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NEUROEDUCATION IN THE CLASSROOM: INTEGRATING MULTIPLE INTELLIGENCES INTO BILINGUAL LEARNING

NEUROEDUCAÇÃO NA SALA DE AULA: INTEGRANDO MÚLTIPLAS INTELIGÊNCIAS NA APRENDIZAGEM BILÍNGUE

NEUROEDUCACIÓN EN EL AULA: INTEGRANDO LAS INTELIGENCIAS MÚLTIPLES EN EL APRENDIZAJE BILINGÜE

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ABSTRACT

This bibliographic research aims to investigate how Neuroeducation and multiple intelligences can contribute to bilingual learning in the classroom. The research corpus is based on authors such as Gardner, Cummins, Mora and Souza, as well as on the international legal provisions of UNESCO and the Organization for Economic Cooperation and Development (OECD), establishing a dialogue with authors who discuss issues relating to the importance of educational policies that respect multiple ways of learning, valuing cognitive, linguistic and cultural diversity and promoting more responsive and equitable educational environments. The data will be analyzed using the content analysis proposed by Bardin. The main results are: the importance of the articulation between cognition, language and neuroscience enhances pedagogical practices that are sensitive to students' singularities, favouring engagement, integral development and the formation of critical citizens who are prepared for a globalized world.

Keywords: Neuroeducation. Multiple Intelligences. Bilingual Literacy. Cognitive Diversity.

RESUMO

A pesquisa de cunho bibliográfico tem como objetivo investigar como a Neuroeducação e as inteligências múltiplas podem contribuir com o aprendizado bilíngue em sala de aula. O corpus investigativo está alicerçado em autores como Gardner, Cummins, Mora e Souza, e, também, nos dispositivos legais em âmbito Internacional da UNESCO e da Organização para a Cooperação e Desenvolvimento Econômico - OCDE, estabelecendo um diálogo com os autores que discutem as temáticas relativas à a importância de políticas educacionais que

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respeitem as múltiplas formas de aprender, a valorização da diversidade cognitiva, linguística e cultural promove ambientes educacionais mais responsivos e equitativos. A análise dos dados dar-se-á por meio da análise de conteúdo proposta por Bardin. Os principais resultados são: a importância da articulação entre cognição, linguagem e neurociência potencializa práticas pedagógicas sensíveis às singularidades dos alunos, favorecendo o engajamento, o desenvolvimento integral e a formação de cidadãos críticos e preparados para um mundo globalizado.

Palavras-chave: Neuroeducação. Inteligências Múltiplas. Alfabetização Bilíngue. Diversidade Cognitiva.

RESUMEN

Esta investigación bibliográfica busca indagar cómo la neuroeducación y las inteligencias múltiples pueden contribuir al aprendizaje bilingüe en el aula. El corpus de investigación se basa en autores como Gardner, Cummins, Mora y Souza, así como en disposiciones legales internacionales de la UNESCO y la Organización para la Cooperación y el Desarrollo Económicos (OCDE). Establece un diálogo con autores que discuten temas relacionados con la importancia de políticas educativas que respeten las múltiples formas de aprendizaje y la valoración de la diversidad cognitiva, lingüística y cultural, lo que promueve entornos educativos más receptivos y equitativos. El análisis de datos se realizará mediante el análisis de contenido de Bardin. Los principales hallazgos son: la importancia de la articulación entre cognición, lenguaje y neurociencia potencia las prácticas pedagógicas sensibles a las características únicas de los estudiantes, fomentando la participación, el desarrollo integral y la formación de ciudadanos críticos preparados para un mundo globalizado.

Palabras clave: Neuroeducación. Inteligencias Múltiples. Alfabetización Bilingüe. Diversidad Cognitiva.

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1 INTRODUCTION

Twenty-first century education requires pedagogical practices that dialogue with the complexity of contemporary subjects and their multiple ways of learning, communicating and interacting with the world. Amid the challenges brought about by globalization, cultural and linguistic diversity and advances in cognitive science, it is essential to rethink traditional teaching models, which are still strongly based on homogenizing processes and focusing on just a few forms of intelligence. In this context, the combination of neuroeducation, the theory of Multiple Intelligences (MI) and bilingual literacy emerges as a powerful proposal for building more inclusive, personalized and effective teaching practices.

The theory of Multiple Intelligences, formulated by Howard Gardner (1983), proposes a break with the unitary conception of intelligence, arguing that human beings are endowed with various relatively autonomous cognitive skills, such as linguistic, logical-mathematical, spatial, musical, bodily-kinesthetic, interpersonal, intrapersonal and naturalistic intelligences. This expanded view of cognition is reinforced by evidence from neuroscience, which demonstrates the existence of different brain circuits specialized in processing different types of information (Tokuhama-Espinosa, 2014). In this way, MI offers a path for pedagogical planning that respects the singularities of learners, favoring more democratic and responsive school environments, as Gardner mentions:

> (...) any important idea, subject or concept should be taught in various ways, which should, through argument, activate different intelligences or combinations of intelligences. This approach pays two huge dividends: a plurality of approaches ensures that the teacher (or the teaching material) reaches more children; it also signals to students what it means to have a deep and balanced understanding. (Gardner, 2010, p. 21).

At the same time, bilingual literacy, which is expanding on the Brazilian scene, is an effective alternative for promoting linguistic equity and students' cognitive development. According to Cummins (2000), the mastery of two languages favors metalinguistic skills and facilitates the transfer of knowledge between languages, as long as the mother tongue is valued and individual learning rhythms are respected. UNESCO (2021) points out that learning in languages understood by students is a decisive factor in their staying in school, their self-esteem and their academic success, especially in multilingual and vulnerable contexts.

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Neuroeducation, in turn, is an interdisciplinary field that integrates contributions from neuroscience, cognitive psychology and pedagogy, seeking to understand the brain mechanisms of learning and apply this knowledge to teaching practice (Sousa, 2020; Mora, 2017). Recent studies indicate that pedagogical strategies that take into account students' brain functioning and emotions can significantly increase content retention, school engagement and emotional well-being (UNESCO, 2023). Thus, neuroeducation presents itself as a bridge between MI and bilingual literacy, by proposing practices that respect both the neurological diversity and the cultural and linguistic diversity of the subjects.

This bibliographic research (Gil, 2019) aims to investigate how Neuroeducation and multiple intelligences can contribute to bilingual learning in the classroom. The research *corpus* is based on authors such as Gardner (1983), Cummins (2000), Armstrong (2000), Mora (2017), Souza (2020) and UNESCO and OECD educational reports. The data will be analyzed using the content analysis proposed by Bardin (2011).

The article is organized into five parts: the first reads as follows, the second refers to the methodological approach, the third presents the rationale on Neuroeducation, multiple intelligences can contribute to bilingual learning, the fourth deals with the analysis and interpretation of the data and, finally, the fifth refers to the final considerations, which summarizes the main findings of this study.

2 METHODOLOGY

The text is the result of a bibliographical survey (Gil, 2019), the aim of which is to investigate how Neuroeducation and multiple intelligences can contribute to bilingual learning in the classroom.

In order to analyze the themes extracted from the selected material, we chose to use the theme as the unit of record, as this is the most appropriate unit for qualitative research.

We categorized the contents of the theoretical references, referring to neuroeducation, multiple intelligences and bilingual learning into a set of four thematic axes:

1. Diversification of teaching strategies;
2. Relationship between emotions and learning;
3. Positive language transfer; and 4. Integral development of students.

The theoretical framework is presented below.

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3 NEUROEDUCATION: FOUNDATIONS AND APPLICATIONS

Neuroeducation has emerged as a promising field that brings brain science closer to pedagogical practice, offering support for the construction of more effective methodologies based on neuroscientific evidence. It is an interdisciplinary approach that brings together knowledge from neuroscience, cognitive psychology and pedagogy to understand how the learning process takes place and how the brain responds to educational stimuli (Sousa, 2020).

According to Mora (2017), understanding how the brain learns is essential for formulating teaching strategies that respect students' rhythms, styles and needs. Learning is not exclusively a rational phenomenon: it involves emotions, memories, previous experiences and social interactions. For this reason, neuroeducation recognizes that the learning process is influenced by emotional, social and environmental factors, and that the brain learns best when the student is involved affectively, in safe and motivating environments. Souza (2020) points out that emotions significantly influence students' attention, memory and motivation. Positive learning environments and trusting relationships between teachers and students are key to optimizing learning. Héctor Ruiz Martín explains the role of emotions in learning:

> The study of how emotions influence the cognitive processes of learning and memory is very recent (with the exception of the study of test stress). There are still few rigorous findings that can be transferred to educational practice. However, we often receive messages supposedly based on science about how emotions modulate learning and how we should use them in the classroom. One of the most repeated ideas is that "you can only learn through emotion" or "you can only learn what makes you emotional". (Ruiz Martín, Héctor, 2024, p. 133).

According to Souza (2020), neuroeducation expands the teacher's didactic repertoire and allows for more humanized and responsive practices, promoting active and empathetic listening to students' cognitive demands. The teacher ceases to be a mere transmitter of content and becomes a conscious mediator of brain functioning in teaching-learning situations. This perspective is close to Paulo Freire's liberating pedagogy (1970), as it values listening, affection and the social context as fundamental elements in the educational act.

In addition, scientific evidence has shown that meaningful learning depends on the simultaneous activation of several regions of the brain, especially when they involve multiple languages - such as sounds, images, movements and emotions (Tokuhama-Espinosa, 2014). This reinforces the importance of personalization in teaching, the integration of technologies

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and articulation with approaches such as Multiple Intelligences, which explore various forms of expression and representation of knowledge.

UNESCO (2023) also recognizes the relevance of neuroeducation, highlighting that investment in pedagogical practices based on brain functioning can contribute to educational equity, especially in vulnerable contexts. In several countries, educational programs that incorporate neuroeducational principles show improvements in academic performance, student engagement and emotional self-regulation, which are fundamental elements for school success.

In this sense, the integration of neuroeducation, Multiple Intelligences theory and bilingual literacy represents a powerful convergence between theory and practice. By considering the brain as a dynamic and adaptive system, these approaches complement each other by promoting pedagogical practices that respect students' neurological, cultural and linguistic diversity.

4 THE INFLUENCE OF MULTIPLE INTELLIGENCES

The theory of Multiple Intelligences (MI), proposed by Howard Gardner (1983), revolutionized the traditional conception of intelligence by presenting a pluralistic and contextualized approach to human development. Contrary to the dominant psychometric model, based on IQ tests and the supremacy of logical-mathematical and linguistic intelligence, Gardner argues that intelligence is a biopsychological potential that can be developed in different cultural contexts, and that each individual possesses a unique combination of these intelligences.

Gardner initially identified seven types of intelligence: linguistic, logical-mathematical, spatial, bodily-kinesthetic, musical, interpersonal and intrapersonal. Later, he added naturalistic intelligence and indicated the possibility of existential intelligence. Each of these intelligences represents a different way of processing information and solving problems, which implies a necessary reformulation of educational practices to take account of this diversity.

> On a scientific level, the theory makes two assertions. Firstly, all human beings possess these intelligences; in informal terms, they are what make us human, cognitively speaking. Secondly, no two human beings - not even identical twins - have the same profile in terms of their qualities and limitations in terms of intelligence, because most of us are different from our own kind, and even identical twins go

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> through different experiences and are motivated to differentiate themselves from each other (Gardner, 2010, p.19).

From a pedagogical point of view, the application of MI theory offers an inclusive, personalized and dialogical alternative, especially relevant in societies marked by cultural and cognitive heterogeneity. According to Armstrong (2000), MI enables a student-centered pedagogical approach in which teaching is designed based on the intelligence profiles identified in the classroom. This not only broadens the ways of accessing knowledge, but also increases student engagement, self-esteem and motivation.

From the perspective of neuroeducation, the MI proposal is supported by the recognition that the brain operates in specialized networks, each linked to different forms of cognitive processing, such as language, music, movement, social interaction and spatial visualization (Tokuhama-Espinosa, 2014). This neuroscientific basis strengthens the understanding that teaching should be multimodal, exploring varied sensory and expressive channels, according to the potential of the learners.

In addition, Chen, Moran and Gardner (2010) emphasize that recognizing MI in the school curriculum does not mean creating fragmented activities or labeling students, but rather building an integrated pedagogy capable of articulating different languages of knowledge. By incorporating the cognitive plurality proposed by Gardner, schools are moving towards a more democratic practice, sensitive to the needs of each individual.

In practice, this translates into methodological diversification, with the use of educational games, role-playing, interdisciplinary projects, body experimentation, the use of music, visual activities and opportunities for group cooperation. Such strategies are especially valuable in bilingual and multilingual contexts, where the use of multiple languages makes it possible to integrate linguistic development with different forms of expression and learning.

Therefore, the theory of Multiple Intelligences constitutes not only an alternative pedagogical approach, but also a powerful epistemological basis for thinking about inclusive and transformative education. By recognizing the multiple forms of intelligence present in each student, the school assumes the commitment to value human diversity as a structuring axis of the educational process.

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5 LITERACY IN MONOLINGUAL AND BILINGUAL CONTEXTS

Literacy in bilingual contexts has gained increasing prominence in the educational field, especially in societies marked by linguistic and cultural diversity, as is the case in Brazil. The inclusion of a second language in the literacy process not only expands the students' communicative repertoire, but also stimulates the development of higher cognitive skills, such as working memory, selective attention, mental flexibility and metalinguistic awareness (Baker, 2011; Cummins, 2000).

According to Cummins (2000), through the model of linguistic interdependence, also known as the hypothesis of common linguistic proficiency, it is possible to understand that the skills developed in the first language (L1) can be transferred to the second language (L2), provided that the development of the L1 is sufficiently promoted. In other words, effective bilingual literacy occurs when there is an explicit appreciation of the mother tongue, in parallel with the teaching of the new language, respecting the subject's process of linguistic construction. From Cummins' (2000) perspective, interlingual transfer is nothing more than a natural consequence of the bilingual development process.

These understanding challenges pedagogical practices that prioritize the L2 exclusively, especially in educational programs that follow immersion models without the proper mediation of the L1, which can cause cognitive and affective lags in students. As Hornberger (2003) points out, the success of bilingual education is directly related to the way languages are integrated into the curriculum, promoting practices that encourage additive bilingualism, which values both languages, rather than subtractive bilingualism, i.e., **the L2 "replacing" or devaluing the L1**, often leading to the loss or weakening of the mother tongue, the cultural identity associated with it and the speaker's linguistic self-esteem.

In this sense, it is essential to recognize that the balanced integration of languages in the educational process must consider not only structural and curricular aspects, but also the phonological and cognitive specificities of each language. The phonetics of Portuguese and English, for example, have characteristics that can be explored strategically during literacy. For this reason, the sound of letters tends to be more easily assimilated when there is a correspondence between phoneme and grapheme, which favors early learning while still in kindergarten. In view of this, the use of playful approaches such as songs, language games, parlanda, poetry and *storytelling*, emerges as an effective pedagogical resource, capable of enhancing the development of listening and speaking skills, as well as promoting, in a natural and meaningful way, the reading and writing process (Alves; Finger, 2023).

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UNESCO (2021) stresses the importance of the first stages of literacy taking place, whenever possible, in the mother tongue, stating that this is a determining factor for educational equity and meaningful learning. According to the report *Education in a Multilingual World* (UNESCO, 2021), students who have access to initial literacy in their home language have better performance, higher self-esteem and greater persistence in their studies. Data from the OECD (2022) also corroborates this view by pointing out that students in well-structured bilingual programs tend to perform better in international assessments, such as PISA, compared to their monolingual peers.

In the Brazilian context, Alves and Finger (2023) argue that implementing bilingual programs requires a curricular and methodological redesign that goes beyond translating content. It's about creating multilingual environments that consider cultural diversity, the contextualized use of language and pedagogical mediation that is sensitive to the profile of the students. Authors such as Kleiman (2005) and Rojo (2009) advocate the adoption of critical literacy practices, capable of broadening the student's view of languages and their social use, connecting bilingualism to the cultural, identity and social dimensions of language.

Another fundamental point is teacher training. Bilingual literacy requires teachers to master not only the linguistic aspects of the languages involved, but also specific bilingual teaching methodologies, such as the CLIL (*Content and Language Integrated Learning*) approach, which combines the teaching of subject content with linguistic development (Costa; D'angelo, 2011). This training must be continuous, reflective and aligned with the scientific evidence of neuroeducation, in order to guarantee a pedagogical practice adapted to the cognitive and affective needs of learners. Dehaene mentions that:

> Only by combining the distinctive strengths of teachers, parents and scientists will we achieve the noble goal of reviving curiosity and the joy of learning in all children, in order to help them optimize their cognitive potential. (Dehaene, 2020, p. 243).

Therefore, literacy in bilingual contexts is a complex and multifaceted process that requires cultural sensitivity, scientific grounding and a commitment to inclusion. It is a practice that, when conducted well, can not only promote mastery of two languages, but also contribute to the student's integral development, preparing them to act in an increasingly interconnected and multilingual world.

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6 DATA ANALYSIS AND INTERPRETATION

In this chapter, we dedicate ourselves to the stage of processing the results, inference and interpretation of the data present in the theoretical references, carrying out the analytical triangulation of the findings through a dialog between the assumptions of the selected authors. Based on the Content Analysis Technique (Bardin, 2011), we categorized the content into four emerging thematic axes: 1) Diversification of teaching strategies, 2) Relationship between emotions and learning, 3) Positive language transfer, and 4) Integral development of students. Below, we discuss each of these axes, articulating the theoretical perspectives between neuroeducation, multiple intelligences and bilingual literacy.

6.1 DIVERSIFICATION OF TEACHING STRATEGIES

Methodological diversification is highlighted as one of the pillars of integration between neuroeducation and Multiple Intelligences (MI). Gardner (2010) and Armstrong (2000) argue that by recognizing the different ways of learning, teachers can adopt broader and more responsive approaches, exploring games, role-playing, music, body expression and visual languages as ways of accessing knowledge. This view is corroborated by Tokuhama-Espinosa (2014), who points out that the brain processes information through multiple cognitive and sensory pathways, making it necessary for teaching to mobilize several brain regions simultaneously.

The theoretical triangulation shows that methodological diversification is not restricted to adapting resources, but is a strategy for equity and inclusion. By integrating MI with the principles of neuroeducation, teachers expand learning possibilities and recognize the cognitive singularities of students. This perspective is even more relevant in bilingual contexts, where the use of multiple languages and visual aids helps to mediate understanding and favours the internalization of two different language systems.

6.2 RELATIONSHIP BETWEEN EMOTIONS AND LEARNING

Neuroeducation has shown that emotions play a decisive role in the learning process, directly influencing students' attention, memory and motivation (Sousa, 2020; Mora, 2017). Affectivity, far from being a peripheral component, is at the heart of cognition. Emotionally safe and motivating environments, according to Dehaene (2020), enhance learning by activating the brain's reward system, favoring neural plasticity.

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Ruiz Martín (2024) warns that although the study of emotion in education is still in development, it is already possible to state that affective involvement is a condition for meaningful learning. The triangulation between Mora, Souza and Ruiz shows that emotion should be understood as a catalyst for learning processes, and is particularly relevant in bilingual classrooms, where the emotional bond with languages can directly affect student performance and engagement.

Gardner (2010) also bridges this gap by stating that meaningful teaching should activate different intelligences together, including those that deal with introspection, empathy and emotional expression, such as intrapersonal and interpersonal intelligence. Therefore, neuroeducation, MI and bilingualism intersect by recognizing the role of emotions as a foundation for learning.

6.3 POSITIVE LANGUAGE TRANSFER

The third axis concerns positive language transfer, a central concept in the theories of Cummins (2000), who argues that cognitive and academic development in one language strengthens the acquisition of the second, as long as the L1 is valued and integrated into the educational process. This model, known as the "common language proficiency hypothesis", indicates that knowledge acquired in one language can be transposed to another, benefiting bilingual literacy.

This idea is reinforced by UNESCO (2021) and the OECD (2022), which show that bilingual programs that respect the mother tongue and work on linguistic interdependence have better academic results. Alves and Finger (2023), when discussing the practice in Brazil, point out that the success of bilingual literacy requires a multilingual pedagogical approach and intentional teacher mediation that articulates the phonological, cultural and cognitive structures of both languages.

The triangulation between the contributions of Cummins, Alves & Finger and the principles of neuroeducation (Dehaene, 2020; Tokuhama-Espinosa, 2014) indicates that language learning is enhanced when there is respect for the stages of cognitive, affective and neurological development, and it is essential that teaching practices are aligned with the functioning of the bilingual brain.

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6.4 INTEGRAL DEVELOPMENT OF STUDENTS

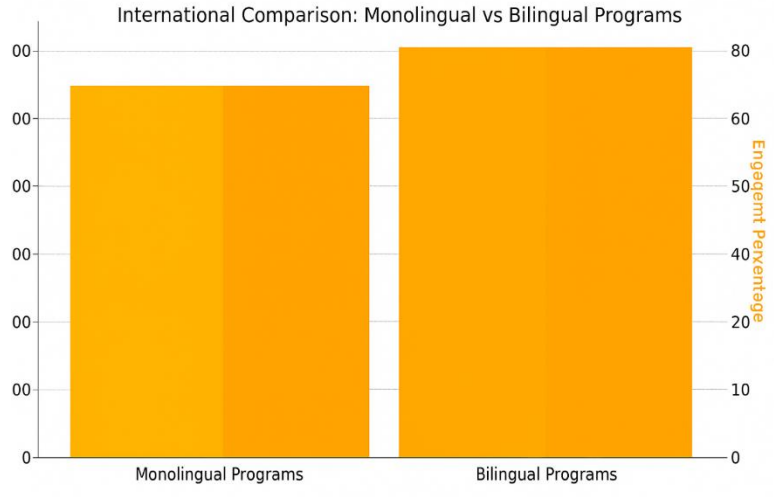
The category of holistic development emerges as an axis of convergence between the three theoretical fields investigated. According to Dehaene (2020), meaningful learning involves the integration of cognition, language, emotion and socialization, which is also defended by Gardner (2010) when he emphasizes that human beings are endowed with multiple intelligences, all of which can be developed through experience and context.

UNESCO (2023) and Tokuhama-Espinosa (2014) point out that educational policies based on respect for neurological and cultural diversity promote equity and global citizenship, preparing students for a complex and interdependent world. Neuroeducation, alongside MI and bilingual literacy, strengthens the concept that teaching is an integral act, aimed at forming autonomous, critical, creative and socially engaged subjects.

In cross-referencing the authors, we identified that integral development is not just a pedagogical ideal, but a practical requirement for building democratic, neurocompatible and culturally sensitive schools. The curricular redesign that emerges from this triangulation implies breaking with traditional paradigms and adopting an interdisciplinary, multisensory and inclusive perspective on education.

Figure 1

Comparison of PISA performance and emotional engagement. As evidenced by data from the OECD (2022) and UNESCO (2023), structured bilingual programs tend to have better academic performance and greater emotional engagement, as illustrated below:



Source: Adapted from OECD (2022) and UNESCO (2023).

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Comparing monolingual and bilingual programs in terms of reading performance (PISA) and students' emotional engagement.

Figure 1 illustrates the difference between monolingual and bilingual programs in terms of academic performance (assessed by PISA) and students' emotional engagement. It can be seen that bilingual programs, when well structured and sensitive to the students' first language, have higher performance and greater emotional engagement, reinforcing the thesis that the articulation between language, cognition and affect is essential for a meaningful education.

7 FINAL CONSIDERATIONS

The aim of this bibliographical research was to investigate how Neuroeducation and multiple intelligences can contribute to bilingual learning in the classroom, in which it sought to establish a dialog with authors of documents at an international level on education, which discuss issues relating to Neuroeducation, multiple intelligences and bilingual learning.

The analysis carried out reaffirms that the articulation between the theory of Multiple Intelligences, bilingual literacy and neuroeducation is an innovative and scientifically based pedagogical approach, capable of transforming teaching and the students' school experience. The theoretical data examined shows that practices based on this integration favor inclusion, increase school motivation and promote students' all-round development.

Methodological diversification, emotions as catalysts for learning, positive transfer between languages and the formation of autonomous subjects were key categories identified in the analysis. These categories point to an education that is sensitive to differences, committed to cognitive and emotional well-being, and guided by a humanistic and transformative vision.

In this sense, it is essential that public teacher training policies incorporate advances in neuroeducation and contemporary linguistic theories, ensuring that educators are prepared to plan and implement personalized, multisensory and culturally responsive educational practices.

Bilingual literacy, understood as an educational right and an instrument of equity, must be conducted with scientific and ethical backing. The studies analyzed here point to the need for a curriculum redesign that articulates content and languages in an integrated way, promoting not only linguistic proficiency, but also critical thinking and cultural identity.

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In short, 21st century education requires a school capable of dialoguing with neuroscience, the diversity of intelligences and the challenges of multilingualism. This integration is not only desirable, but urgent if we are to form more aware, creative and supportive generations, able to act competently in an increasingly complex and interdependent world.

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