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Original Article

Artigo Original

Intervention program efficacy for spelling difficulties

Eficácia do programa de intervenção para dificuldades ortográficas

Maria Nobre Sampaio[1]
Simone Aparecida Capellini[1]

Keywords

Rehabilitation
Education
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ABSTRACT

Objective: To develop an intervention procedure for spelling difficulties and to verify the effectiveness of the intervention program in students with lower spelling performance. **Method:** We developed an intervention program for spelling difficulties, according to the semiology of the errors. The program consisted of three modules totaling 16 sessions. The study included 40 students of the third to fifth grade of public elementary education of the city of Marilia (SP), of both genders, in aged of eight to 12 years old, being distributed in the following groups: GI (20 students with lower spelling performance) and GII (20 students with higher spelling performance). In situation of pre and post-testing, all groups were submitted to the Pro-Orthography. **Results:** The results statistically analyzed showed that, in general, all groups had average of right that has higher in post-testing, reducing the types of errors second semiologycal classification, mainly related to natural spelling errors. However, the results also showed that the groups submitted to the intervention program showed better performance on spelling tests in relation to not submitted. **Conclusion:** The intervention program developed was effective once the groups submitted showed better performance on spelling tests in relation to not submitted. Therefore, the intervention program can help professionals in the Health and Education to minimize the problems related to spelling, giving students an intervention that is effective for the development of the spelling knowledge.

Descritores

Reabilitação
Educação
Escrita manual
Aprendizagem
Ensino

RESUMO

Objetivo: Elaborar um procedimento de intervenção para as dificuldades ortográficas e verificar a eficácia do programa de intervenção em escolares com desempenho ortográfico inferior. **Método:** Foi elaborado um programa de intervenção para as dificuldades ortográficas segundo a semiologia dos erros. O programa foi composto por três módulos, totalizando 16 sessões. Participaram deste estudo 40 escolares do terceiro ao quinto ano do ensino fundamental público da cidade de Marília (SP), de ambos os gêneros, na faixa de oito a 12 anos de idade, sendo distribuídos nos seguintes grupos: GI (20 escolares com desempenho ortográfico inferior) e GII (20 escolares com desempenho ortográfico superior). Em situação de pré e pós-testagem, todos os grupos foram submetidos à aplicação do Pró-Ortografia. **Resultados:** Os resultados analisados estatisticamente evidenciaram que, de maneira geral, todos os grupos apresentaram médias de acertos que se tornaram superiores na pós-testagem, diminuindo os tipos de erros segundo a sua classificação semiológica, principalmente relacionada aos erros de ortografia natural. No entanto, os resultados também mostraram que os grupos submetidos à intervenção registraram melhor desempenho em relação aos não submetidos. **Conclusão:** O programa de intervenção elaborado foi eficaz uma vez que os grupos submetidos a ele apresentaram melhor desempenho nas provas ortográficas em relação aos não submetidos. Portanto, o programa de intervenção pode auxiliar profissionais da área da Saúde e da Educação a minimizar os problemas relacionados à ortografia, proporcionando aos escolares intervenção eficaz para o desenvolvimento do conhecimento ortográfico.

Correspondence address:
Maria Nobre Sampaio
Avenida Hygino Muzzy Filho, 737, Marília (SP), Brasil, CEP: 17017-336.
E-mail: marianobre.unesp@gmail.com

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(1) Faculty of Philosophy and Sciences, Universidade Estadual Paulista "Júlio de Mesquita Filho" – UNESP – Marília (SP), Brasil.
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INTRODUCTION

As students are more involved in the exercise of writing in Portuguese, they need to associate its sounds and graphic representations, since not all letters represent only one sound in this language. In this scenario, it is important to highlight the development of metalinguistic abilities that correspond to explicit manifestations of a functional awareness of the rules that organize the use of language[1]. Thus, phonological and orthography processes are important when an individual is learning how to write[2-4].

Consequently, orthographic skills are directly affected by phonological awareness regarding comprehension and the progress of the alphabetic principle, essentially for regular relations between sounds and letters[5,6]. The writing of irregular words engages syntactic and morphological awareness to a greater extent, as it enables a more detailed contextual analysis when an individual chooses the correct grapheme to be used[3].

Students who have the opportunity to be taught in a reflection-focused manner learn certain orthographic automatisms that decrease their doubts when writing, drawing their attention to the content of the text and not to the correct spelling of a word[7].

To provide more efficient help to students in the process of literacy, it is necessary to understand the nature of the errors found, that is, the reason why these mistakes are made, and to understand the abilities that must be developed for an efficient and easy writing[8].

Considering this, every person who works with students that have spelling difficulties must strive to develop their students' orthographic awareness when writing through teaching and intervention activities that promote reflection about orthographic rules and not merely provide exposure[3].

Concerning orthographic learning and its difficulties, studies that address intervention methods are rare, which results in lack of support to elaborate teaching strategies and indicators of the process of building orthographic knowledge. Thus, in this study, our purpose was to elaborate an intervention procedure for spelling difficulties, and to verify its effectiveness in students with poor spelling performances.

METHODS

This study was conducted after getting approval by the ethics committee of the Faculty of Philosophy and Sciences of Marília (protocol number 1003/2010).

The study was carried out in two parts: (1) elaboration of the intervention program for spelling difficulties; and (2) application of the intervention program to students from the third to fifth grades of elementary school, of both sexes, aged from 8 to 12 years and 11 months.

Detail of the intervention program for orthographic difficulties

In proposing this intervention procedure, we considered that it could be used by teachers in classrooms as well as by health professionals who work in clinics or care centers. It is composed of words, figures, and texts selected from a word bank created and elaborated by the Language, Learning and Schooling at CNPq (National Council for Scientific and Technological Development) research group. The word database is based on textbooks for the first to the fifth grades of elementary school, published by Moderna and adopted by the Ministry of Education in public schools of the city of Marília (SP). The words selected have been then taken from this bank according to the orthographic difficulty addressed in each session of the intervention program.

In all sessions, we first presented a text selected from children's books and educational websites to the students. These texts presented high-frequency words and the orthographic difficulty addressed in each intervention session. Owing to this criterion, it was not possible to establish a standard number of words and gender in all texts.

The intervention program elaborated was based on an international study[9] with adaptations made for the students in our research. According to the authors, spelling errors can occur naturally or arbitrarily. Among those errors that occur naturally, the ones that stand out are due to univocal phoneme-to-grapheme correspondence (PGC), segment omission and addition (SOA), alteration in segment order (ASO), and unnecessary junction or separation of words. Among arbitrary orthographic errors are those made by PGC dependent on context, as well as by PGC that disregards language rules.

In accordance with the semiological classification proposed by Cervera-Mérida and Ygual-Fernández[9], the intervention program was divided in three modules, according to the typology of the orthographic difficulties. The modules and strategies used were divided as follows:

- *Module 1: Intervention for natural orthographic errors*. This intervention aimed at helping the students with spelling errors that are directly related to oral language. The strategies in this module encompassed reading, recognition of letters and sounds, identification of syllables in a word, phonemic analysis, phonemic synthesis, phoneme subtraction, phoneme substitution, identification of words within sentences, sentence identification, and crosswords exercises.
- *Module 2: Intervention for arbitrary orthographic errors – dependent on context.* This intervention aimed to help students understand the system of orthographic rules. The strategies in this module included reading, identification of orthographic rules, formation of words that transgress the rules, sentences with gaps, and dictation of words.
- *Module 3: Intervention for arbitrary orthographic errors – independent of rules.* This intervention aimed helping students to identify and seek ways to minimize the mistakes made when writing words that have irregular orthography. The strategies in this module included reading, memorizing a list of words, sentence elaboration, derivation exercises, sentences with gaps, and word dictation with the help of a dictionary.

Application of the intervention program for orthographic difficulties in students with poor and above-average performances

To verify their orthographic performance, the students were submitted to an orthographic assessment protocol (Pro-Orthography)[10], and their performances were classified as poor, average, or high, according to the score achieved. For this, we used the classification proposed in a national study[11], described in Chart 1.

On the basis of this classification, 40 students from the third to the fifth grades of an elementary school in the city of Marília (SP) were selected for the study. We excluded students with a history of auditory, visual, cognitive, or motor impairments registered in the school's records or reported by the teachers, as well as those who did not produce the informed consent form signed by their parents or legal guardians.

The students' age ranged from 8 to 12 years; 18 (45%) were females and 22 (55%) were males. The individuals were allocated in two groups:

Group I (GI): Composed of 20 students, classified as having poor orthographic performances, subdivided in experimental group I (EGI) — 10 students submitted to the intervention program; and control group I (CGI) — 10 students who were not submitted to the intervention program.

Group II (GII): Composed of 20 students, classified as having high orthographic performances, subdivided in experimental group II (EGII) — 10 students submitted to the intervention program; and control group II (CGII) — 10 students who were not submitted to the intervention program.

In this study, we selected students with above-average orthographic performances as the control group because those with average performances would not enable us to verify the effect of schooling on the students and the effectiveness of the program because they presented the orthographic mistakes expected for their schooling level. After this study was completed, the students in CGI and all individuals who presented any type of orthographic difficulty, regardless of which group they were in, were submitted to the intervention program or referred to speech, language, and audiological care at the Center for Studies in Education and Health of Universidade Estadual Paulista "Júlio de Mesquita Filho" (CEES/UNESP).

The students in EGI and EGII groups were submitted to the intervention program for orthographic difficulties, and those in CGI and CGII groups were exposed only to the school's habitual pedagogical activities. However, all the students in this study were submitted to the same procedures before and after the test with the purpose of verifying the effectiveness of the intervention program used.

Chart 1. Classification of the total performance of students from the first to the fifth grades of a public elementary school on the Pro-Orthography test[10]

School grade	Poor performance	Average performance	High performance
1st	0–26	34–115	123–419
2nd	0–30	38–165	173–419
3rd	0–125	133–226	234–419
4th	0–107	115–214	222–419
5th	0–156	164–236	244–419

As a pre- and posttest procedure, we applied Pro-Orthography[10] using its collective and individual versions. The overall scores were obtained by attributing one point to each correct answer. However, the scores for the semiological classification of errors were obtained by attributing one point to each type of error presented on word dictation (WD), dictation with figures (DF), thematic writing induced by figures (TWIF), and dictation of sentences (DS).

The three modules of the intervention program were applied in 16 sessions, divided in four for Module 1, six for Module 2, and six for Module 3. The program was applied at the students' school, individually, twice a week, with an average duration of 50 minutes per session, at times that did not coincide with the students' class schedule.

The statistical analysis was performed by the program Statistical Package for Social Sciences (SPSS), version 17.0. The results were analyzed statistically at a level of significance of 5% (0.05), marked with an asterisk in the tables showing the results.

RESULTS

Table 1 shows the average of correct answers, standard deviations, and p-value concerning the performance of EGI, EGII, CGI, and CGII groups for all Pro-Orthography[10] tests in the pre- and posttesting stages.

From Kruskal–Wallis test, it was observed that all orthographic tests contained in the protocol presented results with statistically significant differences among the groups evaluated, except purposeful error (PE) test, on which we observed better performances among the groups in posttesting stage. However, we also observed that the groups (EGI and EGII) submitted to the intervention program presented averages that were higher than those of the groups (CGI and CGII) that were not submitted to the majority of the tests evaluated after the application.

Tables 2–5 show the means of errors, standard deviations, and p-value concerning the performances of EGI, EGII, CGI and CGII groups on the WD, DF, TWIF, and DS tests, respectively.

The data presented in Table 2 show that statistically significant differences were found concerning mistakes of univocal PGC, SOA, and phoneme-to-grapheme correspondence independent of rules (PGC/IR) during both evaluations. However, mistakes as a result of alteration of ASO and unnecessary separation or junction of words (USJW) presented statistically significant differences only before the test, which indicates that, overall, the means decreased after the intervention. The same occurred regarding mistakes of phoneme-to-grapheme correspondence dependent on context (PGC/DC) and incorrect or absent punctuation (IAP), which presented statistically significant differences after testing. It was also possible to observe that the groups (EGI and EGII) submitted to the intervention program had lower means of errors compared to those (CGI and CGII) that were not submitted to it in the majority of the tests evaluated after the application.

Table 1. Distribution of the mean, standard deviation, and p-value concerning the performances of EGI, EGII, CGI, and CGII on the orthographic tests before and after intervention

Variable	Group	Mean	Standard deviation	p-value
WLA_Pre	EGI	15.50	9.18	0.001*
	EGII	23.90	6.64	
	CGI	7.90	10.58	
	CGII	25.40	0.84	
WLA_Post	EGI	25.60	0.70	0.010*
	EGII	26.00	0.00	
	CGI	19.40	10.45	
	CGII	25.20	2.53	
RDAL_Pre	EGI	22.40	6.98	0.009*
	EGII	25.80	0.42	
	CGI	19.50	8.18	
	CGII	22.30	8.02	
RDAL_Post	EGI	25.90	0.32	<0.001*
	EGII	25.90	0.32	
	CGI	24.90	0.74	
	CGII	25.90	0.32	
WD_Pre	EGI	15.20	9.85	<0.001*
	EGII	48.60	10.44	
	CGI	13.20	11.86	
	CGII	44.30	10.38	
WD_Post	EGI	41.20	9.43	<0.001*
	EGII	70.20	7.97	
	CGI	21.90	12.55	
	CGII	55.10	7.30	
PWD_Pre	EGI	4.40	3.37	<0.001*
	EGII	10.50	2.99	
	CGI	2.60	3.03	
	CGII	7.90	3.04	
PWD_Post	EGI	11.30	2.67	<0.001*
	EGII	21.60	4.72	
	CGI	7.80	2.86	
	CGII	13.90	2.23	
DF_Pre	EGI	14.30	5.52	<0.001*
	EGII	26.80	2.62	
	CGI	10.70	5.42	
	CGII	25.50	3.31	
DF_Post	EGI	24.50	4.25	<0.001*
	EGII	35.40	1.90	
	CGI	18.70	7.45	
	CGII	30.10	2.73	
DS_Pre	EGI	17.60	16.08	<0.001*
	EGII	57.20	5.29	
	CGI	15.00	14.89	
	CGII	50.90	8.88	
DS_Post	EGI	42.60	7.07	<0.001*
	EGII	62.20	1.32	
	CGI	31.50	15.78	
	CGII	56.10	3.99	
PE_Pre	EGI	0.00	0.00	0.788
	EGII	0.10	0.32	
	CGI	0.10	0.32	
	CGII	0.10	0.32	
PE_Post	EGI	6.60	3.31	<0.001*
	EGII	14.60	3.63	
	CGI	0.00	0.00	
	CGII	1.60	1.43	
SD_Pre	EGI	11.10	4.77	<0.001*
	EGII	22.10	2.89	
	CGI	10.40	4.58	
	CGII	17.50	5.02	
SD_Post	EGI	23.40	2.41	<0.001*
	EGII	27.60	1.35	
	CGI	16.10	4.53	
	CGII	24.20	3.19	
OLM_Pre	EGI	8.90	5.43	<0.001*
	EGII	22.70	2.11	
	CGI	8.00	5.10	
	CGII	18.90	3.99	
OLM_Post	EGI	22.60	3.03	<0.001*
	EGII	26.80	1.23	
	CGI	15.30	5.23	
	CGII	23.10	2.03	

*Statistically significant

Caption: WLA = writing letters of the alphabet; RDAL = random dictation of alphabet letters; WD = word dictation; PWD = pseudoword dictation; DF = dictation with figures; DS = dictation of sentences; PE = purposeful error; SD = spelled dictation; OLM = writing of words by orthographic lexical memory; EGI = experimental group I; EGII = experimental group II; CGI = control group I; CGII = control group II

Table 2. Distribution of the average of mistakes, standard deviation, and p-value concerning the performances of EGI, EGII, CGI, and CGII on the word dictation test, before and after intervention

Variable	Group	Mean	Standard deviation	p-value
PGC_WD_Pre	EGI	27.60	14.76	<0.001*
	EGII	6.40	6.13	
	CGI	23.60	13.58	
	CGII	6.80	5.67	
PGC_WD_Post	EGI	7.90	6.19	<0.001*
	EGII	0.50	0.71	
	CGI	12.60	14.56	
	CGII	1.20	2.10	
SOA_WD_Pre	EGI	27.30	18.09	<0.001*
	EGII	5.80	4.59	
	CGI	32.10	26.33	
	CGII	5.50	3.60	
SOA_WD_Post	EGI	9.20	10.64	<0.001*
	EGII	1.30	1.25	
	CGI	22.50	26.43	
	CGII	2.40	1.58	
ASO_WD_Pre	EGI	1.00	1.25	0.006*
	EGII	0.00	0.00	
	CGI	2.30	3.16	
	CGII	0.20	0.42	
ASO_WD_Post	EGI	0.10	0.32	0.811
	EGII	0.10	0.32	
	CGI	0.80	1.75	
	CGII	0.10	0.32	
USJW_WD_Pre	EGI	1.00	1.83	0.045*
	EGII	0.00	0.00	
	CGI	1.00	2.00	
	CGII	0.10	0.32	
USJW_WD_Post	EGI	0.40	0.70	0.203
	EGII	0.00	0.00	
	CGI	0.90	1.45	
	CGII	2.00	5.66	
PGC/DC_WD_Pre	EGI	13.60	6.13	0.342
	EGII	9.90	4.04	
	CGI	15.10	6.52	
	CGII	10.90	3.67	
PGC/DC_WD_Post	EGI	10.90	2.18	<0.001*
	EGII	3.50	2.55	
	CGI	18.30	4.40	
	CGII	9.00	3.92	
PGC/IR_DP_Pre	EGI	22.50	5.95	0.004*
	EGII	13.20	7.47	
	CGI	22.50	8.45	
	CGII	13.40	5.46	
PGC/IR_WD_Post	EGI	20.90	3.87	<0.001*
	EGII	9.10	4.53	
	CGI	28.30	5.83	
	CGII	11.20	3.91	
IAP_WD_Pre	EGI	13.50	5.10	0.782
	EGII	13.20	3.77	
	CGI	11.30	6.68	
	CGII	12.00	3.09	
IAP_WD_Post	EGI	10.30	2.21	<0.001*
	EGII	4.90	2.92	
	CGI	13.70	1.95	
	CGII	9.40	4.06	

*Statistically significant

Caption: PGC = univocal phoneme-to-grapheme correspondence; WD = word dictation; SOA = segment omission and addition; ASO = alterations in segment order; USJW = unnecessary separation or junction of words; PGC/DC = phoneme-to-grapheme correspondence dependent on phonetic context/position; PGC/IR = phoneme-to-grapheme correspondence independent of rules; IAP = incorrect or absent punctuation; OF = other findings; EGI = experimental group I; EGII = experimental group II; CGI = control group I; CGII = control group II

Table 3 shows statistically significant differences concerning PGC and SOA mistakes when all groups were compared in the pre- and posttesting stages. Statistically significant differences were also found regarding PGC/DC, PGC/IR, and IAP only in the posttesting stage. The data also show that the groups (EGI and EGII) submitted to the intervention program had an average of mistakes lower than those (CGI and CGII) not submitted to it in the majority of the tests evaluated after the application.

The data in Table 4 show that there were statistically significant differences concerning natural spelling errors, such as SOA and TWIF, both before and after intervention, indicating that these types of errors decreased in the posttesting stage. Statistically significant differences pertaining to PGC errors were detected before testing, which indicates that the average of this type of mistake was higher in relation to the posttesting analysis. However, regarding arbitrary spellling errors, no statistically significant differences were found, but, by analyzing the means, we observed a decrease in the quantity of PGC/DC errors after the intervention was conducted and the opposite behavior regarding PGC/IR. Concerning the number of words produced (NWP) by the students in their tests, the table indicates statistically significant differences in the pretesting stage, showing that this number increased after the test. A more thorough analysis about these data will be presented in future publications, in which the correlational data between spelling errors and NWP will be better investigated and interpreted.

Regarding the results presented in Table 5, we verified statistically significant differences concerning PGC, SOA, and TWIF errors between the pre- and posttesting stages in all groups, with lower means of errors found after the intervention. This also occurred with the type of error "other findings" (OF), with significant results in the pretesting stages, and with PGC/DC errors after the test. However, although statistically significant differences were found concerning errors made by PGC/IR, their mean was higher in the posttesting stage. The means of errors also showed that the groups (EGI and EGII) submitted to the intervention program registered lower means of errors than those (CGI and CGII) not submitted to it in the majority of the tests evaluated after the application.

DISCUSSION

According to the data presented, we found that all students showed increase in their overall averages of correct answers in the majority of the orthographic tests. It is also evident that EGI achieved higher means in comparison to CGI, and the same relation was found between EGII and CGII, thus showing the effectiveness of the intervention program for orthographic difficulties for the groups submitted to it.

During the literacy phase, many students can present alterations in writing due to a lack of emphasis on orthography[12,13]. We highlight that students with poor or high spelling performances submitted to strategies targeted at improving orthography make orthographic errors less frequently[14], as evidenced by the results obtained by EGI and EGII in this study.

The performances of the groups on the test that addressed PEs show statistically significant differences regarding EGI, EGII, and CGII. However, on observing the means, it is clear that higher performances were achieved by the groups (EGI and EGII) submitted to the intervention program than the control groups (CGI and CGII) in the posttesting stage.

The PE test is based on the concept that, to make purposeful mistakes, the students need to have mastery of a rule or principle fundamental to spelling of words[15]. This ability is emphasized in Module 2 of the intervention program, which proved to be efficient upon observation of the results obtained by EGI and EGII compared to those obtained by CGI and CGII. This corroborates the results reported by other researchers who used strategies that targeted the construction of, and reflection about, orthographic rules in their studies[14,15].

Concerning all orthographic tests selected for semiological classification of the mistakes made by EGI, EGII, CGI, and CGII, it is observed that, overall, there was a decrease in the majority of mistakes found after the intervention, which confirms the findings of authors who defend that a decrease in error types can be considered a mark of acquisition of orthography skills and point to the normal development of writing in children[16-20].

Among our findings, the decrease in mistakes related to natural orthography, such as PGC, SOA, and TWIF, is prominent. On observing the averages of mistakes of this type, a more significant difference between the pre- and posttesting stages is noticeable in relation to EGI and EGII than that to CGI and CGII. These results are indicative of the emphasis given to these types of errors in Module 1 of the intervention program, in which students are submitted to strategies of phonological awareness.

On the basis of the principle that errors of natural orthography are directly related to speech and language processing[9,21], the results presented here corroborate those reported by authors[2,4] who affirm that phonological and orthographic processes are important for learning how to write, as the patterns of phoneme-to-grapheme conversion can be learned through increased exposure to frequent occurrence and use of orthographic notations.

This study also indicates that the intervention program may have favored an increase in the NWP by the students on the task of thematic writing induced by figures, as the averages indicate. Moreover, the results of this test corroborate those reported in the literature[11,17] in the sense that an increase in the production of words is consequential of writing more frequently and being more exposed to this activity, which also leads to an increase in PGC/IR and IAP errors. These results point to the lack of systematic teaching in the classroom regarding these orthographic aspects.

The results of this study indicate that teaching and learning orthography in a formal manner is fundamental. Only through the formal teaching about the characteristics of orthographic transparency and opacity will students in the phase of acquisition and development of writing be able to decrease the occurrence of spelling errors[3,22].

Table 3. Distribution of the mean of errors, standard deviation, and p-value concerning the performances of EGI, EGII, CGI, and CGII on the dictation with figures test, before and after intervention

Variable	Group	Mean	Standard deviation	p-value
PGC_DF_Pre	EGI	8.70	6.98	<0.001*
	EGII	1.70	1.70	
	CGI	8.20	4.69	
	CGII	2.40	1.27	
PGC_DF_Post	EGI	2.20	2.62	0.001*
	EGII	0.20	0.42	
	CGI	4.80	5.16	
	CGII	0.50	0.71	
SOA_DF_Pre	EGI	6.90	6.77	0.007*
	EGII	1.00	1.25	
	CGI	8.10	12.40	
	CGII	2.00	1.41	
SOA_DF_Post	EGI	3.70	3.13	<0.001*
	EGII	0.20	0.42	
	CGI	8.90	12.49	
	CGII	1.90	1.60	
ASO_DF_Pre	EGI	0.20	0.42	0.106
	EGII	0.00	0.00	
	CGI	0.60	0.97	
	CGII	0.10	0.32	
ASO_DF_Post	EGI	0.00	0.00	0.517
	EGII	0.10	0.32	
	CGI	0.30	0.68	
	CGII	0.10	0.32	
USJW_DF_Pre	EGI	0.30	0.68	0.512
	EGII	0.10	0.32	
	CGI	0.90	1.73	
	CGII	0.10	0.32	
USJW_DF_Post	EGI	0.20	0.63	0.557
	EGII	0.10	0.32	
	CGI	0.30	0.48	
	CGII	0.10	0.32	
PGC/DC_DF_Pre	EGI	2.50	1.90	0.133
	EGII	1.00	1.25	
	CGI	2.30	2.16	
	CGII	1.40	1.43	
PGC/DC_DF_Post	EGI	1.40	1.90	0.006*
	EGII	0.40	0.52	
	CGI	2.60	1.65	
	CGII	1.20	0.79	
PGC/IR_DF_Pre	EGI	3.10	2.13	0.079
	EGII	1.70	1.34	
	CGI	3.80	2.44	
	CGII	1.80	1.03	
PGC/IR_DF_Post	EGI	4.90	2.47	<0.001*
	EGII	0.70	1.06	
	CGI	6.60	2.41	
	CGII	2.10	1.79	
IAP_DF_Pre	EGI	1.80	1.62	0.877
	EGII	1.40	1.08	
	CGI	1.30	1.42	
	CGII	1.30	0.95	
IAP_DF_Post	EGI	0.70	0.48	<0.001*
	EGII	1.10	0.74	
	CGI	2.40	1.35	
	CGII	2.40	1.08	

*Statistically significant

Caption: PGC = univocal phoneme-to-grapheme correspondence; SD = spelled dictation; WD = word dictation; SOA = segment omission and addition; ASO = alterations in segment order; USJW = unnecessary separation or junction of words; PGC/DC = phoneme-to-grapheme correspondence dependent on phonetic context/position; PGC/IR = phoneme-to-grapheme correspondence independent of rules; IAP = incorrect or absent punctuation; EGI = experimental group I; EGII = experimental group II; CGI = control group I; CGII = control group II

Table 4. Distribution of the mean of errors, standard deviation, and p-value concerning the performances of EGI, EGII, CGI, and CGII on the thematic writing induced by figures test, before and after intervention

Variable	Group	Mean	Standard deviation	p-Value
PGC_TWIF_Pre	EGI	4.00	3.27	0.009*
	EGII	1.40	0.97	
	CGI	4.90	2.89	
	CGII	2.10	2.08	
PGC_TWIF_Post	EGI	1.70	2.41	0.264
	EGII	0.30	0.68	
	CGI	0.90	1.37	
	CGII	0.60	1.27	
SOA_TWIF_Pre	EGI	3.90	3.35	0.013*
	EGII	1.10	1.60	
	CGI	8.30	8.72	
	CGII	1.70	1.57	
SOA_TWIF_Post	EGI	2.80	3.33	0.007*
	EGII	0.90	1.29	
	CGI	7.60	6.62	
	CGII	1.20	1.55	
ASO_TWIF_Pre	EGI	0.20	0.63	0.559
	EGII	0.00	0.00	
	CGI	0.20	0.42	
	CGII	0.10	0.32	
ASO_TWIF_Post	EGI	0.00	0.00	>0.999
	EGII	0.00	0.00	
	CGI	0.00	0.00	
	CGII	0.00	0.00	
USJW_TWIF_Pre	EGI	7.70	7.24	0.002*
	EGII	0.60	1.35	
	CGI	7.80	7.04	
	CGII	1.90	3.11	
USJW_TWIF_Post	EGI	2.00	1.83	0.016*
	EGII	0.50	0.71	
	CGI	5.00	5.56	
	CGII	0.90	1.10	
PGC/DC_TWIF_Pre	EGI	1.10	0.88	0.101
	EGII	1.10	1.45	
	CGI	3.10	3.32	
	CGII	0.60	0.97	
PGC/DC_TWIF_Post	EGI	1.80	1.40	0.061
	EGII	0.40	0.70	
	CGI	2.80	2.74	
	CGII	2.80	3.74	
PGC/IR_TWIF_Pre	EGI	2.10	0.99	0.050
	EGII	1.30	2.06	
	CGI	2.40	2.41	
	CGII	0.90	0.88	
PGC/IR_TWIF_Post	EGI	3.00	1.83	0.115
	EGII	2.00	1.63	
	CGI	4.50	2.99	
	CGII	2.00	2.21	
IAP_TWIF_Pre	EGI	0.70	1.25	0.161
	EGII	1.00	1.41	
	CGI	2.00	1.83	
	CGII	0.80	1.14	
IAP_TWIF_Post	EGI	1.30	1.49	0.373
	EGII	3.10	2.81	
	CGI	1.50	1.35	
	CGII	1.80	1.55	
NWP_Pre	EGI	33.60	20.17	0.013*
	EGII	68.20	28.10	
	CGI	51.90	23.88	
	CGII	57.90	17.21	
NWP_Post	EGI	73.00	18.18	0.324
	EGII	97.50	42.69	
	CGI	67.70	26.23	
	CGII	90.00	48.89	

*Statistically significant

Caption: PGC = univocal phoneme-to-grapheme correspondence; TWIF = thematic writing induced by figures; SOA = segment omission and addition; ASO = alterations in segment order; USJW = unnecessary separation or junction of words; PGC/DC = phoneme-to-grapheme correspondence dependent on phonetic context/position; PGC/IR = phoneme-to-grapheme correspondence independent of rules; IAP = incorrect or absent punctuation; NWP = number of words produced; EGI = experimental group I; EGII = experimental group II; CGI = control group I; CGII = control group II

Table 5. Distribution of the mean of errors, standard deviation, and p-value concerning the performances of EGI, EGII, CGI and CGII on the Dictation of Sentences test, before and after intervention

Variable	Group	Mean	Standard deviation	p-value
PGC_DS_Pre	EGI	8.00	5.38	0.044*
	EGII	2.30	1.95	
	CGI	7.30	6.85	
	CGII	4.20	3.68	
PGC_DS_Post	EGI	4.20	3.99	0.004*
	EGII	0.20	0.42	
	CGI	2.20	2.39	
	CGII	1.40	2.12	
SOA_DS_Pre	EGI	7.60	6.84	<0.001*
	EGII	0.60	1.08	
	CGI	9.60	9.96	
	CGII	1.70	1.57	
SOA_DS_Post	EGI	3.80	3.65	<0.001*
	EGII	0.20	0.42	
	CGI	7.60	9.10	
	CGII	0.30	0.68	
ASO_DS_Pre	EGI	0.30	0.48	0.328
	EGII	0.30	0.95	
	CGI	0.40	0.97	
	CGII	0.00	0.00	
ASO_DS_Post	EGI	0.20	0.42	0.228
	EGII	0.00	0.00	
	CGI	0.40	0.97	
	CGII	0.00	0.00	
USJW_DS_Pre	EGI	8.80	7.61	<0.001*
	EGII	0.10	0.32	
	CGI	11.50	7.59	
	CGII	0.70	0.95	
USJW_DS_Post	EGI	2.50	3.24	0.001*
	EGII	0.00	0.00	
	CGI	5.90	4.75	
	CGII	0.50	0.71	
PGC/DC_DS_Pre	EGI	3.00	2.91	0.080
	EGII	1.00	0.94	
	CGI	3.20	2.20	
	CGII	2.10	1.66	
PGC/DC_DS_Post	EGI	2.50	1.18	0.001*
	EGII	0.30	0.48	
	CGI	3.50	2.37	
	CGII	1.60	1.65	
PGC/IR_DS_Pre	EGI	4.30	2.67	0.123
	EGII	2.00	1.89	
	CGI	4.50	3.14	
	CGII	3.10	2.33	
PGC/IR_DS_Post	EGI	5.30	2.41	<0.001*
	EGII	1.40	0.97	
	CGI	8.10	2.08	
	CGII	2.70	1.34	
IAP_DS_Pre	EGI	1.70	2.11	0.361
	EGII	1.00	0.94	
	CGI	2.20	2.49	
	CGII	1.20	0.63	
IAP_DS_Post	EGI	2.20	1.48	0.092
	EGII	1.70	1.16	
	CGI	3.40	1.35	
	CGII	2.40	1.43	

*Statistically significant

Caption: PGC = univocal phoneme-to-grapheme correspondence; DS = dictation of sentences; SOA = segment omission and addition; ASO = alterations in segment order; USJW = unnecessary separation or junction of words; PGC/DC = phoneme-to-grapheme correspondence dependent on phonetic context/position; PGC/IR = phoneme-to-grapheme correspondence independent of rules; IAP = incorrect or absent punctuation; EGI = experimental group I; EGII = experimental group II; CGI = control group I; CGII = control group II

CONCLUSION

On the basis of the results obtained, it is possible to conclude that the intervention program for orthographic difficulties elaborated for this study is efficient, as the groups (EGI and EGII) submitted to the intervention program presented better performances on the tests, especially decreasing the number of errors related to natural orthography, in comparison with those (CGI and CGII) not submitted to it.

Therefore, this intervention program can aid professionals in the areas of Health and Education to minimize problems related to spelling, providing the students with efficient interventions that are conducive to the development of knowledge and the improvement of orthographic performance.

**MNS was responsible for data collection and tabulation, collaborated with collection and tabulation, and supervised data collection; along with SAC, MNS followed the steps of data collection, collaborated with data analysis, and was responsible for the project and study outline, as well as overall supervision of the stages of manuscript writing and elaboration.*

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