhance the identifica-

tion of SDG-relevant research using text-mining techniques applied to academic publications. This endeavor contributes to the broader mission of universities and institutions worldwide in measuring their impact on the SDGs, not only through research but also through teaching and community outreach. This collaborative approach exemplifies the spirit of the 2030 Agenda and reinforces the significance of academic endeavors in advancing sustainable development on a global scale.

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References

- Bower, M., Lister, R., Mason, R., Highfield, K. & Wood, L. (2015). Teacher conceptions of computational thinking - implications for policy and practice. *Australian Journal of Education*, 0(0), 2015, 1-16.
- Daniels, H. (2016). *Vygotsky and Pedagogy*. Routledge. <https://doi.org/10.4324/9781315617602>
- Dorigon, T. C. & Romanowski, J. P. (2008). A Reflexão em Dewey e Schön. *Revista Intersaberes*, 3(5), 8-22. <https://doi.org/10.22169/revint.v3i5.123>
- Duncan, C., Bell, T. & Atlas, J. (2017). What do the teachers think? Introducing computational thinking in the Primary School Curriculum. *Proceedings of ACE'2017 - Proceedings of the Nineteenth Australasian Computing Education Conference*, Geelong, VIC, Australia, 65-74.
- García, G. G., Jiménez, C. R. & Marín, J. A. M. (2020). La trascendencia de la Realidad Aumentada en la motivación estudiantil. Una revisión sistemática y meta-análisis. *Alteridad*, 15(1). <https://bit.ly/3z9l0yA>
- García-Lázaro, D. & Martin-Neto, R. (2023). Competencia matemática y digital del futuro docente mediante el uso de GeoGebra. *Alteridad*, 18(1), <https://bit.ly/3xou564>
- Jonassen, D. H. (2007). *Computadores, ferramentas cognitivas: Desenvolver o pensamento crítico nas escolas*. Porto Editora.
- Kurtz, F. D. & Silva, D. R. (2018). Tecnologias de Informação e Comunicação (TICs) como ferramentas cognitivas na formação de professores. *Contexto e educação*, 33, 5-32. <https://bit.ly/3VMakyQ>
- Kurtz, F. D. & Silva, D. R. (2020). ICT, Media and Education: some considerations from the Brazilian scenario. *Annales Educatio Nova – UMCS Sectio N*, 5, 487-501. <https://bit.ly/3Vu1gNx>
- Kurtz, F. D., Silva, D. R. & Krajka, J. (2021). Rethinking innovation in education from a crosscultural perspective: the role performed by digital information and communication technologies (DICT) in pedagogy change. *Humanidades & Inovação*, 8, 114-131. <https://bit.ly/45sqWip>
- Kurtz, F. D., Machado, G. J. C. & Johann, M. R. (orgs.) (2022). *Educação, linguagens e tecnologia*. Ilustração.
- Kurtz, F. D. (org.) (2023). *Escolas Inteligentes: explorando possibilidades de inovação no processo pedagógico em contexto híbrido*. Metrics.
- Luckin, R., Holmes, W., Griffiths, M. & Pearson, L. B. F. (2016). *Intelligence Unleashed: an argument for AI in Education*. <https://bit.ly/45vmJu5>
- Maureira-Cabrera, O., Vásquez-Astudillo, M., Garrido-Valdenegro, F. & Olivares-Silva, M. J. (2020). Evaluación y coevaluación de aprendizajes en blended learning en educación superior. *Alteridad*, 15(2). <https://bit.ly/3xqz2eQ>
- Mishra, P. & Koehler, M. J. (2006). Technological pedagogical content knowledge: a framework for teacher knowledge. *Teachers College Record: The Voice of Scholarship in Education*, 108(6), 1017-1054. <https://doi.org/10.1111/j.1467-9620.2006.00684.x>
- Moraes, R. & Galiuzzi, M. do C. (2020). *Análise Textual Discursiva* (2nd ed.). Unijuí.
- Ouyang, F., Hu, Y., Zhang, Y., Guo, Y. & Yang, Y. (2021). In-service teachers' knowledge building during face-to-face collaborative learning. *Teaching and Teacher Education*, 107, 103479. <https://doi.org/10.1016/j.tate.2021.103479>
- Popandopulo, A., Fominykh, N. & Kudysheva, A. (2021). Do educators need metacognitive skills in today's educational environment? *Thinking Skills and Creativity*, 41, 100878. <https://doi.org/10.1016/j.tsc.2021.100878>
- Reyes-Cabrera, W. (2022). Gamificación y aprendizaje colaborativo en línea: un análisis de estrategias en una universidad mexicana. *Alteridad*, 17(1). <https://bit.ly/4c56C9j>
- Schön, D. A. (1992). Formar professores como profissionais reflexivos. En *Os professores e a sua formação* (1a ed., pp. 77-91). Dom Quixote.
- Schön, D. A. (2000). *Educando o profissional reflexivo: Um novo design para o ensino e a aprendizagem* (1a ed.). Artmed.

- Shulman, L. S. (1986). Those who understand: knowledge growth in teaching. *Educational Researcher*, 15(2), 4. <https://doi.org/10.2307/1175860>
- Shulman, L. S. (1987). Knowledge and teaching: foundations of the new reform. *Harvard Educational Review*, 57(1). <https://bit.ly/4ex4M2o>
- Shulman, L. (1992). Research on teaching: a historical and personal perspective. En F. Oser, A. Dick y J. Patry (eds.), *Effective and Responsible Teaching* (pp. 14-29). Jossey-Bass.
- Silva, D. R. (2020). Desenvolvimento do pensamento computacional como dimensão estruturante da atividade do professor de cursos superiores de computação. 182 f. UNIJUÍ-RS. <https://bit.ly/3KMubaS>
- Silva, D. R., Kurtz, F. D. & Pansera de Araújo, M. C. (2024). Metacognition and computational thinking in Vygotsky's historical-cultural perspective. *Espaço Pedagógico*, 30(1). <https://bit.ly/3xkYdPT>
- Tardif, M., Lessard, C. & Lahaye, L. (1991). Os professores face ao saber: esboço de uma problemática do saber docente. *Teoria & Educação*, Pannonica.
- Tardif, M. (2010) *Saberes docentes e formação profissional*. Vozes.
- Tardif, M. & Lessard, C. (2013) *O ofício de professor: história, perspectivas e desafios internacionais*. 5. ed., Vozes.
- van Huizen, P., van Oers, B. & Wubbels, T. (2005). A Vygotskian perspective on teacher education. *Journal of Curriculum Studies*, 37(3), 267-290. <https://doi.org/10.1080/0022027042000328468>
- Vygotsky, L. S. (2007). *A formação social da mente: o desenvolvimento dos processos psicológicos superiores*. Martins Fontes.
- Vygotsky, L. S. (2008). *Pensamento e Linguagem*. Martins Fontes.
- Wang, W., Kang, W. & Mu, J. (2023). Mapping research to the Sustainable Development Goals (SDGs), 19 February 2023, Preprint (Version 2). *Research Square* <https://doi.org/10.21203/rs.3.rs-2544385/v2>
- Wertsch, J. V. (1988). *Vygotsky and the social formation of mind*. Harvard University Press. <https://doi.org/10.2307/j.ctv26071b0>
- Wertsch, J. V. (2002). Computer Mediation, PBL, and dialogicality. *Distance Education*, 23(1), 105-108. <https://doi.org/10.1080/01587910220124008>
- Wing, J. M. (2006). Computational thinking. *Communications of the ACM*, 49(3), 33-35. <https://doi.org/10.1145/1118178.1118215>
- Wing, J. M. (2014). Computational thinking benefits society. *Social Issues in Computing- Academic Press*. <https://bit.ly/4esbZkm>
- Zeng, Y., Wang, Y. & Li, S. (2022). The relationship between teachers' information technology integration self-efficacy and TPACK: A meta-analysis. *Frontiers in Psychology*, 13. <https://doi.org/10.3389/fpsyg.2022.1091017>