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## **NORMATIVE PRINCIPLES OF APPLICATION AND INTERPRETATION OF THE PRESCHOOL SCREENING SYSTEM**

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**Abstract:** The presence of adverse situations that may compromise the proper development of the child indicates the importance of having procedures that allow early identification of problems in the main cognitive areas responsible for learning. A development screening, still in the preschool phase, can offer kindergarten and early elementary school teachers the indication of work plans and pedagogical interventions that enhance positive responses, enabling, when applicable, to overcome deficit results . Objectives: To systematize the Preschool Screening System for early identification of signs of developmental delay, comparing results between Brazilian and North American children. Method: Observational, cross-sectional and descriptive study carried out in Early Childhood Education and Elementary School units in Curitiba - Paraná - Brazil. Investigated areas: Consciousness and Body Control, Visuoperceptive-motor and Language. Sampling: 411 children aged 4 to 6 years old. The scores were recorded in an electronic spreadsheet and in graphs of descriptive measures. Results: Comparison of the data obtained verified in which categories the results of Brazilian children were below, equivalent or above those achieved by North American children. Both in the Total Score of the Pre-School Screening System, and in each of its Subtests, there was a progressive increase in the results achieved by Brazilian children, as the age group grew. Conclusion: A practical, effective instrument, easy to understand and quickly applied to assess cognitive areas responsible for learning, but which requires adaptations and norms according to the regional reality where it will be applied.

**Keywords:** Child development. Screening. Pedagogical Intervention. Learning.

## INTRODUCTION

The presence of children who face obstacles

in their learning process has been a constant in Brazilian schools. This reality encourages Education to find ways to overcome a major challenge, which is to identify children with signs of delay in neuropsychomotor development (NPMD), which could result in future learning problems. Therefore, it is fundamental to research about learning and how the brain acts in the learning process, which requires, from Education, the search for understanding in the light of Neuroscience. Relvas (2014) addresses that "(...) Education, Neuroscience and learning are closely linked to the development of the brain, which is shaped according to the stimuli of the environment.

Neuroscience emerges, as a concept, when scholars and researchers from different areas of knowledge understand that it is necessary to study the brain from different approaches and from multiple points of view. The result is an interdisciplinary view, which brings to light a new perspective for the scientific investigation of the nervous system. The studies pervade the molecules that make up neurons, the different organs of the nervous system and their specific functions, a process that determines human behavior.

To unveil brain functioning through neuroscience revolutionizes the educational context, as it significantly advances the understanding of how learning takes place, which neural networks are involved in this process and how information is stored in memory, where it is accessed when required. According to Relvas (2014), during the learning process, the brain undergoes physiological and structural changes resulting from experience and environmental stimuli, when it stores the information received in different areas and consolidates long and short-term memories to be retrieved at the time. of new learning.

Bruer (1997) already pointed to the investigation that science undertook about the brain and its neuronal connections, studies that continue to be present today. Important and significant arguments explain cognition and consciousness, originated by brain activity (HOUZEL-H.S. apud LENT, 2008). This knowledge can grant the school the possibility of re-signifying its pedagogical practice and making use of new teaching strategies that help students to acquire new knowledge, as well as to overcome gaps or obstacles present in their learning process.

According to Almeida (2015),

Today it is no longer possible to dedicate oneself only to Pedagogy to solve problems in the classroom, especially for children. Today, the brain, especially of children of kindergarten age, has received much contribution from Neuroscience in terms of clarifications, aids and learning understandings that were not possible 50 years ago, and that is why we must rethink our actions from this new force of science or from this other information and field of neuroscientific knowledge that is presented before us.

To understand how learning takes place thus becomes a key point for understanding not learning and the possible interurrences that may arise in early childhood and at the beginning of the literacy process. Adverse situations, characterized by the presence of difficulties that register negative results, superior to those naturally found in most children of the same age group, can generate insufficient pedagogical use and negative self-esteem, with a strong impact on the life of the child and his family, causing losses in the areas of personal development, acceptance and social participation. For Molter (et al) 2011, p.13, "Learning represents a complex mixture of diverse elements: pedagogical, emotional, cultural and biological. When a child presents problems to develop his learning, all these

facets need to be analyzed, in order to better lead this child".

The *Committee on Children with Disability* recommends screening the child development period, which allows identifying and informing about the child's development, as well as indicating those who need a more complete evaluation to conclude a conclusive diagnosis and which leads, in both cases, to the indication of interdisciplinary care, when necessary (American Academy of Pediatrics, 2001). Compromising the proper development of sensory-motor, socio-emotional and cognitive skills that occur in early childhood and which are essential for good performance in subsequent stages, indicates the importance of having screening instruments that allow identifying, as early as possible, problems in the main cognitive areas responsible for learning.

According to Moreira; Magellan; Siqueira; Alves (2019),

Considering that less than a third of children with developmental disorders are diagnosed before school age and that less than 30% of developmental disorders are detected by clinical impression, it becomes necessary to use reliable scales that allow intervention at the right time.

Therefore, the screening of child development has some instruments that can help identify possible obstacles in development and learning, while indicating the appropriate intervention and stimulation procedures in each case. It allows Health and Education professionals to indicate the best time for an efficient intervention to reduce negative effects in relation to the expected development (HALPERN et al., 2002). However, most child development screening instruments in Brazil are available only to health professionals. This fact supports the importance of inserting instruments that can track risk factors for learning, in this period of childhood, to be used also by education professionals.

The study presented here was intended to establish the normative principles of application and interpretation of the Preschool Screening System (PSS) – Assessment and Application for Preschool Ages, prepared and developed by Hainsworth and Hainsworth (2009) to verify the development for children aged 2 years and 6 months to 6 years and 7 months. It is an instrument intended for the early identification of signs of delay in the development of children in Early Childhood Education, which allows the evaluation of the fields of Consciousness and Body Control, Visual-perceptive-motor and Language, to be used by both Education and Health professionals.

The PSS provides the equivalent age of the child's development in relation to chronological age, through quantitative results referring to their ability to learn. It is an instrument that aims to identify possible risk factors in brain functions related to cognition and learning, in addition to recognizing possible disorders in the child development process, so that interventions can be provided, preferably before the child enters the age of elementary school or at its beginning. This way, it is possible to avoid any subsequent failures.

Therefore, it is assumed that the existence of a preschool screening instrument, to be used by Education, is of fundamental importance for the identification of possible obstacles to learning, as well as for the proposition of intervention measures. that come to solve or minimize possible gaps found. Therefore, this article presents the results of an investigation carried out with an early childhood population in the city of Curitiba, Paraná, Brazil, using the PSS.

## **METHOD**

The research, submitted for approval by the Human Research Ethics Committee of

the Hospital de Clínicas of the Universidade Federal do Paraná, under number 2091.258/2009-11, aimed to systematize the Pre-School Screening System (PSS) to early identification of signs of developmental delay, comparing results between Brazilian and North American children. It was characterized as an observational, cross-sectional and descriptive study, with the age range of the children involved as the main variable.

The study data that served as the basis for establishing the normative principles for the application and interpretation of the PSS were captured in field research carried out by Freitas (2014) and the author, in the city of Curitiba (PR), from August to November 2010, involving four Municipal Centers for Early Childhood Education (CMEI), four Municipal Elementary Schools and two private schools that provide services from Kindergarten to Elementary Education.

The sample consisted of 411 subjects aged between four years and four months and six years and seven months, as follows: 48 children aged between 4 years and 4 months and 4 years and 7 months; 65 children aged 4 years and 8 months to 4 years and 11 months; 78 children aged 5 years to 5 years and 4 months; 85 children from 5 years and 5 months to 5 years and 9 months; 70 children aged 5 years and 10 months to 6 years and 2 months; 65 children from 6 years and 3 months to 6 years and 7 months. This composition by age ranges is included in the PSS Application Manual, consisting of tests subdivided into fifteen subtests that cover the three main fields of learning: Body Awareness and Control, Visuoperceptive-motor and Language. Each test has, in accordance with North American standards, specific tables for each age range, established in the PSS.

The PSS items have a score according to the Application Form, which may vary depending on the performance of the student, according

to the correction protocol. Each investigated area has its points added independently, which are summed at the end, obtaining the total score, that is, the PSS value. This value defines, according to the chronological age of the child on the date of application of the Test, the equivalent age, in months and tenths of a month, to the age corresponding to development. It is thus verified whether the subject presents compatible results, below or above the expected for his chronological age.

The comparison of the results of the PSS presented by the children of Curitiba (PR) and demonstrated in the graphs that are part of this article, regarding the Total Score, the Subtest Consciousness and Body Control, the Visual-Perceptive-Motor Subtest, the Language Test, to the Imitation Test and the Acquired Concepts Test, it occurred only with the North American normative tables.

## RESULTS

The results of the PSS, obtained during the research, were presented in the form of graphs that register, for the age intervals, the frequency of the percentiles according to the Total Score and the points achieved by the child in each subtest. Data were entered into an electronic spreadsheet, checked and exported for subsequent descriptive statistical analysis (Statistica - Statsoft®), using the Microsoft Excel program®.<sup>1</sup>

The results are shown in a graph with the descriptive measures calculated for each variable, based on a 2nd degree polynomial model. The possibility of an objective interpretation of the data guided the choice of this form of representation.

The original construction of the PSS, which took place in the United States in 1969, with reapplication in 1980, was the reference for carrying out the study that guided the writing of this article. The study generated

the normative tables that served as a basis for the elaboration of comparative tables of the performance of Brazilian and North American children in the Total Score and in the Subtests Consciousness and Body Control, Visual-Perceptive-Motor, Language, Imitation and Acquired Concepts.

Figure 1 shows the result of the PSS Total Score.

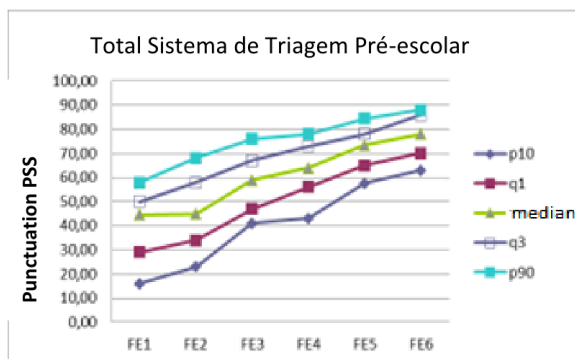


Figure 1 PSS

Source: The author (2015)

Note: Age group 1 – 4 years and 4 months to 4 years and 7 months  
 Age group 2 – 4 years and 8 months to 4 years and 11 months  
 Age group 3 – 5 years to 5 years and 4 months  
 Age group 4 – 5 years and 5 months to 5 years and 9 months  
 Age group 5 – 5 years and 10 months to 6 years and 2 months  
 Age group 6 – 6 years and 3 months to 6 years and 7 months

Chart 1 shows the comparison between the median Total Score obtained by North American children and Brazilian children. In age groups 3 and 4, there is equivalence between the results of the two samples and, from age 5 onwards, Brazilian children have a higher score.

1. <http://regressao.wikispaces.com/file/view/regress%C3%A3o+polinomial.pdf>

Range	American children	Brazilian children
1	48	44,5
2	54	45
3	59	59
4	64	64
5	69	73,5
6	73	78

Table 1 PSS.

Source: The author (2015).

two samples. From age 3 onwards, Brazilian children have a higher score.

Range	American children	Brazilian children
1	10	9
2	11	11
3	13	15
4	14	18
5	15	18
6	16	20

Frame 2 PSS.

Source: The author (2015).

Figure 2 shows the result of the Body Awareness and Control Test score in curves of descriptive measures.

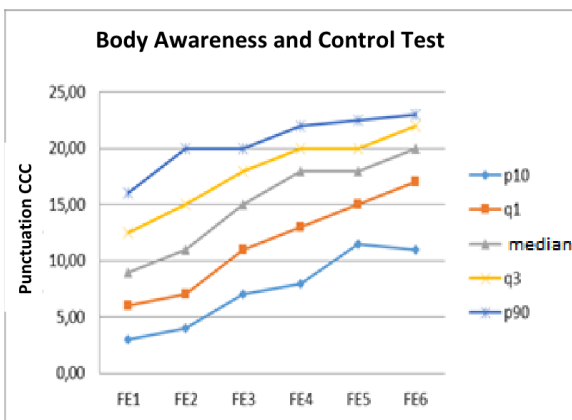


Figure 2 PSS.

Source: The author (2015).

Note: Age group 1 – 4 years and 4 months to 4 years and 7 months

Age group 2 – 4 years and 8 months to 4 years and 11 months

Age group 3 – 5 years to 5 years and 4 months

Age group 4 – 5 years and 5 months to 5 years and 9 months

Age group 5 – 5 years and 10 months to 6 years and 2 months

Age group 6 – 6 years and 3 months to 6 years and 7 months

Figure 3 shows the result of the Visual Perceptual-Motor Test score in curves of descriptive measurements.

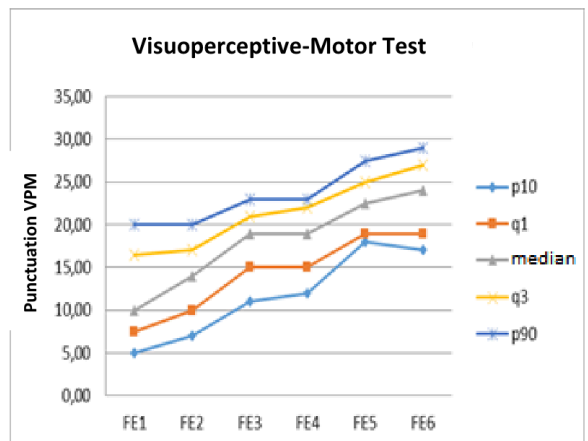


Figure 3 PSS.

Source: The author (2015).

Note: Age group 1 – 4 years and 4 months to 4 years and 7 months

Age group 2 – 4 years and 8 months to 4 years and 11 months

Age group 3 – 5 years to 5 years and 4 months

Age group 4 – 5 years and 5 months to 5 years and 9 months

Age group 5 – 5 years and 10 months to 6 years and 2 months

Age group 6 – 6 years and 3 months to 6 years and 7 months

Chart 2 shows the comparison between the median of the Body Awareness and Control Test obtained by North American children and Brazilian children. In age group 2, there is equivalence between the results of the

Table 3 shows the comparison between the Visual-Perceptive-Motor Test median



obtained by North American children and Brazilian children. From age 3 onwards, Brazilian children have a higher score.

Range	American children	Brazilian children
1	14	10
2	16	14
3	17	19
4	18	19
5	20	22,5
6	21	24

Frame 3 PSS.

Source: The author (2015).

Figure 4 shows the result of the Language Test Score in descriptive measures curves.

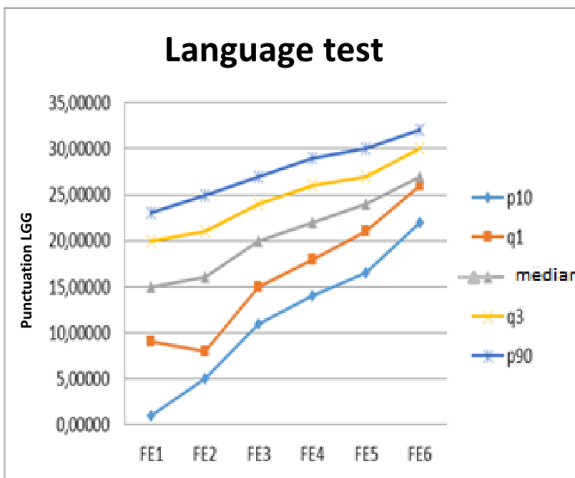


Figure 4 PSS.

Source: The author (2015).

- Note: Age group 1 – 4 years and 4 months to 4 years and 7 months
- Age group 2 – 4 years and 8 months to 4 years and 11 months
- Age group 3 – 5 years to 5 years and 4 months
- Age group 4 – 5 years and 5 months to 5 years and 9 months
- Age group 5 – 5 years and 10 months to 6 years and 2 months
- Age group 6 – 6 years and 3 months to 6 years and 7 months

Chart 4 shows the comparison between the language test median obtained by North

American children and Brazilian children. In age group 3, there is equivalence between the results of the two samples. From age 4 onwards, Brazilian children have a higher score.

Range	American children	Brazilian children
1	17	15
2	18	16
3	20	20
4	21	22
5	23	24
6	24	27

Frame 4 PSS.

Source: The author (2015).

Figure 5 presents the result of the Imitation Test Score in descriptive measures curves.

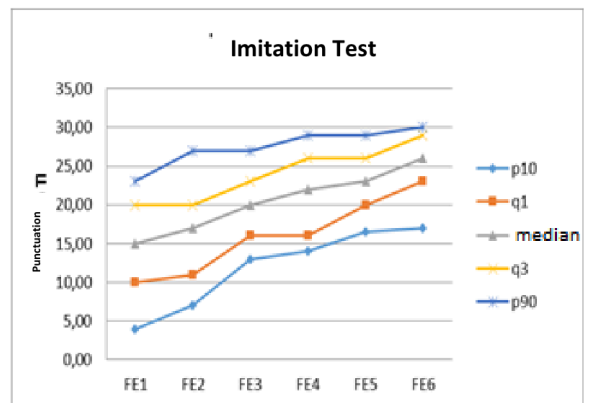


Figure 5 PSS.

Source: The author (2015).

- Note: Age group 1 – 4 years and 4 months to 4 years and 7 months
- Age group 2 – 4 years and 8 months to 4 years and 11 months
- Age group 3 – 5 years to 5 years and 4 months
- Age group 4 – 5 years and 5 months to 5 years and 9 months
- Age group 5 – 5 years and 10 months to 6 years and 2 months
- Age group 6 – 6 years and 3 months to 6 years and 7 months

Table 5 shows the comparison between the median of the Imitation Test obtained by North American children and Brazilian children. All Brazilian children have a higher score.

Range	American children	Brazilian children
1	14	15
2	15	17
3	17	20
4	18	22
5	20	23
6	21	26

Frame 5 PSS.

Source: The author (2015).

Figure 6 shows the result of the Acquired Concepts Test score in descriptive measures curves.

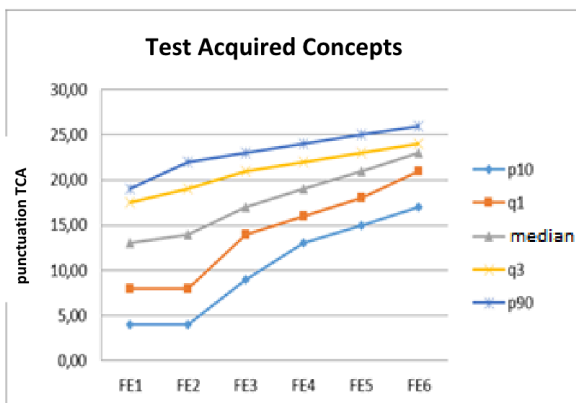


Figure 6 PSS

Source: The author (2015)

Note: Age group 1 – 4 years and 4 months to 4 years and 7 months

Age group 2 – 4 years and 8 months to 4 years and 11 months

Age group 3 – 5 years to 5 years and 4 months

Age group 5 – 5 years and 10 months to 6 years and 2 months

Age group 6 – 6 years and 3 months to 6 years and 7 months

Chart 6 shows the comparison between the median of the Acquired Concepts Test

obtained by North American and Brazilian children. Equivalence in the age group 5 and overcoming of Brazilian children in the age group 6 are highlighted..

Range	American children	Brazilian children
1	16	13
2	17	14
3	19	17
4	20	19
5	21	21
6	22	23

Frame 6 PSS.

Source: The author (2015).

So that the PSS can be applied and interpreted with discretion, it was necessary to establish some normative principles elaborated to give uniformity to the testing conditions. Normative data were interpreted in the light of graphs that recorded the medians, 1st and 3rd quartiles and 10th and 90th percentiles, distributed according to the PSS Total Score and each of its subtests in each age group surveyed. Thus, the distribution of results took place through five ordinal quantitative variables that originated the distribution into five groups, considering a scale of 0-100, thus identified: Lower Group (GI), Lower Middle Group (GMI), Middle Group (GM), Upper Middle Group (GMS) and Upper Group (GS).

The Lower Group (GI) comprises children who are in the 10th percentile, which means that the score obtained is below the score obtained by 10% of children who are in the exact measure, that is, at least 90% of the children will have a highest score (HAINSWORTH et al., 2009, p. 114). Children in this group have a critical score, meaning that it is possible that they have serious learning difficulties that require referral for more complete assessments.



The Lower Middle Group (GMI) is formed by children who are in the 1st quartile, which means that the score obtained is between the 10th percentile and the median, and corresponds to 30% of the subjects. The children who are in this group have a score that indicates the presence of some difficulties, suggesting the need for a new screening after a certain period, or that require complementary assessments and pedagogical interventions.

The Medium Group (GM) is formed by children with median results, which means that the score obtained corresponds to 20% of the subjects. This group comprises children whose performance is relatively within the expected range, but who deserve some care.

The Upper Middle Group (GMS) is formed by children who are in the 3rd quartile, which means that the score obtained is between the median and the 90th percentile, and corresponds to 30% of the subjects. This group comprises children who perform a little above expectations.

The Superior Group (GS) comprises children who are in the 90th percentile, which means that the score obtained is above the score obtained by 90% of children who are in the exact measure, therefore, in the 10% of children who had the highest score. high (HAINSWORTH et al., 2009, p. 114). This group comprises children who perform above expectations.

Below, table 7 is presented, indicative of this distribution according to the PSS total score ranking.

Range age Classification	FE1	FE2	FE3	FE4	FE5	FE6
GI	10-19	20-29	30-39	40-48	49-56	57-63
GMI	20-29	30-39	40-49	49-57	57-64	64-70
GM	30-39	40-49	50-59	58-66	65-72	71-77
GMS	40-49	50-59	60-69	67-75	73-80	78-84
GS	50+	60+	70+	76-78+	81-83+	85-87+

Frame 7 PSS

Source: The author (2015)

Note: GI –Lower Group

GMI – Lower Middle Group GM –Middle Group

GMS – Upper Middle Group GS – Upper Group

Since Brazil is an extremely heterogeneous country, with a large territorial extension and cultural, economic and social differences, it is essential to consider that the results of the PSS presented here concern the population of Early Childhood Education and the beginning of Elementary School in the Municipality of Curitiba ( PR). It is suggested the need to establish norms that take into account the regional characteristics of the place where it will be applied.

## DISCUSSION

The application of the PSS in Curitiba (PR) showed, for the most part, better results than those found in the North American sample. Considering that that application took place 30 years after the review of the original sample, it is possible to raise a hypothesis equivalent to the study carried out in Italy, that is, the fact that the results are related to a more recent application (Sabbadini, em HAINSWORTH et al., 2009).

Another important consideration refers to the fact that the use of the median established in North American tables may not be compatible with the reality of children undergoing PSS in Curitiba (PR), suggesting the need for further research that can investigate the best median for the Brazilian reality.

To compare the PSS with another screening instrument, among the published findings, the Denver Developmental Screening Test – Denver II Test, standardized for the Brazilian population by Drachler et al. (2007) in a study carried out in Porto Alegre (RS), involving 3,389 children under five years of age. It is a test that screens the development of young children, from birth to six years old, assessing areas of personal-social development, adaptive fine motor, language and gross motor. The results obtained in each topic are correlated with age and the percentage of the standardized population that performed a certain item or behavior.

As shown in Table 8, the Denver II Test, significantly used in the clinical area and in research, was configured as an important instrument to establish the comparison with the PSS, due to the points of similarity and also as support for the consolidation of the use of the latter in the Kindergarten and Early Years of Elementary School.

PSS	(DENVER II)
<b>Main objective:</b> Screening.	<b>Main objective:</b> Screening.
<b>Age range:</b> 2 years and 6 months to 6 years and 7 months.	<b>Age range:</b> 0 to 6 years.
<b>Assessed areas:</b> Awareness and body control; Visual-perceptual-motor; Language.	<b>Assessed areas:</b> Adaptive fine motor; Coarse engine; Language; Social staff.
<b>Assessment of cognitive development:</b> Ability to understand instructions, conceptualize words, name pictures and personal social skills.	<b>Assessment of cognitive development:</b> Ability to understand instructions, conceptualize words, naming pictures and personal social skills.
<b>Application:</b> Education professionals and Health	<b>Application:</b> Peditricians and other healthcare professionals.
<b>Characteristic:</b> Easy application.	<b>Characteristic:</b> Easy application.
<b>Time of application:</b> 20 minutes.	<b>Time of application:</b> 20 minutes
<b>Materials:</b> Simple and easily accessible.	<b>Materials:</b> Simple and easily accessible.
<b>Indication:</b> Training of professionals.	<b>Indication:</b> Training of professionals.
<b>Manual:</b> Translated and adapted.	<b>Manual:</b> Translated and adapted.
<b>Tracking:</b> Risk for the child development.	<b>Tracking:</b> Risk for child development.
<b>Indication:</b> Referral for further investigations and/or stimulation when needed.	<b>Indication:</b> Referral for further investigations and/or stimulation when needed.
<b>Possibility:</b> Prolonged follow-up.	<b>Possibility:</b> extended follow-up

Table 8 - Comparison between Denver II and PSS.

Source: The author (2015).

When analyzing and interpreting the PSS, essential aspects about cognitive, affective and social development emerge and therefore must be considered within the scope of this discussion (Piaget, 1975; Vygotsky, 2007; Wallon in Junqueira, 2010).

From the cognitive point of view, the stages of development described by Piaget (1975) allowed understanding how the child progresses from practical sensory-motor actions, passing through symbolic representations, to reach operational intelligence, first concrete and then hypothetical-deductive. These stages serve as a basis for interpreting how subjects structure knowledge, how they relate to the object of knowledge and, therefore, how the educator can think of intervention strategies based on the results obtained in the PSS.

Still regarding the cognitive aspect, it is important to highlight the assumptions of Vygotsky (2007), who emphasize the processes of mediation and internalization, especially the concept of Zone of Proximal Development (ZPD). Although the Russian researcher has not structured a theoretical model based on stages of development, his studies highlight the preponderant role of social interaction in structuring knowledge, as well as the importance of the mediator as a link between the subject and the act of knowing. The PSS results can contribute to the identification of the ZPD in which the child is, as well as indicate pedagogical intervention procedures that contribute to the potential development.

With regard to the affective aspect or the field of “emotions”, there is the contribution of Wallon (in Junqueira, 2010), by presenting studies between cognition and affectivity - cognition understood as intelligence and knowledge structuring and affectivity as motivational aspect, which drives to action.

Considering this complementarity – affectivity and cognition – one can also highlight the existing parallelism between these aspects, that is, the continuous and gradual structuring of knowledge and progress regarding affective development. It is evident that this parallelism significantly serves to interpret, from the results obtained in the PSS, how to act with the child and what are the best intervention strategies. These, in turn, can also be conceived from recreational activities, with the use of different games and games to be selected according to the age group for which they will be intended, since they engender the aspects discussed here. According to Costa et al (2015), the use of games and games in Education allow the child to understand their learning process and, to the teacher, the perception that this child has a different way of learning, suggesting another way of teaching.

In summary, the theories presented here, along with the PSS, elucidate, for educators, possible ways to understand and intervene in the teaching and learning process, without neglecting the knowledge related to Neuroscience and its importance in this process.

## CONCLUSIONS

The research presented here aimed to systematize the Pre-School Screening System (PSS) for early identification of signs of developmental delay, comparing results between Brazilian and North American children and allowed the establishment of some normative principles designed to give uniformity to the your application.

The PSS is a practical, effective instrument that is easy to understand and apply in a short period of time. It is complete and allows the assessment of the main cognitive areas responsible for learning in children aged 4 years and 4 months to 6 years and

7 months. Through this instrument, it is possible to identify the child's learning profile, their skills and facilities, as well as to detect interurrences in the process, allowing them to make the relevant referrals, when necessary, and intervene, early, in the face of possible obstacles to future learning.

The analysis of the Brazilian sample, in comparison with the data found in the North American tables, made it possible to infer that its application is valid for our population. However, it is worth highlighting the importance of adaptations according to the reality where it will be applied, necessary with respect to the regional disparities of our country.

It was possible to verify, both in the PSS Total Score and in each of its subtests, a progressive increase in the results achieved by Brazilian children as the age group increased, that is, the younger the child's age, the lower the score. in relation to American children. This proportional increase in the score obtained by Brazilian children suggests that the period in which they are immersed in a stimulation program, in the preschool phase, allows them to present better results when submitted to the application of the instrument.

The PSS consolidates itself as an alternative for screening children who are part of Early Childhood Education and the beginning of Elementary School, to be applied and interpreted by Education professionals.

It is hoped that the data discussed here can provide subsidies to other applications of the PSS, as well as can encourage new research that will bring results that add and update them, an important aspect in monitoring the educational process of children in Kindergarten and early Elementary School.

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