Effectiveness of a metaphonological and reading remediation program for students with learning difficulties

Eficácia do programa de remediação metafonológica e de leitura para escolares com dificuldades de aprendizagem

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ABSTRACT

Purpose: To verify the effectiveness of the computerized version of a metaphonological and reading remediation program for students with learning difficulties. **Methods:** Participants were 600 2nd to 4th grade students from public elementary schools distributed into Groups I (GI) and II (GII). GI was composed by 300 students with learning difficulties subdivided into GIc: 150 students who were not submitted to the metaphonological and reading remediation program; and GIe: 150 students submitted to the metaphonological and reading remediation program. GII consisted of 300 students with good academic performance subdivided into GIIc: 150 students who were not submitted to the remediation program, and GIIe: 150 students submitted to the metaphonological and reading remediation program. The computerized metaphonological and reading remediation program was developed to be used in evaluation and intervention. The program had three stages: pre-testing, intervention and post-testing. **Results:** Differences were found between pre and post-tests for GIe subjects in all tests of the evaluation version of the program and in all abilities emphasized on the remediation program, and for GIIe subjects in the sound recognition, segmentation and phonemic manipulation tasks. **Conclusion:** The findings evidence the effectiveness of the computerized metaphonological and reading remediation program developed for this study, since the students with learning difficulties submitted to the remediation program developed the metaphonological abilities required for reading development.

Keywords: Learning; Evaluation/methods; Reading; Learning disorders; Comprehension; Computer-assisted instruction

INTRODUCTION

To increase his or her metaphonological capacities, in other words, in order to reflect about language and acquire ability to think about his or her own language, the child has to develop in parallel to language aspects (phonological, morphologic and syntactic levels) the metaphonological capacity, in its phonological level. In this way, the child starts to reflect about the sound system of the language, and acquires awareness of sentences, words, syllables and phonemes as smaller unities[1-4].

Studies have shown that the abilities of the phonological process are related to reading acquisition[5,6]; because the phonological process is divided into: phonological awareness, related to the awareness of the sound structure of the speech; rapid naming, referent to the velocity in naming objects, letters and colors, reflecting, in this way, on the ability of decoding and read words; and phonological memory, related to the capacity of decoding or impression of temporary phonological information, before storing it in the long-term memory[7].

Thus, the direct instruction of phonological awareness combined with the instruction of grapheme-phoneme correspondence assists in the acquisition of the alphabetical principle and the successful development of metaphonological abilities, supporting reading acquisition[2,3,8,9].

In general, the students who fail in the acquisition of the alphabetical principle also fail in the development of initial abilities of reading words; that is, the students with reading disabilities have difficulties in metaphonological tasks. This fact supports the idea that these students present a central phonological deficit, and, as they proceed in grade level, they start to manifest problems related to fluency and reading comprehension[10,11].

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In other words, the students who show reading disabilities in the initial grades of alphabetization, and who remain without instruction to the learning of the alphabetical principle, will persist with the same difficulties during their academic life. In the following years, these difficulties accentuate, and there is an increase in the difference of performance between the students with reading difficulties and their class-group[12,13].

There is no consensus on the definition of learning disability, nor is it agreed upon how, why or when it manifests. Learning disabilities are characterized by a heterogeneous group of manifestations that cause low academic achievement in reading, writing and mathematical calculus tasks. They may be categorized as transitional and occur at any moment in the teaching-learning process[14,15].

In this way, there is a concern for the minimization of the impact and the overcoming of these difficulties in the following years. In this direction there are studies about intervention programs that act on the metaphonological basis of these difficulties[16-18].

Based on what has been shown, this study aims to verify the effectiveness of the program of metaphonological and reading remediation, elaborated in a computerized version, for students with learning disabilities.

METHODS

This study was approved by the Ethical Committee in Research of the School of Philosophy and Sciences of Universidade Estadual Paulista "Júlio de Mesquita Filho" – FFC/UNESP – Marília, under the protocol number 3326/2006.

All the parents or guardians were informed about the procedures of the data collection and signed the Free and Informed Consent Form on behalf of the children.

A number of 600 students from both genders, attending 1st to 4th grades of five municipal public schools of three cities in the state of São Paulo (SP), participated in this study, in the age range between 8 and 12 years old, distributed into two groups:

- Group I (GI): composed by 300 students attending 2nd to 4th grades of elementary level, with learning difficulties, subdivided into Group Ic (GIc): composed by 150 students with learning difficulties, who were not submitted to the metaphonological and reading remediation program; and Group Ie (GIe): composed by 150 students with learning difficulties, submitted to the metaphonological and reading remediation program.
- Group II (GII): composed by 300 students attending 2nd to 4th grades of the elementary level, with good academic performance, subdivided into group IIc (GIIc): composed by 150 students with good academic performance, who were not submitted to the metaphonological and reading remediation program; and Group IIe (GIIe): composed by 150 students with good academic performance, who were submitted to the metaphonological and reading remediation program.

The indication of the students with and without learning difficulties was performed by the teachers from the five municipal public schools where the study was realized, based on the students' development report. The students did not present any cognitive, hearing and visual alterations described in the school records.

The procedure used for evaluation in the situation of pretesting was the metaphonological and reading remediation program in the computerized version[19]. This program was composed by an evaluation session of approximately 30 minutes, realized individually. The answers to these activities were provided through the mouse utilization by the student, who should indicate, with the cursor, the right answer, on the computer screen. The answers were registered by the number of correct marks.

The evaluation was composed by the following activities, applied in the same order to all the students: *reading of words and nonwords*: 21 pictures were presented for the students to recognize among the 42 presented words which ones corresponded to the pictures; *nonwords reading*: 12 real words and 12 nonwords were presented for the student to recognize among the 24 stimuli the nonwords; *rhyme identification*: 40 pictures were presented for the student to recognize when the pictures names presented rhyme; *alliteration identification*: 40 pictures were presented for the student to recognize alliteration; *sounds discrimination*: 40 pictures were presented for the student to recognize if they began with the same sound; *syllabic segmentation*: ten pictures and numbers were presented and the students had to indicate the number of syllables corresponding to each word*; phonemic segmentation*: ten pictures followed by numbers were presented and the students had to indicate the correspondent number of sounds in each word; *syllabic manipulation*: pictures were presented for the students to combine the first syllable of the word in the first picture and the last syllable of the word in the second one to form a new word; and *phonemic manipulation*: pictures were presented for the student to combine the first sound of the first picture with the last sound of the second picture.

In the intervention the metaphonological and reading remediation program in the computerized version[19] was used, composed by six sessions of remediation per student, in the same presentation order, realized twice a week with approximately 50 minutes of duration. In each session the following sequence was presented:

Alphabet sequence presentation for the child to identify the letter name and sound; oral reading of words and nonwords presented in the computer screen; grapheme/phoneme presentation (grapheme/phoneme relation independent from the context) to select the pictures which presented the target grapheme/phoneme in initial, medial and final position; presentation of syllables for the selection of pictures which presented the target syllable in initial, medial and final position; presentation of two graphic stimuli, a dissyllable and a trisyllable real word and nonword, for the students to form, from the syllabic and phonemic segments, new real dissyllable and trisyllable words; presentation of picture, for the identification of those which begin with the same sound (alliteration) and end with the same sound (rhyme); and presentation of ten words in each session for the students, in order to verify the number of correct marks (reading accuracy). Five different words and nonwords were presented in each session.

The program was realized in the computer lab of the school, containing 20 computers, with multimedia kit built-in and speakers, in which the sounds and words used were emitted. This process occurred by the mouse utilization and the activation of sound files by clicking on the computer screen. In the computer lab, besides the researcher, responsible for the monitoring of the task realization and identification of tasks that should be developed, there were also teachers and interns from the areas of Pedagogy and Speech and Hearing Therapy. After the explanation of each activity, the students counted with an only chance for the realization of the activity of each item worked, being their right answer positively enhanced by the clapping sounds emission.

The stimuli (figures, words and non words) used for the elaboration of the program, in its evaluative and interceptive version, of this study derived of the word bank elaborated from Portuguese Language books that are used by the municipal school system.

The evaluation after the testing consisted in the reapplication of the computerized metaphonological and reading remediation program, in the evaluative version.

The results analysis was realized with the application of the Friedman Test, in order to verify possible differences between the variable components of each remediation strategy, to each group, and the Wilcoxon Signed-rank test in order to check for possible differences among the groups in pre an post-testing. The results were statically analyzed by the SPSS program (Statistical Package for Social Sciences), in its 13,0 version, with significance level of 5% (0,050) to the statistic tests application.

RESULTS

When the average of the students from GIc and Gie were compared in pre and post-testing, it was observed that there was no difference between the pre and post evaluation in GIc results. This result indicates that there was no difference on the performances of these students, while in GIe there were differences at all tests, what reveals that after the application of the program on its interceptive version, the students improved their performance in the evaluation tests, evidencing the therapeutic effectiveness of the program (Table 1).

When the average of the students from GIIc and GIIe were compared in pre and post evaluation, it was observed that there was no difference between the pre and post evaluation in GIIc results and, therefore, there was no difference in the performance of these students. In GIIe differences occurred only in phonemic segmentation and manipulation tests, which reveals that after the application of the program on its interceptive version, the students improved their performance in the evaluation tests. This highlights the therapeutic effectiveness of the program for these abilities (Table 2).

The results of the averages comparison, standard deviation and median of the marks of students from GIe and GIIe during the six sessions of the remediation program may be observed in Tables 3 to 5.

When the Friedman Test was applied, it was observed that differences occurred in all the abilities worked in therapeutic situation with GIe. Between the first and the last session there was an increase in the students' performances. It was observed that positive difference occurred only in the ability of recognition of sounds from the letters of the alphabet, which was interpreted as an increase in the performance of the students from GIIe in relation to this ability.

DISCUSSION

This study evidenced the difference in the performance of the students from GI and GII in relation to the reading and metaphonological abilities. This result corroborates the findings of the literature which evidence that students with learning difficulties show discrepancy in relation to their peers in reading abilities[20,21].

The inferior performance of GI in relation to the abilities of phonological awareness and reading of words and nonwords confirms the literature[21,22], which describes inferior results in phonological awareness in students with learning difficulties.

The results obtained by the students from GIe, who showed inferior performance in the tests of sound discrimination, reading of words and nonwords, sound and syllable segmentation and manipulation and also in the phonological awareness ability (rhyme and alliteration), if compared in pre and post-testing situations, are in agreement with the literature[23,24]. For these authors the students with learning difficulties show deficits in the perception of phonemes and in the abilities of temporal ordering judgment, identification and discrimination.

The difficulties in relation to the recognition of a standard of letters in the word as a unity, verified in the inferior performance of GI, corroborates national and international studies[25,26]. These studies link the presence of alteration in memory and in hearing perception in children with learning difficulties, what disturbs the maintenance of a fluent reading. The literature indicates that intervention programs of a phonological basis are efficient to reach greater reading accuracy[9] and this can be verified in the reading performance of GIe, which presented improvement in this ability after being submitted to the remediation program, while the GIc did not present the same result.

The superior performance of the experimental groups in metaphonological abilities and in reading of words and nonwords corroborates the literature[8]. Hearing, visual and memory abilities are implied in the acquisition of reading abilities, and are necessary abilities for the learning of the Brazilian Portuguese writing system.

In this way, it was verified that the more efficient decoding, of both words and nonwords, relieves the cognitive load, allowing more attention to be directed to reading[27].

In this study, the students with reading difficulty (GI) showed difference in pre and post evaluation situation, in the scores obtained for fast automatic naming of pictures and fast automatic naming of digits, which was interpreted as an improvement in working memory after the intervention program. This result has a direct reflex in the reading ability due to the relation between its development and the working memory

Table 1. Distribution of mean, standard desviation, median and p-value of students from GIc and GIe in pre and post evaluation situation in the evaluative version of the program

Group	Variables	Mean	SDesv	Minimum	Maximum	Median	p-value
GIc	RW_PRE	19.99	0.35	19.00	21.00	20.00	0.317
	RW_POS	19.99	0.36	19.00	21.00	20.00	
GIe	RW_PRE	19.51	0.99	16.00	21.00	20.00	<0.001*
	RW_POS	21.00	0.00	21.00	21.00	21.00	
GIc	RNW_PRE	10.07	0.62	8.00	12.00	10.00	0.317
	RNW_POS	10.08	0.64	8.00	12.00	10.00	
GIe	RNW_PRE	10.01	0.56	8.00	12.00	10.00	<0.001*
	RNW_POS	12.00	0.00	12.00	12.00	12.00	
GIc	RHYME_PRE	19.19	2.24	10.00	20.00	20.00	0.317
	RHYME_POS	19.17	2.25	10.00	20.00	20.00	
GIe	RHYME_PRE	19.14	2.03	10.00	20.00	20.00	<0.001*
	RHYME_POS	20.00	0.00	20.00	20.00	20.00	
GIc	ALIT_PRE	19.51	1.59	10.00	20.00	20.00	0.317
	ALIT_POS	19.49	1.59	10.00	20.00	20.00	
GIe	ALIT_PRE	19.57	1.21	10.00	20.00	20.00	<0.001*
	ALIT_POS	20.00	0.00	20.00	20.00	20.00	
GIc	SD_PRE	14.61	1.60	11.00	18.00	15.00	>0.999
	SD_POS	14.61	1.60	11.00	18.00	15.00	
GIe	SD_PRE	14.89	0.74	10.00	18.00	15.00	<0.001*
	SD_POS	20.00	0.00	20.00	20.00	20.00	
GIc	SS_PRE	8.39	0.84	6.00	10.00	8.00	0.317
	SS_POS	8.40	0.85	6.00	10.00	8.00	
GIe	SS_PRE	7.98	0.96	5.00	9.00	8.00	<0.001*
	SS_POS	10.00	0.00	10.00	10.00	10.00	
GIc	PS_PRE	2.18	2.07	0.00	8.00	2.00	>0.999
	PS_POS	2.18	2.07	0.00	8.00	2.00	
GIe	PS_PRE	0.87	1.19	0.00	5.00	0.00	<0.001*
	PS_POS	10.00	0.00	10.00	10.00	10.00	
GIc	PM_PRE	1.35	1.52	0.00	5.00	1.00	>0.999
	PM_POS	1.35	1.52	0.00	5.00	1.00	
GIe	PM_PRE	0.16	0.48	0.00	2.00	0.00	<0.001*
	PM_POS	5.00	0.00	5.00	5.00	5.00	
GIc	SM_PRE	4.90	0.54	0.00	5.00	5.00	>0.999
	SM_POS	4.90	0.54	0.00	5.00	5.00	
GIe	SM_PRE	4.69	0.83	2.00	5.00	5.00	<0.001*
	SM_POS	5.00	0.00	5.00	5.00	5.00	

* Significant values (p≤0.050) – Wilcoxon Signaled Tests

Note: RW = reading words; RNW = reading nonwords; ALIT = alliteration; SD = sound discrimintation; SS = syllabic segmentation; PS = phonemic segmentation; PM = phonemic manipulation; SM = syllabic manipulation; SDesv= standard deviation

development; in which the establishment and manipulation of the phonologic representations will occur[28].

The students with learning difficulties presented increase in all the evaluated abilities, corroborating the authors' results[29,30], who found difference before and after the evaluation, in the access of phonological awareness tasks, after the application of the phonological stimulation program that includes phonological awareness activities and metalinguistic abilities. These results are in accordance with the literature that links the effectiveness of the interventions programs that use strategies of phonological awareness and reading [16-18].

In addition, the study showed that both experimental groups beneficiated from the program, and that the learning of the letter and sound relation by the students with no difficulties favored the development of segmentation abilities and phonemic manipulation. This highlights the necessity of teaching

Table 2. Distribution of mean, standard desviation, median and p-value of students from GIIc and GIIe in pre and post evaluation situation in the evaluative version of the program

Group	Variables	Mean	SDesv	Minimum	Maximum	Median	p-value
GIIc	RW_PRE	21.00	0.00	21.00	21.00	21.00	>0.999
	RW_POS	21.00	0.00	21.00	21.00	21.00	
GIIe	RW_PRE	21.00	0.00	21.00	21.00	21.00	>0.999
	RW_POS	21.00	0.00	21.00	21.00	21.00	
GIIc	RNW_PRE	12.00	0.00	12.00	12.00	12.00	>0.999
	RNW_POS	12.00	0.00	12.00	12.00	12.00	
GIIe	RNW_PRE	12.00	0.00	12.00	12.00	12.00	>0.999
	RNW_POS	12.00	0.00	12.00	12.00	12.00	
GIIc	RHYME_PRE	20.00	0.00	20.00	20.00	20.00	>0.999
	RHYME_POS	20.00	0.00	20.00	20.00	20.00	
GIIe	RHYME_PRE	20.00	0.00	20.00	20.00	20.00	>0.999
	RHYME_POS	20.00	0.00	20.00	20.00	20.00	
GIIc	ALIT_PRE	20.00	0.00	20.00	20.00	20.00	>0.999
	ALIT_POS	20.00	0.00	20.00	20.00	20.00	
GIIe	ALIT_PRE	20.00	0.00	20.00	20.00	20.00	>0.999
	ALIT_POS	20.00	0.00	20.00	20.00	20.00	
GIIc	SD_PRE	20.00	0.00	20.00	20.00	20.00	>0.999
	SD_POS	20.00	0.00	20.00	20.00	20.00	
GIIe	SD_PRE	20.00	0.00	20.00	20.00	20.00	>0.999
	SD_POS	20.00	0.00	20.00	20.00	20.00	
GIIc	SS_PRE	10.00	0.00	10.00	10.00	10.00	>0.999
	SS_POS	10.00	0.00	10.00	10.00	10.00	
GIIe	SS_PRE	10.00	0.00	10.00	10.00	10.00	>0.999
	SS_POS	10.00	0.00	10.00	10.00	10.00	
GIIc	PS_PRE	0.03	0.21	0.00	2.00	0.00	0.317
	PS_POS	0.04	0.26	0.00	2.00	0.00	
GIIe	PS_PRE	0.23	0.52	0.00	2.00	0.00	<0.001*
	PS_POS	10.00	0.00	10.00	10.00	10.00	
GIIc	PM_PRE	0.01	0.16	0.00	2.00	0.00	>0.999
	PM_POS	0.01	0.16	0.00	2.00	0.00	
GIIe	PM_PRE	0.11	0.33	0.00	2.00	0.00	<0.001*
	PM_POS	5.00	0.00	5.00	5.00	5.00	
GIIc	SM_PRE	5.00	0.00	5.00	5.00	5.00	>0.999
	SM_POS	5.00	0.00	5.00	5.00	5.00	
GIIe	SM_PRE	5.00	0.00	5.00	5.00	5.00	>0.999
	SM_POS	5.00	0.00	5.00	5.00	5.00	

* Significant values (p≤0.050) – Wilcoxon Signaled Tests

Note: RW = reading words; RNW = reading nonwords; ALIT = alliteration; SD = sound discrimination; SS = syllabic segmentation; PS = phonemic segmentation; PM = phonemic manipulation; SM = syllabic manipulation; SDesv = standard deviation

the correspondence between letters and sounds, characteristic of the Brazilian Portuguese writing system.

In this study, it was observed that the students from GIe submitted to the remediation responded to the realized intervention, in other words, the program was efficient because it provided the acquisition of the necessary abilities for alphabetization; in this way, teachers need to be oriented by speech therapists about the necessity of focusing on the metaphonological and reading abilities in the initial grades of alphabetization to support the learning of the Brazilian Portuguese alphabetic principle, regardless of the methodology of alphabetization used in classroom[8].

One limitation of the study is that the computerized program does not provide the data related to the correct marks in the form of a report. However, this limitation is about to be overcome and used in further researches.

Table 3. Distribution of mean, standard deviation, median and significance value of students from GIe and GIIe as to the ability of recognizing the alphabetic letter (RL), recognizing of sounds of alphabetic letters (RS) and grapheme/phoneme identification (GPI)

Groups	Variables	Mean	SDesv	Minimum	Maximum	Median	p-value
GIe	RL1	22.63	0.70	20.00	23.00	23.00	<0.001*
	RL2	23.00	0.00	23.00	23.00	23.00	
	RL3	23.00	0.00	23.00	23.00	23.00	
	RL4	23.00	0.00	23.00	23.00	23.00	
	RL5	23.00	0.00	23.00	23.00	23.00	
	RL6	23.00	0.00	23.00	23.00	23.00	
GIIe	RL1	23.00	0.00	23.00	23.00	23.00	>0.999
	RL2	23.00	0.00	23.00	23.00	23.00	
	RL3	23.00	0.00	23.00	23.00	23.00	
	RL4	23.00	0.00	23.00	23.00	23.00	
	RL5	23.00	0.00	23.00	23.00	23.00	
	RL6	23.00	0.00	23.00	23.00	23.00	
GIe	RS1	1.95	0.37	1.00	4.00	2.00	<0.001*
	RS2	10.17	1.53	6.00	19.00	10.00	
	RS3	23.00	0.00	23.00	23.00	23.00	
	RS4	23.00	0.00	23.00	23.00	23.00	
	RS5	23.00	0.00	23.00	23.00	23.00	
	RS6	23.00	0.00	23.00	23.00	23.00	
GIIe	RS1	1.96	0.23	1.00	3.00	2.00	<0.001*
	RS2	23.00	0.00	23.00	23.00	23.00	
	RS3	23.00	0.00	23.00	23.00	23.00	
	RS4	23.00	0.00	23.00	23.00	23.00	
	RS5	22.99	0.12	22.00	23.00	23.00	
	RS6	23.00	0.00	23.00	23.00	23.00	
GIe	GPI1	0.00	0.00	0.00	0.00	0.00	<0.001*
	GPI2	0.57	0.78	0.00	2.00	0.00	
	GPI3	3.00	1.77	1.00	8.00	2.00	
	GPI4	12.00	0.00	12.00	12.00	12.00	
	GPI5	12.00	0.00	12.00	12.00	12.00	
	GPI6	12.00	0.00	12.00	12.00	12.00	
GIIe	GPI1	12.00	0.00	12.00	12.00	12.00	>0.999
	GPI2	12.00	0.00	12.00	12.00	12.00	
	GPI3	12.00	0.00	12.00	12.00	12.00	
	GPI4	12.00	0.00	12.00	12.00	12.00	
	GPI5	12.00	0.00	12.00	12.00	12.00	
	GPI6	12.00	0.00	12.00	12.00	12.00	

* Significant values (p≤0.050) – Friedman Test

Note: SDesv= standard deviation; RL = recognizing the alphabetic letter; RS = recognizing of sounds of alphabetic letters; GPI = grapheme/phoneme identification

Table 4. Distribution of mean, standard deviation, median and significance value of students from GIe and GIIe as to the ability of reading words and nonwords (RWNW) and as to reading accuracy ability (A)

Groups	Variables	Mean	SDesv	Mínimum	Maximum	Median	p-value
GIe	RWNW1	1.79	0.42	1.00	3.00	2.00	<0.001*
	RWNW2	3.81	0.41	2.00	4.00	4.00	
	RWNW3	6.00	0.00	6.00	6.00	6.00	
	RWNW4	6.00	0.00	6.00	6.00	6.00	
	RWNW5	6.00	0.00	6.00	6.00	6.00	
	RWNW6	6.00	0.00	6.00	6.00	6.00	
GIIe	RWNW1	6.00	0.00	6.00	6.00	6.00	>0.999
	RWNW2	6.00	0.00	6.00	6.00	6.00	
	RWNW3	6.00	0.00	6.00	6.00	6.00	
	RWNW4	6.00	0.00	6.00	6.00	6.00	
	RWNW5	6.00	0.00	6.00	6.00	6.00	
	RWNW6	6.00	0.00	6.00	6.00	6.00	
GIe	A1	7.81	0.79	4.00	9.00	8.00	<0.001*
	A2	10.00	0.00	10.00	10.00	10.00	
	A3	10.00	0.00	10.00	10.00	10.00	
	A4	10.00	0.00	10.00	10.00	10.00	
	A5	10.00	0.00	10.00	10.00	10.00	
	A6	10.00	0.00	10.00	10.00	10.00	
GIIe	A1	10.00	0.00	10.00	10.00	10.00	>0.999
	A2	10.00	0.00	10.00	10.00	10.00	
	A3	10.00	0.00	10.00	10.00	10.00	
	A4	10.00	0.00	10.00	10.00	10.00	
	A5	10.00	0.00	10.00	10.00	10.00	
	A6	10.00	0.00	10.00	10.00	10.00	

* Significant values (p≤0.050) – Friedman Test

Note: SDesv= standard deviation; RWNW = reading words and nonwords; A = reading accuracy ability

Table 5. Distribution of mean, standard deviation, median and significance value of students from GIe and GIIe as to the ability of recognizing syllables (RS), syllabic manipulation (SM), rhyme (RHYME) and alliteration (ALIT)

Groups	Variables	Mean	SDesv	Minimum	Maximum	Median	p-value
GIe	RS1	9.91	0.35	8.00	11.00	10.00	<0.001*
	RS2	12.00	0.00	12.00	12.00	12.00	
	RS3	12.00	0.00	12.00	12.00	12.00	
	RS4	12.00	0.00	12.00	12.00	12.00	
	RS5	12.00	0.00	12.00	12.00	12.00	
	RS6	12.00	0.00	12.00	12.00	12.00	
GIIe	RS1	12.00	0.00	12.00	12.00	12.00	>0.999
	RS2	12.00	0.00	12.00	12.00	12.00	
	RS3	12.00	0.00	12.00	12.00	12.00	
	RS4	12.00	0.00	12.00	12.00	12.00	
	RS5	12.00	0.00	12.00	12.00	12.00	
	RS6	12.00	0.00	12.00	12.00	12.00	
GIe	SM1	5.77	0.49	4.00	6.00	6.00	<0.001*
	SM2	6.00	0.00	6.00	6.00	6.00	
	SM3	6.00	0.00	6.00	6.00	6.00	
	SM4	6.00	0.00	6.00	6.00	6.00	
	SM5	6.00	0.00	6.00	6.00	6.00	
	SM6	6.00	0.00	6.00	6.00	6.00	
GIIe	SM1	6.00	0.00	6.00	6.00	6.00	>0.999
	SM2	6.00	0.00	6.00	6.00	6.00	
	SM3	6.00	0.00	6.00	6.00	6.00	
	SM4	6.00	0.00	6.00	6.00	6.00	
	SM5	6.00	0.00	6.00	6.00	6.00	
	SM6	6.00	0.00	6.00	6.00	6.00	
GIe	RHYME1	9.95	0.48	7.00	11.00	10.00	<0.001*
	RHYME2	12.00	0.00	12.00	12.00	12.00	
	RHYME3	12.00	0.00	12.00	12.00	12.00	
	RHYME4	12.00	0.00	12.00	12.00	12.00	
	RHYME5	12.00	0.00	12.00	12.00	12.00	
	RHYME6	12.00	0.00	12.00	12.00	12.00	
GIIe	RHYME1	12.00	0.00	12.00	12.00	12.00	>0.999
	RHYME2	12.00	0.00	12.00	12.00	12.00	
	RHYME3	12.00	0.00	12.00	12.00	12.00	
	RHYME4	12.00	0.00	12.00	12.00	12.00	
	RHYME5	12.00	0.00	12.00	12.00	12.00	
	RHYME6	12.00	0.00	12.00	12.00	12.00	
GIe	ALIT1	9.96	0.20	9.00	10.00	10.00	<0.001*
	ALIT2	12.00	0.00	12.00	12.00	12.00	
	ALIT3	12.00	0.00	12.00	12.00	12.00	
	ALIT4	12.00	0.00	12.00	12.00	12.00	
	ALIT5	12.00	0.00	12.00	12.00	12.00	
	ALIT6	12.00	0.00	12.00	12.00	12.00	
GIIe	ALIT1	12.00	0.00	12.00	12.00	12.00	>0.999
	ALIT2	12.00	0.00	12.00	12.00	12.00	
	ALIT3	12.00	0.00	12.00	12.00	12.00	
	ALIT4	12.00	0.00	12.00	12.00	12.00	
	ALIT5	12.00	0.00	12.00	12.00	12.00	
	ALIT6	12.00	0.00	12.00	12.00	12.00	

* Significant values (p≤0.050) – Friedman Test

Note: SDesv= standard deviation; RS = recognizing syllables; SM = syllabic manipulation; ALIT = alliteration

CONCLUSION

The findings of this study allow to conclude that the metaphonologic remediation and reading program, in computerized version, elaborated for this study, was effective, because the students with and without learning difficulty submitted to the program showed superior performance in post-testing situation, if compared to the pre-test situation.

The students with learning difficulties, submitted to the remediation program showed superior performance in post evaluation situation, if compared to pre evaluation in sounds discrimination abilities, reading of words and nonwords, sounds and syllables segmentation and manipulation, and also in the phonological awareness abilities (rhyme and alliteration), while the students with no learning difficulties showed superior performance in the segmentation and phonemic manipulation abilities, evidencing the necessity of using metapholonogical abilities associated to reading for the acquisition of the alphabetic principle of the Brazilian Portuguese writing system.

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RESUMO

Objetivo: Verificar a eficácia do programa de remediação metafonológica e leitura, elaborado em versão computadorizada para escolares com dificuldades de aprendizagem. **Métodos:** Participaram deste estudo 600 escolares de 2ª a 4ª série do ensino público fundamental, distribuídos em dois grupos: Grupo I (GI) e Grupo II (GII). O GI, composto por 300 escolares com dificuldades de aprendizagem, foi subdividido em GIc: 150 escolares que não foram submetidos ao programa de remediação metafonológica e de leitura; e GIe: 150 escolares do GI submetidos ao programa de remediação. O Grupo II (GII), composto por 300 escolares com bom desempenho escolar, foi subdividido em GIIc: 150 escolares que não foram submetidos ao programa de remediação; e GIIe: 150 escolares submetidos ao programa de remediação. Foi elaborado um programa computadorizado de remediação metafonológica e de leitura em versão avaliativa e interventiva. O programa foi composto por três fases: pré-avaliação, intervenção e após-avaliação. **Resultados:** Houve diferença entre a situação de pré e após avaliação para os escolares do GIe em todos as provas da versão avaliativa e em todas as habilidades trabalhadas na remediação e para o GIIe nas provas de reconhecimento de som, segmentação e manipulação fonêmica. **Conclusão:** Os achados deste estudo evidenciam a eficácia do programa de remediação metafonológica e de leitura elaborado para este estudo, pois os escolares com dificuldades de aprendizagem submetidos ao programa desenvolveram habilidades metafonológicas necessárias para o desenvolvimento da leitura.

Descritores: Aprendizagem; Avaliação/métodos; Leitura; Transtornos de aprendizagem; Compreensão; Instrução por computador

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