Invented Spelling in Kindergarten: comparing two interventions programs

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Abstract

The aim of this study was to compare the effect of two training programs on invented spelling on the quality of written and reading productions. Participated 100 children who could not read or write, distributed by four experimental groups and one of control. Groups 1 and 2 had followed the methodology of Alves Martins, Albuquerque, Salvador e Silva (2013) and groups 3 and 4 the methodology of Ouellette, Sénéchal and Haley (2013). In groups 1 and 3 we used facilitator words whose initial syllable coincides with the name of the letter and in groups 2 and 4 facilitator words whose initial syllable coincides with the sound. Groups 1 and 2 had higher results than groups 3, 4 and control.
Keywords: Preschool; alphabetization programs; reading.

Escrituras inventadas en la guardería: comparando dos programas de intervención

Resumen

El objetivo de este estudio fue comparar el efecto de dos programas de entrenamiento en escrituras inventadas en la calidad de las producciones escritura y lectura. Participaron 100 niños que no sabían leer y tampoco escribir, distribuidas por cuatro grupos experimentales y uno de control. Los grupos 1 y 2 siguieron la metodología de Alves Martins, Albuquerque, Salvador e Silva (2013) y los grupos 3 y 4 la metodología de Ouellette, Sénéchal y Haley (2013). En los grupos 1 y 3 se utilizaron palabras facilitadoras cuya sílaba inicial coincide con el nombre de la letra y en los grupos 2 y 4 palabras facilitadoras cuya sílaba inicial coincide con el sonido. Los grupos 1 y 2 tuvieron resultados superiores a los grupos 3, 4 y control.
Palabras-clave: Educación Infantil; programas de alfabetización; etapas de lectura.

Escritas inventadas no Jardim-de-Infância: comparando dois programas de intervenção

Resumo

O objetivo deste estudo foicomparar o efeito de dois programas de treino em escritas inventadasna qualidade das produções escritas e leitura. Participaram 100 crianças que não sabiam ler nem escrever, distribuídas por quatrogrupos experimentais e um de controle. Os grupos 1 e 2 seguiram a metodologia de Alves Martins, Albuquerque, Salvador e Silva (2013)e os grupos 3 e 4 a metodologia de Ouellette, Sénéchal e Haley (2013). Nos grupos 1 e 3 utilizaram-se palavras facilitadoras cuja sílaba inicial coincide com o nome da letra e nos grupos 2 e 4 palavras facilitadoras cuja sílaba inicial coincide com o som. Os grupos 1 e 2 tiveram resultados superiores aos grupos 3, 4 e controle.
Palavras-chave: Educação Infantil; programas de alfabetização; fases de leitura.

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Introduction

The success of learning to read and write has been related to the acquisition of early literacy skills over the preschool ages. Within these skills, particular relevance has been given to invented spelling in recent years. Read (1971) was one of the first authors to ascribe linguistic meaning to the invented spelling of preschool-age children, which can be defined as the attempt to phoneticize, before any formal learning, the sounds of words as one seeks to write them. This is not a process of memorization and restitution of conventional writings, but a process of experimentation by children who, although unable to read, use the knowledge they have acquired about letter-sound correspondence and seek to represent in writing the sounds they identify as faithfully as possible, so the author concludes that most of the mistakes children make are systematic and revealing of already emerging phonetic awareness. Indeed, writing activities induce practices of metalinguistic reflection with evident consequences in ability to analyze oral segments of words and find out the relationships between them and their letters (Adams, 1998; Treiman, 1998). Thus, it is considered that writing allows children to develop analytical procedures on oral language, essential for the development of literacy (Ferreiro, 2013).

Preschoolers' writing attempts reveal that the notion that letters represent oral language phonemes is preceded by pre-alphabetic conceptions of written language. Several descriptive studies conducted in different languages (Alves Martins, 1993; Besse, 1995; Ferreiro, 1988; Fijalkow, 1993; Pontecorvo & Orsolini, 1996; Sulzby, 1989) have shown that children evolve in their writing and their assumptions about the functioning of the code writing, progressing from writing that is essentially scribbling and therefore not determined by linguistic criteria, subsequently establishing relationships between graphic forms and oral segments, thus appropriately using some conventional letters, and thus gradually evolving into further analysis from word segments to alphabetic writing. In this context, it is considered that there is a different logic in the mistakes made by children at different levels, which reflect a gradual understanding of the linguistic principles underlying the written code (Read, 1971, Ferreiro, 1988). The idea that there is a strong relationship between invented spelling and understanding of the alphabetic principle is now relatively consensual (Ouellette, Sénéchal, & Haley, 2013; Silva & Alves Martins, 2002; Treiman, 1998), between invented spelling and phonemic awareness (Alves Martins & Silva, 2006a, 2006b; Ouellette & Sénéchal, 2008a, 2008b; Silva & Alves Martins, 2002) and between invented spelling and early reading acquisition (Alves Martins, Albuquerque, Salvador, & Silva, 2013). The association between invented spellings and these various literacy skills has been established in this context, through correlational studies and experimental studies. The latter are based on training programs at the level of invented spelling and seek to assess its impact on understanding the alphabetic principle, phonemic awareness and / or reading procedures. The analysis of the effect of this type of training and its characteristics seems to us to be particularly relevant because from them it is possible make inferences about the nature of the most effective interventions that can be done in an educational context in order to promote the quality of the invented spellings in children of preschool age.

Alves Martins e Silva (2006a; Alves Martins et al., 2013; Alves Martins, Mata e Silva, 2014) and Ouellette and Sénéchal (2008a; Ouellette, Sénéchal, & Haley, 2013) carried out experimental intervention studies in the laboratory context which clearly provided a framework for the impact of the evolution of writing on the apprehension of the alphabetic principle and on the development of early reading skills.

Alves Martins e Silva's (2006a, 2009) initial intervention paradigm used cognitive conflict as a factor in the evolution of invented spelling. In this study, the authors worked individually with preschool children who did not yet relate writing to oral segments and who hardly mobilized correct letters (therefore, very poorly evolved from the point of view of writing) and submitted them to a training methodology inspired by socio-constructivist and Vygotskian theoretical frameworks. The intelligence and phonological awareness of these children were evaluated and controlled in relation to the control group subjects. During individual sessions, the children were asked to write a set of words and to confront their writings with those of another hypothetical child of the same age whose spellings were a little more advanced. Thus, children were encouraged to reflect about their perspective on writing and the perspective of another child of the same age who was already writing according to syllable (one letter per syllable) or alphabetic criteria (in which all the sounds of the words were noted with phonetically appropriate letters) depending on the studies. The experimenter had the function of drawing attention to the letters used by both children and the sounds of the oral words, namely the initial letter and the initial sound and progressively to other letters and their oral correspondences, encouraging the children to reflect about these relationships. Facilitating words were used in the initial sessions, in other words, words whose first syllable sound coincides with the name of a letter. These words allow children to more easily mobilize the letter associated with the sound; thus, for example, children more easily mobilize the letter "p" when asked to write "pêra" and "pêssego"[1], where the initial syllable matches the name of the letter than when asked to write "pano" or "parede"[2] where the initial syllable does not match the name of a letter (Treiman, 1994). These training programs allowed children to increase the number of post-test phoneticizations by using many more conventional letters to represent the words that they were asked to write and coming up in a few words with alphabetic writing.

Despite the progress made in this study on the quality of invented spelling, one of the major limitations from the point of view of generalization to educational contexts is that training sessions are individual. In a more recent study, Alves Martins et al. (2014) sought to develop group intervention

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1 "pear" and "peach".

2 "cloth" or "wall".

programs. Keeping the previous procedures (Alves Martins & Silva, 2006), but adapting them to a group context, the authors consider (Alves Martins et al., 2014) that one of the mechanismsof evolution group programs may be the interactions established by the children about the words writing. Thus, the program outlined was based on the hypothesis that when children are confronted with different writings (even in the absence of sociocognitive conflict), they will be able to alter their representations of the written code and improve the graph-phonetic correspondences they perform. . These hypotheses are based on Gilly's (1988) research that, by studying how children interacted with each other in solving problems, demonstrated that children benefited from interactions in which they did not assume a passive role in accepting their children's suggestions, but in disagreeing with each other, they presented their reasons and arguments that supported their positions. Also Pontecorvo (2005) demonstrated that joint reflection in small groups can contribute to improve their thinking. Thus, in the case of the 2014 study, the intervention program was conducted in small groups of four children, heterogeneous as to the level of their invented spellings. In each of the 10 sessions, the children were asked to write four words and agree on how to write it. The adult mediated the discussion with questions of a metalinguistic nature, provided aids adapted to each child, and wrote the letters the children dictated to him. When the word was written, the child was shown the same word written alphabetically by a hypothetical boy from another class and school. They were asked to compare their written version with the hypothetical boy, trying to figure out which one was best, spelling out the reasons for their choice. Also in this study (Alves Martins et al., 2013), children showed great progress in the quality of invented spelling and reading procedures, a competence that had not been evaluated in previous studies.

Other particularly relevant intervention studies that yield similar results to previous studies are those by Ouellette and Sénéchal (2008a; Ouellette et al., 2013; Sénéchal, Ouellette, Pagan & Lever, 2012). These studies compare phonological awareness programs and invented spelling, highlighting the superiority of the latter since children in this group performed better in writing, phonological awareness, spelling awareness and reading words used in the intervention. In the 2013 study, as invented spelling, children worked equally in small groups, but interactions were not encouraged. The children should write four words per session for 16 sessions. The words were pronouncednormally and then slowly by the experimenter and repeated by the child. After each word was written, they received corrective *feedback* and were presented with a written production with one more correct letter than they had been able to produce. The learning principles underlying this approach are explicit *feedback* and anchoring, as adult intervention aims to drive the child beyond his or her initial level.

Both the programs by Alves Martins and Silva (2006a) and Alves Martins et al. (2014) such as Ouellette and Sénéchal (2008a) and Ouellette et al. (2013) proved to be effective, but it is impossible to point out which could lead to further progress even because they have a different number of sessions and have been applied in different languages. It is, however, possible to point out several differentiating dimensions of the two programs - using as a basis of comparison the program used in 2014 by Alves Martins et al, and that of Ouellette et al. Thus, the nature of adult support is clearly differentiated. In the case of Ouellette et al. (2013), the aids are associated with the *feedback* provided in which children are shown a written production with one more correct letter than the one they had been able to produce. In the program by Alves Martins et al. (2014), *feedback* is not explicit (as children are confronted with a hypothetical writing by another child) and adjustment of aids happens in the orientation of the children's metalinguistic reflection activity when the experimenter confronts the children two written versions (the initial version of the children and the hypothetical boy).

Another clearly differentiating aspect between programs is the interactive dimension that does not happen in the program of Ouellette et al. (2013). Only in the program of Alves Martins et al. (2014), interactions are encouraged (as children have to agree on the initial written version) and it is found that through adult mediation, children's discussions with negotiation and exchange of arguments lead to a collective evolution in quality. In addition, only in the program of Alves Martins et al. (2014) facilitative words are used in the initial sessions (in essence, words whose first syllable sound matches the name of a letter) and *feedback* is provided through a cognitive conflict-generating situation.

Another variable to explore in the context of these training programs is exactly the nature of the facilitative words. Most of the referenced studies use facilitative words in the first sessions whose initial syllable matches the letter name. The analysis of a similar facilitating effect for words whose initial syllable coincides with the sound of the letter (example given: writing o p in the word "perú"[3]) has not been explored, probably because it is known that children find it more difficult to learn the words sounds of the letters than their names. This is because the sounds of letters correspond to phonemes, which are more difficult to discriminate, articulate, and lack the acoustic form of a lexical item that is natural to children as the name of the letters. On the other hand, references to letters in social contexts are based on names and not on the sounds of letters. Using the paradigm of Alves Martins and Silva (2006a), Silva, Almeida and Alves Martins (2010) demonstrated that there were no differences in the number of letters correctly used in intervention programs in which the facilitative words had syllables that coincided with the sound of the letters, where children were induced to reflect on the sounds of letters and intervention programs where the facilitative words had syllables that coincided with the name of the letters and which children were induced to reflect on the name of the letters. It is important to highlight that there are no other studies that replicate this result, in addition to this intervention program being conducted in individual sessions rather than in-group sessions. It should

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3 "turkey".

be added that in the study by Silva et al. (2010) the words of confrontation hypothetically written by a boy only presented one correct letter for each of the syllables of the words (for example for PAPU would appear PU) while in the more recent studiesthey use alphabetic matching words (PAPU), even if they do not meet spelling criteria.

In summary: the current state of the art in this area of research has clearly demonstrated the importance of invented spelling for success in acquiring literacy; in this sense, the comparative analysis of the effectiveness of the two referenced programs (Alves Martins et al., 2013; Ouellette et al., 2013) will give us more precise indications in terms of the best intervention in the educational context and the relevance of the principles of instruction Vygotskians that follow in this programs for progress in the quality of invented spelling. It also seems important to us to explore, in comparing these two intervention paradigms, the effect of various types of facilitating words, namely facilitating words whose initial syllable coincides with the letter name *versus* facilitating words whose initial syllable coincides with the sound of the letter.

So we put as research questions for this study:

1. Do the referenced intervention paradigms (Alves Martins et al., 2013; Ouellette et al., 2013) have a different impact on the quality of invented spelling and early reading?

2. What is the impact of the characteristics of the facilitative words (facilitative words whose initial syllable coincides with the name of the letter *versus* facilitative words whose initial syllable coincides with the sound of the letter) in the framework of these intervention paradigms for the quality of the invented spelling in early reading?

Method

Experimental Design

This is an experimental study in which five groups were formed (four experimental and one control). In this study, the selected children were evaluated in a pre and post-test regarding reading and writing. In the selection of participants, pre-test and post-test the children were removed from classrooms and individually evaluated in an office within the school. The selection of participants took place in November and December, and the pre-test took place in January. The programs began in February and ran over five weeks. The post-tests began a week after the programs ended.

Between the two evaluative moments, they were submitted to two types of invented spelling intervention programs (specified in tasks and procedures); one that followed the paradigm of Ouellette et al. (2013) and another that followed the paradigm of Alves Martins et al., (2013). For each type of program, two experimental conditions were performed depending

on the nature of the facilitating words used at the beginning of the sessions (facilitating words whose initial syllable matches the letter name and facilitating words whose initial syllable matches the sound of the letter). The children in the control group participated in story reading activity. All participants performed 10 sessions lasting 15-20 minutes over five weeks (two sessions per week). The experimenters were two graduate students of educational psychology trained for the purpose and without knowledge of the hypotheses and questions had studied, being a double blind study.

Participants

A total of 100 5-year-old children (53 male and 47 female) from three kindergartens in the Lisbon area participated, with an average age of 65.79 months. All spoke Portuguese as a mother tongue and could not read or write. There were no invented spelling activities in the kindergarten classrooms that participated in the study. No child could write, read, or produce alphabetic writing, an essential condition for their participation in the study. The children who were able to write or read one or more words were excluded from the study. The children's reading and writing skills were assessed through individual reading and writing tests. In order to select participants, we passed a letter knowledge test, having selected children who knew at least three vowels (A, I and O) and six consonants (B, D, F, P, T and V), letters that entered in the constitution of the words used in the pre and post-test level of reading and writing. In each session, the children from the four experimental groups were divided into groups of 4. The formation of these groups (which remained constant throughout the intervention) sought to group children with slightly different knowledge according to the reading and writing evaluation performed in the pre-test (from children who did not use any correct letters in their writing to children who used one or two correct letters). The children were distributed by pairing among the 4 experimental and control groups in equal proportion to the class of origin, being equivalent (p> 0.01 in all variables) as to age, intellectual level, number of letters they knew and identified, punctuation in phonological awareness tests (syllable analysis and phonetic analysis) and the number of phonations in the pre-test.

Tasks and procedures

Participant Selection - Assessment of Invented Spelling

The children were asked to write, as best they could, six words and one sentence they were told. The words were common (animals) and consisted of monosyllables, dissyllables and trisyllables of simple structure (gato,

Table 1. *Mean and standard deviation of the variables age, knowledge of letters, cognitive performance, initial syllable and final syllable by experimental and control group.*

	Age		Knowledge of letters		Cognitive Performance		Initial Syllable		Final Syllable	
	M	Sd	M	Sd	M	Sd	M	Sd	M	Sd
G.E.1 (20)	65.95	2.14	14.85	1.53	19.10	2.90	5.55	1.10	7.30	1.49
G.E.2 (20)	65.05	2.52	13.90	3.28	19.95	1.91	5.65	1.14	8.00	0.97
G.E.3 (20)	65.15	3.05	13.35	2.96	19.70	1.13	5.80	1.24	7.40	2.99
G.E.4 (20)	66.00	2.03	15.00	3.67	19.25	1.12	5.60	1.10	7.50	1.57
Control	66.80	1.99	14.25	2.87	19.55	1.96	5.50	1.43	7.60	1.35

Note. G.E.1 = Experimental group 1; G.E.2 = Experimental group 2; G.E.3 = Experimental group 3; G.E.4 = Experimental group 4; G.C. = Control Group.

gata, gatinho, rato, cavalo, boi e o "gato viu o rato")[4]. The children's writings were classified as alphabetic (whenever appropriate graph-phonetic correspondences were made and proper phonetic structure coding with the possibility of spelling errors) and non-alphabetic (when, there may already be attempts to correct phoneticization the words, writing was not conventional alphabetic). Only children whose writing was not alphabetic were selected.

Participants' Selection - Reading Assessment

Written word cards were presented and the children were asked, "What do you think is written here?" The same words used for the evaluation of the invented spelling were used to select the participants. Only children who did not read any words were selected.

Participants' selection - Letters knowledge assessment

To determine how many and which letters the children knew by identifying their name and reproducing their sound, a set of cards with the uppercase letters of the alphabet (excluding W, K and Y), which were presented alternately to ensure that children did not just reproduce the alphabet. Children were asked to name each letter and its sound, and a point was given for each correct letter, with a score ranging from 0 to 23.

Intelligence Assessment

The cognitive performance was assessed using Raven's color-progressive matrices (Raven, Raven, & Court, 1998) as it is a test that is poorly dependent on verbal aspects. One point was awarded for each correct answer, making the score range from 0 to 36 points.

Phonological awareness assessment

The phonological awareness was assessed through two tests taken from Silva's battery (2002): syllable classification and initial phoneme classification. Each of these tests consists of 14 items, preceded by two examples. In each item, four images were presented to the children, representing four oral words. The children then had to categorize two target words into four, using a syllable or phonemic criterion, depending on the test. One point was awarded for each correct answer.

Pre-test and post-test writing assessment

In order to assess the quality of the children's invented spellings, they were asked to write twenty words containing the consonants B, D, F, P, T, and V and the vowels A, I, and O. Thirteen of the words contained consonants used in the language programs training (B, D, P and T). The remaining seven words also contained the unworked consonants F and V. All words (5 monosyllabic and 15 disyllabic) ranged from two to four letters, had several syllable structures although the most frequent was the CV, which is the most common syllable structure in the Portuguese language. None of the words used in the pre-test and post-test were used in the training programs. The words were presented in a fixed random order to all children and no *feedback* was given regarding their correction. For quotation purposes, a point was assigned to each letter correctly used to represent the respective phoneme. The score could range from 0 to 28 points. Cronbach's alpha was performed and the internal consistency was 0.91 for the pre-test and 0.96 for the post-test. Two experimenters made the quotation separately. The level of agreement among the experimenters regarding word-to-word classification using Kappa statistics was 94 in the pre-test and 97 in the post-test.

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4 cat (male), cat (female), kitten, rat, horse, ox and the "cat saw the rat".

Assessment of pre-test and post-test reading

In order to evaluate reading in children we asked them to read the same 20 words used in the writing task. The words were presented in a fixed random order and no *feedback* was given. The children's reading was recorded. It was analyzed whether the children read all or part of the word. The number of words read correctly has been counted. The word reading score could range from 0 to 20 points. For this measure, the internal consistency using Cronbach's alpha was 0.87 in the post-test. At the pre-test level none of the subjects was able to read any word. The post-test occurred one week after the training program was completed.

Invented Spelling Intervention Program I - Experimental Groups 1 and 2

Training program I followed the methodology used by Alves Martins et al (2014); to guide preschoolers to use conventional letters in their invented spelling and was applied to experimental groups 1 and 2. The program was conducted in small groups of four children with slightly different levels of writing. At each session, the children were asked to discuss four-word writing with each other and to reach agreement. The words used consisted of the consonants P, B, T, D and the vowels A, I and O. The words had a simple structure, most of them CVCV structure syllables and CVV monosyllables. Each word was presented by the experimenter orally. Each word was spoken aloud with normal speech rate, then more slowly and again normally. Then the children in unison repeated the word aloud. After that, the children were asked to write the word as they thought it right. The children were guided to write the word as best they could and that their writing did not have to be correct, not even among the children in the group. The adult mediated the discussion and wrote the letters the children dictated after reaching an agreement. Then the children were confronted with an alphabetic writing of the same word of a hypothetical boy from another classroom. In this context, children were asked to compare their writing with the alphabetic, to evaluate which would be better written and to justify the choice. The experimenter had the function of drawing attention to the letters used in both writings and to the sounds of the oral words, namely the initial letter and the initial sound and progressively to other letters and their oral correspondences. All sessions were recorded and registered.

Experimental group 1

In this group in the first four sessions the facilitative words used coincided with the name of the letter. In these first four sessions, the words began with the same consonant and the children's attention was directed to the first two letters of the words. The first word to write in these sessions contained an initial syllable, which then coincided with the letter name to facilitate the mobilization of the corresponding letter. For example, in the word "dedo"[5] the first syllable [de] corresponds to the name of the letter D. The initial consonant was followed in the remaining words by an I, an A, and O (example: Data [datα], Dia [diα], Doto [dɔtu])[6]. In the remaining sessions, the children were invited to write words that began with different consonants.

Experimental Group 2

In this group in the first four sessions the facilitative words used coincided with the sound of the letter. In these first four sessions, the words began with the same consonant and the children's attention was directed to the first two letters of the words. The first word to write in these sessions contained an initial syllable, which then coincided with the sound of the letter in order to facilitate the mobilization of the corresponding letter. For example in the word "dedal"[7], the first syllable [de] corresponds to the sound of the letter D. An I, an A and O, followed the initial consonant in the remaining words (example: Data [datα], Dia [diα], Doto [dɔtu]). In the remaining sessions, the children were invited to write words that began with different consonants.

Invented spelling Intervention Program II - Experimental Groups 3 and 4

The training program II followed the methodology used by Ouellette, Sénéchal & Haley (2013), but with adaptations in order to standardize certain aspects with program I, namely regarding the number of sessions and the written words. The program was conducted in small groups of four children with slightly different levels of writing. At each session, the children were asked to write four words. The words used were composed of the consonants P, B, T, D and the vowels A, I and O. The words had a simple structure, most of them being CVCV syllables and CVV monosyllables. Each word was presented by the experimenter orally. Each word was spoken aloud with normal speech rate, then more slowly and again normally. Then the children in unison repeated the word aloud. Then the children were asked to write the word as they thought it right. The children were guided to write the word as best they could and that their writing did not have to be correct, not even among the children in the group. After writing each word *feedback* was immediately provided to the children by adding a correct letter to the original version of the children (for example, if in their writing the children did not write the first letter correctly it was that letter the experimenter put, if the first letter was spelled correctly, but the last letter was not, the one to be added). The *feedback* was provided along the following lines: the child's written version was praised and another way of writing the word was shown. Then the children were asked to rewrite the word. In

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5 Finger.

6 Date, Day.

7 thimble.

each session, the children wrote four words twice. From the fifth session onwards, the extra letters were removed and the number of letters that would be needed was discussed between the child and the experimenter. The interaction between the experimenter and each child was exploratory and directed to the children evolving to higher levels of writing.

Experimental group 3

They wrote the same wordlist in the same order as Experimental Group 1, in which the first four sessions were facilitative words in which the initial syllable coincided with the name of the letter.

Experimental group 4

They wrote the same wordlist in the same order as Experimental Group 2 where the first four sessions used facilitative words where the initial syllable coincided with the sound of the letter.

Control Group

The Control group program consisted of reading stories.

Results

Invented Spellings

For invented spelling, Table 2 shows the maximum values, standard deviation, and mean number of letters correctly written by children in the four experimental and control groups in the pre and post-tests. Recall that the groups were equivalent in number of phonations at pretest F (4, 95) = 0.151, p> 0.1.

It was intended to analyze if the evolution verified between the moments was significant and if it was different in function of the experimental conditions and control. This evolution between moments and the effect of the experimental conditions was evaluated by a repeated measures analysis of variance. Significant differences were found between pre and post-test moments, F (4, 95) = 224.39, p <0.01, Power = 1.00 and in the condition x moment interaction, F (4.95) = 23.37, p < 0.01, Power = 1.00. The dimension of the effect is, respectively, very high (n2p = 0.703) and high n2p = 0.496. The Tuckey *post hoc* test indicates that participants in experimental groups 1 and 2 correctly represented more letters in the written words than participants in experimental groups 3 and 4 (p <0.01) and more than the control group (p <0.01) in the post-test. Participants in experimental groups 3 and 4 also mobilized more letters in the post-test than participants in the control group (p> 0.01). Between experimental groups, 1 and 2 there are no statistically significant differences. There are also no statistically significant differences between groups 3 and 4. Appendix A illustrates with examples the type of writing found in experimental groups 1 and 2 (see experimental group 1), experimental groups 3 and 4 (see experimental group 3) and control group.

Word Reading

Regarding reading, table 3 shows the minimum, maximum, standard deviation and mean number of words correctly read by children in both experimental and post-test control groups. Remember that at the time of the pre-test the children could not read any words.

The results indicate that there are significant differences between the groups in word reading, F (4, 95) = 37.75,

Table 2. *Means and standard deviation in the number of correct phoneticizations in the invented spelling in the pre-test post-test.*

	Writing			
	Pre-test		Post-test	
	M	Sd	M	Sd
G.E.1 (20)	14.10	2.32	46.00	16.86
G.E.2 (20)	14.25	1.59	52.60	17.54
G.E.3 (20)	14.35	2.25	30.30	12.20
G.E.4 (20)	14.30	1.90	29.85	9.83
G.C. (20)	14.60	2.35	17.80	10.81

Note. G.E.1 = Experimental group 1; G.E.2 = Experimental group 2; G.E.3 = Experimental group 3; G.E.4 = Experimental group 4; G.C. = Control Group.

Table 3. *Mean, standard deviation, maximum and minimum number of words correctly read by children in the reading task.*

	Writing	
	Post-test	
	M	Sd
G.E.1 (20)	8.20	3.55
G.E.2 (20)	8.35	3.53
G.E.3 (20)	3.75	1.74
G.E.4 (20)	3.20	1.82
G.C. (20)	0.30	0.66

Note. G.E.1 = Experimental group 1; G.E.2 = Experimental group 2; G.E.3 = Experimental group 3; G.E.4 = Experimental group 4; G.C. = Control Group.

p <0.01, Power = 1.00. The effect size is very high ($n2p$ = 0.614). The Tuckey *post hoc* test indicates that participants in experimental groups 1 and 2 read significantly more words correctly than participants in experimental groups 3 and 4 (p <0.01) and more than the control group (p <0.01) in the post--test. In addition, participants in experimental groups 3 and 4 read more words in the post-test than participants in the control group (p> 0.01). Between experimental groups, 1 and 2 there are no statistically significant differences. There are also no statistically significant differences between groups 3 and 4.

Discussion

The evolution of the four experimental groups shows the impact that both intervention programs have on the evolution of the quality of invented spelling and reading, confirming, to some extent, the results obtained by Alves Martinset al. (2014) and by Ouellette et al. (2013). This conclusion is supported by the significant increase of all groups in the number of conventional letters correctly mobilized in their spelling and the superior reading performance compared to the control group. Thus, deepening research that has been carried out for almost a decade by Alves Martins e Silva (2006a), Alves Martins et al. (2013, 2014), Oulette and Sénéchal (2008a) and Oulette et al. (2013) is once again evidenced by how intervention in invented spelling with preschool-age children leads children to the development of more sophisticated spelling - in which many of the word sounds are now correctly represented by conventional and appropriate letters - and to evolution of reading behaviors. As emphasized by Oulette et al. (2013) writing and reflection on writing is a learning tool that clearly has positive consequences on early literacy skills and should be encouraged in pre-school settings. However, when compared, it appears that the two experimental groups (G. 1 and G. 2) that follow the training program inspired by the works of Alves Martins et al. (2014) present results significantly higher than the two experimental groups (G. 3 and G. 4) of the research-inspired program by Oulette et al. (2013), both in terms of the quality of invented spelling at the post-test and early reading performance.

Some fundamental aspects may explain the differences found. First, the nature of the *feedback* provided to children. In the case of Ouellette et al. (2013) anchoring occurs when children are shown a written production with one more correct letter than the one they had been able to produce, which corresponds to the procedure adopted in experimental groups 3 and 4. In the case of Alves Martins et al. (2014) aids adapted to children result from the mediation of the adult in child interactions, encouraging metalinguistic reflection both at the time of writing the initial version of the word and at the time of confrontation with the alphabetic writing of a hypothetical boy, a procedure that corresponds to that of the Experimental groups 1 and 2. Thus, according to the previous paradigm, in the help provided in these two groups, the adult emphasizes the most advanced proposals made by the children and guides the discussion regarding the most appropriate letters. On the other hand, the confrontation between the two written versions (the initial and the other alphabetic written by a hypothetical boy) and the potential conflict provoked in this context also induces the children's reflection on the nature of the relations between the oral segments of the words and the corresponding letters.

In addition to these differences is the interactive dimension between children that exists only in the programs in groups 1 and 2 which seems to have made an important contribution to the further evolution of children in these groups. Indeed, it was possible to observe in the context of these groups collective problem-solving processes where the children discussed and argued about what they considered to be the correct way to write each word segment, made their suggestions explicit and defended their points of view, continuing the proposals of both. In line with what was shown by Pontecorvo (2005), the fact that children negotiate meanings, compare solutions or make different interpretations of how each word segment appears to play an important role in children's evolution in their reading and writing skills.

The other variable explored in the context of this study was the characteristics of the facilitative words used as initial words to write in the first four training sessions of the various experimental groups (facilitative words whose initial syllable matches the letter name and facilitative words whose initial syllable matches the sound of the lyrics). The results indicate that this variable does not seem to be particularly relevant for children's progress in writing quality and early reading skills, since there are no differences at these levels, either between experimental group 1 and 2 or between experimental group 3 and 4. To some extent, as regards writing, the results are in line with the study by Silva et al. (2010) who, within the framework of the paradigm of Alves Martins e Silva (2006a), had found that the number of correct letters (or number of correctly mobilized letters during) was identical using one or another type of facilitative words.

In summary, the greater effectiveness of the training program associated with experimental groups 1 and 2 seems to be linked to the adapted aids provided by the experimenter and the discussion and arguments used by the children regarding the use of certain letters to note certain sounds, dimensions that will have led destabilizing the way children represent written code.

This work allowed us to compare, in the context of the Portuguese language, two types of training programs (Alves Martins et al., 2013; Ouellette et al., 2013), and it seems relevant that the same type of research can be conducted in the context of the Portuguese language the relevance of these findings, coupled with a research body of almost a decade, suggests the importance, in natural educational contexts, of the intervention of the invented spellings with an approach to instructional principles that are based on child-level aids, and this approach should be gradually incorporated into the practices and methodologies used by classroom educators.

Lastly, we would like to point out the limitations of this study and suggest some future lines of inquiry. Perhaps the main limitation of this study stems from the fact that there is

no mediated post-test, as with the investigation by Ouellette et al. (2013) to assess whether the benefits obtained and the differences found remain in the first year of schooling. On the other hand, considering the greater effectiveness of the results obtained by groups 1 and 2 using a training program inspired by Alves Martins et al. (2013) it is important to investigate where the characteristics of children's interactions are analyzed in more detail in order to clarify the effects that different dynamics may have on the evolution of children's literacy skills. On the other hand, it is essential to evolve this type of research into real educational contexts and to test their impact when applied by educators.

References

Adams, M. (1998). *Beginning to read: Thinking and learning about print.* Cambridge, MA: MIT Press.

Alves Martins, M. (1993). Évolution des conceptualisations d'un groupe d'enfants d'âge pré-scolaire sur l'écriture portugaise. Études de Linguistique Appliquée, 91, 60-69.

Alves Martins, M.; Albuquerque, A.; Salvador, L.; Silva, C. (2013). The impact of invented spelling on early spelling and reading. *Journal of Writing Research, 5(2),* 215-237

Alves Martins, M.; Mata, L.; Silva (2014). Conceptualizações Sobre a Linguagem escrita. Percursos de Investigação. A*nálise Psicológica, 32, 2,* doi.org/10.14417/ap.841

Alves Martins, M. ; Silva, C. (2006a). The impact of invented spelling on phonemic awareness. *Learning and Instruction, 16*,41-56. doi:10.1016/j.learninstruc.2005.12.005

Alves Martins, M.; Silva, C. (2006b). Phonological abilities and writing among Portuguese preschool children. *European Journal of Psychology of Education, 21*,163-182.

Alves Martins, M.; Silva, C. (2009).Two spelling programmes that promote understanding of the alphabetic principle in preschool children. *Journal of Writing Research 1(3)*,225-241.

Besse, J. M. (1995). *L´ecrit, l´école et l´illettrisme*. Paris: Magnard.

Ferreiro, E. (1988). L´écriture avant la lettre [Writing before the letter]. In Sinclair, H. (Ed.)*, La prodution des notations chez le jeune enfant* [The production of notations in young children] (pp.18-69). Paris: Presses Universitaires de France.

Ferreiro, E. (2013). Entre a sílaba oral e a palavraescrita. In Ferreiro, E. (Ed.), *O ingresso na escrita e nas culturas do escrito*. São Paulo : Cortez Editora.

Fijalkow, J. (1993). *Entrer dans l´écrit.* Paris: Magnard.

Gilly, M. (1988).Interaction entre pairs et construction cognitives. In Perret-Clermont, A. N.; Nicolet, M. (Eds.), *Modèles explicatifs. In interagir et Connaitre: engeux et regulations sociales dans le développement cognitive* (pp.19-28). Cousset: Delval.

Ouellette, G.; Sénéchal, M. (2008a). A window into early literacy: Exploring the cognitive and linguistic underpinnings of invented spelling. *Scientific Studies of Reading, 12(2)*, 195-219. doi: 10.1080/10888430801917XXX

Ouellette, G.; Sénéchal, M. (2008b). Pathways to literacy: A study of invented spelling and its role in learning to read. *Child Development, 79 (4)*, 899-913. doi: 10.1111/j.1467-8624.2008.01164.x

Ouellette, G.; Sénéchal, M.; Haley, A. (2013). Guiding Children's Invented Spellings: A Gateway Into Literacy Learning. *The Journal of Experimental Education*, 81(2), 261-279. doi:10.1080/00220973.2012.699903

Pontecorvo, C. (2005). Discutir, argumentar e pensar na escola. O adulto como regulador da aprendizagem [Discussing, arguing and thinking in school. The adult as a regulator of learning]. In Pontecorvo, C.; Alejo, A. M.; Zucchermaglio, C. (Eds.), *Discutindo se Aprende: Interacção social, conhecimento e escola* [Discussing promotes learning: Social interaction, learning and school] (pp. 65–88). Porto Alegre: Artmed Editora.

Pontecorvo, C.; Orsolini, M. (1996). Writing and written language in children´s development. In Pontecorvo, C.; Orsolini, M.; Burge, B.; Resnick, L. (Eds.), *Children´s early text construction* (pp. 3-23). New Jersey: Lawrence Erlbaum.

Raven, J. ; Raven, J. C. ; Court, J. H. (1998). *Manual for Raven's progressive matrices and vocabulary scale. Section I. General overview.* Oxford: Oxford Psychologists Press.

Read, C. (1971). Pre-school children's knowledge of English phonology. *Harvard Educational Review, 41,* 1–34.

Sénéchal, M.; Ouellette, G.; Pagan, S.; Lever, R. (2012). The role of invented spelling on learning to read in low-phoneme awareness kindergartners: a randomized-control-trial study. *Reading and Writing, 25*, 917-934

Silva, C. (2002). *Bateria de provas fonológicas* [Battery of phonological tests]. Lisboa: ISPA.

Silva, C.; Alves Martins, M. (2002). Phonological skills and writing of pre-syllabic children. *Reading Research Quarterly, 37*,466-483. doi: 10.1598/RRQ.37.4.6

Silva, C.; Almeida, T.; Alves Martins, M. (2010). The letter's names and the letter's sound: It's implication for the phonetization process. *Reading and Writing, 23*(2), 147-172. doi:10.1007/s11145-008-9157-3

Sulzby, E. (1989). Assessment of emergent writing and children´s language while writing. In Morrow, L.; Smith, J. (Eds.), *Writing in

real time: Modelling production processes(pp. 83-109). New York: Longman.

Treiman, R. (1994). Use of consonant letter names in beginning spelling. *Developmental Psychology, 30*, 567-580. doi: 10.1037/0012-1649.30.4.567

Treiman, R. (1998). Why spelling? The benefits of incorporating spelling into beginning reading instruction. In Metsala, J. L.; Ehri, L. C. (Eds.), *Word recognition in beginning literacy* (pp. 289-313). Mahwah, NJ: Erlbaum.

This paper was translated from Portuguese by Ana Maria Pereira Dionísio

Appendix A

Examples of pre-test and post-test written productions of control group, experimental group 1 and experimental group 3.

Control		Word	Experimental Group 1		Word	Experimental Group 3	
Pre-test	Post-test		Pre-test	Post-test		Pre-test	Post-test
		Fio			Fio		
		Dado			Dado		
		Fita			Fita		
		Babo			Babo		
		Tio			Tio		