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Universal Design for Learning as a pedagogical framework for addressing diversity in basic education

Diseño Universal para el Aprendizaje como marco pedagógico para atención de diversidad en básica educativa

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ABSTRACT

The purpose of this article is to analyse Universal Design for Learning as a pedagogical framework for addressing diversity in basic education as an educational approach for the Ecuadorian pedagogical context. Using a hermeneutic approach, twenty-four scientific articles published between 2015 and 2025 were analysed through three interpretative stages: comprehensive reading, categorical analysis and integrative synthesis. Three emerging categories were identified: pedagogical foundations of UDL that shift the responsibility for adaptation to curriculum design; neuroscientific contributions that document neurological variability as a basis for pedagogical flexibility; and teacher and student emotional intelligence as mediating factors for effective implementation. SUD constitutes a scientifically grounded and legally relevant pedagogical framework for Ecuadorian basic education, whose effective implementation requires systemic transformations in educational policies, teacher training, curriculum organisation, and assessment systems that allow for overcoming the tensions between inclusive ideals and structural constraints of the current educational system.
Descriptors: inclusive education; teaching technique; teaching method. (Source: UNESCO Thesaurus).

RESUMEN

El artículo tiene por propósito analizar el Diseño Universal para el Aprendizaje como marco pedagógico para la atención de la diversidad en educación básica como enfoque educativo para el contexto pedagógico ecuatoriano. De enfoque hermenéutico, se analizaron veinticuatro artículos científicos publicados entre 2015 y 2025 mediante tres momentos interpretativos: lectura comprehensiva, análisis categorial y síntesis integradora. Se identificaron tres categorías emergentes: fundamentos pedagógicos del DUA que desplazan la responsabilidad de adaptación hacia el diseño curricular, contribuciones neurocientíficas que documentan la variabilidad neurológica como sustento de la flexibilidad pedagógica, e inteligencia emocional docente y estudiantil como factores mediadores de la implementación efectiva. El DUA constituye un marco pedagógico científicamente fundado y jurídicamente pertinente para la educación básica ecuatoriana, cuya materialización efectiva requiere transformaciones sistémicas en políticas educativas, formación docente, organización curricular y sistemas evaluativos que permitan superar las tensiones entre ideales inclusivos y restricciones estructurales del sistema educativo actual.
Descriptores: educación inclusiva; técnica didáctica; método de enseñanza. (Fuente: Tesauro UNESCO).

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Research articles section

INTRODUCTION

In the context of contemporary educational transformations, training systems face the challenge of serving student populations characterised by increasing heterogeneity, where individual differences in learning styles, cognitive abilities and specific requirements demand pedagogical models that incorporate flexibility and adaptability as constituent features of their regulatory and operational structure. In response to this reality, Universal Design for Learning is configured as a conceptual framework aimed at transforming conventional educational practices through anticipatory strategies that recognise diversity as an inherent element of the training process, thus overcoming approaches that have traditionally considered differences as deviations from a normative pattern that requires subsequent correction in accordance with criteria of pedagogical homogenisation. Consequently, the construction of inclusive models in basic education has been positioned as a priority for those systems that aspire to guarantee equity and quality in learning, transcending remedial perspectives that have historically characterised the attention given to students with special educational needs, which often operate from a logic of individual deficit rather than from a systemic understanding of the barriers that curriculum designs themselves generate in the exercise of the fundamental right to education.

From a theoretical perspective that redefines the epistemological foundations of pedagogical practice, UDL represents a paradigm shift that shifts the responsibility for adaptation from the student to the curriculum design itself, thus configuring an epistemological inversion that questions entrenched assumptions about normality and difference in educational contexts from a perspective that could be described as guaranteeing educational rights. In line with this conceptual orientation and in accordance with the principles of educational inclusion, Moreira-Cuadros et al. (2025) argue that the integration of universal design and neuroeducation constitutes an innovative approach to educational inclusion, which allows learning barriers to be anticipated through an understanding of the brain mechanisms involved in knowledge acquisition, thus establishing bridges between pedagogical principles and neuroscientific discoveries that open up possibilities for designing learning experiences based on the recognition of neurological variability as an inherent characteristic of any human group, without this constituting grounds for any restriction of educational rights or opportunities. For their part, and complementing this argument from the field of curriculum planning, Ortiz-Sánchez et al. (2025) argue that teaching planning based on the DUA approach provides a systematic model for addressing diversity, transforming the traditional concept of individualised curricular adaptations into flexible designs that benefit the entire student body. This implies substantial reconfigurations in the ways in which learning experiences are conceived, organised and executed in school contexts subject to regulatory frameworks for educational inclusion.

Notwithstanding the above, and recognising the complexity inherent in pedagogical transformation processes, contemporary research on the implementation of UDL has documented both potentialities and tensions in diverse educational contexts, revealing that the transition to this pedagogical framework involves transformations that exceed the technical dimension to engage beliefs, values, and professional cultures rooted in traditions that often resist the proposed paradigm shift. In relation to this complexity and based on a systematic analysis of the perceptions of teachers and students, Han and Lei (2024) developed a systematic review that examines the beliefs of teachers and students towards the DUA framework, identifying that conceptual understanding and disposition towards this approach vary significantly according to contextual, formative and experiential factors, which suggests that the effective adoption of UDL requires not only theoretical understanding but also a transformation of mental frameworks about teaching and learning that have been consolidated through professional trajectories and previous school experiences that operate as true precedents in educational practice. Complementarily, and expanding the empirical evidence on practical application experiences, Wea et al. (2025) explored the implementation of UDL in primary and secondary educational units, showing that the transition to universally designed practices requires sustained support, appropriate resources and the development of specific skills in teaching teams, thus confirming that the rhetoric of inclusion requires concrete material

and training conditions to materialise in effective pedagogical practices that can be enforceable and verifiable in terms of regulatory compliance.

At the same time, in the field of neuroscience applied to education, neuroscience provides substantial insights into how the brain learns and how environments can be designed to optimise these processes, empirically substantiating proposals that historically relied on intuition or pedagogical tradition without much support from objectively verifiable scientific evidence. Regarding this aspect and establishing connections between neurobiology and pedagogy, Thomas and Arslan (2025) argue about the relevance of the brain for education, establishing connections between neurobiological functioning and pedagogical practices, which scientifically supports the proposals of the DUA by demonstrating that variability in learning processes has documentable neurological bases that justify the need for instructional flexibility as a technically sound response to the diversity of the student body.

These contributions from educational neuroscience make it possible to move beyond purely intuitive approaches to understandings based on empirical evidence about brain plasticity, attentional systems, and information processing, thus providing a scientific basis for pedagogical decisions that previously lacked neurobiological foundations that could be objectively verified. In a similar vein, and delving deeper into the evolutionary aspects of brain development, Hoferichter and Raufelder (2025) analyse the neuromechanisms during child development, highlighting the importance of considering the evolutionary stages of the brain when designing educational experiences, particularly during the formative years of basic education, where asynchronous brain maturation between different cognitive domains has direct implications for pedagogical expectations and instructional design, which must be adjusted to neurologically determined capacities at each stage of development.

Additionally, recognising the comprehensiveness of the educational phenomenon beyond its purely cognitive components, the socio-emotional component constitutes another connecting thread between DUA and educational effectiveness, recognising that learning processes do not operate in an affective vacuum, but are deeply mediated by emotional states, motivations, and competencies to regulate affective experiences that directly impact the results of the educational process. With regard to this dimension and using an explanatory model of relationships between emotional variables, Casino-García et al. (2019) developed a relational model between subjective emotional well-being, emotional intelligence and moods, establishing that these variables interact in complex ways in the educational experience of students. This is particularly relevant when considering that the DUA proposes multiple forms of involvement, recognising that motivation and commitment to learning are mediated by emotional and affective factors that vary between individuals and contexts, with no single universally applicable pattern. Similarly, providing quantitative evidence through statistical synthesis techniques, Peng and Shuhong (2025) conducted a meta-analysis demonstrating how emotional factors influence language learning, confirming that emotional intelligence is a significant predictor of academic achievement with effect sizes comparable to variables traditionally considered central, which underscores the need to integrate socio-emotional development as a constitutive component of the curriculum rather than as a peripheral or complementary dimension in the normative structure of educational programmes.

Consequently, and given the central role of teachers in the implementation of any pedagogical innovation, teacher training emerges as a determining factor for the successful implementation of DUA, since the pedagogical transformations proposed by this framework require not only conceptual knowledge but also professional skills that enable teachers to manage the complexity inherent in heterogeneous classrooms where diverse needs converge and demand differentiated responses. In this vein, through an experimental study of training programmes, Özdemir-Cihan and Dilekmen (2024) investigated emotional intelligence training programmes for teachers in initial training, documenting that the development of socio-emotional skills in educators is positively correlated with their ability to create inclusive environments and respond effectively to diversity. This suggests that teacher training should integrate not only knowledge of the DUA framework but also emotional and relational skills that enable its sensitive and contextualised application in accordance with the particularities of each educational situation.

Similarly, exploring the intersection between teachers' contemplative and emotional competencies, Wang (2023) explored the synergy between teacher mindfulness and emotional intelligence in building positive teacher-student relationships, identifying that these competencies facilitate the implementation of flexible, learner-centred pedagogical practices, since educators with greater emotional awareness and regulatory capacity tend to respond more adaptively to emerging needs in diverse instructional contexts that demand continuous adjustments in pedagogical strategies.

Considering the above and based on the identification of gaps in the available scientific literature, there is a need to analyse how UDL, articulated with contributions from neuroscience and emotional intelligence, can constitute a comprehensive pedagogical framework for addressing diversity in basic education. Although there is literature that addresses these elements separately, a systematic understanding of their interactions and complementarities in elementary education contexts is required to guide both public policies and institutional practices.

Consequently, and in order to address this identified need, the research objective of this article is to analyse Universal Design for Learning as a pedagogical framework for addressing diversity in basic education as an educational approach for the Ecuadorian pedagogical context.

METHOD

In accordance with the objectives set out and given the nature of the subject matter, which requires interpretative rather than experimental approaches, this research is carried out using a hermeneutic approach,

understood as an interpretative process aimed at understanding and constructing meanings from academic texts and discourses related to Universal Design for Learning and its application in basic education contexts, thus constituting a qualitative research method that allows for a deeper understanding of complex educational phenomena through the analysis and systematic interpretation of contemporary scientific literature subjected to peer review processes. This approach is particularly appropriate when the research objective is to reveal meanings, establish conceptual relationships, and construct integrated understandings based on existing academic productions, thus going beyond merely descriptive approaches to achieve interpretations that coherently articulate the scattered contributions in the specialised literature according to criteria of methodological rigour that are verifiable and susceptible to intersubjective verification.

In terms of the documentary corpus analysed and following inclusion criteria based on thematic relevance and methodological quality, this includes twenty-four scientific articles published between 2015 and 2025, selected for their thematic relevance and methodological rigour verified through their publication in journals indexed in internationally recognised databases, which address various dimensions of the object of study, such as the fundamentals of DUA, educational neuroscience, emotional intelligence, teacher training, and implementation experiences in various educational contexts that provide verifiable empirical evidence. The selection prioritised recent publications to ensure the theoretical approaches and empirical evidence considered were up to date, with an emphasis on studies that articulate DUA with neuroeducation and emotional intelligence, thus configuring a corpus that allows for the triangulation of complementary perspectives on the phenomenon under investigation by confronting diverse sources that enrich the understanding of the subject of study.

With regard to the analysis process implemented and in accordance with the methodological principles of philosophical hermeneutics, the hermeneutic process was structured in three interpretative stages that constitute a dialectical movement between understanding and explanation according to the Gadamerian tradition of textual analysis. Initially, and as the first phase of the interpretative process, a comprehensive reading of each document was carried out to identify its central arguments, methodologies used and main conclusions, which allowed for the establishment of an overview of the state of knowledge on the subject without imposing preconceived categories on the texts analysed, thus respecting the hermeneutic principle of

openness to the meaning that emerges from the text itself in its context of production. Subsequently, moving towards deeper levels of interpretation, an analytical reading was carried out to identify emerging categories, conceptual relationships, and theoretical convergences between the different authors. In this phase, three main categories of analysis were established: pedagogical foundations of DUA, neuroscientific contributions to inclusive learning, and emotional intelligence as a mediating factor. These categories emerged from reflective dialogue with the texts rather than from prior theoretical impositions that could bias the interpretation toward confirmation of preconceived hypotheses. Subsequently, and as the culmination of the interpretative process, an interpretative synthesis was developed that integrated the categorised findings into a coherent and systematic understanding of DUA as a pedagogical framework for addressing diversity in basic education, thus articulating the parts into a meaningful whole that illuminates both the individual components and their interrelationships in a coherent narrative that accounts for the phenomenon in its complexity.

In relation to the epistemological foundations of the analysis carried out and in accordance with the continental hermeneutic tradition, the hermeneutic interpretation was based on the principle of the hermeneutic circle, whereby the understanding of the parts (individual studies) illuminates the understanding of the whole (the DUA as an integral framework), while understanding the whole reframes the interpretation of the parts, thus configuring a recursive movement that progressively deepens the understanding of the phenomenon under investigation without claiming to reach a definitive or closed interpretation. This dialectical movement between the particular and the universal made it possible to construct an analytical narrative that transcends the mere description of isolated discoveries to articulate a comprehensive view of the phenomenon studied, recognising that meaning emerges from the dialogue between the interpreter and the texts rather than from the mechanical extraction of information contained in them, which is the fundamental principle that distinguishes hermeneutics from other methods of documentary analysis.

With regard to the criteria of methodological rigour applied and in order to guarantee the validity of the proposed interpretations, interpretative rigour was ensured through triangulation of sources, constant comparison between the approaches of different authors, and explicit statement of the researcher's interpretative assumptions. These processes sought to minimise bias and ensure that the proposed interpretations were solidly grounded in the texts analysed, in accordance with the standards of academic rigour required in qualitative research. Hermeneutic validity was achieved when the proposed interpretations demonstrated internal consistency, empirical basis in the analysed texts, and explanatory capacity with respect to the educational phenomenon examined, which was verified through iterative review of the emerging categories and their comparison with the documentary corpus until theoretical saturation was achieved in the identified categories. This interpretative process sought not to impose pre-established categories on the texts but to allow the categories to emerge from reflective dialogue with the scientific literature, thus respecting the hermeneutic principle of openness to what the texts have to say rather than confirming preconceived hypotheses that would limit the heuristic potential of interpretative analysis.

RESULTS

This section presents the results in the form of hermeneutic categories:

Category 1: Pedagogical and epistemological foundations of Universal Design for Learning

From a perspective that questions the very foundations of traditional school organisation, Universal Design for Learning is based on the recognition that cognitive, sensory, and affective diversity is the norm in any human group, not the exception. This epistemological premise challenges traditional conceptions that assume a typical student as a reference point for curriculum design, subsequently requiring adaptations for those who do not fit this normative parameter, which is culturally constructed rather than based on empirical evidence. UDL proposes to reverse this logic by creating in advance multiple means of representation,

expression and involvement that accommodate the variability inherent in learning processes, thus configuring a framework that shifts the responsibility for adaptation from students to the pedagogical designs themselves in a movement that has both pedagogical and legal implications in terms of guaranteeing the right to education in conditions of material equality.

Consequently, and in view of the practical implications of this conceptual framework, the literature analysed shows that the effective implementation of DUA requires substantial transformations in educational planning that go beyond superficial methodological adjustments to commit to reconceptualisations of the purposes and means of education from a perspective that could be described as guaranteeing educational rights. According to the documentation from the field of curriculum planning by Ortiz-Sánchez et al. (2025), teaching planning based on the DUA approach must be structured taking into account the multiplicity of learning profiles present in the classroom, which implies designing experiences with built-in flexibility from the outset, thus contrasting with conventional models where diversification is conceived as a process subsequent to general planning, often limited to students with special educational needs formally identified through diagnostic procedures that frequently operate from a deficit logic that stigmatises difference as a pathology susceptible to correction or normalisation.

However, in relation to the structural principles that organise this pedagogical framework, the guiding principles of UDL establish that the curriculum must offer multiple forms of representation (the what of learning), multiple forms of action and expression (the how of learning) and multiple forms of involvement (the why of learning), principles that respond to specific brain systems such as recognition networks, strategic networks and affective networks respectively, thus establishing a direct link between pedagogical prescriptions and neurological functioning. This explicit link between pedagogical principles and neurological functioning distinguishes DUA from other models of instructional differentiation that lack explicit neuroscientific foundations or are based exclusively on didactic considerations without reference to the biological bases of learning. Following this line of argument and emphasising the scientifically grounded nature of the approach, Moreira-Cuadros et al. (2025) argue that the articulation between DUA and neuroeducation represents an innovative approach to inclusion, as it allows pedagogical decisions that were historically based on intuition or tradition to be scientifically grounded, thus providing an empirical basis for practices that previously lacked neuroscientific justification that could be verified by objective methods. This integration implies that the options of representation, expression and involvement are not mere methodological preferences but informed responses to the understanding of how different brains process information, plan actions and motivate themselves towards learning goals, thus recognising neurological variability as a constitutive characteristic of any student population that must be addressed through appropriate pedagogical designs.

Notwithstanding the above, and recognising the resistance faced by the implementation of innovative pedagogical frameworks, research carried out through case studies in real school contexts by Wea et al. (2025) on the implementation of DUA in primary and secondary educational units reveals that the transition to this pedagogical framework faces resistance linked to entrenched conceptions of normality and difference, which have been consolidated through professional trajectories and school experiences that naturalise homogeneity as a desirable and technically viable pedagogical ideal. Participating teachers initially expressed scepticism about the feasibility of designing simultaneously for multiple learning profiles, perceiving this demand as an overload that exceeds the capacities and resources available in real school contexts characterised by material, time and training limitations that condition the effective possibilities for pedagogical transformation. However, as the training and practical experimentation process progressed, they reported recognising that anticipated flexibility reduces the need for subsequent individualised adaptations, which are often implemented in a reactive and fragmented manner when learning difficulties have already taken root and crystallised into trajectories of academic failure that are difficult to reverse through late interventions.

From another perspective and through methodological approaches to synthesising scientific evidence, Han and Lei (2024) identified through systematic review that teachers' beliefs about

UDL vary considerably, observing greater receptivity in educators who have experienced contexts of high student diversity, suggesting that awareness of learning variability emerges not only from theoretical training but also from direct experience with students whose needs challenge homogeneous pedagogical approaches that are manifestly insufficient to address the heterogeneity inherent in contemporary classrooms. Student beliefs also showed heterogeneity, with marked preferences for options of expression and representation that aligned with their predominant learning styles, thus confirming that diversity of preferences is not a theoretical construct but an experiential reality that students articulate when given opportunities to do so through pedagogical designs that legitimise and value difference as an educational resource.

Table 1. *BLP principles and their pedagogical implications for basic education.*

UDL Principle	Neurological Basis	Application in Primary Education	Implementation Challenges
Multiple means of representation	Recognition networks of the brain	Present content in diverse formats: visual, auditory, kinaesthetic, and digital	Resource limitations; teacher training in educational technologies
Multiple means of action and expression	Strategic brain networks	Provide a range of ways for learners to demonstrate understanding: oral, written, artistic, and practical	Standardised assessment systems; limited curriculum time
Multiple means of engagement	Affective brain networks	Provide options to enhance motivation: autonomy, personal relevance, and collaboration	Classroom management demands; individualised monitoring; established pedagogical traditions

Source: Own elaboration (2026).

As can be seen in Table 1 and in terms of the structural synthesis of the components of the pedagogical framework, each principle of DUA is linked to specific neural systems and translates into concrete pedagogical practices for basic education, revealing that the challenges identified are not primarily conceptual but rather operational and cultural, related to institutional conditions, professional training, and established educational traditions that operate as real structural obstacles to pedagogical innovation. This finding suggests that the implementation of UDL requires not only theoretical understanding but also the transformation of school structures, assessment systems, and pedagogical cultures, which implies systemic interventions that exceed the will or competence of individual teachers to engage in educational policies, resource allocation, and institutional reorganisation that require decisions at management levels that transcend the individual classroom.

Additionally, from an epistemological perspective that redefines traditional concepts of ability and disability, the epistemological perspective of UD design reconceptualises disability as a mismatch between learner abilities and the design of the learning environment, rather than as an inherent deficit in the individual. This constitutes a substantive epistemological shift from medical or psychological models that locate the difficulty in the student, attributing pathological characteristics that require treatment or correction through specialised interventions. In line with this orientation and through the application of data analytics tools in educational contexts, Roski et al. (2024) applied learning analytics approaches to DUA, demonstrating that when educational environments are designed with built-in flexibility, students traditionally categorised as ‘underachievers’ demonstrate abilities that remained invisible in rigid contexts, reinforcing the DUA premise that many learning difficulties are iatrogenic, i.e., generated by the education system itself through designs that exclude variability, thus constructing deficits that are artefacts of the system rather than essential characteristics of individuals.

Extending this perspective to dimensions often overlooked in pedagogical analysis and broadening the scope of the framework beyond the traditional classroom, Sturges et al. (2025) theorised about the application of DUA in outdoor play spaces, extending the principles beyond the traditional classroom to the entire school experience in recognition that learning transcends formal moments of instruction. Their preliminary analysis suggests that school recreational

spaces are often designed for a limited range of motor skills, excluding students with reduced mobility or different sensory preferences, which reproduces in the recreational sphere the exclusions that UDAD seeks to overcome in the academic sphere, thus perpetuating segregations that affect the right to comprehensive development. The proposal to universalise the design of these spaces exemplifies how the DUA transcends the purely academic dimension to encompass the entirety of the school experience, recognising that learning and development are not limited to formal moments of instruction, but occur in the multiplicity of experiences that make up everyday school life and that all of them must be designed in accordance with principles of universal accessibility that guarantee full participation.

Category 2: Contributions of neuroscience to inclusive learning

From the field of neuroscience applied to education, and constituting one of the scientific pillars underpinning the DUA, educational neuroscience has generated substantial knowledge about how the brain learns, providing empirical support for pedagogical practices that historically lacked scientific basis. It has thus established itself as a discipline that articulates neural understanding with educational applications through methods that allow for the objective testing of hypotheses about learning processes. Understanding the neural mechanisms involved in attention, memory, emotional processing, and executive function allows for the design of educational interventions informed by evidence about brain functioning, thus overcoming purely intuitive approaches or those based exclusively on pedagogical tradition that lack support in verifiable scientific knowledge about how learning processes occur at the neurological level. This articulation between neuroscience and pedagogy constitutes one of the pillars that support the DUA proposal, since the principles of this framework are based on understandings of how different brains process information and construct learning, thus establishing scientific bases that justify pedagogical flexibility as a technically grounded response to the neurological diversity that constitutes any population.

In line with the above and establishing the epistemological basis for the integration of neuroscience and education, Thomas and Arslan (2025) systematically examine why the brain matters for education, arguing that neuroscientific knowledge allows us to overcome educational myths and base instructional decisions on an understanding of the learning organ, which represents a substantial advance over times when pedagogical decisions were made without reference to neurobiological bases that could guide instructional design towards formats compatible with brain functioning. Among the relevant contributions are the recognition that individual brains exhibit significant structural and functional variability, which justifies the need for pedagogical flexibility as a technically sound response to objectively verifiable neurological differences; the confirmation that learning physically modifies the brain through neural plasticity, which provides a basis for learning expectations for all students regardless of initial conditions that do not determine future abilities; and the identification of sensitive periods during development when certain abilities are acquired more easily, which has implications for curriculum sequencing that must be adjusted to neurologically determined windows of opportunity.

Delving deeper into the evolutionary aspects of neurological development and their implications for pedagogical design, Hoferichter and Raufelder's (2025) research on neuromechanisms during child development documents how brain maturation follows different trajectories across cognitive domains, revealing that while visual and auditory areas reach maturity early, the prefrontal regions responsible for executive function continue to develop into early adulthood in a process that extends far beyond what was traditionally assumed in models of cognitive development. This asynchrony of maturation has direct implications for primary education, suggesting that uniform expectations regarding self-regulation, planning, or inhibitory control may be inappropriate for certain age ranges, which justifies the provision of external scaffolding for executive functions that have not yet been neurologically consolidated and therefore cannot be demanded as if they were fully available capacities in all students regardless of their chronological age or level of brain maturation.

From another perspective and focusing on a specific sensory system with relevant pedagogical implications, Chen (2020) conducted a mini-review on education and visual neuroscience, identifying that visual perception is not a passive process of receiving information but rather an active construction in which the brain interprets stimuli based on previous experience and expectations. This has substantial implications for the design of visual educational materials, which often assume uniform processing of visual information among students. This discovery underpins the DUA's proposal to offer multiple visual representations, recognising that students with different experiential backgrounds will interpret visual representations in different ways, thus requiring variety in formats and modes of presentation to ensure universal accessibility that does not depend on uniform visual processing, which neuroscience has shown does not exist in heterogeneous populations.

Complementarily, and recognising the influence of environmental factors on neurological development, the work developed from an ecological perspective of development by D'Angiulli et al. (2021) on pre- and post-school influences on learning adaptations establishes that environmental, socioeconomic, and relational factors significantly modulate neurological and cognitive development, which underscores that observable learning differences in classrooms reflect not only genetic variability but also inequalities in early development opportunities that generate neurological differences attributable to social conditions rather than essential biological determinants. From this perspective and with implications for educational justice, DUA can be conceptualised as an educational justice strategy that partially compensates for accumulated disadvantages through inclusive pedagogical design, recognising that educational equity requires not only equal access but also intentional differentiation that addresses diverse needs resulting from unequal developmental trajectories determined by socioeconomic conditions that the education system must compensate for through appropriate pedagogical designs.

From another perspective, linking neuroscience with population mental health, Jia and Schumann (2022) discuss how cognitive neuroscience can enhance education and population mental health, pointing out that neurobiologically informed educational interventions have the potential to prevent learning difficulties and socio-emotional problems, suggesting that neuroeducation not only improves academic learning but also contributes to overall well-being, understood as an educational objective that transcends the mere transmission of disciplinary content. Early identification of signs of difficulties, based on neurocognitive markers that can be objectively verified using neuroscientific methods, allows for more effective preventive interventions than late remedial approaches, which are often implemented when difficulties have already become chronic and low performance trajectories have been established through self-fulfilling prophecy processes that are difficult to reverse through late interventions.

Table 2. *Relevant neuroscientific contributions to the implementation of DUA in basic education.*

Neuroscientific Finding	Implication for UDL	Practical Application	Empirical Evidence
Interindividual neurological variability	Justifies multiple means of representation	Present information simultaneously in diverse formats	Thomas and Arslan (2025); Hoferichter and Raufelder (2025)
Brain plasticity	Supports learning expectations for all learners	Design scaffolded, gradable challenges with adjustable supports	Chen (2020); D'Angiulli et al. (2021)
Multiple attentional systems	Requires varied engagement strategies	Alternate instructional modalities and incorporate active breaks	Jia and Schumann (2022)
Integrated emotional processing and cognition	Links emotional engagement with effective learning	Create emotionally safe and personally meaningful learning environments	Casino-García et al. (2019)
Asynchronous development of executive functions	Calls for differentiated scaffolding based on developmental maturity	Provide external supports for planning and self-regulation	Hoferichter and Raufelder (2025)

Source: Own elaboration (2026).

As shown in Table 2 and summarising the neuroscientific contributions to the pedagogical framework, the integration of these neuroscientific contributions with DUA principles allows for the scientific substantiation of pedagogical decisions that were previously based on tradition or intuition, thus forming a robust empirical basis for inclusive practices that can be justified by reference to objectively verifiable scientific knowledge about brain functioning. Evidence on

neurological variability validates the need for instructional flexibility as a response to constitutive diversity rather than as a concession to individual deficits requiring special treatment. Knowledge about plasticity justifies high expectations for all students with appropriate supports, thus overcoming biological determinism that limits expectations about learning abilities. and understanding the integration between emotion and cognition supports the principle of multiple means of engagement, recognising that learning is not a purely cognitive process but an experience that involves the whole person in their cognitive, emotional and relational dimensions, which must be addressed in an integrated manner.

From another perspective, and although developed in a clinical context with potential transferability to the educational field, Larsen et al. (2024) investigated education in pain neuroscience in rehabilitation contexts, demonstrating that understanding the neural mechanisms underlying subjective experiences improves adherence to interventions and outcomes. Although developed in a clinical context, its logic transfers to education, where understanding neurological processes can empower students. Understanding how the brain learns can empower students as agents of their own learning, developing metacognition that allows them to identify strategies that work for their particular neural configurations and thus adjust their approaches to learning in an informed manner. This meta-understanding is particularly relevant in basic education, where patterns of self-regulation and beliefs about learning ability are established that can enhance or limit future educational trajectories through effects that accumulate throughout school careers.

Likewise, recognising the impact of emerging technologies on contemporary education, Leng (2024) analyses the challenges and opportunities that ChatGPT presents for anatomical education, arguing that artificial intelligence-based technologies modify both what is learned and how it is learned, which connects with the DUA principle of leveraging technological tools to provide multiple representations and expression options that were previously technically unfeasible or excessively costly. Neuroscience-informed educational technology can personalise learning experiences on previously unfeasible scales, allowing for real-time adaptations that respond to individual response patterns, thus creating unprecedented possibilities for realising DUA principles through intelligent digital tools that can adjust content, formats and sequences according to individual needs detected by machine learning algorithms.

Consequently, emphasising the need for disciplinary integration that reflects integrated brain functioning, Basu et al. (2021) describe the design and implementation of integrative STEM education for neuroscience at the university level, whose principles are transferred to basic education insofar as they propose disciplinary integration that recognises that the brain does not process knowledge in silos corresponding to school subjects but rather constructs interconnected understandings that transcend disciplinary boundaries artificially constructed by academic traditions. The DUA aligns with this vision by proposing flexibility that allows for emerging interdisciplinary connections, thus overcoming the curricular fragmentation that often characterises traditional school organisation, where knowledge is presented in a disconnected manner, hindering the construction of integrated understandings that require articulation between diverse disciplinary domains.

Category 3: Emotional intelligence as a mediating factor in the implementation of the DUA

Recognising the comprehensiveness of the educational phenomenon beyond its purely cognitive components, emotional intelligence, understood as a set of abilities to perceive, understand, regulate and use emotions in an adaptive manner, constitutes a significant mediating factor for both teachers and students in the effective implementation of the DUA, since socio-emotional skills facilitate the creation of inclusive environments, the management of diversity and the use of involvement options that DUA proposes in response to the motivational and affective variability of students. The literature analysed shows that the development of these skills is not a peripheral or complementary dimension but a substantive component that largely determines the effectiveness of universally designed pedagogical practices, since the

implementation of pedagogical flexibility requires emotional skills that enable the management of the complexity inherent in heterogeneous educational environments.

In line with this perspective and using an explanatory model of relationships between emotional variables, Casino-García et al. (2019) developed a relational model between subjective emotional well-being, emotional intelligence and mood in students, identifying that these variables influence each other in complex ways, shaping differentiated educational experiences that cannot be explained exclusively by traditional cognitive or academic variables. Their findings show that students with higher emotional intelligence report better subjective well-being and more positive moods regardless of whether they are identified as talented or not, suggesting that the development of socio-emotional skills should be a cross-cutting objective in basic education, not only because it facilitates academic learning but also because it contributes directly to overall well-being, a dimension that is often neglected in education systems focused exclusively on academic achievement measured by standardised tests that ignore the socio-emotional dimensions of development.

With regard to the role of teacher training in the development of emotional skills, teacher training in emotional intelligence emerges as a determining factor for the implementation of DUA, recognising that the pedagogical transformations proposed by this framework require emotional and relational skills that exceed technical knowledge of instructional design or mastery of disciplinary content, which have traditionally constituted the core of teacher training. As documented by experimental research on the effects of training programmes by Özdemir-Cihan and Dilekmen (2024), emotional intelligence training programmes for teachers in initial training generate significant improvements in emotional recognition, affective regulation and interpersonal relationship management skills, results that are relevant when considering that the implementation of DUA requires sensitivity to diverse emotional states, flexibility to adjust instruction according to emerging needs, and the ability to manage the complexity inherent in heterogeneous classrooms where multiple needs coexist simultaneously, demanding differentiated responses that require real-time pedagogical decision-making.

Complementarily, and analysing the components that make up effective training programmes in this area,

Dolev and Leshem (2017) analysed components of effective emotional intelligence training designs for teachers, identifying that successful programmes combine theoretical instruction with reflective practice, modelling, and specific feedback, training elements that are transferable to DUA professional development programmes in accordance with teacher training principles that emphasise situated learning. This suggests that teacher training should go beyond the presentation of theoretical principles to incorporate practical experimentation and reflection on implementation, recognising that pedagogical change does not occur merely through conceptual understanding but through the transformation of practical schemes that have been consolidated through years of professional experience and that often operate tacitly without the full awareness of teachers.

Similarly, focusing on pedagogical strategies to develop emotional intelligence in contemporary students, Ghita-Pirnuta and Cismaru (2022) investigated teaching strategies to develop emotional intelligence in millennial students, documenting that experiential and collaborative approaches generate greater impact than transmissive instruction, evidence that aligns with the DUA principle of providing multiple forms of engagement that recognise generational preferences for active and socially mediated learning. This convergence recognises that emotional engagement with learning is facilitated by active, socially contextualised, and personally relevant experiences, which contrast with transmissive pedagogies where students adopt passive roles as recipients of information disconnected from their life experiences and meaningful contexts that could give meaning and relevance to school learning.

Table 3. *Teacher and student emotional intelligence as mediators of DUA.*

EI Dimension	Role in UDL Implementation	Manifestation in Teachers	Manifestation in Students
Emotional perception	Identifying affective states that facilitate or hinder learning	Recognising signs of frustration, disengagement, or commitment in students	Identifying one's own emotions during learning tasks
Emotional understanding	Interpreting the causes and consequences of affective states	Understanding why certain students become demotivated by specific tasks	Understanding how emotions influence academic performance
Emotional regulation	Modulating affect to optimise teaching and learning processes	Maintaining composure in response to challenging behaviour and adjusting instruction accordingly	Managing test anxiety and frustration when facing difficulties
Strategic use of emotions	Harnessing emotions to motivate and support learning	Creating a positive emotional climate and linking content to learners' interests	Using positive emotions to persist when facing challenges

Source: Own elaboration (2026).

As shown in Table 3 and summarising the dimensions of emotional intelligence relevant to DUA, each dimension of emotional intelligence fulfils specific functions in both teachers and students to facilitate the effective implementation of universally designed practices that require emotional competencies for their effective operationalisation. In this order, research developed from contemplative perspectives applied to education by Wang (2023) on the synergy between teacher mindfulness and emotional intelligence in teacher-student relationships establishes that educators with high levels of these competencies build bonds characterised by greater warmth, understanding and perceived support, quality relationships that facilitate students to take risks in participating in diversified learning options without fear of judgement or stigmatisation.

These relationships of trust allow students to express confusion without fear of judgement, demonstrate learning in formats that may initially be uncomfortable, and experiment with diverse strategies, recognising that error is a natural component of learning rather than a sign of incompetence that must be hidden to preserve academic image.

Notwithstanding the above, and recognising the complexity of the relationships between emotional variables and pedagogical practices, Su et al. (2022) examined the relationships between teacher emotional intelligence, teaching for creativity, and work engagement, identifying that work engagement mediates the relationship between EI and creative pedagogical practices. This suggests that educators' emotional intelligence does not directly influence their instructional practices but rather through the mediation of their engagement and professional well-being, which operate as intervening variables. For the implementation of DUA, this implies that working conditions that promote teacher well-being will indirectly facilitate flexible and innovative pedagogical practices, thus recognising that pedagogical transformation does not depend exclusively on individual will or competence but on structural conditions that enable or limit professional teaching practice through organisational, material and relational factors that shape the work context.

From the students' perspective and examining how emotional competencies moderate educational experiences, Li and Zhang (2024) explored relationships between teacher-student dynamics, enjoyment of learning, and burnout in students of English as a foreign language, finding that emotional intelligence moderates these relationships so that students with higher EI reported less burnout and greater enjoyment even in contexts where relational dynamics were suboptimal and potentially stressful. This evidence suggests that the development of student emotional intelligence is a protective factor that cushions the effects of adverse educational conditions, thus establishing itself as a skill that not only facilitates academic learning but also protects psychological well-being in potentially stressful contexts, such as school environments characterised by evaluative pressures and social comparisons.

Consolidating the evidence through quantitative synthesis methods, Peng and Shuhong (2025) conducted a meta-analysis of emotional factors in language learning, confirming that emotional intelligence significantly predicts academic achievement with effect sizes comparable to variables traditionally considered central, such as linguistic aptitude or time of exposure to the language, challenging traditional hierarchies that prioritise cognitive variables over emotional ones. This discovery reinforces the relevance of incorporating socio-emotional development as an integral component of the curriculum, rather than as an optional add-on that may or may not be implemented depending on the availability of resources, recognising that emotions are not a separate dimension of learning, but are intrinsically intertwined with cognitive processes, shaping integrated educational experiences that cannot be artificially fragmented without losing pedagogical effectiveness.

Extending the evidence to vocational training contexts in health areas with principles transferable to basic education, the non-technical skills training programmes for nursing students researched by Jiménez-Rodríguez et al.

(2022) showed that structured training in socio-emotional skills improves both emotional intelligence and resilience. Although the study was conducted with a university population, its implications can be transferred to basic education, where these skills can be developed from an early age. Consequently, emotional skills can be developed through intentional and structured intervention; they are not fixed personality traits determined genetically, which justifies their explicit inclusion in curriculum objectives and the design of learning experiences that intentionally promote these abilities through appropriate methodologies that have proven effective in controlled research.

Consequently, systematising knowledge about effective strategies for developing emotional competencies, Napolitano et al. (2023) developed a systematic review protocol on the effectiveness of learning strategies for developing emotional intelligence in nursing students, preliminarily identifying that experiential approaches, role-playing, and simulation-based learning are promoters according to available empirical evidence. The transfer to basic education suggests that DUA can incorporate these strategies as options within the principle of multiple means of expression and involvement, recognising that socio-emotional development is facilitated by active experiences that allow for experimentation, reflection, and feedback in safe contexts that enable emotional risk-taking without negative consequences that inhibit future learning.

In this regard, and providing qualitative evidence on learning experiences that integrate academic and socio-emotional objectives, MacKinnon et al. (2015) reviewed qualitative evidence on maternal-infant simulation-based learning experiences, documenting that these experiences generate the development of both technical and socio-emotional competencies, which exemplifies how pedagogical strategies can integrate academic and socio-emotional objectives into coherent learning experiences that do not artificially fragment dimensions that occur in an integrated manner in lived experience. In this component, simulation as a pedagogical strategy exemplifies how DUA can be operationalised through methodologies that offer multiple forms of representation (observing, participating, reflecting) and expression (acting, discussing, written analysis), configuring learning experiences that simultaneously develop disciplinary knowledge and socio-emotional competencies in recognition that both dimensions are interdependent and mutually constitutive.

INTEGRATIVE THEORETICAL CONTRAST

Based on the analysis of the three emerging categories and through a process of synthesis that articulates the various components examined, theoretical convergences can be identified that support DUA as a comprehensive pedagogical framework for addressing diversity in basic education, revealing articulations between dimensions that have often been addressed in a fragmented manner in the educational literature without recognising their substantive interconnections that form a coherent whole. The first convergence is established between the principles of DUA and neuroscientific discoveries about brain variability, forming an articulation

where DUA proposes to design in advance for diversity, while neuroscience empirically confirms that such diversity is an inherent characteristic of any human group determined by constitutive neurological variability.

This convergence scientifically substantiates what could initially have been proposed based on values of equity and inclusion without robust empirical support, thus providing a verifiable scientific basis for pedagogical practices that recognise and value individual differences as an expression of neurological diversity rather than as deficits requiring correction through normalising interventions.

Additionally, establishing a second line of convergence between components of the proposed framework, the second convergence articulates emotional intelligence with the principle of multiple means of engagement, recognising that evidence on the role of emotional factors in learning validates the DUA proposal to offer options that connect with the diverse motivations, interests, and affective states that characterise heterogeneous student populations. It is not only a matter of recognising that students prefer different modalities according to arbitrary individual preferences, but also of understanding that emotional involvement is a necessary condition for meaningful and lasting learning that transcends superficial memorisation, thus transcending cognitive views of learning that minimise or ignore affective and motivational dimensions that research has shown to be determinants of academic achievement with effects comparable to purely cognitive variables.

Likewise, establishing a third convergence that links teacher training with emotional competencies, the third convergence links teacher training in DLA with the development of professional emotional intelligence, since the studies reviewed suggest that effectively implementing DLA requires not only conceptual knowledge of the principles of the framework but also socio-emotional competencies that enable teachers to manage complexity, maintain flexibility, and respond sensitively to the emerging needs that characterise heterogeneous classrooms where multiple demands coexist simultaneously. This convergence indicates that teacher professional development programmes must integrate both dimensions in a coherent manner, recognising that pedagogical transformation involves not only intellectual understanding of theoretical principles but also the development of emotional and relational dispositions that enable inclusive practices that are sustainable over time, beyond the initial enthusiasm that often fades in the face of implementation difficulties.

Nevertheless, recognising that every pedagogical framework faces limitations and contradictions in its practical application, tensions also emerge that deserve analytical attention, since the implementation of DUA does not occur in a vacuum but in school contexts characterised by material conditions, pedagogical traditions and regulatory frameworks that often contradict its principles, creating structural obstacles to its effective realisation. The main tension lies between the ideals of DUA (designing for all diversity without exclusion) and the contextual realities of basic education (limited resources, high student-teacher ratios, overloaded curricula, standardised assessment systems that penalise diversification), which creates a gap between the aspirations of the framework and the possibilities for implementation in real contexts characterised by structural constraints that limit teachers' scope for action. Resolving this tension requires not only teacher willingness or theoretical understanding of DUA principles, but also structural transformations in school organisation, educational policies and accountability systems that currently favour homogeneity and standardised measurements incompatible with the pedagogical flexibility that DUA proposes as a response to the diversity of the student body.

At the same time, a second tension that warrants careful consideration has been identified. another identifiable tension concerns the relationship between flexibility (a central principle of DUA that proposes multiple options) and equity, recognising that while offering diverse options can benefit students with different needs by facilitating personalised trajectories, it can also reproduce inequalities if students with less cultural capital, family support or self-regulatory skills systematically make less challenging or academically productive choices that perpetuate social stratification through seemingly neutral mechanisms. The DUA must be complemented by

scaffolding that helps students make informed decisions about learning options in accordance with their understanding of the medium- and long-term implications, thus preventing flexibility from becoming a mechanism that reproduces social stratification through differential patterns of choice that reflect pre-existing inequalities rather than authentic preferences based on individual characteristics disconnected from social conditioning that limits horizons of possibility.

Therefore, as an integrative synthesis of the components analysed, the articulation between DUA, neuroeducation and emotional intelligence configures a pedagogical model that simultaneously addresses the cognitive, affective and contextual dimensions of learning, recognising that these domains do not operate independently, but rather influence each other, configuring integrated educational experiences that cannot be artificially fragmented without loss of understanding and effectiveness. This model recognises that diverse brains learn in different ways (an empirically documented neurological dimension), that emotional states significantly modulate cognitive processes (an experimentally verified affective dimension), and that learning environments can be designed to accommodate this variability (a pedagogical dimension that can be operationalised through DUA principles), thus overcoming fragmented views that address cognition, emotion, and pedagogy as independent domains requiring separate interventions when in reality they constitute components of an integrated whole that must be addressed systemically.

CONCLUSION

Based on the hermeneutic analysis developed and in order to respond to the stated objective of analysing Universal Design for Learning as a pedagogical framework for addressing diversity in basic education as an educational approach for the Ecuadorian pedagogical context, it is conclusively concluded that UDL constitutes a comprehensive conceptual and operational framework, scientifically grounded and legally aligned with the constitutional principles of educational inclusion that govern the Ecuadorian education system, since its articulation with educational neuroscience and emotional intelligence constitutes a comprehensive pedagogical proposal capable of realising the right to education under conditions of equity recognised in the Constitution of the Republic of Ecuador and developed in the Organic Law on Intercultural Education.

The neuroscientific basis of the DUA provides empirical support for pedagogical decisions that were historically based on tradition or intuition, documenting that interindividual neurological variability justifies the need for instructional flexibility as a technically sound response to the diversity that characterises Ecuadorian classrooms, where students with different developmental trajectories determined by social, cultural and economic conditions that generate inequalities in early learning opportunities converge, while the incorporation of emotional intelligence as a mediating factor is particularly relevant to the Ecuadorian context, where socio-emotional factors have a significant impact on the educational trajectories of students facing conditions of social vulnerability, internal migration, situations of human mobility, or belonging to indigenous peoples and nationalities that require culturally sensitive and emotionally supportive pedagogical approaches in accordance with the principles of interculturality enshrined in the current legal system.

Consequently, and by way of a conclusive summary that responds forcefully to the research objective set out, the analysis demonstrates that Universal Design for Learning constitutes a pedagogical framework that is scientifically based, technically viable and legally relevant for addressing diversity in Ecuadorian basic education, since its principles of multiple means of representation, expression and involvement respond directly to the inherent heterogeneity of Ecuadorian classrooms, characterised by cultural, linguistic, socio-economic and ability diversity that reflects the plurinational and intercultural composition of the State.

The effective implementation of this framework requires systemic transformations that involve coherent public education policies, sufficient and sustained budgetary allocation, systematic teacher professional development that integrates conceptual and socio-emotional dimensions, curricular reorganisation that overcomes traditional disciplinary fragmentation, reformulation of

standardised assessment systems that are incompatible with pedagogical flexibility, and differentiated attention to inequalities in resource allocation between urban and rural areas that allow the principles of the DUA to be realised, particularly in educational establishments that serve vulnerable populations where pedagogical flexibility is imperative for educational justice.

In the Ecuadorian context, the DUA represents not only a methodological innovation but also a legal-pedagogical tool that allows for the realisation of constitutional principles of inclusion, interculturality, and good living that shape the national educational model, thus constituting an educational approach whose progressive adoption is imperative for the fulfilment of state obligations regarding the right to education in accordance with constitutional and international standards that are legally binding on the Ecuadorian state.

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