

Performance of public and private school students in cognitive and learning tasks

Desempenho de escolares de escola pública e privada em tarefas cognitivas e de aprendizagem

Desempeño de escolares de escuelas públicas y privadas en tareas cognitivas y de aprendizaje

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Abstract

Purpose: Learning in the early years of elementary school involves reading, writing, and mathematics skills, which are closely related to neurocognitive development and socioeconomic context. There is a clear disparity between public and private schools, with better performance observed in private schools, especially after the pandemic. This difference affects both academic performance and cognitive functions. Therefore, this study aimed to compare the academic and cognitive performance of first-grade students from public and private schools. **Methods:** This is a cross-sectional, quantitative, and exploratory study, part of the multicenter project “Multiprofessional intervention program to reduce pandemic-related harm

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for students, parents, and teachers: evidence from cognitive, physical and mental health, and occupational mapping.” The sample included 21 first-grade students, 10 from a public school and 11 from a private school. The School Performance Test – Second Edition (TDE-II), including the writing, reading, and arithmetic subtests, was used to assess academic performance, along with other tests for cognitive evaluation. **Results:** Private school students showed higher average scores in academic skills and in most of the cognitive skills assessed. Despite differences in the TDE-II subtests, both groups presented average scores above the expected norms. **Conclusion:** Better performance was observed among children from private schools in learning skills and in some cognitive indicators when compared to those from public schools. These results suggest the influence of educational and contextual factors on child development and point to the need for strategies aimed at reducing inequalities and promoting educational equity. Public schools require effective actions to promote educational equity.

Keywords: Literacy; Elementary School; Cognition; Executive Function; Socioeconomic Factors.

Resumo

Introdução: O aprendizado nos primeiros anos do Ensino Fundamental envolve habilidades em leitura, escrita e matemática, ligadas ao desenvolvimento neurocognitivo e ao contexto socioeconômico. Observa-se uma desigualdade entre as redes pública e privada, com desempenho superior da rede privada, especialmente após a pandemia. Essa diferença impacta tanto o rendimento acadêmico quanto as funções cognitivas. Diante disso, esta pesquisa teve como objetivo comparar o desempenho de crianças do primeiro ano do Ensino Fundamental das redes pública e privada em tarefas acadêmicas e cognitivas. **Métodos:** Estudo transversal, quantitativo e exploratório, vinculado ao projeto multicêntrico “Programa de intervenção multiprofissional de redução de danos da pandemia para estudantes, pais e professores: evidências de mapeamento cognitivo, de saúde física e mental, e laboral”. Fizeram parte da pesquisa 21 alunos do 1º ano do Ensino Fundamental, sendo 10 de escola pública e 11 de escola privada. Aplicou-se o Teste de Desempenho Escolar - Segunda Edição (TDE-II), subtestes de escrita, leitura e aritmética para avaliação da aprendizagem e outros testes padronizados para avaliação da cognição. **Resultados:** Estudantes das escolas privadas apresentaram médias superiores em comparação com os das escolas públicas nas habilidades acadêmicas e na maioria das habilidades cognitivas avaliadas. Apesar das diferenças nos subtestes do TDE-II, ambas as redes apresentaram médias acima das normas esperadas da avaliação. **Conclusão:** Observou-se melhor desempenho de crianças da rede privada em habilidades de aprendizagem e em alguns indicadores cognitivos, em comparação à rede pública. Esses resultados sugerem a influência de fatores educacionais e contextuais no desenvolvimento infantil e apontam para a necessidade de estratégias voltadas à redução das desigualdades e à promoção da equidade educacional. A rede pública exige ações efetivas para promover equidade educacional.

Palavras-chave: Alfabetização; Ensino Fundamental; Cognição; Função Executiva; Fatores Socioeconômicos.

Resumen

Introducción: El aprendizaje en los primeros años de la Educación Primaria implica habilidades de lectura, escritura y matemáticas, vinculadas al desarrollo neurocognitivo y al contexto socioeconómico. Se observa una desigualdad entre las redes pública y privada, con un desempeño superior en la red privada, especialmente después de la pandemia. Esta diferencia impacta tanto el rendimiento académico como las funciones cognitivas. En este contexto, el presente estudio tuvo como objetivo comparar el desempeño de niños de primer grado de la Educación Primaria de redes pública y privada en tareas académicas y cognitivas. **Métodos:** Estudio transversal, cuantitativo y exploratorio, vinculado al proyecto multicéntrico “Programa de intervención multiprofesional de reducción de daños de la pandemia para estudiantes, padres y docentes: evidencias de mapeo cognitivo, de salud física y mental, y laboral”. Participaron 21 estudiantes de primer grado de la Educación Primaria, 10 de escuela pública y 11 de escuela privada. Se aplicó el Test de Desempeño Escolar – Segunda Edición (TDE-II), incluyendo los subtests de escritura, lectura y aritmética para la evaluación del aprendizaje, así como otras pruebas estandarizadas para la evaluación

cognitiva. **Resultados:** Las escuelas privadas presentaron medias superiores en comparación con las escuelas públicas en las habilidades académicas y en la mayoría de las habilidades cognitivas evaluadas. A pesar de las diferencias en los subtests del TDE-II, ambas redes presentaron medias por encima de las normas esperadas de la evaluación. **Conclusión:** Se observó un mejor desempeño de los niños de escuelas privadas en habilidades de aprendizaje y en algunos indicadores cognitivos, en comparación con los de escuelas públicas. Estos resultados sugieren la influencia de factores educativos y contextuales en el desarrollo infantil y señalan la necesidad de estrategias orientadas a reducir las desigualdades y promover la equidad educativa. La red pública requiere acciones efectivas para promover la equidad educativa.

Palabras clave: Alfabetización; Educación Primaria; Cognición; Funciones Ejecutivas; Factores Socioeconómicos.

Introduction

Learning in Elementary Education develops through the acquisition of reading, writing, and mathematical skills, which are directly related to students' age, motivation, and stage of neurocognitive development. These academic competencies are considered fundamental, as they constitute the basis for the appropriation of other academic content throughout the school trajectory^{1,2}.

When addressing the literacy process, it is essential to consider the structural challenges faced by Brazilian education, particularly regarding disparities between public and private school systems. For more than a decade, studies have highlighted the influence of socioeconomic status on children's exposure to learning experiences and language development, which in turn impacts school-related difficulties^{3,4}. Although access to education has become universal, public and private schools still differ in terms of efficiency and learning opportunities.

Studies have demonstrated differences in reading and writing performance⁵ as well as arithmetic performance^{6,7} between students from public and private schools. Students from private schools showed superior results compared to those from public schools. Such discrepancies became even more evident in the post-pandemic period due to the limitations imposed by remote learning⁵.

The process of acquiring reading and writing skills is complex, as it involves metalinguistic and cognitive abilities, ranging from phonological decoding and encoding to text comprehension and production, thus requiring structured and continuous teaching practices⁸. In the context of the Portuguese language, the dual-route theory of reading and writing predominates: the phonological route, which is based on grapheme-phoneme conversion

for the recognition and encoding of unfamiliar words, and the lexical route, which occurs through direct access to visual representations stored in lexical memory^{9,10}.

In the field of mathematics, arithmetic skills begin with learning the four basic operations and play a central role in children's cognitive development¹¹. Mathematical competence is considered critical for individual success in adulthood, being associated with higher employability as well as better physical and mental health¹².

Several studies have demonstrated a significant predictive relationship between cognitive abilities — such as executive functions (EF), attention, and language — and academic performance in reading, writing, and mathematics^{2,13,14}. EF comprise processes such as working memory, inhibitory control, and cognitive flexibility, which are essential during the literacy period because they allow children to maintain focus, inhibit irrelevant stimuli, update relevant information, and shift between cognitive tasks¹⁵.

These cognitive abilities are also influenced by socioeconomic status. Children from families with lower socioeconomic status tend to present poorer cognitive development outcomes¹⁶. In Brazil, this relationship can be observed through performance on cognitive tasks when comparing students from public and private schools. Children attending private schools tend to perform better in aspects such as visual and auditory attention, planning, stimulus selection, and cognitive shifting. These differences are also associated with family environment, income, and parents' educational level¹⁷.

Despite the available evidence, further studies are still needed to investigate, in an integrated manner, children's performance in both cognitive and academic tasks (reading, writing, and arithmetic), especially at the beginning of Elementary Education, considering the specificities of public

and private school systems. Therefore, the present study aimed to compare the performance of first-grade elementary school children from public and private schools in reading, writing, arithmetic, and cognitive tasks.

Materials and methods

This is a cross-sectional study with a quantitative and exploratory approach. The present research is part of a multicenter project entitled: “Multidisciplinary intervention program for reducing the impacts of the pandemic on students, parents, and teachers: evidence from cognitive, physical and mental health, and occupational mapping.”

The study was approved by the Research Ethics Committee of the Pontifical Catholic University of Rio Grande do Sul under protocol number 5.760.268, with the Federal University of Santa Maria serving as a collaborating institution. The present study was conducted in accordance with the guidelines and regulatory standards for research involving human subjects, as established by Resolution 466/12 of the Brazilian National Health Council. To conduct the research, the participating schools signed the Institutional Authorization form consenting to the project, parents and/or legal guardians signed the Free and Informed Consent Form (FICF), and the students signed the Research Assent Form (RAF).

Participants

The participants of this study were first-grade elementary school students aged between 6 and 7 years from one public and one private school in the state of Rio Grande do Sul. The institutions were selected by convenience sampling in the municipality of Santa Maria. A total of 44 students were invited to participate in the study. Of these, twenty-three agreed to participate; however, one student was absent from school on the assessment days, and another had a previous diagnosis of Attention-Deficit/Hyperactivity Disorder and Autism Spectrum Disorder. Thus, the final sample consisted of 21 students, including 10 from the public school and 11 from the private school.

Due to delays in institutional authorization for the beginning of data collection, assessments were conducted at two different moments during the academic year: students from the public school were

evaluated at the end of the first semester, whereas students from the private school were assessed at the end of the second semester.

Participants were selected according to the following inclusion and exclusion criteria: being enrolled in the first year of Elementary Education, having Brazilian Portuguese as their native language, and not presenting any prior diagnosis of neurodevelopmental disorders (information provided by the schools). It is important to note that the children did not differ significantly in age ($M = 6.43$; $SD = 0.507$; $p = 0.099$) or in general intelligence level ($M = 25.52$; $SD = 4.523$; $p = 0.145$). General intelligence was assessed using Raven's Colored Progressive Matrices (CPM)¹⁸.

Procedures and Instruments

For the assessment of the participants, standardized tests were used to evaluate cognitive functions, language, memory, reading, writing, and arithmetic. All protocols were administered individually, in a quiet environment, during the period most frequently attended by the child at school. The sequence and duration of the tasks are described below.

The Attention Cancellation Test (ACT)¹⁹ can be administered to children aged 5 to 14 years and consists of three printed matrices with different types of stimuli. The first and second stages assess selective attention, whereas the third stage evaluates alternating attention. Task execution requires approximately one minute and is conducted simultaneously with the examiner at a maximum time of one minute per task. Each stage is composed of a specific number of target stimuli which, when identified, receive one point each. The three matrices total 107 targets. Partial scores are calculated for each stage, in addition to the total score, according to the participant's age group described in the manual. In the present study, only the total correct score was used.

The Free Verbal Fluency Test²⁰ was used to evaluate several cognitive processes and language abilities, including monitoring, cognitive flexibility, planning, initiation and processing speed, as well as lexical-semantic memory, working memory, and linguistic abilities such as organization and retrieval strategies. The test can be administered to children aged 6 to 12 years. The child must verbally produce as many words as possible within two

minutes, while avoiding words that are not allowed (proper names and numbers). Each word produced correctly is repeated aloud at one-second intervals until the child exhausts the available words (types of errors, retrieval strategies, and evocations). In the present study, only quantitative data were analyzed through the participant's total score and score type.

The Hayling Infant Test²¹ is a verbal instrument designed to assess inhibitory control, cognitive flexibility, and processing speed through a sentence completion task. The test is divided into two parts (A and B). It evaluates children between 6 and 12 years of age. In Part A, the child must complete a sentence with a word that makes sense and is semantically related to the sentence as quickly as possible. Reaction time in seconds is recorded for the 10 sentences administered, as well as the total number of errors. In Part B, the child must complete the sentence with a word that is unrelated in meaning to the sentence, as quickly as possible. In this stage, reaction time in seconds is again recorded for the 10 administered sentences, together with the total number of errors and the sum of error scores for each task type. In the present study, only the scores from each task were considered, according to the correction criteria for each child.

The Digit Span Test²² can be administered to children aged 4 to 10 years. This instrument is used to assess short-term memory storage capacity and working memory. The test consists of two parts: forward span, in which the child repeats a sequence of numbers in the same order spoken by the examiner; and backward span, in which the child repeats the digit sequence in reverse order. In the forward span task, the examiner says three consecutive numbers aloud, and the child must repeat them in the same sequence. To score the test, the number of correct responses in Part 1 is summed, resulting in the raw score for forward span, while in Part 2 the number of correct responses is summed for the backward span score.

The School Performance Test – Second Edition (TDE II)²³, composed of the Reading, Writing, and Arithmetic subtests, was used to analyze fundamental abilities related to academic performance. This instrument is used as a universal screening tool for the learning process in students from the 1st to the 9th grades of Elementary Education in both public and private schools.

In the Reading subtest, the assessment consists of 36 isolated words. The child is instructed to read all words aloud in the way they believe to be correct. The subtest is discontinued after 10 consecutive errors or when the child is unable to read the presented words. Scoring is performed quantitatively, with each correctly read word corresponding to one point (correct = 1 point; errors = 0), and qualitatively, considering the types of errors, reading strategies used, and number of attempts to read each word.

The Writing subtest evaluates the writing of 40 isolated words dictated to the child. Each word is repeated twice before the child begins writing. A third repetition is not permitted if requested. The assessment is discontinued after 10 consecutive errors or when the child is unable to write the dictated words. Scoring is based on quantitative analysis (1 point for correct responses, 0 for incorrect responses, and X for “does not know”) and qualitative analysis of orthographic errors, including phoneme-grapheme conversion, contextual spelling rules, language irregularities, and word-level errors. Any written production that differs from the graphically correct form of the word is considered an error.

The Arithmetic subtest is divided into two parts, totaling 37 items, which assess numerical processing, the ability to solve and identify the four basic arithmetic operations (addition, subtraction, multiplication, and division), the ability to write decimal numbers, and basic concepts of fractions. The first stage comprises items 1 to 11, which are read aloud by the examiner, whereas the second stage includes items 12 to 37, consisting of calculations to be solved by the child. The test is discontinued after 6 consecutive errors or when the child is unable to solve the presented calculations. Scoring of the subtest is quantitative (1 point for correct responses, 0 for incorrect responses, and X for “does not know”), while the types of strategies used to solve the problems are qualitatively recorded.

Data Analysis

Data were analyzed using the Independent Samples t-test or the Mann–Whitney U test, according to the results of the Shapiro–Wilk normality test. Thus, the variables Hayling A, Hayling B, Digit Span Correct Responses – Forward Order,

Forward Span, Backward Span, Reading, and Writing were best described using measures of central tendency based on percentiles, particularly the median, according to the Shapiro–Wilk normality test. Differences were considered statistically significant when $p < 0.05$. Statistical analyses were performed using the IBM SPSS Statistics statistical software package.

Results

Table 1 presents the means, medians, and standard deviations of the performance variables in learning assessment tasks (writing, reading, and arithmetic) and cognitive function measures (ACT, Digit Span, Free Verbal Fluency – FVF, and Hayling Test).

Table 1. Comparison of the means and medians of learning assessment and executive function scores between public and private schools

	School type	Public			Private			p-value
	Variável	Mean	Median	SD	Mean	Median	SD	
TDE-II	Reading	8.90	5.50	11.911	28.27	31.00	8.113	0.002
	Writing	6.80	4.00	7.871	15.09	14.00	6.564	0.020
	Arithmetic	9.10	9.00	3.035	13.64	14.00	3.613	0.006
Cognitive Function	FVF	30.60	28.50	18.204	27.09	30.00	13.141	0.616
	Hayling A Errors	1.40	1.00	0.843	0.82	1.00	0.751	0.152
	Hayling B Errors	5.90	6.00	1.287	4.09	4.00	1.700	0.013
	Digit Correct Responses FO	5.20	5.00	1.033	5.91	6.00	0.831	0.132
	Digit Span FO	3.90	4.00	0.738	4.27	4.00	0.467	0.282
	Digit Correct Responses BO	3.60	4.00	1.350	3.55	4.00	1.036	0.918
	Digit Span BO	2.80	3.00	0.789	3.00	3.00	0.632	0.557
	ACT matrix 1	30.20	28.50	13.596	38.09	42.00	9.170	0.132
	ACT matrix 2	1.30	1.00	0.823	2.91	3.00	1.814	0.019
	ACT matrix 3	18.50	19.00	5.421	23.55	24.00	4.156	0.026
	ACT total	50.00	47.50	16.713	64.55	62.00	13.079	0.038

Legenda: SD= standard Deviation; FVF= Free Verbal Fluency; ACT= Attention Cancellation Test. FO= Forward Order; BO= Backward Order
T test or Mann-Whitney, according to Shapiro-Wilk.
 $p^* > 0.05$

When analyzing the obtained results and comparing the two school systems, differences were observed in all learning tasks (reading, writing, and arithmetic) as well as in cognitive tasks involving inhibition and cognitive flexibility (Hayling Test – Part B), selective attention (ACT, Matrix 2), and alternating attention (ACT, Matrix 3). Students from the public school demonstrated poorer performance (Table 1).

It is important to highlight that, although differences were observed across the three TDE-II subtests, the mean performance scores remained above the expected range according to the assessment norms.

Discussion

The present study aims to compare first-grade children from public and private schools in cognitive tasks, reading, writing, and arithmetic. The results showed that children from the private school demonstrated better performance in most of the analyzed tasks, both cognitive and academic.

As expected, the groups differed in reading, writing, and arithmetic tasks. These findings reinforce what previous studies have discussed regarding the influence of the school environment on the development of learning abilities and the disparities between educational systems^{6,7}.

Good performance in these academic skills requires an environment that enhances the learning process. However, it is also important to emphasize that these results may be related to the timing of data collection, since students from the private school may have been advantaged by being assessed at the end of the academic year.

Although the results showed that, overall, students maintained performance within the expected average range when compared with the normative sample of the TDE-II, the differences observed between school systems reinforce the influence of the school environment on the development of these abilities⁵. Even the normative standards of assessment instruments differ for children from public and private schools due to these performance differences. When analyzing children's results according to the TDE-II norms for reading, for example, both groups would still be classified within the expected range considering school type, public ($M = 8.55$) and private ($M = 27.67$). The same pattern was observed for writing and arithmetic, with mean scores of public ($M = 5.18$) and private ($M = 18.79$), and public ($M = 8.07$) and private ($M = 12.63$), respectively²³. Among the hypotheses proposed to explain inequalities in academic achievement are teaching methodology, availability of advanced educational materials, and smaller classroom sizes⁵. Moreover, these discrepancies became even greater during the pandemic period.

Regarding cognitive tasks, differences between groups were observed in tasks requiring inhibitory control and cognitive flexibility (Hayling B), as well as alternating and complex selective attention (ACT Matrix 2 and ACT Matrix 3). These abilities exert a direct influence on the learning process. Reading performance, for example, is associated with inhibitory capacity, especially interference control, and cognitive flexibility. Arithmetic performance is related to attention, cognitive flexibility, and inhibition, particularly with respect to the control of impulsive responses¹⁴. In addition, visuospatial attention, executive attention, and inhibitory control are important for the acquisition of writing skills².

Regarding cognitive tasks, no differences were observed between groups in Free Verbal Fluency, digit span (forward and backward order), or more basic attention measures (ACT Matrix 1). Free Verbal Fluency involves language, cognitive flexibility, working memory, and planning; digit span

assesses short-term and working memory; and ACT Matrix 1 investigates sustained and selective attention. Although normative data for these tests indicate differences between school systems, in the present study the type of school did not influence these abilities^{20,22}.

This finding may indicate that certain core cognitive abilities develop more homogeneously at this age range and may therefore be less sensitive to early school-related differences. Alternatively, the reduced sample size may have limited the detection of subtle differences between groups. It is also possible that, during the first year of Elementary Education, pedagogical factors and learning opportunities have a more direct impact on academic performance than on basic cognitive abilities that are already consolidating.

Furthermore, recent studies^{2,24,25} indicate that these cognitive abilities have a strong predictive relationship with academic performance in reading, writing, and arithmetic. Specifically, working memory and selective attention show a strong influence on mathematical performance, whereas cognitive flexibility is particularly relevant for reading and writing unfamiliar words, and inhibitory control is essential for distinguishing graphically similar words.

Although these cognitive abilities appeared to be relatively well developed in both groups, they do not seem to have contributed effectively to literacy acquisition, since TDE-II scores were lower in the public-school group (Table 1). Given the recognized influence of these abilities on academic performance and the absence of differences between groups in the aforementioned measures, the hypothesis is reinforced that the observed variations in reading, writing, and arithmetic are not exclusively due to individual factors. Rather, these differences seem to be more strongly associated with external factors, such as the school environment, socioeconomic status, and teaching methodology, aspects that were not explored in depth in the present study²⁶.

Among the limitations of this study, the reduced number of participants in each group should first be highlighted, as this restricts the statistical power of the analyses and limits the generalizability of the findings. In addition, the sample consisted of students from only two schools selected by convenience sampling, which reduces representativeness regarding other educational contexts.

Another important limitation concerns the fact that assessments were conducted at different moments during the academic year, since students from the public school were assessed at the end of the first semester, whereas students from the private school were assessed at the end of the second semester. This temporal difference may have particularly influenced developing abilities such as reading, writing, arithmetic, and executive functions, which tend to change throughout schooling.

As highlighted by Turesky et al.²⁸, brain development and the acquisition of academic abilities during the early years are dynamic processes, characterized by accelerated changes during critical literacy periods. Therefore, the findings should be interpreted with caution. Finally, the cross-sectional design and the absence of direct measures of contextual variables, such as family socioeconomic status and pedagogical characteristics of the schools, prevent causal inferences regarding the factors associated with the observed differences between groups.

Conclusion

In the present study, first-grade elementary school children from the private school system demonstrated better performance in learning tasks and in some cognitive indicators when compared to children from the public school system. These findings should be interpreted within the post-pandemic context and may be related to differences in school, pedagogical, and socioeconomic factors.

Despite the differences observed between the groups, both presented performance within the expected average range for reading, writing isolated words, and solving basic arithmetic operations. However, the lower mean performance observed in the public-school group reinforces the importance of actions aimed at promoting equity in the teaching and learning process.

Finally, further studies with larger samples and longitudinal designs are recommended to deepen the understanding of academic and cognitive development during the early years of schooling.

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