

METACOGNITIVE PROCESSES IN COMPUTER SCIENCE TEACHER TRAINING

PROCESOS METACOGNITIVOS EN LA FORMACIÓN DEL PROFESORADO DE
INFORMÁTICA

PROCESSOS METACOGNITIVOS NA FORMAÇÃO DE PROFESSORES DE
COMPUTAÇÃO

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ABSTRACT

Individual Learning Portfolios demonstrate the development of metacognitive skills, including self-monitoring, self-regulation, and reflection-in-action, as well as the construction of a teaching identity and teacherhood. This study aims to map metacognitive processes in solving concrete teaching problems, based on innovative pedagogical practices in the context of initial teacher training in Computing at the University of Brasília. The methodological approach is qualitative methodology with content analysis of Individual Learning Portfolios produced by 69 undergraduate students. Emerging themes related to the role of the teacher, challenges in teacher training, metacognition, collaborative learning, and the Brazilian educational context were identified. The results highlight the importance of integrating reflection-in-action, collaborative projects, and authentic learning situations into teacher training curricula. This study contributes to improving teacher training programs and public policies, promoting innovative and inclusive pedagogical practices that align with the demands of contemporary education.

Keywords: Teacher Training. Computer Education. Metacognition. Individual Learning Portfolio. Teacher Identity.

RESUMO

Portfólios Individuais de Aprendizagem demonstram o desenvolvimento de habilidades metacognitivas, incluindo automonitoramento, autorregulação e reflexão-na-ação, bem como a construção de uma identidade docente e da docência. Este estudo tem como objetivo mapear processos metacognitivos na resolução de problemas concretos de ensino, a partir de práticas pedagógicas inovadoras no contexto da formação inicial de professores em Computação na Universidade de Brasília. A abordagem metodológica é a metodologia qualitativa com análise de

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conteúdo de Portfólios Individuais de Aprendizagem produzidos por 69 alunos de graduação. Foram identificados temas emergentes relacionados ao papel do professor, desafios na formação de professores, metacognição, aprendizagem colaborativa e contexto educacional brasileiro. Os resultados destacam a importância de integrar a reflexão-na-ação, projetos colaborativos e situações autênticas de aprendizagem aos currículos de formação de professores. Este estudo contribui para o aprimoramento dos programas de formação de professores e das políticas públicas, promovendo práticas pedagógicas inovadoras e inclusivas que se alinhem às demandas da educação contemporânea.

Palavras-chave: Formação de Professores. Educação em Informática. Metacognição. Portfólio de Aprendizagem Individual. Identidade Docente.

RESUMEN

Los Portafolios Individuales de Aprendizaje demuestran el desarrollo de habilidades metacognitivas, como el autocontrol, la autorregulación y la reflexión en la acción, así como la construcción de una identidad docente y de la propia condición docente. Este estudio busca mapear los procesos metacognitivos en la resolución de problemas docentes concretos, con base en prácticas pedagógicas innovadoras en el contexto de la formación inicial docente en Informática en la Universidad de Brasilia. El enfoque metodológico es cualitativo con análisis de contenido de los PIA producidos por 69 estudiantes de pregrado. Se identificaron temas emergentes relacionados con el rol docente, los desafíos en la formación docente, la metacognición, el aprendizaje colaborativo y el contexto educativo brasileño. Los resultados destacan la importancia de integrar la reflexión en la acción, los proyectos colaborativos y las situaciones autênticas de aprendizaje en los currículos de formación docente. Este estudio contribuye a mejorar los programas de formación docente y las políticas públicas, promoviendo prácticas pedagógicas innovadoras e inclusivas que se alinean con las demandas de la educación contemporánea.

Palabras clave: Formación docente. Educación informática. Metacognición. Portafolio de aprendizaje individual. Identidad docente.



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INTRODUCTION

Teacher training in Brazil takes place at the initial level, that is, at the undergraduate level. Unlike other countries, where teacher training reflects *stricto-sensu* projects, in Brazil, the teacher training policy establishes initial teacher training at the undergraduate level, qualifying the professional for the field of work, and allowing them to advance their academic journey at higher levels of training, but not necessarily mandatory to qualify them for professional practice.

The teacher training process, especially in the context of Computing, is a strategic and challenging field in the contemporary educational scenario. In an increasingly connected, technological and dynamic world, immersed in new ways of teaching and learning, teachers in training are invited to develop technical-scientific skills related to the mastery of specific computing content and the pedagogical, metacognitive, ethical and communicative skills that will allow them to act in an emancipatory and transformative way in different educational contexts.

In Brazil, historically, teacher training has fragmented theory and practice in its curricula, overlapping pedagogical knowledge with technical knowledge, demanding training practices inserted in the concrete school reality. In the specific field of Computing teaching, these challenges are amplified, since courses often emphasize technological and operational aspects, to the detriment of training approaches that contemplate the human, social and independent development of the future teacher.

Undergraduate courses aimed at training computer teachers have undergone several phases of restructuring in their curricula, seeking to meet the social transformations that forced them to rethink and restructure themselves in accordance with new pedagogical and technological demands.

Historically, teacher training in computing in Brazil began to be debated in 1986 by the Advisory Committee on Computer Science in Education of the Secretariat of Elementary and Secondary Education, which proposed, together with the state secretariats, the creation of the Immediate Action Program in Computer Science in Elementary and Secondary Education, with the aim of training teachers, stimulating the production of educational software and encouraging research that was being developed in Brazilian universities. In the following years, several projects were created, such as the Educational Computing Project in the Basic Education Area, the National Educational Computing Program, the Computing in Education Program, among others, with the objective of promoting the advancement of computing in education.

In 1996, the Brazilian Computer Society (SBC) published an edition of the reference curriculum for undergraduate courses in the area of Computing, all with in teacher training undergraduate degree. It was only in 2002 that the Working Group of the SBC Education Board established the Reference Curriculum for Undergraduate Courses in Computing, which would work together with the National Curricular Guidelines for the area of Computing and Information Technology, thus constituting a reference for the creation of curricula for undergraduate courses focused on teacher training in computing. In this context, the University of Brasília (UnB) was

the first university in the country to offer a higher education course in teacher training in computing, which began in 1997.

In this context, it is important to understand how students in initial teacher training in Computing develop pedagogical, ethical and metacognitive skills based on the activities proposed in the different curricular components and which they attribute to the experiences they have had during their training. Understanding how the curriculum, research projects, collaborative work and reflection on action are important for strengthening teaching identity constitutes professional knowledge that is more connected to the reality of basic education.

This study aims to map metacognitive processes in solving concrete teaching problems, based on the analysis of Individual Learning Portfolios (ILP) of students in their innovative pedagogical practices in the context of Computing teacher training. How does the development of emancipatory thinking and literacy of students manifest itself in pedagogical practices based on action research and aligned with school demands?

One of the contributions of this study is the analysis of the ILP, a pedagogical and evaluative instrument that materializes the educational path of students throughout the curricular component, enabling experiences, the development of metacognitive skills, privileged self-assessment and reflection on practice. From the point of view of social contributions, this study is part of the perspective of training teachers committed to the transformation of public schools, to tackling educational inequalities and to the construction of more inclusive and innovative pedagogical practices, strengthening the improvement of undergraduate curricula and public policies for teacher training for the development of pedagogical practices linked to the challenges of contemporary education.

REFLECTION ON ACTION IN TEACHER TRAINING

Reflection on action is one of the foundations of the teacher training process, and is considered a metacognitive practice for the development of contemporary teaching skills. In the field of education, reflection is a constant exercise in recalling experiences and assumes the character of a critical and intentional movement, aimed at transforming pedagogical practices and constructing new teaching knowledge.

Knowledge for teaching must go beyond mastery of disciplinary content, integrating pedagogical knowledge, understanding of students and contexts, as well as the development of

reasoning and pedagogical action (Shulman, 1987). In this sense, the reflective teacher transforms knowledge into a meaningful experience for the student, which requires constant analysis and reinterpretation of his or her own practice.

The Model of Reasoning and Pedagogical Action emphasizes that reflection occurs at different times: before action (pre-reflection), during action (reflection in action) and after action (retrospective reflection) (Shulman, 2014). This perspective understands the teacher as a "reflective practitioner", capable of analyzing teaching situations, making contextualized decisions and, based on lived experiences, reconstructing their pedagogical strategies. Furthermore, reflection on action is intrinsically related to the development of conversational skills (Thiollent, 2011), where speech acts, active listening and the construction of networks of commitments are essential, and such skills enable cooperation in practical pedagogical actions and the construction of bonds of trust between teacher and student.

Reflective practice, when inserted in the context of teacher training, enables the construction of a teacher who is a researcher of his or her own practice, in line with the concept of action research (Echeverría, 2001). In this process, the teacher investigates his or her performance, systematizes learning, identifies problems and proposes solutions, becoming a protagonist in the production of pedagogical knowledge \cite{b6}.

Another relevant aspect is the relationship between reflection and metacognition. Reflecting on action involves thinking about what has been done and developing the ability to monitor and self-regulate one's own learning and teaching processes. This practice enhances the construction of an autonomous and emancipatory teaching posture, capable of promoting contextualized and meaningful pedagogical practices for students (Perrenoud, 2002).

The challenge, however, is to include this reflective practice in a structured and systematic way in the training processes. Often, initial teacher training is marked by a fragmentation between theory and practice, distancing the future teacher from real experiences and reflections on their performance in the classroom. Teacher learning effectively occurs when the teacher experiences teaching, makes mistakes, reflects and reworks their practices (Schön, 1987). In this sense, the reflective portfolio emerges as a pedagogical tool for teacher training, as it allows the systematic recording of learning, difficulties faced, strategies used, results achieved, investigative understanding and deep learning. This practice allows the teacher in training to construct a critical narrative about their trajectory, favoring their teacher training. Reflecting on action in the context of teacher training is a movement that requires intentionality, pedagogical mediation and

institutional spaces that favor listening, dialogue and sharing of experiences. Reflection is a means for transforming educational practices, empowering teachers and building an education capable of solving concrete problems in society (Freire, 1996).

METHODOLOGICAL APPROACH

This study is characterized as qualitative research, with an applied nature, guided by an interpretative perspective (Bogdan; Biklen, 2013), aiming to understand the meanings attributed by the subjects to their experiences, considering the teacher training context in which the subject engages in reflective and metacognitive practices. Qualitative analysis, therefore, makes it possible to capture subjective, symbolic, and representational aspects present in the Individual Learning Portfolios (ILP).

This is a descriptive-analytical research, with a focus on action research (André, 2005), as it involves the analysis and critical reflection on real pedagogical practices, in a process of reflection-in-action within the curricular component itself, centered on the transformation and improvement of educational practices through the participation of the subjects in the research process.

The information sources of this study were the textual records prepared by the students in their ILP, available in the Moodle virtual learning environment of the University of Brasília.

The data collection instrument was the ILP itself, considered a pedagogical and methodological tool for students' recording, reflection, and self-assessment (Nóvoa, 2009). The portfolio was built in a procedural way throughout the academic semester and subdivided into four formative assessment moments: 25%, 50%, 75%, and 100% completion of the course component.

The research was conducted within the scope of the curricular component "Teacher Training in Computing", offered in teacher training undergraduate degree in Computing at Universidade de Brasília, during the second semester of 2024. This curricular component has a theoretical-practical nature, grounded in active learning methodologies, formative assessment, collaborative knowledge construction, and metacognitive practices.

The study involved 69 students who submitted the ILP. The textual records were analyzed according to the four assessment stages: 25%, 50%, 75%, and 100%. It was observed that all 69 students submitted their portfolios at the 100% stage, with a progressive increase in the

submission frequency from 25% to 100% — a situation commonly observed in long-term academic activities (Perrenoud, 2000).

Data analysis followed the content analysis technique (Bardin, 2011), structured in three phases: (i) Pre-analysis: initial reading of the records; identification of analysis units and preparation of the corpus; (ii) Exploration of the material: categorization of the data into emerging thematic axes; and (iii) Treatment of the results and interpretation: interpretative analysis of the data, establishment of relations with scientific literature, identification of meanings, inferences, and construction of the results.

The thematic categorization emerged from the students' reports, allowing the identification of the following analysis axes: (i) Reflection on the role of the teacher; (ii) Challenges and practices of teacher training; (iii) Metacognition and self-assessment; (iv) Collaborative experiences and active learning; (v) Connections with the theory and the Brazilian educational reality; (vi) Critical perception of education and teacher training in Computing.

FINDINGS

Taking into account the distribution of the number of ILP submissions in the four stages of formative assessment, it was observed that 100% of the students (n=69) submitted their portfolios, corresponding to the completion of 100% of the curricular component. However, there was a progressive increase in the number of submissions throughout the planned stages: 28 submissions with 25%, 58 submissions with 50% and 58 submissions with 75%. This phenomenon, recurrent in longitudinal assessment practices (Perrenoud, 2000), presents one of the challenges of formative assessment: maintaining student engagement in activities that require continuity, self-regulation and metacognitive discipline.

Emerging Categories from Content Analysis: The content analysis of the ILP (Perrenoud, 2006) allowed the identification of the following main thematic categories:

Reflection on the Role of the Teacher

Most students highlighted that engaging with the theory planned for the didactic sequence of the curricular component (Freire, 1996; Schön, 1987) led to a critical review of their teaching concepts. The reports revealed an appreciation for the reflective, ethical, dialogic teacher

committed to social transformation — basic dimensions of teacher training (Perrenoud, 2002). In addition to promoting a review of teaching concepts, engaging with important educational theorists allows future teachers to question the structural conditions of the school context and the social role of education itself. This process broadens the scope of reflection, going beyond the micro level of classroom practices to encompass the systemic and sociopolitical dimensions of education.

Teacher training cannot be dissociated from the development of a reflective awareness of inequalities, power relations, and cultural dynamics that shape educational spaces. Furthermore, this reflexive movement contributes to the deconstruction of technical-instrumental teaching models, still recurrent in many teacher training programs, which emphasize standardized procedures and the transmission of content to the detriment of contextualized pedagogical action. It requires the training of teachers who assume themselves as intellectuals and social agents (Freire, 2005), capable of interpreting the complexity of educational realities and engaging in the collaborative production of knowledge in school communities. The development of this critical-reflexive stance requires that initial teacher training integrate sociocultural, ethical and political dimensions into its curriculum, fostering interdisciplinary dialogues and problematizing everyday school practices.

This requires that teacher training programs create personalized learning situations that simulate the dilemmas, uncertainties and challenges faced in real educational settings — reinforcing the pedagogical notion in conditions of uncertainty (Thiollent, 2011). This analytical orientation must be accompanied by the cultivation of dialogic skills and emotional intelligence, enabling teachers to establish pedagogical relationships based on respect, empathy, and recognition of diversity. In this sense, the development of conversational skills, as planned in organizational and educational contexts (Freire, 2005), coordinates learning actions, fostering participatory environments and sustaining ethical communication in the classroom.

Reflecting on teaching practices implies adopting a stance of epistemic humility and professional inquiry, realizing that teaching knowledge is situated, provisional, and always open to concealment. It challenges teachers to position themselves as learners in their own professional trajectory, continually dialoguing with their students, peers, and educational contexts (Bogdan; Biklen, 2013). This transformative vision of teacher training transcends content mastery and technical expertise, positioning the teaching profession as a space of professional responsibility, social engagement, and the pursuit of collective human development.

Challenges in Teacher Training

The students identified challenges related to teacher training in Computing, such as the need for practices that are more connected to the school reality and the valorization of pedagogical knowledge. This finding converges with the criticism (Nóvoa, 2009) of the fragmentation of initial teacher training and the lack of significant experiences in pedagogical practice.

The challenges identified by the students in relation to teacher training in Computing reveal structural tensions that go beyond the curricular design or isolated pedagogical practices. They expose a persistent epistemological imbalance between technical knowledge and pedagogical knowledge in teacher training programs, particularly in Computing, where disciplinary knowledge often predominates over educational and didactic reflection (Nóvoa, 2009). This imbalance reinforces a utilitarian view of teaching, reducing it to the mere transmission of content or efficiency in problem-solving, neglecting its human, ethical and formative dimensions.

Furthermore, the fragmentation between theory and practice reflects a historical limitation of teacher training policies in Brazil, which are often structured around disciplinary specialization, with little investment in pedagogical laboratories, supervised internships or integrated projects that allow for the experience of real educational practices (Nóvoa, 2009). In Computer Science education, this fragmentation is intensified by a technological determinism that tends to prioritize the development of technical skills to the detriment of reflective, collaborative and inclusive teaching practices.

A critical analysis of this scenario requires that teacher training in Computer Science overcome the dichotomy between knowing how to program and knowing how to teach. This requires the design of pedagogical environments that promote learning ecologies, where knowledge is not compartmentalized, but emerges from collaborative processes, from dialogue with school contexts and from situated problem-solving (Perrenoud, 2000), with the centrality of reflective action in complex and uncertain environments, a typical condition of contemporary classrooms (Bogdan; Biklen, 2013)

Furthermore, the valorization of pedagogical knowledge is inseparable from the recognition of the professional identity of the teacher as a builder of culture, mediator of meanings and agent of social transformation. This implies rethinking teacher training as technical preparation and as an ethical-political training process, capable of training teachers for

emancipatory action in the face of social inequalities, educational exclusions and digital exclusion — issues particularly relevant in the Brazilian educational context.

Therefore, facing the challenges of teacher training in Computing requires systemic strategies that integrate school-university partnerships, verticalizing teaching, collaborative research projects, communities of practice and spaces for pedagogical innovation in initial training. It also involves reconfiguring the role of teaching practice as a privileged locus for the construction of knowledge and professional identity, transforming schools into active and dialogical spaces for teacher training.

Metacognition and Self-Assessment

Student reports indicated the development of metacognitive skills such as planning, monitoring, and self-assessment of learning, key elements of a student-centered formative curriculum. The ILP records revealed that students began to perceive learning as an active, contextualized, and self-regulated process.

In addition to the emergence of student-reported metacognitive skills, the report recognizes that metacognition in teacher education transcends individual cognitive regulation and assumes a collective dimension within professional learning communities. The development of metacognitive skills is inseparable from the fostering of a culture of reflection and shared inquiry, where learning is based on personal monitoring as well as collaborative meaning-making and critical analysis of pedagogical practices.

In this sense, promoting metacognition in teacher education requires the intentional design of formative environments that allow future teachers to experience uncertainty, deal with ambiguity, and engage in problem-solving situations anchored in real educational contexts. This perspective aligns with the concept of reflective practice, but also resonates with recent approaches in digital pedagogy and networked learning, in which the teacher ceases to be the sole source of knowledge and begins to act as a mediator of learning experiences, fostering autonomy, responsibility and critical agency among students.

Furthermore, metacognitive development in teacher education cannot be reduced to technical strategies of self-regulation. It requires the cultivation of epistemological awareness, in which future teachers critically examine the nature of knowledge, the purposes of education and the implications of their teaching practices. This reflective epistemology invites teachers to

question standardized curricula, assess the cultural relevance of their teaching materials and rethink their role in promoting emancipatory and transformative educational experiences.

In the specific context of Computing education, this metacognitive engagement becomes even more relevant. Rapid technological change and the increasing complexity of digital environments require teachers who can adapt their knowledge and also foster in their students the ability to learn how to learn in a continuous, autonomous and reflective way. Teacher training programs should therefore provide spaces for digital experimentation, ethical reflection on the use of technology and critical discussions about the social and cultural implications of computing.

The promotion of metacognitive skills in teacher training should be seen as an instructional objective and as a structuring axis of professional identity formation. Future teachers who develop the ability to plan, monitor and evaluate their learning trajectories are more likely to develop adaptive competences, engage in lifelong learning and become agents of educational innovation in their communities. This perspective reaffirms the understanding of learning as an active, contextualized and socially situated process, a fundamental principle for rethinking teacher training in a rapidly changing and increasingly complex world.

Collaborative Experiences and Active Learning

Group work dynamics, text discussions and collective presentations were identified as significant pedagogical strategies. Students emphasized the development of communication, argumentation and collaborative work skills as structuring competencies for teacher training (Schön, 1987)

In addition to fostering communication, argumentation and collaborative work skills, group work dynamics and collective learning experiences play a role in shaping the social dimension of teaching professionalism. Teacher training, especially in contemporary contexts marked by diversity and complexity, requires the development of relational skills that allow future teachers to act constructively in educational communities characterized by plurality, divergent perspectives and cultural heterogeneity (Nóvoa, 2009)

Collaborative learning practices transcend their operational or instrumental value; they constitute formative experiences that challenge future teachers to negotiate meanings, mediate conflicts and build consensus in the context of school culture, often marked by tensions, power relations and the need for dialogue between different educational actors.

The experience of working in groups allows future teachers to face one of the central dilemmas of teaching practice: balancing individual autonomy with collective responsibility. This relationship is recurrent in school life, where pedagogical decisions, planning and classroom management require negotiation and shared commitments within educational teams. Collaborative and cooperative learning during initial teacher training therefore anticipates the professional demands of collegial work, interdisciplinary projects and collaborative school governance.

In the specific case of Computer Education, where teaching practices are often individualized and centered on technique, the emphasis on collaborative strategies challenges traditional models of isolated work and promotes the development of networked pedagogical practices. These practices prepare future teachers to work in educational environments, managing technological tools as well as social interactions, virtual communities and processes of co-creation of digital knowledge.

Furthermore, collaborative pedagogical strategies create fertile ground for the development of affective dimensions of teaching, such as empathy, respect for differences and openness to dialogue, attributes valued in educational policies and in discourses on the humanization of education (Rabelo, 2013). The formative experience of collaborative work therefore contributes to the construction of a teaching identity anchored in cognitive and technical skills, and in ethical and relational values, essential for a democratic education committed to social justice.

The integration of collaborative learning in teacher training requires institutional policies and conditions that value collective work, promote peer learning and foster professional development communities. Such initiatives contribute to overcoming the isolation of teaching practice and create sustainable environments for reflection, innovation and collective production of pedagogical knowledge. This approach reaffirms the importance of training teachers capable of learning together, teaching collaboratively and acting as agents of social and political emancipation.

Connection with the Brazilian Educational Reality

Several ILPs have addressed criticisms of the Brazilian educational system, the devaluation of teachers and the need for public policies that promote continuing education and professional development for teachers.

The results of this study confirm important advances in teacher training, such as: (i) the development of a reflective and active listening attitude regarding the role of the teacher; (ii) the incorporation of metacognitive and self-assessment practices; and (iii) the valorization of collaborative work and active learning.

However, there are still structural challenges: (i) maintaining student engagement in ongoing training activities, in the construction of teacher identity and in the political struggle to strengthen the teaching profession; (ii) more effective integration between theory and practice in teacher training programs; and (iii) the promotion of institutional policies for teacher valorization and pedagogical training in computer education.

The results highlight the role of metacognitive awareness in strengthening adaptive teaching strategies and problem-solving skills among computing teachers. Participants demonstrated increased ability to articulate their thought processes, assess educational challenges, and refine their teaching methodologies. Metacognitive engagement skills identified include self-monitoring, self-regulation, and reflection-in-action, suggesting that metacognitive analysis can contribute to the development of teacher identity in computing education.

CONCLUSION AND FUTURE WORKS

The ILPs produced by students of the "Teacher Training in Computing" curricular component of the Computer Science degree course at the University of Brasília were analyzed using the Content Analysis technique. An analysis of the training revealed that the ILP is a powerful tool for metacognitive and formative learning, by providing opportunities for critical reflection, procedural recording of learning, active listening from the perspective of language ontology, and the development of self-assessment skills regarding teaching actions, fundamental elements in teaching without its more complex context (Rabelo, 2013).

The results indicated significant advances in the construction of teaching knowledge related to teaching identity, social commitment, the appreciation of the reflective teacher, and the

importance of collaborative practices in teaching. Contact with classical authors of education made it possible to recover epistemological foundations related to teaching, causing shifts in students' conceptions of teaching and learning. On the other hand, challenges persist, especially with regard to maintaining student engagement throughout long-term assessment activities and integrating theory and practice in initial training, with the need for monitoring strategies, continuous feedback and intrinsic motivation.

Based on the results obtained, it is recommended to intensify formative feedback strategies (Flavell, 1979) and personalized monitoring of students during the construction of the ILP, in order to stimulate constant and reflective deepening; to expand the moments of socialization of ILP records in face-to-face activities, strengthening the dialogic, collaborative and social nature of learning; to further integrate practical activities (classroom observation, interviews with in-service teachers, school visits) to articulate theory and practice in teacher training; to develop workshops and guided metacognitive practices, helping students to plan, monitor and evaluate their learning, enhancing the construction of formative autonomy; investing in innovative digital pedagogical practices that favor student protagonism, engagement and authorship in the training process; opening spaces for the development of conversational skills from the perspective of language ontology.

This study contributes to the field of teacher training, especially in the area of computing, by demonstrating that procedural, reflective, and metacognitive assessment practices, such as ILP, favor the construction of a critical, ethical, collaborative teaching profile committed to educational transformation. The empirical evidence from this research reinforces the strategic role of higher education in the construction of a new teaching profession, aligned with contemporary demands and emerging challenges in Brazilian education.

Teacher training curricula in computing need to integrate theory learned in universities and real practice in schools. Teacher training programs in computing need to increasingly approach the realities faced in basic education, in diverse and often challenging school environments, seeking a practical and integrated understanding of the needs and challenges of teaching computing in different educational contexts.

Teacher training in computing has been the subject of increasing discussions in the contemporary educational scenario, especially in view of the inclusion of this area as a curricular component for basic education. However, one of the main challenges encountered in this process is the need to bring teacher training curricula closer to the real practices experienced in schools,

so that future teachers can acquire theoretical and practical skills that enable them to deal with the challenges of the classroom in diverse environments (Holanda; Valente, 2007).

Teacher training curricula in computing, as in other areas, need to establish a solid bridge between the theory acquired in universities and pedagogical practice in schools. This requires a curricular approach that not only covers the technical content required for teaching computing, but also provides future teachers with opportunities to experience and reflect on the realities faced in the school environment. Teacher training should be seen as a reflective and continuous practice, in which the teacher in training has the chance to articulate theoretical knowledge with the practical situations of everyday school life (Nóvoa, 2009).

The connection between theory and practice is essential to prepare teachers capable of teaching computing in diverse contexts, with different levels of infrastructure and in scenarios marked by social and educational inequalities. In this sense, supervised internship plays a central role, as it is the moment in which the teacher in training can confront the theory learned with practice in real teaching environments, in addition to developing adaptation and problem-solving skills when faced with concrete challenges (Pimenta; Lima, 2004). Furthermore, teacher training in computing must include a broad understanding of the role of technologies in education and their social and cultural implications. It is not just about training teachers who know how to program or use digital tools, but about preparing them to understand how computing can be used to transform the teaching and learning process, promoting a more inclusive, critical and reflective education (Pimenta; Lima, 2004).

Basic education in Brazil is characterized by a wide diversity of educational contexts, which include urban schools with advanced technological infrastructure, as well as schools in rural or peripheral areas, where access to technological resources is limited. These different scenarios present specific challenges for teaching computing, requiring teacher training programs to address this diversity in a practical and contextualized manner. Teacher training in computing should prioritize a contextual approach, considering the real conditions of Brazilian schools. This means that future teachers need to be prepared to work in environments with different levels of access to technologies and to adapt their pedagogical practices according to these conditions (Valente, 2021).

In addition to addressing the diversity of school environments, teacher training curricula in computing also need to provide critical training, which enables teachers to reflect on the ethical and responsible use of technologies. Computer teaching should go beyond technical instruction

and address issues such as privacy, information security, digital citizenship, and the social impact of technologies. It contributes to a broader and more meaningful education that prepares students for the conscious use of technologies in their daily lives. Active methodologies are essential to promote more dynamic and engaging computing teaching, especially in a world where technologies are constantly evolving. The methodologies not only help to make computing learning more accessible and interesting for students, but also prepare future teachers to adopt an innovative and flexible stance in their pedagogical practices.

The implementation of public policies that encourage the training of computer science teachers is essential to ensure the quality of teaching in this area in basic education. Strengthening undergraduate courses in computer science, as well as offering continuing education programs, are strategies that can help meet the growing demand for well-trained teachers to work in computer science teaching. In addition, it is essential that these policies consider the specific needs of students and undergraduates and of the different educational contexts, ensuring that all teachers have access to quality training, regardless of the location or infrastructure of the school where they work.

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