

# CROSS-DOMINANCE AND READING AND WRITING OUTCOMES IN SCHOOL-AGED CHILDREN

## *A lateralidade cruzada e o desempenho da leitura e escrita em escolares*

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### ABSTRACT

**Purpose:** analyze the performance of reading and writing in students with cross-laterality. **Method:** the sample consisted of 166 students in the third year of primary school, aged eight and nine. To evaluate the laterality was used scale EDM motor development, and for the analysis of reading and writing used the Manual School Performance – MDE. The comparative analysis of the performance of reading and writing as a function of laterality (Crusade), the sample was divided into 2 groups. For analysis and interpretation of data were used programs Excel and SPSS for Windows 17.0 and for comparative analysis between the two groups, the “t” test for independent samples when data showed symmetrical, and the Mann-Whitney test for asymmetric data and for data distribution, the Shapiro-Wilk test. The significance level used in this study was  $p < 0.05$ . **Results:** it was found that of all the variables on the performance of reading and writing, were higher for the group of children with complete lateral dominance than for the group of children with laterality crusade. In writing, significant differences between the two groups, being awarded best performance for children with full-handedness right-handed. **Conclusion:** evidence that children have crossed laterality underperform in reading and writing compared to children with complete lateral dominance. These data justify the relevance of psychomotor development in infancy as an essential factor in the learning process at school.

**KEYWORDS:** Reading; Handwriting; Functional Laterality; Students

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### ■ INTRODUCTION

Learning is a complex and dynamic process based on a perceptive and motor act, which originates the cognition as it is organized in cortex level<sup>1</sup>. Myelination of the cerebral cortex improve human motor function, also dependant on the effect of nurturing on children's life<sup>2</sup>. However, structural modifications in the Central Nervous System, at areas related to body scheme, spatial-temporal orientation and laterality, are among the neuropathology for psychomotor impairment, which can lead to difficulties on reading, writing and math learning skills<sup>1,3</sup>.

Laterality as a component of the psychomotor development is an important aspect to learning skills evolution. Current research highlight that laterality is paramount to the development of academic

learning<sup>4,5</sup>, showing a strong relationship between cross-dominance and learning difficulties, as well as with literacy problems.

Overall, laterality is defined as the preference on using symmetrical body parts: hand, eye, ear, leg<sup>6</sup>. It is *crossed* when there is a disagreement while using one of these parts, like writing with the right hand and kicking with the left foot as an example; it is *undefined* when there is no dominance, no preference between right or left handedness, for example. When there is a harmonic specialization among the body parts, laterality is classified as complete left dominance (left hand writing, left foot kicking), or complete right dominance (right hand writing, right foot kicking). The establishment of the lateral dominance occurs at around six years of age<sup>7</sup>, which highlights the importance of its definition before the child starts school.

More specifically, as the left brain hemisphere controls the right side of the body, and the right brain hemisphere leads the way to the the corporal left half, this dominance is fundamental for cerebral function efficiency.

Each brain hemisphere is ready to perform operations of high precision and complexity, which are going to allow praxis feasibility, speech, writing and cognitive thinking, dependents of their own cooperation and combined work. For that to happen, the body bilateral integration must be structured and automatized, otherwise learning and behaviour are affected as a consequence of impairment in the quality of relationship and interaction among several brain functional units<sup>8</sup>.

In a research study<sup>9</sup> involving school-aged children, the ones that had ambiguous handedness showed inferior outcomes in literacy and numeracy tests when compared with children of defined hand preference. According to Siviero et al.<sup>10</sup> and Capellini and Souza<sup>11</sup>, children with dyslexia often present cross-dominance.

Currently there has been indicated a narrow relationship between what the child is capable of learning (cognitive) and what one is able to perform (motor). Knowing that laterality is one of the psychomotor development components and a relevant aspect within the learning capabilities, the aim of this study was to analyse the reading and writing outcomes in students with crossed-dominance.

## ■ METHOD

The study was approved by the Research Ethics Committee from the State University of Saint Catarina under approval registration 103/2009.

The sample was composed by 166 students from the Year 3 of Elementary School from 5 schools part

of the Florianópolis/SC Municipal Public Network, aged between 8 and 9 years old, with 45,8% male (76) and 54,2% female (90). Exclusion criteria based on grade repetition and/or students who presented important developmental (mental, sensorial, neurological) disorders.

The instrument used to evaluate reading and writing outcomes was the School Performance Manual (from the literal translation of Brazilian Portuguese *Manual de Desempenho Escolar*) – Analysis of Reading and Writing in Primary School – MDE<sup>12</sup>, with usage of its Level II texts directed to Year 3 for 9 years old children administered as following:

- Reading Outcome: Category I (Upper and Lower case letters, syllables and words), Category II (texts) and Category III (reading comprehension);
- Writing Outcome: Category IV (copy skills), Category V (dictation) and Category VI (spontaneous writing);

All test items have a score from 1 to 10, where the bigger the scoring the better the performance.

To assess Laterality, the homonymous subtest (for hands, eyes and feet) from the Scale of Motor Development (Escala de Desenvolvimento Motor) – EDM<sup>6</sup> was used. It consisted of 3 assessments: handedness, eyedness and footedness, each one performed 3 times as per-protocol. The test classifies laterality in “complete right dominance”, “complete left dominance”, “cross-dominance” and “undefined”.

The students were individually assessed within the school premises, in an exclusive and relevant setting, with adequate lighting and free of external disturbances, returning straight to their classroom after the evaluation. Only one evaluation session was required to perform all tests, approximately lasting for 15 minutes for the reading and writing assessment, and another 10 minutes to address laterality, with some variance second to individual differences among the children.

For data analysis and comprehension softwares Excel and SPSS 17.0 for Windows were consulted. Descriptive analysis of the reading and writing outcomes and laterality was based on indicators of mean, variance, standard deviation, minimum and maximum variable, simple frequencies and percentage.

When comparing reading and writing outcomes in terms of laterality (cross-dominance), children with undefined laterality and complete left dominance were excluded from the sample. On the same way, children with cross-dominance were selected and paired up by age and gender with children with complete right dominance. Age pairing was done by considering the date of birth related to the date of

the assessment, matching children in 2 months age groups. By doing so, the 2 groups for the comparative study was defined. Group 1 (G1) consisted of 44 children with complete right dominance, 22 male and 22 female. Group 2 (G2) also had 44 components, those with cross-dominance, equally distributed in terms of gender.

For statistically comparing the study groups, “t” test for independent samples was used when symmetrical data, and Mann-Whitney test when assymmetrical, data distribution been tested with Shapiro-Wilk test. The adopted level of significance for the study was  $p < 0,05$ .

## ■ RESULTS

### Academic Performance

Results for letters, syllables and words reading showed a successful (9,58 points) achievement for the majority of students. However, when assessing a written text expressive language performance, where children were conducted to read aloud a Level II text with approximately 119 words, the average score was 6,37 out of 10. It was evident that only a few students were able to read with fluency and rhythm, and about 3,61% (6) of them were unable to accomplish the task.

On Category 3, for reading comprehension, where students answered 10 questions related to a text, the obtained score reached 7,52 out of 10. However, a total of 22 students (13,3%) scored less than 50% out of the 10 questions. Regarding the previously quoted 6 students from Category II, labelled as “non-readers”, only one children was successful on interpreting, whereas the remaining 5 showed great difficulty on achieving the task. At this point, the researcher conducting the test read the story and analysed the students’ auditory comprehension. Referring to the overall reading outcome, a mean of 78,31% positive scoring was found.

Regarding to writing, in terms of choosing the type of font, 118 students (71,1%) opted for “cursive” whereas the rest of them preferred using “script” or “mixed”. About the outcomes of copying from writing, the students had great results with a score of 9,51. When writing from dictation, where students were requested to write a text of approximately 18 words and pay close attention to the title

of small sentences (level II), the average score was 5,92.

On spontaneous writing, where students should write from pictures, results were similar of the dictation, scoring 5,80. On this category, children may be able to organise their interior speech and use familiar words to write, what differs from dictation writing where words are predetermined.

In relation to the general writing outcome, a mean of 70,57% positive scoring was verified. Overall, students had an average of 74,53% of right answers on general outcome measured by MDE.

### Laterality

57,8% of the students had complete right dominance, 33,1% had cross-dominance, 7% undefined and 2% were complete left dominants.

60,2% of the students presented homogeneous laterality, having “complete right dominance” or “complete left dominance”. From those, 39% were male and 61% female and regarding to their age, 30% were 8 years old and 70% were 9 years old.

Cross-dominance was the second more frequent type found, a total of 33,1% with 56,4% (n=31) being male and 43,6% (n=24), female, age varying from 8 years old in 25,5% and 9 years old in 74,5%.

The third type of laterality in frequency was “undefined” with 6,6% of the cases. 54,5% were male and 45,5% female. Regarding to age, 36,4% were 8 years old and 63,6%, 9 years old.

### Reading and Writing X Laterality

Data from the study showed that students with complete lateral dominance (right or left) had better outcomes in testing, according to the MDE average score on reading, writing and general, as per Table 1.

Table 2 shows that all variables related to the outcomes in reading and writing were higher for the group with complete right dominance (G1) in comparison with the cross-dominance group (G2). However, the smallest mean was found on G2 writing and only for this variable there was significant difference between the 2 groups ( $p=0,049$ ).

For reading ( $p=0,299$ ) and general scoring ( $p=0,159$ ), no significant difference was found.

**Table 1 – Scoring on reading, writing and overall on MDE according to laterality**

Laterality	RIGHT			CROSS			LEFT			UNDEFINED		
	Reading	Writing	Overall	Reading	Writing	Overall	Reading	Writing	Overall	Reading	Writing	Overall
Mean*	8,090	7,551	7,820	7,620	6,709	7,164	8,105	7,835	7,970	6,438	4,575	5,510
Standard Deviation*	1,022	1,249	1,007	1,427	1,731	1,513	,354	,880	,417	1,781	1,803	1,472
Variance*	1,045	1,561	1,015	2,038	2,999	2,291	,126	,776	,174	3,172	3,252	2,167
Minimum*	3,67	2,33	4,67	4,08	2,33	3,29	7,67	6,67	7,58	3,58	1,33	3,29
Maximum*	9,67	9,33	9,50	9,67	9,00	9,33	8,50	8,67	8,46	8,33	8,00	8,17
Total	N = 96 (57,8%)			N = 55 (33,1%)			N = 4 (2,4%)			N = 11 (6,6%)		

\* Points (1 to 10)

**Table 2 – Descriptive analysis of the Scoring on reading, writing and overall performance on MDE from G1 (children with complete right laterality) and G2 (children with cross-dominance)**

	G1			G2		
	Reading	Writing	Overall	Reading	Writing	Overall
Mean	7,9927	7,3561	7,6750	7,7382	6,7811	7,2586
Median	8,0850	7,6700	7,8350	7,8750	7,3300	7,5200
Variance	,899	2,135	1,140	1,968	3,057	2,266
Standard Deviation	0,94800	1,46109	1,06772	1,40285	1,74854	1,50518
Minimum	6,1	2,3	5,1	4,1	2,3	3,3
Maximum	9,7	9,3	9,5	9,7	9,0	9,3
Reach	3,6	7,0	4,4	5,6	6,7	6,0
Asymmetry	-,293	-,941	-,335	-,931	-,695	-,909
Kurtosis	-,776	1,669	-,750	,553	-,291	,381

■ **DISCUSSION**

The Scale of Motor Development – EDM<sup>6</sup> is broadly used to assess laterality of children who attend childhood education and elementary school. In relation to the frequency on the type of laterality, the majority (57,8%) of the students had “complete right dominance” followed by 31,1% with “cross-dominance”, a small percentage (6,6%) had “undefined” laterality and only 2.4% were “complete left dominants”.

Corroborating with this study<sup>13</sup>, on assessing 101 students without difficulties, in the age range 6 to 10 years old, found 59% students with complete right dominance and 35% with cross-dominance. Another study<sup>14</sup> involving 123 students from Years 2 to 4 from the municipality of Descanso/SC, verified that complete right dominance was prevalent in the early classes, exception made at Year 4, where cross-laterality was predominant.

Researching the association between cortical function and reading and writing learning in children from elementary education with average age of 7,4

years old, Guardiola, Ferreira e Rotta<sup>1</sup> found similar results of this study regarding laterality. On the authors’ opinion, problems with laterality definition are keen to cause language difficulties and a risk factor for literacy.

According to Faria<sup>15</sup>, visual-motor coordination and the organisation of tactile and visual perception are paramount for child development, providing practices that emphasize spatial systems, on which laterality is dependent.

Researches<sup>4</sup> have investigated the association between hand, eye and foot dominance and spatial organisation deficit of 400 public and private students from 6 to 10 years old from João Pessoa/PB. Results presented a significant association (p<0,05) between the type of laterality and deficit on spatial organisation. For Linares<sup>16</sup>, along with reflecting the functional organisation of the Central Nervous System, laterality exposes body awareness, what impacts on performing activities with more strength, accuracy, preference, speed and coordination, all important to school learning. Studies with children with no learning difficulties factors found great

number of children with complete right dominance and cross-dominance (34,3%)<sup>1,4,13,14</sup>.

Cross-dominance can be the cause of some unbalances and disturbances<sup>17</sup>. If eye and hand, for example, have inverted dominance (right handedness and left eyedness), there is likelihood for reading learning difficulties.

On the same way, learning difficulties can be a consequence of laterality disruption and disturbances on spatial organisation<sup>18</sup>.

Complete right dominance is more frequently found than the left one. When comparing handedness, eyedness and footedness, people with right hand dominance tend to mainly have homogeneous lateral dominance, presenting complete right dominance also for lower limbs and eyes. Same was found on the studies of Bobbio et al.<sup>19</sup>, where 238 Year 1 students from Campinas/SP were assessed.

Right handedness was also a finding for general population on the reports of Habib<sup>20</sup>. The author discusses the probability of right handedness prevailing on more than 90% of the world population, which 70% seem to be exclusively right hand dominants. Therefore, that implies on the possibility of a percentage of the world population having non-complete right hand dominance.

In accordance with Bell<sup>21</sup>, the incidence of non-complete right handedness could be a consequence of social factors, as it is not rare observing the family promoting the use of the right hand instead of the left one by the child, or also seeing left handed children turning into cross-dominants second to social pressure. Same author reports also that even though the world seems to be built for complete right handed people, approximately 10% of children could be left handed.

It is believed that laterality is not the responsible alone for the learning difficulties, but psychomotor disturbance plays a major role in dyslexia, in general, where laterality and body scheme are highlighted<sup>18</sup>.

Studies approaching literacy risk population, children with learning difficulties, other findings are shown. Researches<sup>22,23</sup> involving children with learning difficulty indicators, enrolled in Florianópolis/SC municipal education network, found a great percentage of students with undefined laterality. Same results were reported by Rosa Neto, Costa e Poeta<sup>24</sup>, studying 105 children and adolescents with learning difficulty indicators who were referred to the Allied Centre for Supporting Human Development (Núcleo Desenvolver) – Paediatrics Division from the Teaching Hospital of Florianópolis - UFSC. Accordingly to other studies, the results showed 21,9% of the students with undefined laterality. On the same direction, Rosa Neto, et al.<sup>25</sup>, in a sample of 28 Spanish children diagnosed with specific learning

difficulty (dyslexia), age range varying between 6 and 10 years old, reported high percentage (17,9%) of children with undefined laterality and with cross-dominance (46,4%).

Fonseca<sup>8</sup> describes the importance of laterality for child development, closely associating lateral dominance problems with motor difficulties (dyslexia, dysorthography, stammering, problems with temporal and spatial organisation, etc.). A motor disorganisation can be triggered by insufficient lateral dominance impacting on problems generally co-dependents to body scheme under tonus regulation.

Regarding the gender, a study<sup>26</sup> done with 253 children showed that male had a higher incidence of left handedness than female. Another study<sup>27</sup> assessing 112 from 7 to 9 years old children found differences on hand preference according to gender, seemingly task-specific, but with no clear explanation for its reasons. Nevertheless, the higher percentage of left handed male could be justified on differences in brain organisation, or related to social interaction, considering that women seem to be more susceptible to social, cultural and environmental pressure, and from learning by imitation, whereas men perform more freely in terms of the usage of the left hand.

About the age, according to Faria<sup>15</sup>, the lateral predominance starts at around the age of 2, but laterality is not to be defined in the child before the age of 5. From the age of 6 or 7, the child will be able to realize that right and left hand are not interdependent, also noticing the position of other people in relation to themselves and their displacement<sup>15</sup>.

Data from this study showed that, in accordance with the average score on writing, students with complete lateral dominance performed better. When comparing the general outcome on MDE from complete right dominance group (G1) to the group with cross-dominance (G2), it was verified that a lower mean for the score on writing was found in children with cross-dominance (G2) in relation to reading and general scores. Therefore, what could explain those findings is, according to Lofiego<sup>28</sup>, the fact that writing skills require development of spacial-temporal organisation, motor dexterity for handling the pencil, balanced gross and fine motor skills, sufficient definition of laterality and adequate perceptive, visual and auditory development. Despite of this, the understanding of this area seems to lack comprehensiveness, as no scientific research was found to back up the findings of this study, relating cross-laterality with difficulties on writing more than on reading.

For Rodrigues, Castro Ciasca<sup>29</sup>, an optimal handwriting requires fine-motor control, visual-motor

integration, motor planning, proprioception, visual perception, prolonged attention span and finger sensorial awareness, among others. Flaws may result in unreadable handwriting and impairment on the child's academic outcome.

It is common for preschool-aged children, when beginning to copy letters shapes, inverting or mirroring them. Parents, educators, psychologists, speech pathologists, physicians and all other professionals involved with the learning of writing by a young child have been worrying about those orthographic errors<sup>30</sup>. Such worry is relevant as those inversions, or mirroring, have been considered a significant sign of possible dyslexia, with difficulties on spatial-temporal dominance linked to the learning of writing and also reflecting on reading and outlining letters and numbers. Although it is likely to find reference about that problem in the relevant literature, finding the characteristics of those children are not so easily found<sup>30</sup>.

At the present study, despite children been studying at Year 3, inversion of letters and/or syllables in words was noticed in 12,65% (n=21) of the students and 3% (n=5) of rotation of letters on the writing test.

Some authors<sup>31,32</sup> affirm that difficulties on reading and writing (characteristics of dyslexy) may be linked to lateral dominance, body scheme, and spatial-temporal orientation. Therefore, children with laterality not yet defined may need special attention<sup>17</sup>. The settlement and self-awareness of laterality are paramount for the development of spatial orientation and relation, interfering directly on school learning.

By all means, questions risen deserve deep investigation as this study did not give emphasis on both streams, neurologic and psychosocial, that are related to cross-dominance and undefined laterality. That way, children with not yet defined laterality must not be considered pathologic, yet vulnerable in terms of the literacy process.

## ■ CONCLUSION

Based on the criteria adopted on identifying scholar outcomes, a great number of the assessed children had some degree of difficulty being writing the test with major impact, where the students showed underperformance

It was expected that Year 3 students would perform better on that evaluation as literacy was approach from its base. Findings of this study show the need of reinforce some basic abilities that must be consolidated by the students, and the introduction of new ones aiming literacy achievement.

Regarding to laterality, there is the need of introducing motor stimulation programs specific towards children's functional laterality and spatial orientation within school curriculum. That measure could prevent and intervene in possible difficulties in the process of school learning.

It becomes much evident the importance of teachers as a facilitator of the learning process for children, along with the Physical Education teacher in the first school years. Through psychomotor activities, used as "tool", the Physical Education teacher can help the student on their physical, cognitive, affective and social development, subsidizing a successful learning process.

For years, the discussion about the children literacy process goes on, but the interdisciplinary work is very humble within the educational system. Perhaps what is missing is a broader discussion and consequent action from teachers (room leaders and Physical Education), combined, giving solid base for improving the students teaching process and their full potential development.

In general, this study showed that children with cross-dominance presented inferior outcomes on reading and writing when compared to children with complete lateral dominance. Such data justify the relevance of psychomotor development during childhood as an essential factor for school learning.

**RESUMO**

**Objetivo:** analisar o desempenho da leitura e escrita em escolares com lateralidade cruzada. **Método:** fizeram parte da amostra 166 escolares do terceiro ano do ensino fundamental, com idade entre oito e nove anos. Para avaliação da lateralidade, foi utilizada a escala de desenvolvimento motor –EDM, e para a análise da leitura e escrita foi utilizado o Manual de Desempenho Escolar – MDE. Na análise comparativa do desempenho da leitura e escrita em função da lateralidade (Cruzada), a amostra foi dividida em 2 grupos. Para análise e interpretação dos dados foram utilizados os programas Excel e SPSS for Windows 17.0 e para a análise comparativa entre os dois grupos, o teste “t” para amostras independentes quando os dados se mostraram simétricos, e o teste Mann-Whitney para os dados assimétricos, e para a distribuição dos dados, o teste Shapiro-Wilk. O nível de significância adotado nesse estudo foi  $p < 0,05$ . **Resultados:** verificou-se que de todas as variáveis do desempenho da leitura e da escrita, foram maiores para o grupo das crianças com dominância lateral completa do que para o grupo das crianças com lateralidade cruzada. Na escrita, houve diferença significativa entre os dois grupos, sendo atribuído melhor desempenho às crianças com lateralidade destro-completa. **Conclusão:** evidencia-se que as crianças com lateralidade cruzada apresentam desempenho inferior na leitura e escrita quando comparadas às crianças com dominância lateral completa. Estes dados justificam a relevância do desenvolvimento psicomotor na infância como fator essencial no processo de aprendizagem escolar.

**DESCRIPTORIOS:** Leitura; Escrita Manual; Lateralidade Funcional; Estudantes

**■ REFERENCES**

- Guardiola A, Ferreira LTC, Rotta NT. Associação entre desempenho das funções corticais e alfabetização em uma amostra de escolares de primeira série de porto alegre. *Arq Neuropsiquiatr.* 1998;56(2):281-8.
- Rocha NA, Tudella EA. Influência da postura sobre o estado comportamental e a coordenação mão-boca do bebê. *R Bras Fisioter.* 2002;6(3):167-73.
- Araujo MR, Minervino CASM. Avaliação cognitiva: leitura, escrita e habilidades relacionadas. *Psicol. Estud.* 2008;13(4):859-65.
- Lucena, NMG, Soares, DA, Soares LMMM, Aragão, POR, Ravagni E. Lateralidade manual, ocular e dos membros inferiores e sua relação com déficit de organização espacial em escolares. *Estud. Psicol.* 2010;27(1):3-11.
- Rider RA, Imwold CH, Griffin M, Sander A. Comparison of hand preference in trainable mentally handicapped en nonhandicapped children. *Percept Mot Skills.* 1985;61:1280-2.
- Rosa Neto F. Desenvolvimento neuropsicomotor do lactente ao ensino fundamental. Ed. Unisul, 2011.
- Tan LE. Laterality and motor skills in four-year-olds. *Child Dev.* 1985;56:119-24.
- Fonseca V. Manual de observação psicomotora: significação psiconeurológica dos factores psicomotores. 2ª ed. Lisboa. Ed Âncora. 2007.
- Corballis MC, Hattie J, Fletcher R. Handedness and intellectual achievement: an even-handed look. *Neuropsychologia.* 2008;46(1):374-8.
- Siviero MO, Rysovas EO, Juliano Y, DelPorto JA, Bertolucci PHF. Eye-hand preference dissociation in obsessive-compulsive disorders and dyslexia. *Arq Neuropsiquiatr.* 2002;60(2):242-5.
- Capellini SA, Souza AV. Avaliação da função motora fina, sensorial e perceptiva em escolares com dislexia do desenvolvimento. In: Sennyey AL, Capovilla FC, Montiel JM (Orgs.). *Transtornos de aprendizagem: da avaliação à reabilitação.* São Paulo: Artmed; 2008.
- Rosa Neto F, Santos ER, Toro J. Manual de Desempenho Escolar: Análise da leitura e escrita: Séries iniciais do Ensino Fundamental. Palhoça: Ed. Unisul, 2010.
- Rosa Neto F, Santos APM, Xavier RFC, Amaro KN. A Importância da avaliação motora em escolares: análise da confiabilidade da Escala de Desenvolvimento Motor. *Rev Bras Cineantropom Desempenho Hum.* 2010;12(6):422-7.
- Forchezatto R, Fachineto S. Lateralidade e equilíbrio em crianças de 1ª a 3ª série do município de Descanso/SC – diagnóstico e proposta de intervenção. *Cinergis.* 2009;10(1):8-15.

15. Faria AM. Lateralidade: implicações no desenvolvimento infantil. 2ª ed. Rio de Janeiro: Sprint, 2004.
16. Linares P. Educación psicomotriz e aprendizaje escolar: motricidad y disgrafía. Madrid: Polibea, 1993.
17. Fonseca V. Manual de observação psicomotora: significação psiconeurológica dos fatores psicomotores. Porto Alegre: Artmed, 1995b.
18. Corazza TDM, Brusamarello S, Cardoso FGC, Rosa Neto F. Validação de uma bateria de testes de Organização Espacial: Análise da Consistência Interna. *Temas desenvolv.* 2011;17(100):179-82.
19. Bobbio TG, Morcillo AM, Barros Filho AA, Gonçalves VMG. Avaliação da dominância lateral em escolares de dois níveis socioeconômicos distintos no Município de Campinas, São Paulo. *Rev. Paul. Pediatr.* 2006;24(3):200-6.
20. Habib M. Bases neurológicas dos comportamentos. Lisboa: CLIMEPSI, 2000.
21. Bell A. Left or righty? *Parenting.* 2005;19(5):1-9.
22. Rosa Neto, F, Almeida GMF, Caon G, Ribeiro J, Caram JA, Piucco EC. Desenvolvimento Motor de Crianças com Indicadores de dificuldades na aprendizagem escolar. *R. Bras. Ci. e Mov.* 2007;15(1):45-51.
23. Amaro KN, Santos AM, Jatobá, LG, Rosa Neto F. Desenvolvimento motor em escolares com dificuldades na aprendizagem. *Mov. Percepção.* 2010;11(16):39-47.
24. Rosa Neto F, Costa SH, Poeta LS. Perfil motor em escolares com problemas de aprendizagem. *Pediatr Mod.* 2005;41(3):109-17.
25. Rosa Neto F, Oliveira ÁJ, Pires MMS, Luna JLS. Perfil biopsicossocial de crianças disléxicas. *Temas desenvolv.* 2000;51(9):21-4.
26. Vasconcelos O. Asymmetries of manu motor response in relation to age, sex, handedness and professional activies. *Perceptual Motor Skills.* 1993;77:691-700.
27. Pedersen AV, Sigmundsson H, Whiting HT, Ingvaldsen RP. Sex differences in lateralisation of fine manual skills in children. *Brain Res Exp.* 2003;149(2):249-51.
28. Lofiego JL. Disgrafia: Avaliação Fonoaudiológica. Rio de Janeiro: Revinter, 1995.
29. Rodrigues SD, Castro MJMG, Ciasca SM. Relação entre indícios de disgrafia funcional e desempenho acadêmico. *Rev CEFAC.* 2009;11(2):221-7.
30. Zorzi JL. As inversões de letras na escrita o “fantasma” do espelhamento. *Pró-Fono R Atual. Cient.* 2001;13(2):212-8.
31. Alvim MPB, Borges OP. Análise da relação da estrutura espaço-temporal e alfabetização em crianças de 6 a 7 anos. (Resumo). *Rev Port Ciên Desp.* 2004;4(2):164.
32. Medina-Papst J, Marques I. Avaliação do desenvolvimento motor de crianças com dificuldades de aprendizagem. *Rev. Bras. Cineantropom. Desempenho Hum.* 2010;12 (1):36-42.

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