ISSN. 1815-7696 RNPS 2057 -- MENDIVE Vol. 17 No. 3 (July-September)
Puentes de Armas., T., Sánchez Valdés., X., "Neurosciences for inclusive education in the training of child education professional" p.333-345
Available from: http://mendive.upr.edu.cu/index.php/MendiveUPR/article/view/1622
2019

MENDIVE
REVISTA DE EDUCACIÓN

Translated from the original in Spanish

Neurosciences for inclusive education in the training of child education professional

Las neurociencias para la educación inclusiva en la formación del profesional de la educación infantil

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Received: April 23, 2019.
Approved: June 18, 2019.

ABSTRACT
The integration of Neuroscience knowledge in teacher formation is a challenge that must be assumed based on its pertinence for achieving better professional performance in the face of the challenges of inclusive education. The aim of this work is to propose a set of themes for the formation of Infant Education professionals on the relations between neurosciences and education. For this purpose, methods were applied at the theoretical level, such as analysis-synthesis, induction-deduction, content analysis, and modeling; at the empirical level: documentary analysis, observation, and the interview. For the tabulation of information, descriptive statistics was used. The integration of the results made it possible to make assessments of the existing strengths and weaknesses in this field. The proposal includes suggestions for the integration of diverse topics with subjects of the curriculum in the initial formation of the careers of Infant Education, its evaluation by means of integrating exercises and the realization of a course as a postgraduate response to the problems that persist in the training of teachers in exercises and the elaboration of a basic text with the systematization of the main contents of the neurosciences that contribute to inclusive education. As results the integration of the topics into the Special Education career formation curriculum was obtained, an increase in the quality of the integrating exercises with 90% of students with 5-mark evaluations, and the training of 14 teachers who reported high levels of satisfaction.

Key words: neuroscience; inclusive education; Special Education; Infant Education.

RESUMEN
La integración del conocimiento de las Neurociencias en la formación de los docentes, es un reto que se debe asumir a partir de su pertinencia para el logro de un mejor desempeño profesional ante los desafíos de la educación inclusiva. El trabajo tiene como objetivo proponer un conjunto de temas para la formación de los profesionales de la Educación Infantil sobre las relaciones entre las neurociencias y la educación. Para ello se aplicaron métodos del nivel teórico, como análisis-síntesis, inducción-deducción, el análisis de contenido y la modelación; del nivel empírico: análisis documental, observación y la entrevista. Para la

tabulación de la información, se empleó la estadística descriptiva. La integración de resultados permitió realizar valoraciones sobre las fortalezas y debilidades existentes en este campo. La propuesta incluye sugerencias para la integración de diversos temas con asignaturas del currículo en la formación inicial de las carreras de la Educación Infantil, su evaluación mediante ejercicios integradores y la realización de un curso como respuesta posgraduada a las problemáticas que persisten en la superación de los docentes en ejercicios y la elaboración de un texto básico con la sistematización de los principales contenidos de las neurociencias que tributan a la educación inclusiva. Como resultados se obtuvo la integración de los temas al currículo de formación en la carrera Educación Especial, un aumento de la calidad de los ejercicios integradores con un 90% de alumnos con evaluaciones de 5 puntos y la superación de 14 docentes que refirieron altos niveles de satisfacción.

Palabras clave: neurociencias; educación inclusiva; Educación Especial; Educación Infantil.

INTRODUCTION

The need to generate educational training and innovation actions aimed at raising the quality of the preparation of teachers who annually graduate at our Universities is one of the priorities of the Ministry of Higher Education (MES), endorsed in the agreements of the Project meetings Regional Education for Latin America and the Caribbean (Regional Office of Education for Latin America and the Caribbean, 2015), and the Summits of Latin American and Caribbean States (CELAC, 2017).

One of the priorities highlighted in the Educational Goals project (Ibero-American Conference of Ministers of Education, 2015) calls for the need for continuous training and the development of the professional career through continuing education and educational innovation programs (Organization of Ibero-American States for Education, Science and Culture, 2010, p. 157), leading to a higher quality and better grounded education from all fields of scientific knowledge.

In the effort to form an enriched pedagogical activity that incorporates new resources to the preparation of teachers for a quality education with the most recent contributions of science, in particular those related to the brain, behavior and learning, « (...) Neuropedagogy emerges, as a branch of Neurosciences and emerging discipline, which attempts to build "bridges" for the integration of Neurosciences and Pedagogy (Calzadila Pérez, 2017).

To make an analysis from the university, the article entitled «The integration of neurosciences in the initial training of teachers» is taken as a result of the research of the Neuropedagogy development group of the University of Holguin (Calzadilla Pérez & Álvarez Clemente, 2017). In this regard, Calzadilla Pérez & Álvarez Clemente (2017) refers to the insufficiencies in the integration of scientific knowledge of Neurosciences and Pedagogy in the curriculum of Cuban university careers for the initial training of teachers, which in their opinion, is cause of the pedagogical misunderstanding of brain changes that occur when learning, which implies the modifiability and diversification of teaching strategies.

The fragmented vision of the knowledge of the exact and natural sciences, with respect to the social sciences, the insufficient argumentation of the criteria

for the transfer of neuroscientific knowledge to the theoretical, referential and operational framework of Pedagogy as science, the scarce socialization, of the results of the Neurosciences, feasible to integrate the scientific-pedagogical knowledge and the practices of the educators, and the «conservative» attitude of not biologizing the pedagogical practice referred to the identification and attention of the special educational needs (NEE) associated or not to disability constitutes some of the barriers that must be broken down.

However, neuroscience research reveals new information about the human brain, its development process and the factors that can influence it, its functions, its relationship with the experiences with the other and the environment, which marks profound changes about the way children, teenagers and young people think, attend and educate.

The present investigation is an alternative to face the great challenge of closing the gap between what we know and what we do in practice. The first step in closing that gap, and *sine qua non* condition, is to create a mechanism to disseminate the scientific evidence that contributes to the theory and practice of the teaching and education processes.

The training of the Special Education professional is developed according to the characteristics of the training of a broad-profile professional, typical of the Cuban university at the present time. This process, unique from the initial and continuous conception, is based on the Professional Model, which projects how each teacher should perform to achieve comprehensive educational care for children, adolescents and young people with special educational needs associated or not to the disability that constitutes the object of work.

In this area, the integration of the knowledge of the Neurosciences in the initial and permanent training of teachers is a challenge that we must assume from a clear understanding of the relevance for the achievement of a better professional performance.

With the application of theoretical, empirical and statistical methods it was found that the following **strengths** are identified in the process of training of Special Education professionals at the University of Pinar del Río «Hermanos Saiz Montes de Oca»:

- The existence of a research project that promotes research, innovation and creativity, responds to the main functions of any university (research, teaching and social projection), within the framework of institutional autonomy (Initial and permanent training of teachers of Special Education for educational attention to diversity)
- The presence of scientific results on the relationship between neurosciences and education.
- The possibilities of the university curriculum to make adjustments that respond to the social reality of the territories from the own and optional/ elective curriculum.

However, some **weaknesses** were identified, among which are:

- There is insufficient research conducted from the pedagogical sciences that address the issue of relations with neurosciences from interdisciplinarity.
- The integration of the knowledge coming from neurosciences in the disciplines and subjects is limited for the training of the Special

Education professional to successfully fulfill their work object.

This balance reveals the contradiction that is established between the need for the training of nursery education professionals to integrate the knowledge coming from the neurosciences and the limitations that exist in the treatment of these contents in the training process.

With the interest of contributing to the solution of the proposed problem, this work arises that proposes to develop a course of overcoming for the professors of the Special Education and Speech Therapy of the University of Pinar del Río on Neurosciences in a way that facilitates the understanding and theoretical foundation applied to the teaching, education and neurodevelopment of students with special educational needs associated or not with disability, as well as the projection of the contents of neurosciences in the interdisciplinary and intersectoral conception of teacher training (Sánchez, Puentes and Sotolongo, 2018).

MATERIALS AND METHODS

To carry out this study, the intentional selection of the sample was made up of 14 professors from the Special Education and Speech Therapy respectively, representing 66.7 % of the population. 100% are graduates in Education in Special Education and Masters in Education. Three professors (21.4%) are doctors in Pedagogical Sciences and 35.75% are 10 years or more as professors in the Special Education and Speech Therapy courses. The representatives of the sample group cover all the subjects of the general pedagogical training discipline in both careers and 28.5% also cover subjects of the specialty Speech therapy and Educational Research Methodology.

In the investigation, the materialist dialectic was assumed as a general method, which allowed the study of the integration of the knowledge of the Neurosciences in the training of teachers as a process, explaining the logic of their execution, the contradictions that manifest themselves and the selection of the research methods of the theoretical, empirical and mathematical statistical levels.

Among the theoretical level methods used are the analysis-synthesis that allowed to decompose the phenomenon under investigation, the appropriation of its multiple relationships and arrive at synthesized reasoning on the integration of the knowledge of the Neurosciences in the training of teachers.

The induction-deduction, allowed the achievement of the necessary abstractions that allowed to discover the regularities that typify the process of integrating the knowledge of the Neurosciences in the initial and permanent training of the teachers of the Special Education, and the relevance in order to raise the quality of professional performance.

The content analysis was used in the treatment and interpretation of various documents, among which the Professional's model for the degree programs in Special Education and Speech Therapy, Study Plans D and E, course programs offered by the University of Pinar del Río, the projection of the main integrating discipline, the methodological work strategies of groups of years, disciplines and careers necessary to make inferences and interpretations of the situations encountered and fulfill the proposed objective.

The modeling was used in the process of representing the social reality that wants to transform and shape the scientific product that is proposed.

Among the methods of the empirical level are the participant observation in the year groups, disciplines and careers in order to verify the treatment given to neuroscientific knowledge related to learning, behavior, diagnosis and the compensatory corrective process. The interview with teachers, aimed at obtaining information on the incorporation of neuroscientific knowledge in the process of teacher training, knowing their needs to overcome the subject and the opportunities for its realization.

The methodological triangulation technique allowed to integrate the information obtained in the different instruments applied in the investigation that was processed using the index calculation for each of the indicators, considering the range 0-0.2 as inadequate; 0.2-0.4 as inadequate; 0.4-0.6 as adequate; 0.4-0.8 as quite adequate and 0.8 -1 as very adequate.

In order to assess the essential aspects that characterize the integration of neuroscientific knowledge into the training process of teachers in the Special Education and Speech Therapy courses at the University of Pinar del Río, two dimensions were specified:

Dimension I (cognitive): referred to the level of knowledge that teachers have about neurosciences, their contributions to education and the relevance of their inclusion in the curriculum of careers in early childhood education.

Dimension II (methodological): addresses how the contents are selected, how they are incorporated into the curricula and how they are evaluated.

RESULTS

The results of the study of the Professional model for the Bachelor's degrees in Special Education and Speech Therapy and the study plan E allowed to verify that although the term neurosciences is not explicitly stated in these documents, its application requires the integration of neuroscientific knowledge in the initial training of the students of these careers, which was already indicated by (Calzadilla Pérez & Álvarez Clemente, 2017) ; (Calzadilla, 2015) in relation to the requirements of the Professional Model for each of these careers corresponding to the curriculum D.

The analysis of the inclusion of the neuroscientific contents in the curricular design, in the Bachelor degrees in Special Education and Speech Therapy respectively and its concretion at the level of the academic years and disciplines in which the following results were obtained:

- The tendency towards the inclusion of neuroscientific contents to the knowledge system of the base curriculum of the careers, more evident in the General Pedagogical Training and Speech Therapy disciplines, but its departure in the different subjects and academic years depending on the problems is insufficient professionals that the teacher must face in educational practice.
- In the projection of the own and optional/ elective curriculum, the effective insertion of contents that complement the assimilation of the neuroscientific content conceived

in the base curriculum is not achieved.

- The organization of the subjects in the disciplines of the different careers of Early Childhood Education in the -called common trunk has not yet reached the necessary consensus that propitiate the incorporation of neuroscientific contents for the training of the professional from the educational inclusion.
- Didactics teachers do not always manage to link the contents of their subjects with those of neurosciences.
- There is little research aimed at articulating the contents of neurosciences in the initial and permanent training of teachers of Speech and Special Education.
- No agreements are reported with other universities, research centers and institutions of other sectors, aimed at the scientific update of the cloister in the area of neurosciences. In the same sense, there are few activities carried out with students where neuroscientific contents are incorporated that conform to the interdisciplinary and intersectoral conception of initial training for their professional performance in an inclusive school.

In the interviews carried out, it was known that 100% of the professors recognize that they have little level of update on the contributions of the Neurosciences to Pedagogy, 57.1% do not consciously plan these contents in their classes. 35.7% believe that these contents are only an object of interest for professors of the subjects Anatomy and Developmental Physiology, Psychology and Speech Therapy.

The study carried out showed that the most affected dimension was 2 when it was placed in the category of Inadequate with an index of 0.1936. While dimension 1 was placed in the category Unsuitable with index of 0.2380. The total results were evaluated as inadequate when reaching the general index of 0.2172.

From the results presented, it was determined to undertake a set of actions for the incorporation of the contents of the neurosciences to the initial and postgraduate training of teachers of Special Education and Speech Therapy, which serve as a reference for the design of strategies that address the problem in all its theoretical, methodological and practical complexity.

In this sense, we worked on the integration of different subjects of the base, own and optional / elective curriculum for the realization of integrative exercises that involve specialists and officials from different sectors such as MINSAP and INDER as part of an interdisciplinary and intersectoral conception of the teacher training (Sánchez, Puentes and Sotolongo, 2018). One example is summarized in Table 1.

Table 1 - Proposal of integrative exercises with an interdisciplinary and intersectoral nature in the Special Education career.

Academic year	Integrative Exercise	Sectors involved
1st (E)	Characterization of the preventive work of the Provincial Center of Medical Genetics.	MES, MINED, MINSAP
2nd (E)	Case study of a schoolchild with special educational needs in the area of behavior and learning.	MES MINED MINSAP INDER
3rd (E)	Modeling a class for children with special educational needs associated or not with disabilities.	MES, MINED, MINSAP, INDER
4th (D)	Management of compensatory corrective activities for schoolchildren with SEN associated or not with disabilities.	MINED MES
5th (D)	Direction of the teaching-learning process in the context of Primary Education where there are students with a diagnosis of a disability.	MES, MINED

In all cases, the collegial planning of the integrative exercises that covered all academic years was carried out, after analyzing the objectives to be met and determining the actions that corresponded to each specialist in the development of the activity.

The scenarios were selected according to the peculiarities of the actions to be undertaken. In this way, academic, labor, research and extension activities were carried out in: Provincial Center of Medical Genetics, Provincial Center of Diagnosis and Orientation, Integral Rehabilitation Service «Hermanos Cruz », primary schools, special schools, popular council Hermanos Cruzand the Laboratory Speech Therapist, Psychomotor and Early Stimulation of the University of Pinar del Río.

The next step involved the necessary improvement of teachers to fulfill the task of assuming from the action research tasks that allow the innovation of the curriculum framework, the implementation of new methodologies and the improvement of the profile of educators and other agents involved in the process of training in the different specialties of Early Childhood Education.

In this sense, an internal improvement course was designed in the Department of Special Education of the University of Pinar del Río to update teachers in the most valuable contributions of neurosciences applied to teaching, education and neurodevelopment, which Serve as a theoretical support for the foundation and construction of appropriate experiences for professional practice from their respective spheres of action, in the process of training students of the Logopedia and Special Education careers.

The following were outlined as specific objectives:

1. To base the process of educational attention to children, adolescents and

young people with special educational needs associated or not with disability by incorporating the most current contributions of neurosciences applied to teaching, education and neurodevelopment.

2. Systematize actions that allow directing educational strategies aimed at preparing students for the Logopedia and Special Education careers for the application of the contributions of neurosciences to the care of students with special educational needs associated or not with disability.

The contents were grouped according to the following thematic distribution summarized in Table 2:

Table 2 - Thematic distribution of the Neurosciences and Education course.

Do not	TOPICS	DISTRIBUTION (H / C)		
		P	NP	T
I	Introduction to the study of Neurosciences.	6	18	24
II	The body-mind problem in explaining the neurophysiological processes of the human brain and its dynamics.	10	30	40
III	Cognitive neuroscience and education.	10	30	40
IV	Contributions of neurosciences to child development.	10	30	40
	Totals	**36**	**108**	**144**

* **P-** face-to-face **NP-** face-to- face **T-** total hours

The **topic I:** Introduction to the study of neuroscience, including aspects such as Neuroscience: What is Neuroscience? Basic concepts. Mega concepts raised by the Society for Neuroscience of the United States (2007). Approaches and applications. Interdisciplinarity

In **Theme II:** The body-mind problem in the explanation of the neurophysiological processes of the human brain and its dynamics, addresses elements related to the philosophical and mystical religious conceptions prevalent in the study and understanding of the human brain relationship, psychic processes and the conduct, from antiquity to the present. Locationist and antilocalizationist theories: most important representatives and their contributions. Theory of the functional units of Alexander Romanovich Luria. Location of superior nerve functions. The associative areas of the brain and its functions. Effects of lesions in the associative areas of the brain. Brain dominance Interhemispheric information transfer.

On the other hand, **Theme III:** Cognitive Neuroscience and education, deals with the relationship between neurosciences and education. Pillars of educational neuroscience. Executive functions: neural bases and neuropsychological evaluation. Styles and types of learning:

the brain quadrants model. The creative process in the light of Neuroscience. Thought development. Theories, programs and strategies of thought development. Cognition-Metacognition. Cognitive habilyties. Cognitive strategies from a theoretical perspective.

The program ends with **Theme IV:** Contributions of neurosciences to child development, where an analysis of genetic inheritance and the behavioral environment is made. Brain plasticity, sensitive periods in brain development and early stimulation and the importance of experiences. Health, nutrition and sleep. Neurodevelopment, the dimensions of development and the graduation of activities.

The Course of Overcoming teachers of the department entitled "Neurosciences and Education" had an enrollment of 14 teachers, of which 85.7% obtained an excellent grade (5 points).

The course was accompanied by a basic material, the result of the systematization of the authors on the subject at hand. The material was organized in five chapters:

I. An approach to Neurosciences. Basic concepts. Approaches and applications.

II. The body-mind problem in explaining the neurophysiological processes of the human brain and its dynamics.

III. Cognitive neuroscience and education.

IV. Contributions of neurosciences to child development.

V. Some considerations about the development of neurosciences in Cuba and their applications in the field of education.

Three doctoral theses are developed that incorporate elements of neuroscience in the study of educational care for people with disabilities.

The incorporation of the contributions of the neurosciences to the different subjects of the base, own and optional / elective curriculum enrich the interdisciplinary and intersectoral approach to the extent that fosters a better understanding of the relevance of performing integrative exercises as a superior form of evaluation and promotion of new theoretical and practical learning, the results of which are expressed in the increase in the quality of the exercises with 90% of students with 5-point assessments.

DISCUSSION

Disciplinary education sciences have long since incorporated many of the findings that cognitive sciences have established to deal with and investigate the phenomenon of learning and teaching in people, repeatedly finding that appreciations regarding the treatment of information and the mental processes of cognitive interpretation have direct application in properly educational disciplines as they refer. (Puebla & Paz Talma, 2011)

In the main scientific poles of the world, including the United Kingdom, the United States, Germany, Denmark and the Netherlands, studies have been carried out that link neurosciences with education that, in the opinion of Barrios Tao (2016), constitute a fruitful scenario to socialize and confront the results. These are: "Mind, Brain and Education" program at Harvard University, the Center for Neuroscience in Education at the Faculty of Education at the University of Cambridge (United Kingdom), the Danish Learning Laboratory

(LAD), the Center for the Transfer of Neuroscience and Learning in Ulm (Germany), the Center for Educational and Innovative Research (CERI) of the OECD are a sample of the potential for Neuroscientific research.

In Cuba, interest in neurosciences began very early. His background is in 1969 as one of the first groups in the world to use computing for the analysis of brain electrical activity and was officially established in 1990. As the Cuban Neurosciences Center (CNEURO) is the largest institution of the BioCubaFarma Group dedicated to the development of neurotechnology and basic research based on the main problems related to the brain and mind and its implications in health and education. Among its main lines of research related to education are:

- The introduction of methods for the early detection of hearing losses in children that includes cochlear implant technology in deaf and deaf-blind children.
- The introduction of methods for diagnosing and conducting studies on learning and behavior disorders in schoolchildren.
- Other research related to the basic mechanisms underlying mental processes of selective attention and emotions, autism and other neurodevelopmental disorders.

However, the process of generalization of research carried out in the field of education and its dissemination in high impact journals are insufficient; which limits the possibility of teachers' access to neuroscientific knowledge that has been generated and possible application in their daily educational activity.

The main studies carried out on the relationship between Neurosciences and Education are limited to cognitive approaches, lacking the holistic depth of the Historical-Cultural School, in which the biological role of matter is not rejected but important attention is paid to role that in the cerebral functioning and even in its own anatomy has had the social factor and the environmental influence in the process of formation of each historically conditioned human being. »The current challenge is to base and understand how Neuropedagogy extends beyond the usual studies of learning and is able to explore the most varied topics of educational relevance» (Calzadila Pérez, 2017 , p.2).

Although the Professional Model for Special Education and Education Logopedia careers does not explicitly contemplate the incorporation of neuroscientific content in training, its fulfillment demonstrates the need for its integration that becomes from the work object of each specialty.

For Rico Calvano & Puentes Rozo (2016), the contribution of neurosciences is essential to achieve excellence in education. We agree with Cuevas Zárate (2017) that the path that must be followed to reach this goal is none other than the commitment to the progress of education, interdisciplinary work that makes education compatible with the functioning of the brain and research in the classroom as a normal practice of teaching activity.

The integration of the knowledge of neurosciences in the initial and permanent training of teachers of Special Education and Speech Therapy, responds to the demands of scientific and social development that have been operating at the international and national level and the understanding of their relevance for the achievement of a better professional performance for the attention of students with disabilities.

In the analysis of the impact that these advances have had on the initial training of educators, the research of Calzadilla Pérez & Álvarez Clemente (2017) on the integration of Neurosciences in the curricular design of university careers for teachers of Education stands out Childish. The research represents an experience since the implementation of Study Plan D, contextualized from the conception of the own and optional/ elective curriculum of the University of Holguín, valuable for the in-depth analysis not only of the own and optional curricula / but also in the Implementation of the base curriculum of the Preschool, Primary, Special and Speech Therapy specialties of the Bachelor of Education in accordance with the requirements of Study Plan E that is currently applied in the different careers of Pre-school Education.

In this sense, the results of the actions carried out in the Special Education department have allowed enriching the theoretical preparation of the professors of the Special Education and Speech Therapy careers in the most current contributions of neurosciences applied to teaching, education and neurodevelopment. Students with special educational needs associated or not with disability.

At the level of initial training the design of an interdisciplinary and intersectoral conception of teacher training (Sánchez, Puentes and Sotolongo, 2018) in which different subjects of the base, own and optional / elective curriculum are integrated for the realization of Integrative exercises that involve specialists from different branches of scientific knowledge sectors such as MINSAP and INDER have contributed to the preparation of students of the Logopedia and Special Education careers with a more comprehensive view of educational problems.

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