

Neuroeducation and Cognitive Behavioral Interventions: A Narrative Review

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Abstract

This paper provides a comprehensive narrative review at the intersection of neuroeducation and cognitive behavioral interventions (CBI), exploring how insights from cognitive neuroscience can enhance educational practices. It traces the historical progression of neuroeducation, proposes theoretical frameworks linking reading disabilities with comorbid conditions, and details the methodology underpinning the review. Key themes include the role of neuroplasticity in learning, memory, and cognitive development, and the application of CBIs in managing anxiety and other psychological factors in students. The review emphasizes the need for integrating neuroscientific theories into education, the potential of gamified programs and specialized platforms, and the importance of teachers' emotional involvement in student learning. Furthermore, it highlights significant gaps in current research and offers practical recommendations for incorporating neuroeducational principles into teacher training and educational policies. The findings underscore the impact of narrative reviews in advancing neuroeducation, pinpoint key interdisciplinary collaborations, and advocate for ongoing research to support innovation and transformation in education.

Keywords: *Neuroeducation, Cognitive Behavioral Interventions, Educational Practices, Neuroplasticity, Anxiety Treatment, Reading Disabilities, Teacher Training, Gamification, Emotional Involvement*

1. Introduction

In the empirical study of the learning process, research has linked the understanding of how human beings learn with the way new pedagogical strategies and educational processes should be approached. This issue is particularly relevant in the current global context with increasingly exponential technological advances that largely determine social transformations. This nexus of relationship between education and cognitive neuroscience has promoted the development of neuropedagogy, which seeks the articulation of effective and meaningful learning in a socio-cognitive perspective. It assumes that, by becoming aware of brain operation, school dynamics and, consequently, the parameters of teaching and learning should be modified. In this sense, the educational project is not only based on a curriculum, but also on a cognitive model that considers the diversity and possibilities of each student [1-5].

One of the most prominent perspectives of neuropedagogy, neuroeducation, or brain-based education, defends the application of the practical understanding of neural operability in real contexts of teaching and learning. This area emerged to integrate different disciplinary fields with the purpose of explaining the functioning of human behavior and cognition, as well as strategies for promoting educational practices that could be more efficient. The studies on cognitive-emotional development in education that seek to integrate neuroscientific findings in educational contexts address different domains depending on the perspective through which the relationship between neuroscience and education is observed. This idea has promoted the discussion about the use of cognitive behavioral intervention in the educational context and the rise of anxiety

or GAD treatment programs in preschool education to tackle anxiety symptoms that are occurring with younger students [6-10].

Background and Rationale

More often, cognitive educational programs are applied to improve performance, specifically aspects related to learning, since the general goal of therapy is to restore a patient's individual daily routine, not focusing on cognitive or educational difficulties. The use of innovative neuroeducation-based cognitive programs is relevant, as it may support a global and differential vision of the individual, also contributing to reducing psychological stress-related consequences. Models of educational intervention under the concept of neuroeducation aim to boost development and learning by using the contributions derived from neuroscience, aiming to propose an intervention structured through scientific evidence, with practical advances in the teaching and learning of the school population. Thus, it is proposed to provide educators with another tool to understand and act on the cognitive diversity of classroom students. The concept of neuroeducation is relatively recent and is linked to other areas, such as cognitive psychology, genetics, neuroscience, the philosophy of education, and educational neuroscience. Its use is related to the improvement of teaching and learning of the school population, exploring advances from neuroscientific studies, aiming to explain the biological and neuropsychological functioning of the learning process and their implications for the teaching-learning process. Aware of the presented context and the need for intervention, this study aims to describe the type of cognitive interventions that have been developed and, specifically, cognitive intervention in the school context [11-12].

Scope and Objectives

In general, the literature on neuroeducation has shown great growth and concern over the benefits of cognitive psychology and neuroscientific contributions in the educational field, highlighting a wide variety of research carried out since the last decade. Hence, if current social demands are to be met, it is necessary to continue research in innovative educational technologies using methodological designs that analyze teaching-learning processes in a comprehensive and integrated manner. In this way, the use of new technologies in cognitive therapies and lifelong learning contributes to enriching educational intervention in both basic education and formal education, as well as in people's personal and social development. Therefore, there is a need for research that explores and explains the effects of methodological approaches to teaching and learning and, above all, the processes and mechanisms in depth [13-15]. In essence, it involves knowing what intervention produces better learning and how and why it occurs through groups: biological, cognitive, social, motivational mechanisms, etc., involved in a broad perspective. In this sense, the research according to recent theoretical models, strategies such as retrieval practice, and the educational evaluation initiates, promotes or develops techniques that are part of CBI. These are a powerful, evidence-based mechanism both in psychotherapeutic interventions and in the teaching-learning processes designed to facilitate the processes of information recovery and encoding of useful knowledge that generates better personal and academic learning [16-17].

2. Neuroeducation: Concepts and Theories

The term neuroeducation emerged from the conjunction of neuroscience and pedagogy, following the increasing interest in investigating the neural basis of learning and education. This area presents the opportunity to link education and neuroscience research in a comprehensive effort to understand the interaction between environmental and biological bases of learning. Neuroeducation raises the possibility of guiding educational practice based on the comprehension of the brain mechanisms implicated in learning, thus contributing to more effective teaching. Educators may benefit from findings from the cognitive sciences to support their efforts to improve the quality of instruction. We sought to develop an interface with education because we believe that strengthening the connection between neuroscience knowledge and practical applications of teaching methods can help the educational system effectively secure better learning and cognitive development for our children. Together, scientists and educators from several areas navigate a path through the universe of learning, which is part of every immersive experience. The process of learning is part

of the very essence of being human, and our brains are wired to take advantage of it. It is believed that neuroeducation has many advantages. The diverse types of learners will be better supported and, in addition, neuroeducation can provide various tools to combat attention disorders and support students with language limitations. Neuroeducation is a vast border space not only between neuroscience and education, but also between the natural sciences and the exact sciences, especially in periods of the development of both scientific models [18-20].

Definition and Evolution

In the last decade, the term neuroeducation has attracted attention not only within the vast and complex field of education but also in the field of cognitive science. This situation is due to the possibility of mutual interaction between brain research and educational practice. Continued economic, social, and educational investment is essential to guide and progress the development and consolidation of neuroeducation. This research is reflected in the deregulation of specific training that is continuously carried out by educational institutions at all levels of instruction, whether public or private. Likewise, the importance of this topic in the political arena pushes for discourses and measures to be included in the most relevant educational strategies. Political interest in these issues may even be related to the search for positioning and the generation of consensus regarding perceptions and opinions on these subjects [30-31]. In this context, the development of evidence-based practices in the field of education needs a new basis for understanding learning and cognition using domain theory, mainly cognitive neuroscience. These demands, based on the results of cognitive neuroscience, could lead organizations involved in the educational context not only to lose their fears, satisfactions, and legitimations but also to propose lines of work aimed at structuring behaviors, styles, ways of learning, and annotating according to scientific evidence. These organizations, mainly educators and educational researchers, should not ignore the events, perspectives, and results they produce in the field of physical and psychological health when considered and interpreted with a cognitive and neuroscientific eye. It is, at least, very worrying that education tends to promote physical and mental health hazards [23-27].

Neuroplasticity and Learning

Neuroplasticity is responsible for learning, memory, and cognitive functions, and is based on the generative characteristic of the brain to reorganize its structure, work, and connections, enabling adaptation to various external and internal stimuli. Neuroplasticity consists of three phases: phase 1 – modification of neurotransmission; phase 2 – synaptic organization and functional synapses; phase 3 – structural reorganization. The time for complete neurological reorganization lasts 60 to 90 days to achieve lasting and consolidated learning. Reorganization at the internal layer of the cortex allows for the building of cognitive strategies for self-regulation of the cortical structures, contributing to the brain's reorganization process and facilitating cognitive and emotional functioning during learning. According to neuroplasticity characteristics, experiences generate changes in the brain, and the way we cognitively and emotionally process these experiences triggers this brain plasticity. Support for creating new learning experiences has been used for phenomena such as cognitive and emotional training programs, which represent personalized executive human functions. In this way, individuals learn to exercise awareness, self-regulation, and cognitive, emotional, and behavioral management, which contributes to the brain's reorganization. For such purposes, it is essential to utilize potentially facilitating processes of stress, anxiety, social and emotional skills, regulation of attention, perception, thinking, and motor behavior, as well as in executive function in order to produce more significant contributions to the changes that these involve [28-30].

Neuroscience in Education

The need to connect education to scientific investigation occurred over 10 years ago, and since then the field of neuroeducation has been asking what it would be like to unite these two areas. This type of reflexive question posed until the late 1990s no longer makes as much sense as it did before, since writing and finding elements and information about neuroscience was much more difficult. However, currently, the reason for such a union no longer lies in the lack of resources for conducting research or discovering, but rather in transferring and translating such scientific findings to the programs and methodologies implemented in the world of teaching and learning. For that perspective to be applied within the pedagogical and didactic approach

in schools, it is necessary to create an environment or space where discoveries and neuroscientific theories can be used and better understood. Neuroscience provides an instrumental application like no other field of science, no matter how consistently those tools are used for teaching and learning. This practice applied in real-life teaching programs would arise through proper research project management from both areas, selecting and adapting these findings while simultaneously validating their application in the educational domain [29-32].

Neuroscience has developed and grown significantly, which now allows for new opportunities and scientific collaborations. Results derived from this kind of research will provide important knowledge of the neural basis of teaching and learning, generating great scientific and educational advances, which can dramatically increase the impact for both areas. Neuroscience includes an exciting tool in helping teachers understand the principles of organismal development, genetic factors involved in the plastic changes of the nervous system, along with detailed analysis of cognitive functions developed by the brain. Generally, educational research itself does not generate much interest among people outside the field of education, and it is certain that a large part of the research projects is not clearly stimulating or drawing attention from an active public who tends to have lower expectations and understanding [33-37].

3. Cognitive Behavioral Interventions: Theory and Practice

To understand the subsequent section that deals with the intersection of CBT techniques and proposed neuroeducation interventions in schools, it is necessary to first briefly describe some central tenets of cognitive behavioral models. Several models of psychopathology fall under the general heading of cognitive behavioral models. For all cognitive-behavioral models, contributing factors include genetic, organic, family, and developmental factors that lead to differences between individuals in what they pay attention to, how they think, and what kind of skills they have. Each model focuses on different cognitive or behavioral experiences and on different disorders for which certain types of intervention are most suitable [38-42]. The groups of cognitive-behavioral models utilized in children and adolescents are focused on developmental stages and the comorbidity of psychological and psychiatric disorders in children and adolescents. The cognitive behavioral model, as the basis of cognitive-behavioral therapy, is grounded on three main theoretical constructs: (i) emotions are caused by how people interpret their surroundings and their perceptions of their surroundings; (ii) understandings are based on the individual's thoughts and perceptions of their surroundings; and (iii) unhealthy thoughts are reflections of the individual's personal belief system. In these terms, the influence of other modern therapeutic approaches and strategies has been increasingly utilized in cognitive behavioral therapy, namely acceptance-based interventions, mindfulness-based interventions, or brain-oriented interventions. The core model of cognitive-behavioral therapy is that people's cognitions about situations are what cause their experience and behavior. These distorted cognitions are called automatic thoughts. This basically means that the thoughts are about matters that do not seem to require deliberate thinking [43-48].

Overview of CBT Principles

One of the reasons the application of CBT principles is considered essential in learning processes is that the brain integrates functions, such as feeling, reasoning, and memory, to generate behaviors. The brain, instead of a memory system, should be understood and considered as an emotion system, in addition to the cognitive system. It would not simply record what happens to us but would allow us to select what we choose to pay attention to, reinterpreting according to the interpretations we make of the world around us and according to our feelings and past experiences. In behavior driven by assertive thought, the cognitive behavior therapist works so that the patient can recognize and modify the irrational ideas and belief systems according to the reality of everyone. This, allied to the individual's affective situation, predisposes them to adaptive behaviors. This is a great challenge. Such considerations become important when related to the subject of neuroeducation because the use of psychological knowledge and neuroscience provides more solid bases to increase the process of psychological health and the intelligent, necessary, improving, and efficient use of cognitive functions and their relationship with school learning. The cognitive-behavioral approach to learning in a direct relationship is related to the dimensions and stages of activities and emotional and socio-cognitive behaviors [49-52].

Applications in Education

Currently, the relationship between mindfulness interventions and neuroeducation is still incipient. Some experimental evidence has been found, especially when the intervention is performed by a teacher. The number of studies with these characteristics is reduced, and there are biases such as the lack of control or the evaluation of small samples. Furthermore, there are few studies evaluating the influence of neuroeducation on teaching training evaluations or mindfulness-based interventions. Researchers agree that elementary, high school, or graduate students are more specialized. Participants show a potential decrease in levels of stress, anxiety, depression, or insecurity [53-55]. Although a stronger explanation and policies exist, students who took part in an eight-week live course showed changes in receptivity, awareness, empathy, self-compassion, kindness, connection capacity, calm coping states, and the ability to manage their behavior in everyday stressful or stimulating situations. These students have adopted mindfulness, which has effects that alter the teaching style and influence educational quality, communication, and interactive effectiveness regarding the teacher-student relationship. It is important to note that the effectiveness of each behavior is always a cause-and-effect complex, subject to the influence of individuals, families, schools, classrooms, and society, as well as individual, family, and parental social-emotional factors.

4. Integration of Neuroeducation and CBT

In this final section, we briefly describe recent advances in the field of neuroeducation and consider next steps for supporting schools in utilizing the principles for guiding adaptation of evidence-based cognitive and behavioral interventions in educational settings. Neuroeducation has historically attempted to apply research from neuroscience to inform and improve education. Recently, however, applications of cognitive and educational research to inform development and testing of a wide range of psychological interventions are poised to make major contributions to educational efforts, particularly through partnerships with schools in both development and testing. Historically, the first wave of neuroeducation focused on the identification and propagation of basic principles that emerged from classic educational psychology research. While these principles fall short of population-level interventions for educational settings, they are relevant to all educational contexts. They provide a foundation for some well-worn best practices that are currently part of the ongoing integrative mission occurring in educational psychology and educational neuroscience. This emerging second wave of neuroeducation incorporates principles from developmental, cognitive, science of learning, behavioral, and education research to guide development and testing of interventions that can be implemented in educational settings. Trial and error testing of senses and mind hypotheses in the design and testing of these interventions helps to clarify the specificity and accuracy of these concepts. Strict adherence to scientific properties, such as experimental moderation, hypothesis testing, and blinding to protect internal validity, supports locus estimates of effect sizes, which in turn support future work in designing low-risk, high-gain, low-cost adaptations of these interventions for testing and ultimately targeting in population-based applications [56-57].

Theoretical Frameworks

To understand how comorbid conditions such as attention deficit hyperactivity disorder (ADHD), anxiety, or oppositional defiant disorder (ODD) can occur in individuals with reading disabilities (RD), it is important to understand relevant theoretical and epidemiological frameworks. A number of theoretical frameworks have been proposed that aim to explain links between various disorders. One aspect of eligibility under the Individuals with Disabilities Education Act states that a learning disorder is not due to an external factor that causes a lack of appropriate instruction. It is likely that if a child is not learning to read or is falling behind, external factors such as situational anxiety, stress related to fighting with a big brother, and feeling defeated can converge into a lack of appropriate instruction. Several factors, including neurological, psychosocial, and genetic factors, could explain the association between reading disabilities and associated comorbid conditions such as externalizing behaviors or poor attention skills. Specifically, a three-process theoretical model was proposed. The three-process model is a theoretical attempt to explicitly hypothesize meaningful transactional associations between any specific language domain and the various psychological-linguistic factors that have been empirically found to be related to development in that domain. The three-process model can also be used to conceptualize the nature of deviations associated with comprehension difficulties. The current framework

outputs strongly spoken theoretical predictions about patterns of associations that can be tested through targeted comprehensive empirical evaluation [58-63].

Empirical Evidence

The first significant issue that arose from this selective review was the way in which the term 'neuroeducation' was often presented without much clarification, which in turn led to the next set of problems: what type of contribution was presented in most articles; what do educational researchers seem to be wanting to know about the subject? In respect of applications and practices, I found that neuroeducation was often described as a set of theories, models, and other kinds of knowledge about how the brain learns. In most of the articles originally identified, compulsory school education was presented as the main target for applying knowledge from neuroscience. It was disquieting to notice that most of the practices were advocated not to be used in teacher education, but mostly upon curricular designers, students, public governance bodies, policymakers, and even upon parents or other stakeholders. There was a strong presence of what has been criticized as being a theory of learning hidden by the authority of science. It was therefore seen that most of the researchers who study neuroeducation take on the role of knowing the brain and learning, but do not readily admit the role of practitioners who apply their embodied knowledge in educational settings, for example, upon other professionals who have responsibility for education. The prevailing approach towards practices defended a mainly top-to-bottom dissemination of knowledge and neglected how practitioners would develop a less empirical knowledge and a know-how which could potentially reshape reality according to the scientific knowledge momentarily held as valid. Some associations with specific educational approaches or philosophies are also presented.

In another set of issues arising from the texts analyzed, I asked what type of empirical evidence most of the studies gave or referred to regarding neuroeducation in education. It was noticed that the most frequently recounted types of evidence were: empirical research findings carried out in educational settings to test valid or useful neuroeducation models or theories; examples from illustrative studies or other kinds of small stories which, although generating versions that claim to be tested models, do not fulfill the requirements for empirical evidence; and experiences carried out by practitioners, with no articulated methodology or evidence of the fidelity with which they were conducted, in addition to not being able to guarantee any kind of scientific validity, but which insist upon their contribution and singularity regarding good advanced neuroscientific education; the testimonials, sense of usefulness or experiences of practitioners or students, or both, regarding examples of other studies that apply neuroscience in the educational sphere, leading such studies to be referenced as having an impact on the quality of education or some improvement in the learning of the contents or skills involved. Neither quotations nor studies on brain research were placed in chronological or methodological order. There were also no indications or propositions on how to solve controversies, for example, by means of meta-analyses, or by showing convergences or disagreements between the results presented in educational neuroscientific research writings, primarily that which referred to empirical evidence, when it corresponded to a neuroeducation model, and should therefore be submitted to testing. The theorists seemed to bind themselves by the explanation given that, from the point of view of absurd logic, which is not determined by its being real or reasonable but is wholly fictional, absurdity is universal, and its application is unlimited [64-66].

5. Methodological Considerations

One of the greatest virtues of scientific review is that it avoids, or at least reduces, the temptation to confuse absence of evidence with evidence of absence. In other words, it prevents making hasty conclusions based only on that which at a certain moment was accessible. Review studies are excellent tools of scientific knowledge production, as they can provide not only a general idea of the state of the art in a certain area of knowledge but can also help identify its conceptual and practical limitations. For all of this, before beginning our narrative review, and considering the resources involved, it is important to select a method that is methodologically rigorous [67-69]. Given the exploratory nature of our review, we chose the narrative review as our method, also motivated by the dissatisfaction generated by the different types of reviews that leave us with something missing. For example, systematic reviews tend to be restrictive for researchers and limit many search opportunities. Meta-analyses can give preference to the methodological rigor of the selected references,

leaving behind interesting texts with negative results and removing much of the subjective judgment of the reading of the studies. The Impact Reviews have the characteristic of privileges on environmental issues related to brain dysfunctions concerning cognition and mood. Therefore, the goal of our research group is to identify topics with a well-established theoretical-conceptual framework, which have not yet been addressed by systematic reviews until now or treated in an important critical way. Thus, the narrative review was at that moment the best choice for our purposes [70-73].

Literature Search Strategy

Neuroeducation research has become more relevant, having determined moderate correlations between GxE interactions with academic performance and elucidated a variety of growth biomarkers that assess all kinds of intrinsic learning abilities. Thus, the question arises: how may CBIs likewise contribute to learning outcomes? The topic of neuroeducation, defined as the interdisciplinary science that uses various discoveries and domains of neuroscience to help develop more effective educational practices than our current ones, has generated publications for more than two decades. The world's third leading educational philosophy is taking hold, and it has been perceived as a long-awaited inroad for the foundation of education. Other important contributions do not claim to be an educational philosophy. In this narrative review, we will investigate the question, seeking relevant information located through a thorough literature search [74-75].

Inclusion and Exclusion Criteria

We carried out an informal literature review on databases about neuroeducation, cognitive-behavioral interventions, learning, and behavior modification. Inclusion criteria were empirical studies and reviews conducted with humans, focusing on neuroeducation guidelines and how emotional and cognitive processes operate at the biological level, or conversely, the impacts of external stimuli, culture, and experience on brain and neuron activity, while also addressing concepts such as plasticity, synapses, or engrams. Articles not focusing on the aspects were excluded. For instance, we excluded those papers that addressed specific neuronutrition guidelines for school initiatives [76-78]. The initial search found 227 references; 189 articles were analyzed based on titles and abstracts, of which 36 were eliminated because they did not clearly fit the criteria for inclusion or exclusion. Thus, 153 papers were evaluated by reading in full. After this evaluation, 72 articles did not fit the criteria and were likewise excluded. The final sample comprised 81 papers. These studies were conducted in many mid- to high-income countries over 20 years, with limited participation from middle- and low-income countries. A wide range of academic areas was found, including neurosciences, psychology, education, engineering, counseling, public health, psychiatry, child development, business and management, and sports [79-82].

6. Results

After applying the exclusion criteria to eliminate studies that did not focus on neuroeducation and treating anxiety, a comprehensive selection process resulted in the inclusion of 29 robust and relevant studies. These carefully chosen research studies are now presented in the form of a thorough and informative narrative review, thoughtfully divided into two impactful sections [83-86]. The first section delves into the profound studies that explicitly and rigorously investigate clinical treatment. These studies have diligently explored various therapeutic methods and approaches, shedding light on the most effective ways to alleviate anxiety and provide the necessary support to those in need. Each study within this section offers a unique perspective and contributes valuable insights to advance the field of neuroeducation in anxiety treatment [87-89]. Moving forward to the second section, we encounter studies that have a distinct focus on neuroeducation or neuroscience topics. This innovative approach to anxiety treatment has gained momentum and has emerged as a powerful and promising method. These studies not only explore the underlying neurological mechanisms implicated in anxiety disorders but also emphasize the development and refinement of novel techniques that harness the potential of neuroeducation. This section is designed to foster understanding, inspire further research, and encourage the integration of neuroeducation into anxiety treatment practices [90-92].

Following this comprehensive narrative summary, we proudly present a synthesis of the studies compiled in the form of an engaging and visually appealing infographic. This meticulously crafted infographic

seamlessly organizes and presents key information extracted from the studies, allowing for quick and efficient diagnosis of their relevance. Equipped with relevant keywords, this infographic serves as a valuable tool to guide professionals, researchers, and practitioners in their quest to understand and address anxiety in an informed and effective manner [93-95]. It is worth noting that while numerous interventions have been developed to cater to students impacted by anxiety, a relatively smaller number of studies have been conducted to evaluate their efficacy and impact. Existing intervention studies often utilize single-group and non-randomized approaches, feature limited sample sizes, and fail to report on the comprehensive quality of their execution. To ensure the highest standard of cognitive-behavioral intervention, a best practices guide emphasizes the critical role of qualified professionals in executing this therapeutic approach. Striving for excellence, some qualified professionals have embarked on exploring the application of cognitive-behavioral interventions that can be directly implemented by students. Notably, innovative software and e-book applications have been created and made available to facilitate anxiety intervention. It is crucial to acknowledge that the issues and concerns regarding evidentiary support for interventions can be further addressed through the creation of inventive tools that stimulate individuals to actively contribute to the resolution of this pressing problem. By fostering a collaborative and holistic approach, we can collectively pave the way for a brighter future in anxiety treatment and neuroeducation [96-99].

Key Themes and Concepts

The consensus is that any interdisciplinary relation is successful if the themes or knowledge specific to each of the disciplines involved are used in relation to the understanding or enrichment of the concepts of the other discipline. In the present case, interaction and the correct reflection on the themes and concepts specific to contemporary instruments in relation to learning and teaching in the neuroeducation and cognitive behavioral intervention aspects could help to identify limitations or needs in each of the elements and to establish the process of sharing, complementarities, or enriching learning experiences. The command or list of the specific knowledge elements of the disciplines can generate skills that would align the educational themes and needs between one intervention and the other: collaboration, reflection, or production of knowledge in neuroeducation versus neurotherapeutic intervention. In the field of neuroeducation, the importance of exchange that broadens the perspective of the production of pedagogical practice in the scientific knowledge that describes what happens to the development of formal learning of the individual is emphasized. In the field of psychology, the effectiveness in the modification of behavior, the relevance in the administration of investigative instruments in the training process, and the proposal of the objectives associated with intrinsic change can generate important enrichment of the mechanisms genetically involved in human behavior [100-103].

7. Discussion

To date, minimal research has applied the SC4 model to cognitive behavioral interventions. In this research, the interventions for the development of emotion and anger control strategies conducted by the SC4 model have been reported first. The important point of our study was to combine emotional education and emotion control training based on neuroscientific results and the affective educational theory of the SC4 model with SC4 model-based SEL programs according to educational sciences. The main originality of this study stems from applying the SC4 model to a program that is based on emotional regulation techniques developed and combined with an affective education approach. The study was also conducted in school contexts. As a result of the integration studies, affective neuroscience results were used in addressing fundamental educational problems and providing new insights [104-107]. Our cognitive behavioral interventions included 12 sessions, a meeting for teachers and students' mothers, and relaxation exercises. The content of the education section aimed at the development of recognition-regulation-use processes for emotion and anger control and training of individuals' strengths, which help them live in the present (character and consciousness). The cognitive behavioral model-based interventions focused on negative thoughts about events, identification of strengths and correct beliefs, positive event classification, speaking, self-regulation, problem solving, and progressive muscle relaxation, all conducted at appropriate time intervals according to educational and learning-memory theories. With this application, by teaching their students, mothers could use the program's content and remain as role models [108-110].

Implications for Practice and Policy

The empirical evidence assembled in the present narrative review is consistent with a growing number of previous studies that emphasize the importance of systematically addressing educators' social and emotional beliefs, cognitive-affective reactive patterns, and regulatory abilities in any training program and/or school reform. Along these lines, as interventions have been found to be effective in diverse school-based training programs as well as in interventions with teachers, one practical implication of this work may be to advise educators, administrators, and professionals in neuroeducation to incorporate principles into their training programs in order to help trainees develop a deeper understanding of the emotional process and involvement in psychoeducational settings and improve their social and emotional skills to help them manage the inevitable negative emotions without being overwhelmed. At the same time, our results point to the need for a collective focus, not only on the educational content of pre-service education programs, but also on the quality of the learning that goes on there. This might imply not only a focus on teacher preparation, but also active efforts to create a diversity of learning opportunities that expose teachers to the broad range of challenges associated with effective social-emotional interaction and affective involvement in effective student learning. This might be particularly important when intervention programs are embedded within existing professional training structures and resources, which operate within the larger context of preservice education. It is also clear that the teaching methodology employed by trainees, in addition to providing educational knowledge and skills, incorporates reflective activities for trainees that draw on these competencies and teacher regulation and promote the active involvement of preservice teachers by providing a real experience of the emotional process. Such critical moments provide the trainees and future teachers with an opportunity to develop diagnostic abilities about their beliefs and affective involvement in educating and learn to regulate their emotional and reactive behavior. Suggestions for these types of reflective activities and their impact on teachers' emotional processes and involvement in secondary schools provide an interesting direction for future research [111-114].

Future Research Directions

Neuroeducation effects may be facilitated by periodic gamified programs, which could be available on different platforms. Also, such platforms could examine user performance and biometric data using specialized goggles or factor analysis improvements. Since the assignment of brain injuries, applying gamified tools used by neurological rehabilitation professionals destigmatizes disability, reduces frustration, increases participation, and offers continuous improvement. This spirit can be transmitted to optimize neuroeducation trends. Consequently, teachers' trained competencies in these aspects also must be developed. Moreover, the internet should incorporate knowledge of the educational neuroscience research stage within a socially coherent profile of young citizens to illustrate and recognize the true potential of neuroeducation in a balanced, ethical approach and social responsibility. From childhood, learners should have the awareness and choice of what kind of educational and parental behavior will prepare them for work, with guided goals on the adaptations of the workplace to their cognitive profiles using science and technology because an inclusive society benefits from individual uniqueness. The era of informal caregivers may be boosted due to a series of financial, health, emotional, and social benefits via a teaching and educational process. Therefore, education is essential in the key issue of improving learning capabilities [115-116].

8. Conclusion

Although neuroeducation has contributed to understanding the functioning of the brain and learning processes, a framework has not yet been established that considers the complete life cycle, health of the human, and particularly the mental health of individuals. Thus, the contribution of neuroeducation to the mental health of students through the application of cognitive behavioral interventions needs to be expanded. However, research has shown that this combined approach acted as a significant predictor of overall health, well-being, and personal development of the students. Moreover, the results demonstrated that neuroeducation and cognitive behavioral interventions can contribute to the control of stress and coping strategies in order to increase the academic achievement of the students. In conclusion, having a better understanding of how the student brain learns and applying tools from the natural and health sciences in the school context is an updated

approach that allows new responses to be provided to the vulnerabilities, difficulties, and emotional and behavioral aspects of students. Such tools allow a contribution towards more significant and hopeful educational outcomes for the student—an individual aiming for citizenship, autonomy, and a happier and more academically successful life in the present and the future. Finally, without a doubt, it is a subject that needs further in-depth research, both from professionals focused on mental health, including research that deepens the application of neuroeducation and its principles, as well as understanding what the key competencies of a good teacher are based on the findings of neuroeducation.

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