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Teaching competences for the development of computational thinking in students in a borderline context

Competencias docentes para el desarrollo del pensamiento computacional en estudiantes en un contexto fronterizo

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ABSTRACT

This article presents a study on the teaching skills needed to promote computational thinking in border contexts, taking the Cúcuta-Venezuela region as a reference. The research objective is to reveal the teaching skills for the development of computational thinking in students in a Colombian-Venezuelan border context. Through a hermeneutic review of 27 scientific articles, dimensions such as technical, pedagogical, intercultural and decisive, among others, are identified that articulate the teaching of logical and creative skills with sociocultural reality. The results demonstrate the importance of inclusion, continuous training and adaptation to the linguistic and cultural diversity of the students. The use of active methodologies and emerging technologies as tools for integration and social cohesion is emphasised. In contexts with high migratory mobility, these teaching skills make it possible to reinforce educational equity.
Descriptors: reasoning; creativity; comparative education (Source: UNESCO Thesaurus).

RESUMEN

Este artículo presenta un estudio sobre las competencias docentes necesarias para fomentar el pensamiento computacional en contextos fronterizos, tomando como referencia la región Cúcuta-Venezuela. Se presenta como objetivo de investigación develar las competencias docentes para el desarrollo del pensamiento computacional en estudiantes en un contexto fronterizo colombo – venezolano. A través de una revisión hermenéutica de 27 artículos científicos, se identifican dimensiones como la técnica, la pedagógica, la intercultural y la resolutiva, entre otras, que articulan la enseñanza de habilidades lógicas y creativas con la realidad sociocultural. Los resultados evidencian la importancia de la inclusión, la formación continua y la adaptación a la diversidad lingüística y cultural de los estudiantes. Se resalta el uso de metodologías activas y tecnologías emergentes como herramientas de integración y cohesión social. En contextos con alta movilidad migratoria, estas competencias docentes permiten reforzar la equidad educativa.
Descriptores: razonamiento; creatividad; educación comparada. (Fuente: Tesauro UNESCO).

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Review articles section

INTRODUCTION

In recent decades, globalisation and digital transformation have driven profound changes in the way education and the teaching of 21st century skills are conceived. Among these skills, computational thinking has emerged as a fundamental competence for students' cognitive, creative and analytical development. This concept, which goes beyond simply learning programming, encompasses the ability to decompose problems, identify patterns, abstract concepts and design algorithms for the resolution of complex situations (Acevedo, Suarez, & Medina, 2024).

The Cúcuta-Venezuela border context presents particular characteristics that influence the educational process. This region, marked by migratory mobility, cultural diversity and socio-economic challenges, requires pedagogical strategies that take into account both the heterogeneity of the student body and the limitations in infrastructure and technological resources. The integration of computational thinking in education in this area is seen as a transformative tool that can contribute to social inclusion, the strengthening of critical competencies and the improvement of educational quality (Bello & Borrero, 2020; Haddad, Sánchez, & Cardona, 2020).

In consideration of the above, the research objective is to unveil the teaching competences for the development of computational thinking in students in a Colombian-Venezuelan border context.

Definition and relevance of computational thinking

Computational thinking has been defined as a cognitive process that involves formulating problems and their solutions in a way that makes them computationally representable (Padrón, Planchart, & Reina, 2021). This skill includes problem decomposition, pattern identification, abstraction and algorithm development. According to Acevedo, Suarez & Medina (2024), computational thinking is not limited to programming, but is a transversal competence that benefits students from different areas, promoting logical reasoning and the ability to solve complex problems in a structured manner.

In the current context, the relevance of computational thinking has intensified due to the increasing digitalisation of society, in this order, the ability to understand and use digital technologies has become an indispensable requirement for insertion in the world of work and in making informed decisions in everyday life. Likewise, computational thinking fosters creativity and critical thinking, essential skills to face the challenges of a global and changing environment (Castañeda, 2023; Jiménez & Albo, 2021).

Teaching competences in the field of computational thinking

The incorporation of computational thinking into the educational curriculum requires teachers prepared not only in technological content, but also in methodologies that favour active and collaborative learning; therefore, teaching competences in this area include the handling of digital tools, the design of activities that integrate logic and problem solving, and the ability to adapt pedagogical strategies to the needs and realities of students (Collado Sánchez, Pinto Llorente, & García-Peñalvo, 2023; González-Martínez, Peracaula i Bosch, & Meyerhofer-Parra, 2024).

Therefore, it is imperative that teachers acquire not only technical knowledge, but also pedagogical skills that enable them to implement innovative teaching strategies adapted to different contexts. In this sense, the literature review has highlighted the importance of training in computational thinking as a competence that should be transversal at all educational levels (Párraga et al., 2024; Guiza & Bennasar, 2021).

The Cúcuta-Venezuela border context

The Cúcuta - Venezuela border region is characterised by a high cultural diversity and a dynamic migratory flow, which poses specific challenges for the education system, it should be taken into account that the Venezuelan migration crisis has had a significant impact on the educational infrastructure, the availability of resources and teacher training (Haddad, Sánchez, & Cardona, 2020). In this context, the teaching of computational thinking can function as a mechanism for integration and social cohesion, providing students with skills that allow them to adapt as well as thrive in a competitive and changing environment.

It is important to bear in mind that cultural diversity and the presence of migrant students require teachers to develop intercultural competences and pedagogical strategies that promote inclusion and respect for diversity. These competences are essential to address the challenges that arise in a context where heterogeneity of backgrounds, languages and life experiences is the norm. Manrique, 2021; Pérez, Velásquez, & Silva, 2022).

Computational thinking and its educational application

In this sense, Acevedo, Suarez & Medina (2024) offer a systematic review of the literature in which computational thinking is highlighted as an essential competence of the 21st century. The authors indicate that, in order to effectively integrate this skill in the classroom, teachers need to be trained in active and collaborative methodologies that promote learning based on problem solving. Similarly, Ángel-Díaz, Segredo, Arnay & León (2020) highlight the use of educational robotics simulators as tools that enhance computational thinking, allowing students to experience abstract concepts in a practical way.

On the other hand, studies such as those by Caballero-González & García-Valcárcel (2020) and Olabe & Parco (2020) show that the implementation of playful and collaborative activities favours the development of digital and computational competences in students. This research mentions the importance of contextualising learning, using scenarios that reflect the realities and challenges of the environment in which students are inserted, which is especially relevant in border contexts where cultural diversity and socio-economic challenges are marked.

Teaching competences and training in computational thinking

Teacher training and updating are fundamental issues from the point of view of Collado Sánchez, Pinto Llorente & García-Peñalvo (2023) highlight the need to design training programmes that integrate both technical aspects and innovative teaching methodologies. Likewise, González-Martínez, Peracaula i Bosch & Meyerhofer-Parra (2024) analyse the impact of intensive training in programming, showing significant improvements in teaching skills and in the implementation of pedagogical strategies focused on computational thinking.

The study by Guiza & Bennasar (2021) provides a critical view of the adoption of these competences in times of crisis, suggesting that, in scenarios of high vulnerability, it is essential that educational institutions implement continuous training plans that allow teachers to adapt to new technological demands and challenges, which is particularly relevant in the border region of Cúcuta - Venezuela, where socio-economic conditions and migration have forced a rethinking of traditional educational strategies.

Challenges and opportunities in border contexts

Venezuelan migration has had a profound impact on the education system in Cúcuta, generating challenges ranging from overcrowded classrooms to the need to adapt curricular content to an expanded cultural diversity (Bello & Borrero, 2020; Haddad, Sánchez, & Cardona,

2020). In this context, the development of computational thinking is configured as an opportunity to transform education, providing students with cognitive tools that allow them to face the challenges of an increasingly digitalised world.

Studies such as those by Galvis, Montero & Jaimes (2020) and Leal, Manrique & Manrique (2021) highlight the importance of developing intercultural competences in teachers, so that they can design didactic strategies that respond to the needs of a diverse student body; therefore, the integration of digital technologies and the use of active methodologies are presented as effective strategies to promote meaningful learning, where computational thinking is articulated with the resolution of real problems and the construction of collaborative knowledge. On the other hand, it is suggested that the adoption of a learner-centred pedagogical approach oriented towards the development of digital competences can contribute to the social integration of migrants by offering them opportunities to improve their skills and actively participate in learning processes (Párraga et al., 2024; Roig-Vila & Moreno-Isac, 2020).

Pedagogical and technological innovations

The use of digital technologies in the classroom has opened up new possibilities for the development of computational thinking, and it is important to bear in mind that it has been shown that the implementation of simulators and practical activities allows students to understand complex concepts in a playful way, thus favouring autonomous and collaborative learning (Caballero-González & García-Valcárcel, 2020; Vera, 2021). These innovations not only enhance logical reasoning, but also stimulate creativity and problem-solving skills, which are essential competences in the contemporary world. On the other hand, the importance of integrating programming and other digital tools into the educational curriculum as a means to develop computational thinking in a transversal way is highlighted. Studies such as those by León et al. (2020) and Iturbide & Lope (2021) show that performing "unplugged" tasks - activities that do not require the use of computers - can also be highly effective in introducing fundamental concepts of computational thinking, with an emphasis on logic and abstraction.

Therefore, combining hands-on activities with the use of emerging technologies has proven to be a promising strategy for strengthening teaching competencies. This integration allows educators to design learning environments that are flexible and adaptable to the needs of students in highly diverse contexts, as is the case of the Cúcuta-Venezuela border (Medina, Torres, & Zúñiga, 2023).

METHOD

The review article was based on the hermeneutic perspective, understood as an interpretative method that enables the analysis of discourses, documents and socio-educational realities (Marañón & González-García, 2021). From this perspective, it is assumed that the study of the teaching competences needed to develop computational thinking in border contexts requires a comprehensive understanding of the cultural, technological and pedagogical phenomena that converge in these regions (Caicedo, 2021).

Specifically, an analytical review of 27 scientific articles was carried out in order to unravel the dimensions of computational thinking and the associated teaching competences. This process involved several phases:

1. **Selection and delimitation of the corpus**: Academic documents, case studies, refereed journal articles and institutional reports related to the teaching of computational thinking, teacher training and educational challenges at borders, particularly that of Cúcuta-Venezuela, were identified and refined.
2. **Analysis and interpretation of the texts**: From the analytical reading, the central ideas relating to pedagogical, technical, intercultural and technological competences

were extracted. Special consideration was given to the complexities of migratory mobility, cultural diversity and infrastructural constraints, which are typical of a border environment (Bello & Borrero, 2020; Haddad et al., 2020).

3. **Contrasting and integrating findings**: Through a process of triangulation, the data obtained in the review were compared with the empirical reality described by previous studies and with the guidelines on teacher education and training in challenging contexts (Leal et al., 2021). This phase allowed the results to be grouped into specific dimensions and teaching competences, which are shown in Table 1.

4. **Hermeneutic reflection**: An integrative interpretation was developed that articulates the results with the pedagogical and social implications that the development of computational thinking entails in border contexts. This reflection points to the urgency of assuming inclusive and creative educational approaches that are aligned with contemporary technological realities (Acevedo et al., 2024).

RESULTS

The analysis of the teaching competences necessary for the development of computational thinking in border contexts, such as that of Cúcuta-Venezuela, reveals the complexity inherent to the integration of this skill in educational environments marked by cultural diversity, migratory mobility and technological limitations, in this sense, competences are proposed from a documentary context with the intention of promoting a state of the question coherent to the ontological reality studied, for which purpose, table 1 is presented.

Table 1. Teaching competences for the development of computational thinking in borderline contexts.

Dimension	Competition	Description	References
Technique	Handling of digital tools	Ability to use software, platforms and technological devices to facilitate the teaching of computational thinking.	Collado Sanchez et al. (2023); Gonzalez-Martinez et al. (2024)
Pedagogical	Designing innovative teaching strategies	Ability to plan activities that integrate active methodologies, such as problem-based learning, gamification and the use of educational simulators.	Acevedo et al. (2024); Ángel-Díaz et al. (2020)
Intercultural	Adaptation to cultural diversity	Competence to implement inclusive pedagogical strategies that consider the cultural, linguistic and social particularities of students in border contexts.	Leal et al. (2021); Perez et al. (2022)
Resolute	Promoting critical thinking and problem solving	Ability to guide students in decomposing complex problems, identifying patterns and designing structured solutions using algorithms.	Padrón et al. (2021); Jiménez & Albo (2021)
Collaborative	Fostering collaborative learning	Ability to design activities that promote interaction between students, favouring teamwork and the joint construction of knowledge.	Olabe & Parco (2020); Caballero-González & García-Valcárcel (2020)
Creative	Stimulating creativity in the classroom	Ability to integrate activities that foster imagination and innovation, using tools such as educational robotics and "unplugged" tasks.	Vera (2021); León et al. (2020)
Formative	Continuous updating in computational thinking	Willingness to participate in education and training programmes that strengthen both the technical and methodological skills necessary for teaching computational thinking.	Gonzalez-Martinez et al. (2024); Guiza & Bennasar (2021)
Contextual	Integration of socio-cultural reality in pedagogical design	Ability to contextualise the learning of computational thinking, using examples and scenarios that reflect the challenges and opportunities of the border environment.	Galvis et al. (2020); Bravo-Preciado et al. (2024)
Inclusive	Promoting equity and social inclusion	Competence to design strategies to reduce educational gaps, fostering the active participation of students in vulnerable situations, such as migrants or in unfavourable socio-economic conditions.	Haddad et al. (2020); Párraga et al. (2024)
Technological	Use of emerging technologies	Ability to integrate advanced technological tools, such as simulators, programming platforms and digital resources, into the teaching-learning process of computational thinking.	Medina et al. (2023); Castañeda (2023)

Source: Own elaboration.

Table 1 shows that the technical dimension stands out as a fundamental aspect, as the use of digital tools is essential for implementing teaching strategies that promote computational thinking. However, this competence cannot be developed in isolation; it must be accompanied by solid pedagogical skills that enable teachers to design innovative and contextualised activities. In this sense, the importance of active methodologies, such as problem-based learning and gamification, which not only encourage logical reasoning but also stimulate creativity and collaborative work, is endorsed.

On the other hand, the intercultural dimension acquires particular relevance in border contexts, where the cultural and linguistic diversity of students poses significant challenges for the education system, therefore, teachers must be able to adapt their pedagogical strategies to the socio-cultural realities of their environment, promoting inclusion and respect for diversity, this competence is especially critical in regions such as Cúcuta, where Venezuelan migration has profoundly transformed school dynamics, generating the need for educational approaches that favour social cohesion and equity.

Furthermore, the problem-solving dimension highlights the need for teachers to guide students in the decomposition of complex problems and the design of structured solutions using algorithms, a skill that is not only essential for the development of computational thinking, but also contributes to the strengthening of critical thinking, a transversal competence that is key in the context of digital transformation and globalisation.

With regard to the training dimension, there is an urgent need to implement continuous training programmes that allow teachers to keep up to date with technological advances and new educational demands; in this sense, teacher training must be comprehensive, covering both technical aspects and the didactic methodologies necessary for teaching computational thinking. It is also essential that these programmes consider the particularities of border contexts, where limitations in infrastructure and technological resources can represent a significant obstacle.

The technological dimension therefore highlights the transformative potential of digital tools in the classroom. The integration of simulators, programming platforms and hands-on activities has proven to be an effective strategy to strengthen teaching competences and promote meaningful learning in students. However, it is important to emphasise that the use of emerging technologies must be accompanied by a student-centred pedagogical approach that prioritises real-world problem solving and collaborative knowledge construction.

Hermeneutic reflection on teaching competencies in computational thinking in border areas.

Training in computational thinking is fundamental for the acquisition of skills related to problem solving, creativity and logical reasoning (Acevedo, Suarez, & Medina, 2024). In environments with complex social and cultural conditions, such as the Colombian-Venezuelan border environment, an interpretative approach that encompasses discourses and socio-educational realities is required (Marañón & González-García, 2021). This text seeks to connect the technical, the pedagogical and the cultural in order to identify the teaching competencies needed to foster computational thinking in communities affected by migratory mobility and cultural diversity (Bello & Borrero, 2020).

Hermeneutic reflection is based on the interpretation of academic texts and pedagogical practices. On this basis, training in computational thinking is not limited to the use of computer platforms or programming languages, but includes the ability to decompose and structure challenges, formulate strategies and design logical solutions (Padrón, Planchart, & Reina, 2021). Its relevance encompasses different training scenarios and prepares participants for a world subject to constant mutations and increasingly demanding labour requirements (Jiménez & Albo, 2021).

Border areas pose particular dynamics; in the Cúcuta-Venezuela area, the student population brings together diverse origins, backgrounds and degrees of familiarity with digital technologies (Haddad, Sánchez, & Cardona, 2020). Teachers face challenges in incorporating methodologies that promote inclusion and in adapting content to the linguistic and cultural heterogeneity of the classroom (Leal, Manrique, & Manrique, 2021). The use of techniques based on participation, collaboration and active learning improves the understanding of computational thinking and, at the same time, strengthens social interaction.

The literature review highlights the presence of scarce teacher training in relation to advanced computer skills, combined with infrastructure limitations (Collado Sánchez, Pinto Llorente, & García-Peñalvo, 2023; Párraga, Morales, Andrade, Ortiz, & Castillo, 2024). Teaching demands the adaptation of curricula, the adoption of versatile didactic strategies and the use of resources that are meaningful for each group (Galvis, Montero, & Jaimes, 2020). These elements are enriched when teachers are immersed in continuous updating processes, both in terms of methodologies and digital tools (González-Martínez, Peracaula i Bosch, & Meyerhofer-Parra, 2024).

The intercultural dimension takes on great importance in the work of teachers, due to the coexistence of contrasting customs, languages and life experiences (Pérez, Velásquez, & Silva, 2022). Those who teach need methods that respect these variations and stimulate educational equity. The creation of environments conducive to cooperation, the promotion of empathy and the inclusion of local realities in the content nurture social cohesion and allow the educational community to be strengthened (Bello & Borrero, 2020).

Continuous training enables the adoption of technological tools and the application of teaching strategies that promote the logic of programming and the principles of computational thinking (Guiza & Bennasar, 2021). This training integrates the planning of didactic projects, the design of teamwork dynamics, the approach to simulated robotics activities and the contextualisation of the contents according to the problems of the region (Acevedo et al., 2024). Active methodologies, linked to problem-solving projects, prepare the school population to face changing and complex situations (Olabe & Parco, 2020).

Hermeneutic analysis also invites us to see the importance of creativity, as the construction of solutions through abstraction and experimentation stimulates the inventiveness of the participants (Vera, 2021). As for the production of digital projects, the design of home-made devices and the so-called "unplugged" activities allow to get into computational logic without relying entirely on expensive equipment (Iturbide & Lope, 2021). These initiatives can become even more relevant when the technical infrastructure of the school or community is limited, as is often the case in border areas.

The collaborative dimension complements the creative environment, while cooperative learning encourages interaction between students with different backgrounds and knowledge, group actions, focused on the design and execution of prototypes, help participants develop empathy, leadership, effective communication and flexibility (Caballero-González & García-Valcárcel, 2020). The support of the teacher is crucial to achieve an environment that stimulates discussion and exploration of different approaches (León, Vega, Fuentes, & Pérez, 2020).

In scenarios with mass displacement and pronounced diversity, curriculum adaptation demands intercultural adaptations, in this order, teachers need to differentiate content for individuals with different migration histories, customs and languages, and ensure that the teaching of computational thinking contributes to their social well-being (Leal et al., 2021). The border context creates challenges related to lack of resources, frequent changes in enrolment and high student turnover (Haddad et al., 2020). In such circumstances, the combination of didactic innovation, technical competence and inclusive strategies offers a possibility for progress towards equity and educational quality (Bello & Borrero, 2020).

The use of emerging technologies, including simulators and interactive platforms, opens new ways to address the fundamentals of computational thinking (Medina, Torres, & Zúñiga, 2023). The use of these tools facilitates the understanding of programming languages and the practical application of algorithms. According to Castañeda (2023), the growing digitalisation in Latin

America demands solid skills in the handling of software and the development of logical solutions, aspects that have an impact on labour market insertion and competitiveness.

At the level of teacher training, it is necessary to reflect on the need to incorporate preparation programmes that are not limited to the technical component. Teachers require didactic approaches that are conducive to the participation of children who may lack prior knowledge and who often face additional barriers (González-Martínez et al., 2024). Strengthening the skills to design creative teaching sequences, introducing computational logic with everyday examples and using community problems as a starting point reinforce the meaningful appropriation of this knowledge.

Learning strategies connected to the social reality of the border environment not only contribute in terms of motivation, but also encourage interaction with local elements that offer opportunities to innovate (Galvis et al., 2020). Each territory has its own particularities. Taking advantage of this diversity in the classroom enriches the educational experience by allowing the creation of projects that take into account issues related to the community (Bravo-Preciado, López, Hurtado, & Correa, 2024). Computational thinking is strengthened when it is approached from multi-sectoral approaches, allowing for the exploration of problems and solutions with practical impact.

Within this diversity, the inclusive dimension seeks to reduce educational gaps and facilitate access for all groups to skills that are essential in the digital age (Haddad et al., 2020). Those arriving at the frontier may be lagging behind in school and have few resources, which increases integration difficulties. An inclusive approach, coupled with targeted support schemes, can reverse the risk of exclusion (Párraga et al., 2024). Computational thinking serves as a bridge to training and employment opportunities, provided that a pedagogical approach is designed to be sensitive to the challenges of each individual.

The problem-solving dimension drives the development of structured logic and critical thinking (Padrón et al., 2021), whereby students learn to decompose challenges and detect patterns. These skills impact not only the understanding of programming, but also everyday decision making. A teacher who motivates enquiry and guides the learning process activates curiosity and promotes the search for alternatives to real problems (Jiménez & Albo, 2021). This approach to content transcends the classroom and can be applied to specific needs that arise in a context of migration and precariousness.

The pedagogical aspects are linked to technological competence and the ability to innovate (Acevedo et al., 2024), stimulating creativity and solving practical tasks helps to take on the difficulties of the frontier with a constructive vision. Examples such as educational robotics and visual programming inspire enthusiasm, as they allow young people to apply what they have learned in projects with social purposes: the creation of assistance databases, the design of apps for migrants or the implementation of alert systems (González-Martínez et al., 2024).

Collaboration also feeds on cultural diversity, bringing together students with different backgrounds and knowledge contributes to the formation of groups capable of an exchange that can translate into more robust solutions (Caballero-González & García-Valcárcel, 2020). Teacher accompaniment operates as a guiding thread to keep the focus on the learning objective and the social relevance of the projects (León et al., 2020). The joint construction of programmes, algorithms or prototypes deepens learning and reinforces social cohesion.

The hermeneutic approach indicates the importance of interpreting the characteristics of the environment, in a border space, teachers and students occupy a scenario where economic and migratory dynamics generate uncertainty (Roig-Vila & Moreno-Isac, 2020). The implementation of strategies for the development of computational thinking has the potential to equip the community with tools to overcome changing situations (Bello & Borrero, 2020). Resilience increases when intellectual autonomy is promoted and youth are encouraged to face challenges using logic and project structuring (Leal et al., 2021).

The incorporation of participatory methodologies adds value to the educational process, in this order, gamification and cooperative project work make learning a more engaging experience

(Olabe & Parco, 2020). Computer-free activities, known as "unplugged," reinforce the focus on logic and working together, focusing on understanding sequences of instructions without the need for expensive components (Iturbide & Lope, 2021). Such initiatives offer possibilities to overcome budgetary obstacles, as the teacher can reproduce the essence of computational thinking using elementary resources.

Training in computational thinking should not be seen as an imposition of content, but as a process that encourages exploration and questioning (Padrón et al., 2021), and points out that examples can be used to address specific problems in the region, such as health, security or humanitarian assistance (Galvis et al., 2020), 2020), therefore, the development of projects that address these aspects achieves a greater sense of collective responsibility and empathy for the situation of other groups, which fits with the aim of generating inclusive environments (Párraga et al., 2024).

The hermeneutic concern goes beyond the methodological level and is introduced into the meaning of educational practice. In this order, the teacher who masters intercultural, pedagogical, technical and collaborative competences becomes a catalyst for social transformation (Caicedo, 2021). Computational thinking, understood as a means for logical reasoning and creativity, becomes a resource that empowers those living at the frontier (Haddad et al., 2020). With the expansion of this proposal, classrooms could become spaces of convergence where diversity is recognised and values such as cooperation and mutual respect are strengthened.

The reflective exercise shows the need for training programmes that connect technical updating with intercultural sensitivity (Acevedo et al., 2024); this balance depends on the presence of institutions that encourage teachers to explore approaches related to regional issues (Bravo-Preciado, López, Hurtado, & Correa, 2024). It also requires educational management committed to the provision of equipment and access to networks, as well as the implementation of support strategies for those who start with a digital skills gap (Leal et al., 2021).

The design of tasks applied to the real world tends to inspire greater motivation and participation, as students observe the relevance of what they learn (Iturbide & Lope, 2021). By proposing exercises that touch on the reality of the sector, computational thinking becomes an instrument for the search for alternatives in the face of shared challenges (Roig-Vila & Moreno-Isac, 2020). Institutions can propose innovation fairs, prototype exhibitions or programming competitions aimed at solving problems related to migration, community health or local productivity (Galvis et al., 2020).

In border areas, this set of competences gives rise to the transformation of education, provided that the migratory phenomenon and cultural diversity are considered as factors with great formative potential (Bello & Borrero, 2020). The promotion of creativity, logic and solidarity participation contributes to integration, the classroom ceases to be a place for the simple transmission of data and becomes a space for co-creation, where digital experience and social coexistence are woven together (Párraga et al., 2024). The development of computational thinking favours the formation of subjects with the ability to solve challenges, express ideas clearly and assume diversity as a source of joint learning.

The teacher is fundamental when designing environments that provide adequate stimuli, integrate collaborative methodologies and encourage the intelligent use of technology (Vera, 2021, a broad formative approach is advised, encompassing instruction in programming languages and the exploration of approaches that provoke reflections on the impact of digitalisation on everyday life. This vision connects with the consolidation of intellectual autonomy, ethical training and the promotion of cooperative work (Castañeda, 2023).

This text highlights the technical, pedagogical, intercultural, problem-solving, collaborative, creative, formative, contextual, inclusive and technological dimensions, all of which intertwine and reinforce each other. Without a minimum of technical knowledge, the logic of programming cannot be taught; without pedagogical skills, interactive practices cannot be achieved; without intercultural strategies, certain groups are excluded; without continuous updating, there is no substantial progress. Each of these dimensions finds an interpretative substrate in the

hermeneutic view, which conceives the border as an area where identities and aspirations converge, and where teaching transcends the classroom to become an agent of change (Marañón & González-García, 2021).

The configuration of teachers prepared to promote computational thinking is not only a technical process, but also a reflective one; the complex conditions that characterise the frontier require interpretations that allow for a reading adjusted to the needs of the community (Caicedo, 2021). The approach to the life experience of the learners makes it possible to design training itineraries where logic, robotics, recreational activities and community projects are attractive and transformative (Collado Sánchez et al., 2023).

The teaching of programming and problem solving makes sense when the activity is linked to the local reality, with an inclusive orientation, taking advantage of linguistic and cultural diversity to stimulate cooperation and critical thinking. When infrastructure restrictions are taken into account, the optimisation of resources is sought with creativity, resorting to strategies such as "unplugged" practices or the reuse of materials (González-Martínez et al., 2024).

Social reality and computational logic come together in projects that link the school and community spheres, through low-cost simulations or prototypes, appropriate for areas with difficult access to technology (Medina, Torres, & Zúñiga, 2023). Teachers thus need management skills, problem-solving skills and, above all, a commitment to equity by overseeing an inclusive teaching-learning process (Haddad et al., 2020).

Thus, educational transformation begins with teacher preparation, supported by institutions that facilitate continuous training plans and the acquisition of equipment, the studies reviewed confirm the importance of approaches based on real application, the generation of shared initiatives and priority attention to cultural differences (Galvis et al., 2020). This body of knowledge configures a scenario in which computational thinking transcends the idea of computing itself and is projected as a pathway for the integral development of the student population.

Therefore, the hermeneutic perspective suggests that the teaching of computational thinking in a complex and diverse context benefits from a teacher who recognises socio-cultural complexity, seeks to improve the quality of life and promotes integral education (Acevedo et al., 2024). The border zone offers opportunities for the exchange of experiences, innovation and the joint construction of knowledge. Computational thinking, in this line, is positioned as a tool for the creation of participatory and collaborative environments oriented towards collective growth (Bello & Borrero, 2020). In this order, teachers play a decisive role by integrating methodologies that combine digital skills, intercultural values and reflective processes, goals that encourage the development of responsible, autonomous and creative citizens.

CONCLUSION

The review developed allows us to demonstrate the relevance of integrating computational thinking in border contexts such as Cúcuta-Venezuela, recognising its contribution to the training of students capable of facing increasingly complex social, technological and cultural challenges. From a hermeneutic point of view, this incorporation goes beyond a simple technical mastery or digital tools, to enter into the socio-cultural and migratory reality of the border. Therefore, teachers not only require pedagogical and technological skills, but also the willingness to adapt to the particularities of the communities, cultural diversity, high school turnover and infrastructure limitations, factors that require a critical, reflective and inclusive teaching praxis.

In this scenario, the teaching competences described as technical, pedagogical, intercultural, problem-solving, collaborative, creative, formative, contextual, inclusive and technological, are configured as fundamental axes for fostering active learning of computational thinking. These competences do not operate in isolation, but are intertwined in the search for educational quality and social equity, enabling students from different backgrounds and experiences, including those associated with migratory mobility, to develop not only cognitive and logical skills, but also values of cooperation and respect for diversity. This hermeneutic perspective, which articulates

the critical understanding of academic discourses with the educational praxis in border territories, accounts for the need for a teaching staff capable of mobilising, adapting and transforming didactic strategies according to local challenges, thus promoting the comprehensive development of the community and strengthening the social fabric.

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