THE NEUROEDUCATION PERSPECTIVE IN THE EVALUATION OF THE TEACHER'S METHODOLOGICAL-DIDACTIC SKILLS

LA PROSPETTIVA NEURODIDATTICA NELLA VALUTAZIONE DELLE COMPETENZE METODOLOGICO-DIDATTICHE DELL'INSEGNANTE

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ABSTRACT

The boost provided by Brain-based studies entails reflection and self-reflection on methodological-didactic practices and choices.
The contribution frames a research project started in 2021, at the University of Palermo, aimed at defining strategies and tools for the evaluation of neurodidactic activities for the development of the teacher's methodological-didactic competences with respect to five areas of neurodidactic interest: transversal, cognitive, socio-emotional, expressive, and motor.

La spinta fornita dagli studi *Brain-based* comporta la riflessione e l'auto-riflessione sulle prassi e sulle scelte metodologico-didattiche.
Il contributo inquadra una ricerca avviata nel 2021, presso l'Università di Palermo, finalizzata alla definizione di strategie e strumenti per la valutazione di attività neurodidattiche per lo sviluppo delle competenze metodologico-didattiche dell'insegnante rispetto a cinque aree di interesse neurodidattico: trasversale, cognitiva, socio-emotiva, espressiva e motoria.

KEYWORDS
Neuroeducation; teaching skills; teacher training.
Neuroeducazione; competenze; insegnanti; formazione.

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Introduction[1]

The boost provided by brain-based studies is a source of inspiration and change for teaching and for teacher training (Gola, 2022). In fact, knowing that the synaptic changes in the brain depend on the teaching and the context should generate a different attitude in teachers from an emotional and cognitive point of view (Mora, 2022). Becoming aware that brain plasticity is a genetically programmed property of the brain that develops starting from the person's life experience and from the context and that persists throughout the life cycle, for example, means planning interventions by providing an environment that acts as a support (holding environment), favours cooperative activities (social brain), creates the possibility of having direct experience of knowledge, pay attention to the windows of opportunity and don't forget the common thread between emotion and cognition.

It seems amazing how much a child can learn from the immediate context and how imprinting mechanisms (Lorenz, Evans, 2005) play a fundamental role in the development of synaptic connections. In fact, it is estimated that a child born after only 42 minutes is already able to imitate some gestures such as showing the tongue or opening the mouth (Mora, 2022). In other words, it is known that immediately after birth, one of the first mechanisms that the brain implements to adapt to the environment is learning. The genetic codes are intertwined with motor, sensory and emotional acts experienced in the context of life (Gola, Compagno & Albanese, 2023).

In accordance with all this, as Caine & Caine (1997) reaffirm, it is possible to draw up a reference framework for rethinking teaching, managing the class in compliance with the neural specificities, intellectual typologies, and cognitive styles of the students.

All this implies, first of all, that teachers are trained so that the gap between knowledge of the brain, education and teaching is bridged by innovative programs (Mora, 2022, 29); and furthermore, that the reflection and self-reflection on the methodological-didactic practices and choices introduced in the classroom are based on careful analyses and systematic and continuous checks with respect to the educational procedures, methods and principles aimed at promoting the educational success of each learner (Albanese, Compagno, 2022).

[1] The contribution is a joint work of the two authors, however, the introduction, par. 1, 1.1 and 2 are by Giuseppa Compagno; while par. 3, 3.1, 3.2, 4 are by Martina Albanese.

1. Brain-based Studies

The 90s of the last centuries saw the birth and development of Brain-based studies. In doing so, the thrust provided by these studies is so important that Bruer (1999), highlights the joint effort of government agencies, foundations and advocacy groups made in that period; although, he does not forget the temporal dimension that imposes «a bridge too far» between education and the brain (Bruer, 1997).

Caine and Caine (1990), thanks to a publication that takes on the appearance of a real manifesto, are the emblem of this fervour. The two scholars invite educators to consider the potential of the mind and their effects on the preparation of the learning environment. In doing so, they provide real principles that have the intention of revolutionizing traditional schemes, programs, and methodologies, combining neuroscientific discoveries and effects in the educational field[2].

The first reflections developed on Brain Based Studies are based on an awareness that if until then, the scientific evidence came «from our scientific understanding of the mind[3]», now, however, with studies on the brain we begin to focus on our «scientific understanding of the brain» (Bruer, 1999). Therefore, Neurosciences represent a new way of interpreting and guiding pedagogical action, considering that: «Psychologists were interested in our mental functions and capacities - how we learn, remember, and think. Neuroscientists were interested in how the brain develops and functions» (Ibidem).

This step has been favoured and strengthened thanks also to the development of new techniques for studying the brain. In fact, if until the Seventies it was not possible to locate the brain structures in vivo, and the functional anatomy of the brain was only possible *post-mortem*, from the seventies onwards a series of studies have been developed which have led to a revolution in the field of in vivo

[2] The principles enucleated are twelve, some of which are mentioned: 1 "Principle one: The Brain is a Parallel Processor"; 2. "Principle Two: Learning Engages the Entire Physiology"; 3. "Principle Seven: Learning Involves Both Focused Attention and Peripheral Perception"; 4. "Principle Ten: The Brain Understands and Remembers Best When Facts and Skills Are Embedded in Natural Spatial Memory".

[3] The reference made by Bruer (1999) is directed, for example, towards the studies of cognitive and developmental psychology, of the behavioural, non-biological sciences.

techniques of in vivo cerebral localization thanks to bio-imaging techniques (Làdavas, 2009).

Computed tomography (CT[4]) and nuclear magnetic resonance (NMR or MRI[5]) have proved to be illuminating tools for constructing structural images of our brain. To this it is necessary to add the techniques that instead have provided, and still provide, information on brain functionality, such as: the technique for measuring cerebral blood flow (CBF), single photon emission computed tomography (SPECT), positron emission tomography (PET[6]) and functional magnetic resonance imaging (fMRI). Finally, it is also interesting to mention some techniques that have allowed and allow the study of the electrical activity of the brain and the magnetic fields generated: EEG and MEG and transcranial magnetic stimulation (TMS).

On the national scene, the new neuroscientific evidence has been slow to establish itself, both on a theoretical level and on a practical-operational level. Therefore, the international terrain has proved to be more fertile, so much so that Goswami (2006), at the beginning of the new millennium, notes how the school is «hunger» for information with respect to the functioning of the brain. The Director of the Centre for Neuroscience in Education at Cambridge University highlights the presence of numerous courses and training programs already in circulation that arouse great interest among teachers and educators, but which risk, however, leading to the minefield of "neuromyths" if not properly updated or applied (Goswami, 2006). The scholar, she identifies as "neuro-myths", therefore as distorted knowledge about the brain: the clear distinction between "right brain" and "left brain" which determines complementary and alternative characteristics and according to which students learn; and again the definition of a learning style identifiable exclusively as "A" (auditory - auditory), "V" (visual - visual) or "K" (kinesthetic - kinesthetic)[7] by the teachers (Goswami, 2006). In identifying the neuro-myths and in her study aimed at increasing knowledge about the brain,

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[4] The CT, born in the 70s, exploits the different levels of absorption of x-rays by the tissues to highlight the various brain structures (B.R.A.I.N., 2010).

[5] MRI, born in the 1980s, uses magnetic fields and harmless radio waves to acquire data and provides even more accurate images of the brain than CT (B.R.A.I.N., 2010).

[6] PET, specifically, records the variations in blood flow (B.R.A.I.N., 2010).

[7] Around the 1970s, within PNL (Neuro-Linguistic Programming) studies, we began to talk about the VAK representational system to indicate the ways and channels through which thoughts are represented. According to this approach, the person tends to use one of the three identified channels (visual, auditory, kinaesthetic) predominantly, for this reason we speak of a primary representational system. Furthermore, specific characteristics of people are associated with each of these modalities (Bandler & Grinder, 1975).

Goswami (2006) focuses on the empowerment of the communicative skills of neuroscientists, in her opinion, too distant from school language.

It is therefore clear that the twenty-first century has seen the flowering of a new educational paradigm that Jensen (2008) defines as follows: «Brain-based education is the engagement of strategies based on principles derived from an understanding of the brain». This definition clarifies an important aspect: it is not neuroscientists who reflect on pedagogical strategies, and it is not neuro-myths who are supposed to guide educational action, but solid scientific knowledge based on principles that can be deduced from studies on the functioning of the brain. However, Jensen (2006) notes that the "first generation" of Brain-based Studies has been useful in providing education professionals with a new lexicon to acquire new knowledge. In other words, the path undertaken by neuro-education is not free from critical issues and limits, in addition to the one just mentioned of the diffusion of neuro-myths, Mora (2022), identifies others: the difficulty of language in transferring neuroscientific knowledge from neuroscientists to education professionals and the selection of neuroscientific data which, once acquired, must be made of real and effective application.

1.1. A multi-perspective approach

There are several studies that reflect on the functioning of the brain just as there are several disciplines involved in this process. «There is no separation of brain, mind, body, feelings, social contacts, or their respective environments» (Jensen, 2006). Damasio, director of the Department of Neurology at the University of Iowa Medical Centre, during an interview stated that relating brain systems, cognition and behaviour is an operation that calls into question the overall consideration of the nervous system and not just a part of it (Liston, 2001). Therefore, according to the scholar, to approach this complex relationship between the brain, cognitive and behavioural systems it is necessary to resort to a complete set of theories and facts relating to all levels of organization of the nervous system, from molecules, cells and circuits to large-scale systems and physical and social environments. In other words, learning and teaching processes should be considered interacting (Battro, 2010).

Guillén (2021), in this regard, speaks of an "integrative approach" and, representing it graphically, places neuroeducation at the centre of the mix between neuroscience, pedagogy and psychology.

According to Salmaso (2017) all this international fervour does not find fertile ground in Italy since there is no diffusion and/or application of cognitive neurosciences either in studies (intended as teacher training) or in educational practice. According to the scholar, this has a double consequence: it blocks the didactic improvement and the preparation of scientists, who do not benefit from it in terms of questions, problems, and requests to reflect on (Salmaso, 2017).

However, it is inaccurate to state that, at an academic level, there is no reactivity to neurobiological scientific evidence (Minerva, 2018; Rivoltella, 2018; Cambi, 2011; Oliverio, 2018; Santoianni, 2018, Gola, 2022).

Rivoltella (2018) states, for example, that there are at least two reasons underlying the opening of pedagogy and teaching to Neurosciences:

1. «the need, in the study of man in a situation, to acquire a complex point of view, more capable of rendering the entire dimension of the problems». The penetration of technology, cultural contamination, health promotion, are just some of the challenges on which an in-depth study is urgently needed, starting from a necessarily interdisciplinary approach.

2. «the contribution that Neurosciences can guarantee to Didactics in relation to the validity of its affirmations». Scientific evidence on attention spans, the influence of learning experience, the contribution of educational technologies is just some of the issues raised that require the contribution of Evidence Based Education.

Furthermore, Rivoltella (2012) clarifies some denominations with respect to the mingling of Neuroscience and Education, allowing a specification between expressions that can be confused: if we speak of Neuroeducation or Neuropedagogy we must understand a new science aimed at rethinking objects and methods of educational research in the light of the contributions of Neuroscience; if we talk about Mind, Brain and Education, we refer to a transdisciplinary space of investigation whose components maintain their specificity; finally, with the denomination Educational Neuroscience or Brain-based Education we refer to that line of study that questions how research on the brain can be useful for solving learning/teaching problems.

Despite the proliferation of Brain-based studies, however, some scepticism and caution do not cease in stating that the functioning of the brain applied to educational sciences is the keystone for solving problems related to the development of effective learning; others point out how premature it is to talk about educational biology; despite this, there is no doubt in stating that «an important way in which the sciences of the mind can enrich the educational processes is to inform teachers to reflect critically, develop an understanding of their own practice, also through the information that comes from different studies» (Gola, 2022). Reflecting that education causes changes in the brain means working so that new techniques and new approaches can be designed to improve the learning process and development of children (Mora, 2022). On the other hand, the results of neuroscientific evidence make it possible to examine how neural architectures infer behaviours and actions that are also directly related to teaching practices (Gola, 2021).

2. Tools for evaluating neurodidactic skills

In the United States as early as the 1970s, authors such as McClelland (1973), Gardner (1992), Glaser and Resnick (1989) indicated the need to experiment with evaluation methods and tools capable of overcoming the limitations of evaluation based on tests. Thus, the evaluation arises as a moment to «read and interpret the processes that generate learning, how the knowledge acquired is transformed into effective behaviours, into personal skills that can be used in multiple contexts» (Capperucci, 2018).

Evaluation, understood in this way, aims to train skills, considers knowledge as resources to be mobilized, works for problem situations, focuses attention on processes, differentiates paths in relation to training needs (Castoldi, 2016).

A first method useful for understanding the uniqueness and individual or group dynamics characterizing the learning/teaching process is systematic observation.

Systematic observation is a method capable of guaranteeing a high degree of structuring in the collection of information since it makes use of grids and other systems for data collection (Benvenuto, 2018). In this sense, observation takes the form of an oriented and aware gaze (Rizzo, Salmaso, 2009). The functions of observation identified by Postic and De Ketele (1988) reveal an essential

importance for the educational context. In fact, one observes to describe (descriptive function), to act based on observed situations (formative function); one observes in order to evaluate (evaluative function); it is observed to formulate hypotheses to be verified (heuristic function); observed to test hypotheses and measure variables (verification function).

It is necessary to develop a real professional competence to be able to conduct a systematic observation, otherwise the risk is that it ends up being random and an end. Observing implies a process of selecting and coding information, carried out in accordance with pre-established criteria and according to careful data collection (Benvenuto, 2018). In other words, the observation must possess the characteristics of systematicity, repeatability, communicability, transferability (Cappuccio, Cravana, 2014). Moreover, if neuroscience affirms the possibility of infinite formations and transformations of brain synaptic circuits, it is necessary that observation brings to light its possibilities, resources, peculiarities, and potential.

Calonghi (1983) proposes the technique of spoken reflection as a means of promoting the understanding of cognitive processes, the diagnosis of difficulties and ways of solving problems (Zanniello, 2016). Indeed, as argued by Pellerey (2007), verbalized reflection is a technique capable of verifying reasoning during its development. Spoken reflection is not only referable to the student, but the teacher can also use it to verbalize the strategies that guide his choices, to underline the hypotheses he puts forward, the recall of previous knowledge and in doing so it is possible to activate a modelling process in the situation (Cardarello, 2010).

Another tool that can evaluate the complexity of a competence is the evaluation rubric. This tool allows you to name the skills to be assessed, conceptualize them, identifying their component dimensions and the expected levels of mastery (Castoldi, 2016). Furthermore, the evaluation rubrics are also an excellent test bench for the design because, by identifying the expected and desirable results, it is also possible to direct the design activity, even in progress. Also, the promotion of metacognition and the development of critical thinking are hallmarks of self-assessment through the rubric (Guillén, 2021).

Another tool in line with the docimological principles of the rubric is the portfolio: a systematic and thought-out collection of works in which the effort, progress, results obtained, and processes are highlighted. Also, in this case the promotion of self-reflection is primary, moreover, it is an excellent tool for valuing individual differences (Guillén, 2021).

This type of mobilization involves the activation of skills experienced in situations, highlights process and makes learning challenging. In this way, as Resnick (1995) points out, the connection between school and the real world is aimed at even during the evaluation moment.

Summarizing what has been said, it is possible to state that the role of systemic observation has been mentioned in order to understand and grasp the specificity of the individual and the dynamics of the working group; to spoken reflection as a tool to encourage verbalisation, narration, and to analyse logical-creative thinking; to the evaluation rubric as a tool for analysing competence as a set of knowledge, practical life and specific and multi-coded abilities of each one.

This brief examination of tools and techniques, albeit succinctly outlined, invites us to reflect on the fact that Docimology today finds itself having to deal with persistent and new critical issues that educational contexts cannot help but consider.

Neuro-educational and neuro-docimological research has highlighted the importance of creating a bridge between information and educational contents and their connection with the experiential praxis of life contexts. Thus, methodologies and techniques are analysed that are consistent with this desirable theoretical-experiential continuity, and at the same time we reflect on the challenge posed: the evaluation of an acquired competence rather than the measurement of a performance in the here and now, with the focus on processes rather than products.

3. Research

The research we are presenting, aimed at identifying and implementing the methodological-neurodidactic skills of teachers, started in the A.Y. 2020/2021 and envisaged 3 macro-actions: choice of the Brain Based Studies framework and exploratory investigation (2020/2021), construction and validation of the teacher's Neuro-Competencies Framework (QNC) (2021/2022), quasi-experiment single group for skills enhancement (2023/2024).

3.1 The exploratory investigation

The first macro-action of the research started in March 2020 and was aimed at an in-depth study of the birth and development of Brain Based studies, at focusing on specific neuro-didactic areas of interest and finally at identifying some neuro-orientation teaching. Following the construction of the theoretical framework of reference for the research, the exploratory investigation was launched.

The survey involved the construction and validation of a neuro-assessment tool for teachers: the Self-assessment questionnaire of neuro-didactic and educational practices for teachers.

The construction of the tool began in January 2021 and lasted until April 2021, in line with the formulation of the neuro-didactic principles and of the studies carried out which are condensed and deepened in the text «The evaluation of the neuro-didactic activities of teachers» (Albanese & Compagno, 2022).

The self-evaluation tool of the educational-teaching practices of teachers (cf. Albanese & Compagno, 2022) was validated in three phases:

- try-out (or pilot test), the first version of the questionnaire was administered to 69 teachers in training about neuro-education.

- First administration aimed at 439 future teachers, second year students of the study course in Primary Education Sciences of the University of Palermo of the A.Y. 2020/2021.

- Second administration aimed at 1421 teachers in the Sicily region.

The validation process is shown in the table below:

VALIDATION TIMES AND METHODS

	Time	**Sample**	**Process**	**Results**
Try-out	19-23 April 2021: administration e 26 Aprile- 16 May 2021: adaptation	69 teachers. Non-probability sample with reasoned choice (*Purposive or judgment sampling*[8])	Face validity: assessment of the tool by the person submitting to the administration	First adaptation of the instrument

[8] This sample choice is based on specific characteristics (Benvenuto, 2018), in this case the characteristic in question concerns the ongoing training of this group of teachers on neuro-educational issues.

FIRST ADMINISTRATION	16-30 May 2021: administration	439 students in training. Accidental non-probability sample (*Convenience sampling*[9])	Construct validity: assessment of the correspondence between the collection of information and the theoretical framework of reference	Second instrument adaptation
Second ADMINISTRATION	30 May – 30 July 2021	1421 teachers. Non-probability sample by size (*Dimensional sampling*[10])	Content validity: control of the possible range of behaviors that define the reference concept or construct	Final tool version

Table 1 (timing and methods for validating questionnaires)

The purpose of the validation of the questionnaire was to obtain a tool capable of measuring the level of knowledge and use of neuro-educational and neuro-didactic principles in the teaching practice of teachers, investigating five macro-areas:

1. transversal area (item 1-29) (further divided into: general organization of the brain, general methodological-didactic principles, soft skills, learning environment/setting).

2. Socio-emotional-affective area (items 30-34).

3. Cognitive area (items 35-43).

4. Linguistic-communicative area (item 44-47).

5. Praxis-motor area (item 48-55).

The reference sample, through the administration of the built tool, was asked to express the frequency according to which the proposed neuro-didactic statements occur, according to a 5-point Likert scale (from 1 "Never" to 5 "Always")[11].

[9]This type of sampling was chosen on a voluntary basis as it is easily accessible.

[10] This type of sampling allows you to select a variant of the sample for quotas (Benvenuto, 2018); in this case the quotas identified are the different grades and levels of schooling (infancy, primary, lower secondary and lower secondary).

[11] For more information on the results of the survey, see Albanese, 2022.

Overall, the validation process led to an adaptation of the tool which was based on some fundamental changes summarized in the following table:

First version	Second version
70 items	55 items
Technical-specialist language	Simple and understandable language
Cognitive articulated area	Cognitive simplified area
Mirror neurons item	Mirror neuron item deletion
Brain plasticity	Brain plasticity explanation

Table 2 (Post-validation questionnaire changes)

The assessment thus understood aims to create new balances in the docimological and didactic fields that are in harmony with the new developments dictated by neuroscience. In fact, neuroeducation needs to reflect precisely on the possibility of making use of data from neuroscience to experiment with new pathways capable of exploiting the brain processes triggered by emotion, curiosity, and attention (Mora, 2022). On the contrary, boredom, stress, a negative climate are all elements that do not make the teaching-learning process optimal (Guillén, 2021). So triggering moments of evaluation and self-evaluation of the processes in progress is essential to understand the dynamics in their succession, but also to self-reflect on one's own brain mechanisms that guide the action. A relevant fact in this regard, which invites us to reflect, comes from research in which some scholars have found that teacher burnout causes a negative emotional contagion within the class dictated by the increase in cortisol in students (Oberle & Schonert -Reichl, 2016).

In this perspective, docimology must consider the complex nature of learning which involves various factors: environmental, personal, relational, biological, psychodynamic, neuroeducation.

3.2 The construction of the Neuro-Competencies Framework (NCF)

After the drafting of the first results of the survey which took place during the first months of 2022, starting from September 2022 the process was started, still ongoing, of identifying the fundamental key skills that the teacher must possess from a neurodidactic perspective (second macro-action). To this end, a framework of competencies has been built aimed at the first cycle school and which condenses all the competencies identified in relation to the areas studied (transversal area -

further divided into: general organization of the brain, general methodological-didactic principles, soft skills, Learning environment/setting - socio-emotional-affective area, cognitive area, linguistic-communicative area, praxis-motor area).

The construction of the teacher's Framework of Neuro-Competences (NCF) was accompanied by a docimological reflection applied to the study of the functioning of the brain which allowed us to direct the process. If it is true that docimology, in general, aims to analyse, measure, and detect complex traits involved in the learning-teaching process and in reference to this, today there is more and more talk of certification of skills; we wondered which system of expertise was better to focus attention on.

The multi-perspective dimension called into question by the concept of competence "requires broadening the gaze to the set of components that contribute to forming competence: not only what the student knows, but also what he can do with what he knows" (Castoldi, 2016). Rychen & Salganik (2007) speak of competence as a set of knowing, knowing how to be and knowing how to do; this is expressed in four key words that revolve around the construct of competence: realization (of a recognizable and identifiable product), integration (of the resources available), context (specific context of action) and responsibility (active role of the subject). Le Boterf (1990) defines competence as “A recognized and proven set of representations, knowledge, skills and behaviours mobilized and pertinently combined in a given context”. According to the scholar, representations, knowledge, skills, and behaviours can be identified with the term "resources", which is why competence translates into the possibility of knowing how to combine different resources, to effectively manage/deal with given situations, within a specific context. In this sense, therefore, competence is a quality of the person. Pellerey (2004) calls into question the ability to cope with one or more tasks through the deployment of internal resources (related to the cognitive, socio-emotional, and metacognitive order) and external (including human - caregiver - and material resources - tools, means and environments). We supported the three levels of analysis of competence identified by Castoldi (2016) to the French-speaking system of the competent process:

1. the first related to cognitive resources understood as a set of knowledge and skills.

2. The second aimed at investigating the cognitive and operational processes that the person implements in solving a task.

3. The third aimed at identifying the dispositions to act that determine the behaviour implemented in the management of a task.

The Framework of Neuro-Competencies (NCF) that we have identified is outlined in the table below:

FIRST CYCLE SCHOOL	
Neurodidactics Area	**Teacher's competences**
A.1. Transversal: general functioning of the brain	- Planning of individualized and personalized educational interventions. - Integration and activation of innovative methodological solutions for the promotion of personal excellence. - Planning of activities oriented to do. - Creating meaningful experiences.
B.1. Transversal: general methodological-didactic strategies	- Integration of learning categorization tools such as mind maps and mnemonic techniques. - Assumption of clear and upright behaviour. - Planning of creative activities. - Planning of short and concrete learning experiences. - Planning of participatory activities aimed at implementing the active role of the person. - Analysis and identification of the student's anxiety states that affect learning. - Preparation of error correction techniques.
C.1. Transversal: Development of soft skills	- Planning of metacognitive and self-reflection activities. - Construction of observation and documentation tools. - Design and implementation of activities cantered on reflection and problem-solving strategies. - Enhancement of the various personal expressive and communicative heritages.
D.1. Transversal: Learning/setting environment	- Design of the learning environment. - Identification of the materials to be prepared in the environment and of the best learning conditions. - Differentiation of materials and teaching aids.
2. Socio-Emotional-Affective Area	- Design and implementation of activities cantered on the promotion of emotional intelligence. - Planning and implementation of activities cantered on the educational relationship, on the shared construction of the rules to be applied in the classroom and on the role of classmates as scaffolding for learning. - Design and implementation of activities cantered on cooperative learning and peer tutoring. - Enhancement of prosocial behaviours.
3. Cognitive area	- Planning of activities that involve both the activation of focused attention (directed at a specific object) and peripheral perception (senses). - Construction of observation tools and documentation of students' attention levels and times. - Scheduling activities of retrieval of acquired information and repetition of events that consolidate memories.

4. Linguistic-Comunicative area	- Mastery and use of symbolic-verbal language (listening, speaking, reading, writing). - Mastery and use of symbolic-non-verbal language (iconic-visual, mimic-gestural, sound). - Mastery and use of mixed languages (traffic signs, advertising signs, LIS, Braille). - Simulation of interventions for the management of paralinguistic elements.
5. Praxis-Motor Area	- Integration and activation of innovative educational paths for the experimentation of space and its representation. - Planning and implementation of activities cantered on the body dimension of the child/young adult. - Planning of motor activities diversified by age group. - Design of recreational-motor activities that favour the exploration of the environment.

Table 3 (Neuro-Competencies Framework - NCF)

We have launched the first step of the validation process of the skills outlined in March 2023.

With respect to the path developed so far, it is possible to state that it is necessary to base oneself on «a school idea, on the basis of which to focus the comparison between observed and desired situations, a model to be subjected to verification and which, at the same time, makes the measures which it gives rise» (Lucisano, Corsini, 2015). For this reason, no tool is to be considered definitive if it is intended to provide an improving and incisive neuro-didactic model of teachers' practices.

4. Future developments

Although there are still several critical issues with respect to an evaluation action aimed at ascertaining skills, there are some expedients, tools, and methodologies that the teacher can make use of so that the person can be valued in a reasoned and aware way.

The teacher's Neuro-Competencies Framework (NCF) needs further validation. The intention is to start a new phase of the research which projects its progress towards the third macro-action. This action will see the involvement of the school context and it is hoped that it will initially lead to the validation of the competence framework, but also to test the acquisition of the same competences by teachers.

It is not excluded that, by experimenting in educational practice with activities and tools in line with recent discoveries on the brain, it is possible to arrive at a reformulation of the skills exposed.

The future developments of the research, therefore, foresee a temporal scan of the work which is based on:

1- a pilot test to be developed in May 2023, in which a small group of future teachers, suitably trained in neuroeducation, carries out a SWOT analysis to identify the strengths, weaknesses, opportunities and threats of the NCF (to complete the second research macro-action).

2- A trial on the acquisition of skills starting from September 2023, during the 2023/2024 school year, based on the training and updating of a group of about 80 teachers on the recent discoveries of the brain and on the implementation of activities neuro-didactics that will allow the measurement of the acquisition or otherwise of the skills acquired.

The experimentation, currently in the planning stage, provides for a quasi-experimental single-group design with simple interrupted time series. The choice of operating the time series implies the possibility of carrying out various measurements whose inspection can provide information on the effectiveness of the experimental treatment. The data collection tools to be used are in line with what is stated in par. 2, therefore, in addition to the validated teacher's self-assessment questionnaire, it is intended to use systematic observation as a tool for collecting valid and reliable data, spoken reflection as a means to favour verbalisation, narration, and to analyse logical thinking - creative underlying the neuro-didactic activities, the evaluation rubric as a tool for analysing the acquired competence.

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