

## Invented spelling intervention programmes: Comparing explicit and implicit instructions

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This study aims to compare the effectiveness of two invented spelling intervention programs, one with explicit instruction of graph-phonetics matches and another based on questioning and reflection on the graph-phonetic correspondences (implicit instructions). Ninety pre-school children, whose invented spellings use conventional letters unconventionally to represent sounds, were allocated to three groups, two experimental and one control. All groups were equivalent in age, intelligence, letter knowledge, and phonological awareness. We manipulated the type of instructions (implicit *vs.* explicit) between the pre- and post-tests in two experimental groups where children participated in an intervention programme of invented spelling. Children who participated in the implicit intervention programme showed a significant improvement in the number of correct letters mobilized in their spelling and phonemic awareness compared with children of control and explicit instruction group. Children from explicit instruction group showed significant more improvements than the children from the control group. These results suggest that questioning and reflection applied to invented spelling programmes seems to enhance a more significant knowledge about the relations between the oral and written code.

**Key words:** Explicit instruction, Implicit instruction, Invented spelling, Interventions programmes, Preschool children.

### Introduction

The concept of invented spelling refers to children, without formal instruction regarding reading writing and reading, ability to represent through written letters the oral segments they hear in words (Ferreiro, 1988). According to Read (1971), first spellings are not determined by rote memorization of conventional spelling patterns. Instead reveal children first comprehensive attempts in dealing with sound to letter correspondences (Ouellette & Sénéchal, 2008a). Adams (1998) and Treiman (1998) asserted that spelling is related to metalinguistic thinking which enhances the abilities to analyse oral segments and about correspondences between letters sounds and written words.

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These early spelling attempts reveal that pre-alphabetic conceptions about the written language precede the knowledge that letters represent oral language phonemes (Alves Martins, 1993; Ferreiro, 1988; Pontecorvo & Orsolini, 1996; Silva et al., 2010; Tolchinsky, 2005; Tolchinsky & Teberosky, 1998). The research conducted in different languages (e.g., Alves Martins, 1993; Ferreiro, 1988; Pontecorvo & Orsolini, 1996) provided evidence that spelling development progress gradually from non-linguistic scribble to a closer analysis of word segments until eventually reaching alphabetic writing. As Read (1971) and Ferreiro (1988, 2002) have already stressed, spelling errors at different stages reveal the growing understanding of linguistic principles underlying the written code.

Research consistently shows that there is a strong relation between invented spelling activities and understanding the alphabetic principle (Albuquerque & Alves Martins, 2019; Alves Martins et al., 2017; Ouellette & Sénéchal, 2008a; Ouellette et al., 2013; Silva et al., 2010; Treiman, 1998), phonemic awareness (Alvarado, 1998; Alves Martins & Silva, 2006a,b; Ouellette & Sénéchal, 2008a,b; Silva, 2002), and early reading (Albuquerque & Alves Martins, 2018, 2019; Alves Martins et al., 2013, 2015; Mann, 1993; McBride-Chang, 1998; Ouellette & Sénéchal, 2008a, 2016; Ouellette et al., 2013; Richgels, 1995; Shatil et al., 2000).

As pointed previously, research (e.g., Albuquerque & Alves Martins, 2018, 2019) suggest that the quality of invented spelling in pre-school-age children may positively influence their reading and writing learning in primary school. Albuquerque and Alves Martins (2019) analysed the results in reading and writing of children in primary school after they participated in an invented spelling intervention programme at the previous year. When compared with the results of children that didn't participate in the programme, the results suggest the influence of the invented spelling programme in the differences found.

While there is evidence of the impact of this kind of intervention programmes, there are few investigations comparing the effect of different intervention methodologies (Pulido & Morin, 2017). For example, Alves Martins and Silva (2006a,b; Alves Martins et al., 2013, 2015) and Ouellette and Sénéchal (2008a; Ouellette et al., 2013), have designed intervention procedures, which used invented spelling as a teaching tool, with relevant results in children's invented spelling development.

In Ouellette et al. (2013) study, children who participated in the invented spelling program had to write down four words in each session (total of 16 sessions). After that, they received feedback while was shown the same word with one more accurate letter represented. The rationale underlying this approach was corrective feedback and anchoring once the intervention is explicitly used to drive children conceptions about spelling to a higher level. The results indicated that children enrolled in invented spelling training performed better in spelling, phonological awareness, orthographic awareness and word reading when compared to children in a phonological training group.

Alves Martins and Silva (2006a, 2009; Silva et al., 2010) worked individually with preschool children allocated to experimental and control conditions showing equivalence in measures of intelligence and phonologic awareness. The participants did not know the relation between letters and oral segments, and therefore they had little or no spelling skills. Each child spelt some words, and then they had to compare their spellings with those of a hypothetical child of the same age with a more advanced spelling. These confrontational spelling add some conventional letter to the word written by the child. After the presentation of the confrontational spelling, the adult (Alves Martins & Silva, 2006a, 2009; Silva et al., 2010) based the interaction between him and the children in calling children's attention to the letters used in both spellings and to the sounds of each word, particularly the initial letter and its sound. The adult progressively extended the feedback to other letters and their oral correspondences (Quinteros, 1994). Doing so the adult was encouraging children to reflect on their own and other children's perspectives towards spelling.

In this intervention programme the primary cognitive activities involved in the process of confronting the written words were: (1) predicting the number and type of letters needed to write the words dictated; (2) comparing the child's spelling with spellings more one level higher; (3) evaluating which one was better; and, (4) justifying their choice. Alves Martins and Silva (2006a, 2009; Silva et al., 2010) used facilitating words at the initial training sessions where the sound of the first syllable coincided with a letter name. For example, in Portuguese words such as "**p**êra" (pear) or "**p**êssego" (peach), the sounding of the first syllable (in bold) coincides with the letter name of "p" while in "**p**ano" (cloth) or "**p**arede" (wall) such effect is absent. This procedure facilitates accuracy in children's mobilization of letters (Mann, 1993; Treiman, 1994). The results (Alves Martins & Silva, 2006a, 2009; Silva et al., 2010) indicated an apparent evolution in the quality of the children's invented spellings after ten sessions of the intervention programme when compared to the control group (children who made draws and didn't participate in the intervention programme).

Hence, both Ouellette et al. (2013) and Alves Martins and Silva (2006a, 2009; Silva et al., 2010) studies do not resort to explicit instructions on graph-phonetic correspondences. Instead, they question children, leading them to reflect on the written code. Thus, in these studies, children's learning stems from the fact that the activities occurred in the context of what they are already capable of doing as outlined by the Vygotskian perspective (Vygotsky, 1978). Both programs use Vygotsky ZPD principles, but the first does not have an adult mediating interaction between children. Another relevant aspect is the dialogues and interactions established to enhance children thinking about spelling. Their invented spelling programs have an impact on children understanding of the alphabetic principle, their phonemic awareness and their reading skills. The results obtained by Ouellette et al. (2013) and Alves Martins and Silva (2006a, 2009; Silva et al., 2010) suggest that children in the interventions groups enlarged the number of conventional letters used and, in some words, reached an alphabetic level, representing all the phonemes of words.

While the previous studies mentioned use what we may call implicit instruction in invented spelling intervention programmes to help children reflect about the relations between oral speech and writing, there is a lack of research studying the impact of an explicit and direct instruction in these kind of intervention programmes. While several studies use explicit and systematic instruction about letters names and graph-phonetic correspondences, those studies do not evaluate the impact of that kind of intervention on the quality of invented spelling (concerning the number of correct graph-phonetic correspondences) in pre-school children. For instance, Foorman and colleagues (1997) conducted a training study to investigate the relationships among letter knowledge, phoneme awareness, reading, and spelling over the 1<sup>st</sup> year of schooling. Direct and systematic letter-sound instruction was associated with both faster growth rates and better achievement in reading and spelling at three test times over a year. Other authors (Bus & van IJzendoorn, 1999; Cunningham, 1990) showed that teaching directly graph-phonetic correspondences to pre-school children improves the impact of phonological training interventions in their learning ability for reading and writing at the first year of primary school.

The relevance to compare different intervention programmes is pointed by several studies analysing the effect of intervention programmes of different nature and evaluating their impact on the quality of children's writing, phonological awareness, and other emerging literacy skills (Almeida & Silva, 2019; Pulido & Morin, 2017). One of the first was from Rieben and colleagues (2005). The authors developed an experimental study with five-year-old children to analyse the effects of different spelling conditions on reading, writing, letter knowledge and phonological awareness. These spelling conditions were related to different instructional practices: (1) invented spelling; (2) copy of words; and (3) invented spelling with accurate feedback. Another group participated in drawing activities and acted as a control group. However, there is not a clear training intervention program since the authors (Rieben et al., 2005) consider that invented spelling condition can promote evolution *per se*

because it is a problem-solving task requiring word segmentation and practice of phoneme to grapheme matches. In the condition invented spelling with correct feedback children benefits of invented spelling practice and of being exposed to correct spelling through feedback given by the experimenter. In the copy condition, children copied the same words from a conventional model given by the experimenter, so there was not a direct instruction process of graph-phonetic correspondences. The results suggest that neither invented spelling alone nor copied spelling alone is as effective as the practice of invented spelling combined with exposure to correct spelling.

Pulido and Morin (2017) evaluated the progress made by six-year-old French children in four types of intervention, three of which focused on training invented spelling:

- 1) children were encouraged to reflect on conventional writing;
- 2) children were encouraged to think about pre-conventional writing that was slightly more sophisticated than the initial version produced (named as the proximal condition);
- 3) children reflected on pre-conventional writing gradually more advanced than their original writing (named as proximal + conventional condition);
- 4) control condition, children underwent a phonological training program.

In all groups, there was an evolution between pre-and post-test in the various dimensions tested. However, the results point to a more significant evolution in the quality of invented spelling, word decoding, letter knowledge and syllabic awareness in children who performed the second condition. The children in the control group submitted to the phonological training program were the ones that had the best results in the phonemic tasks. These results suggest that interventions that consider the level of children's original spelling are the ones that appear to perform best.

Pulido and Morin (2017) differentiate intervention studies in invented spelling by the type of training used. For example, they refer to interventions focusing on the exposition of conventional writings, as it happens in two conditions of the Rieben et al. (2005) study, which they reflect in the so-called "conventional condition". For another hand, they point studies that focus on the spontaneous writing of children and where they are encouraged to reflect on slightly more advanced writings than those initially produced (Ouellette & Sénéchal, 2008a, 2013; Alves Martins & Silva, 2006a, 2009; Almeida & Silva, 2019) which Pulido and Morin (2017) reflected in the proximal condition. Finally, the authors (Pulido & Morin, 2017) considered studies focusing on children's invented spellings and how they could lead to conventional spellings, which they reflected in the "conventional + proximal condition". Their study concluded, in line with the results obtained by Ouellette et al. (2013) and by Alves Martins and Silva (2006a, 2009), that children evolve more in their invented spelling when confronted with slightly more evolved writings than their initial version.

Thus, there is sufficient data to conclude that when children participate in discussions to reflect on slightly more evolved writings over the initial version produced this has effects on the quality of their invented spelling and phonological awareness.

However, in the current state of the art, there are few studies (Dean & Kuhn, 2006; Kuhn, 2005; Nie & Lau, 2010) that prove that intervention using questioning and inducing reflection (Kuhn, 2007, 2011) on word writing (named from here on as implicit instruction) has better results than an intervention where graph-phonetic correspondences are taught explicitly. This comparison becomes particularly relevant if we consider authors such as Kirschner and colleagues (2006) who defend the superiority of explicit instructions (in this case, applying to the phonetic correspondences) when compared with implicit instructions (Richardson, 2003). The authors (Kirschner et al., 2006; Sweller et al., 2007) argues that learning based on discovery and using minimal guidance during the instruction of novice learners (Clark, 2009; Kirschner et al., 2006) is less productive (Sweller, 2004, 2012). While there is some evidence that the implicit instruction seems to promote more advanced invented spelling, there is no evidence that these results are not

exceeded by invented spelling intervention programmes with an explicit and direct instruction about the correspondences between oral speech and written language.

Thus, this study seeks to compare an intervention program where children reflect on written words (implicit instruction) with an intervention program in which children are taught the graph-phonetic correspondence through slightly better versions (explicit instruction).

The research questions are as follows:

- 1) Would those programmes with explicit vs implicit instructions impact differently on the number of letters correctly written?
- 2) Would those programmes with explicit vs. implicit instructions impact differently on children's phonological awareness as assessed by initial phoneme classification and phonemic analysis tasks?

## Methods

### *Experimental design*

Children's spelling level was pre- and post-tested with the same spelling test. Children were assigned to 3 conditions, two experimental and one of control. The experimental groups participated in a writing programme designed to prompt children spelling level, one based on an implicit instruction (experimental group 2) and the other through explicit instruction (experimental group 1) of the graph-phonetic relations. The control group performed drawings.

Children in all groups received six training sessions within 15-20 minutes devoted to instruction (controlled by the experimenters). The intervention programmes lasted three weeks (two sessions per week), and after the programme's conclusions, we carried out immediately a post-test. The effectiveness of the intervention period is supported by previous studies of Alves Martins and Silva (2006a, 2009) and Silva and colleagues (2010).

The programmes were administered by three trained educational psychologists familiar with all intervention's programmes, without knowing the research questions and hypothesis; thus, the experimenters were blind to the investigator's goals. The three experimenters participated in the same number of sessions (2) in each group. All sessions occurred in May and were recorded.

### *Participants*

The participants were 90 Portuguese children (49 boys and 41 girls) from 3 kindergartens in Lisbon, selected from 128 preschool children. We conducted *a priori* power analysis for the sample size using G\*Power software for an ANOVA (Oneway, fixed effects) with an effect size of 0.5 (Cohen's *d*), power 0.95 and with alpha varying from 0.01 to 0.05. The minimum total sample size was 66 participants.

The average age of the 90 children selected was 65.84 months, and all attended the same level of kindergarten (5-to-6 years' class). In those kindergartens, there were no regular classroom activities related to invented spelling, reading, learning the alphabet or phoneme awareness (criteria to choose those kindergartens). The only regular activities related to reading and writing were story reading and activities in which children had to write their names (e.g., to identify their drawings). In Portugal, the formal teaching of reading and writing usually begins in the first year of elementary school and is usually the absence of reading and writing activities in kindergarten (Alves Martins et al., 2020). All children start to attend to pre-school since they were three years old and classes organized per age, with a range of children per class between 24 (minimum) and 28 (maximum), in all kindergarten.

The children were randomly assigned to each of the three groups (two experimental and control groups) in the same proportion from each class using the performance in control variables (children's age, number of letter names and sounds known, level of intelligence, and phonemic awareness). Because there is the same number of children from each class in groups, we also guarantee that teacher's beliefs and perception of curriculum does not influence the outcomes of each group.

### *Tasks and procedure*

#### *Participants selection*

*Assessment of teacher practices and beliefs regarding early reading and early writing in Preschool.* We survey the teacher's beliefs and practices for early reading and writing in Preschool (Santos & Alves Martins 2011). This survey analyses the existence of pedagogical project (maximum of 3 points), space and time organization (maximum of 18 points) and the practices regarding early reading and writing (maximum of 39 points). We selected a total of six teachers (two from each kindergarten) with similar partial and total scores. The scores for the pedagogical project were 1, for the organization of space scored 4, in practices scored 9, and the total score was 14. Both partial and total scores are considered low regarding beliefs and practices for early reading and writing in Preschool (Santos & Alves Martins 2011).

*Evaluating the children's knowledge of letters.* To determine how many and which letters children were familiar with we presented a set of cards containing both individual uppercase and lowercase letters. Children had to identify the letter's name and its sound ("K", "W", and "Y" were excluded as they are scarce in Portuguese words). Letters were presented in a fixed random order. The range of possible points in this test was 0 to 23 for the names and the sounds. We score 1 for each letter named correctly. The reliability for the task of letters name identification was  $\alpha=0.91$ , and the reliability for the task of letters sound identification was  $\alpha=0.87$ .

*Evaluating children's intelligence.* The level of the children's intelligence was assessed through the coloured version of Raven's Progressive Matrices test (Raven, Raven, & Court, 1998) because it is not dependent on verbal aspects. The test consists of 36 items in 3 sets (A, Ab, B), with 12 items per set.

The three sets of 12 items are arranged to assess the chief cognitive processes of which children under 11 years of age are usually capable of. The items assess cognitive development up to the stage when a person is sufficiently able to reason by analogy and adopt this way of thinking as a consistent method of inference. This stage in intellectual maturation appears to be one of the earliest to decline as the result of organic dysfunction. It has shown a series of patterns with parts missing. The parts removed are of a simple shape and have been placed below the matrix, among other similarly shaped pieces. Children should choose one of the six pieces presented to complete the missing part. Each piece chose correctly scored one point. The Raven's CPM produces a single raw score from 0 to 36. In this task, the reliability was  $\alpha=0.93$ .

#### *Pre and post-test*

*Evaluating children's phonemic awareness.* To evaluate the children's phonemic skills, we used a battery of tests that included one classification test and a segmentation test (see Appendix 1). This battery, created by Alves Martins and Silva (2009), is commonly used with Portuguese children to evaluate their phonemic awareness.

The initial-phoneme classification task was composed of 14 items preceded by two trial examples. In each item, children were presented with four drawings, each representing a spoken word (there were no written words). Two of these words began with the same phoneme and

children have to name which words began with the same sound. The reliability of this task was strong ( $\alpha=0.90$ ).

In the phonemic segmentation task, children had to pronounce in isolation each of the phones in the presented words. The task was also made up of 14 experimental items, again preceded by two trials. In this task, the reliability was  $\alpha=0.89$ . One point awarded for each correct answer.

*Evaluating children's invented spelling at the pre- and post-test.* To evaluate the initial competence in invented spelling (pre-test) and the progress resulting from intervention spelling programmes (post-test), we conducted another spelling test, which served as pre- and post-test. Children had to spell a set of words to the best of their ability. After spelling each word, they had to read what they had spelt. The verbal expressions that frequently accompanied the act of spelling were recorded.

We dictated 40 CVCV words (Appendix 2), initiated by nine different consonants. Words starting with the same consonant were followed by one vowel (“A”, “I”, “O” or “U”) since the CV structure which is the most common syllabic structure in Portuguese (Vigário et al., 2006). The words were presented in a fixed random order in two separate sessions, 20 words per session. No feedback was given.

We analysed whether children represented consonants and vowels by a correct letter in a correct position for each syllable in the different words, both at the pre-and the post-tests. We allocated 1 point for each correctly spelt letter at the correct syllable. Here, the total result could range from 0 to 160 phonetizations. The letters and positions accepted and scored with 1 point are in Appendix 2. Only children who score 0 at pre-test spelling task continued to the intervention program.

Just in the post-test we also analysed separately the number of consonants represented by a correct letter in a correct position for the first syllable. We allocated 1 point for each correctly spelt letter at the correct position in the first syllable. Here, the total result could range from 0 to 40 phonetizations. We did the same to the vowels analysing separately the number of vowels represented by a correct letter in a correct position for the first syllable. We allocated 1 point for each correctly spelt letter at the correct position in the first syllable. Here, the total result could range from 0 to 40.

In resume, we scored the invented spelling with three measures:

- 1) number of correct total phonetisations,
- 2) number of correct phonetisations of the initial consonant, and
- 3) number of correct phonetisations of the vowel of the first syllable.

Here are some examples of the scoring system used:

Writing of the word “Dita” [dita]. A score of 0 was given for a random string of letters such as “OU” or “MB” where non-correct letters were used. A score of 1 was given for “DHO” or “IMF”, where the first letter or a correct letter in the first syllable is correct. A score of 2 was given if the child wrote two conventional letters in the proper sequence, such as “IT”, “DI”, “IA”, “DA”. A score of 3 was given if he/she wrote three conventional letters in the proper sequence, such as “ITA” or “DIT”. A score of 4 points was given for proper conventional spelling.

Three researchers used the scoring system separately. The inter-scorer agreement in word-by-word classification using the Kappa statistic was 0.97 for the number of total letters correctly phonetized. The internal consistency of this task was  $\alpha=0.86$

### *Invented spelling interventions programmes*

The goal of the writing programmes was to lead children to use conventional letters to represent sounds in dictated written words. During each intervention session, the experimenter worked individually with each child. The words that were used were always different from those used in the pre- and post-test (Appendix 1). Each child had to write a word as best he/she could and was

then shown the same word written by “a hypothetical child from another class”. The invented spelling presented were the same for each spelling in both groups. In words written down by a hypothetical child, some correct letters were added to the initial written version using the strategies advocated by Ouellette and Sénéchal (2008a; Ouellette et al., 2013). Each child received developmentally appropriate feedback: to each child was shown a spelling containing one more letter than those he/she was able to produce. Then, the child had to analyze both spellings and think which one was the best spell of the dictated word and why. The child’s attention was brought to the first letter added to the word by the hypothetical child. Every group used ten words in each session, and all began with the consonant “P” or “T”. Sessions 1 and 2 – words were beginning with the consonant P; sessions 3 and 4 – words beginning with the consonant T; sessions 5 and 6 – half the words began with the consonant P and half with the consonant T. When children began to write alphabetically, we withheld the words written by our hypothetical child.

As in previous research (Silva et al., 2010), we used two facilitating words at the beginning of each session. The initial syllable of the first two words in each session of both experimental groups coincided with the name of the first letter. The initial letter of the remaining words was followed by the vowels “a”, “o”, “i” or “u”. For example, in session 1, children were asked to write the words *Pena* [pena] and *Pêssego* [pesəgu] (peach), where the sounding of the initial syllable coincides with the letter name P [pe]. The next words were *Papo* [papu], *Página* [pajina], *Povo* [povu], *Pousada* [pozada], *Pico* [piku], *Picada* [pikada], *Pulo* [pulu] and *Pomada* [pumada] (pouch, page, people, inn, peak, sting, jump, ointment) (Appendix 2).

As detailed earlier in the design section, we used two versions of the instruction guidelines when children were asked to compare their spelling with that of the hypothetical child. The interaction in the “explicit experimental group” (experimental group 1) was based on an explicit explanation of the letters needed to spell the words dictated and in “implicit experimental group” (experimental group 2) was based on questioning to think about an answer as stated in previous studies (Silva et al., 2010). The duration per sessions was 15/20 minutes, and the number of interactions between researchers and children was controlled (7/8 interactions per session).

Children in the explicit instruction (experimental group 1) had explicit instruction for the letters written down by “the other child” and no questioning to compare both writings was undertaken. In this experimental condition, we tried to use Clark principles (2009). Mainly we have provided an explicit demonstration, a set of diversified exercises and an explanation of the declarative knowledge that allow children to adopt the procedure used in new situations. Children carried out individual exercises where they practised the procedures learned, accompanied by corrective feedback. The explicit instruction served as a form of corrective feedback for the initial spelling attempt. The following example of the interaction between the researcher and a child of explicit instruction experimental group illustrates the dynamics that occurred during the spelling session:

- (1) Researcher: *I will ask you now to write down a few words. It is not important whether it is right or wrong. You may write them as you think best. The first word is PENA (feather). Pay good attention to the letters you need to write down this word.*
- (1) Participant: writes IMDOA.
- (2) Researcher: *Good! Look at the word you have written. Can you read it and point with your finger?*
- (2) Participant: Reads PENA and points to IMDOA.
- (3) Researcher: *Outstanding! There was a boy (girl) of your age, from another school, that wrote down PIMDOA (syllabic reading). Can you read the word now?*
- (3) Participant: Reads PENA.
- (4) Researcher: *Excellent. What about the letters? [PE], [NA], the first letter sounds like PE and the other child wrote a P. For [PE] he wrote a P Can you repeat it? (The researcher points to the first letter).*
- (4) Participant: *A P [PE].*

- (5) Researcher: *Good! Can you write the word PENA again?*
- (5) Participant: writes PIMDOA
- (6) Researcher: *Tell me why you write PENA like that.*
- (6) Participant: *Because [PE], [NA] starts with a P.*
- (7) Researcher: *Can you write it again without looking?*
- (7) Participant: *PDOI*
- (8) Researcher: *Perfect. We can write PENA with a P because its the first letter. Let us now look at another word! (the same procedure is repeated for each dictated word).*

In implicit experimental group, the interaction was based in calling children's attention to the letters used in both spellings and to the sounds of each word, particularly the initial letter and its sound and progressively to other letters and their oral correspondences encouraging children to reflect on their own and other children's perspectives towards spelling, comparing both. The following example describes the interaction between the researcher and a child of the implicit instruction experimental group as an illustration of the dynamics that occurred during a spelling session under an implicit rationale:

- (1) Researcher: *"I will ask you now to write down a few words. It is not important whether it is right or wrong. You may write them as you think it is best. The first word is PÊRA (pear). Pay good attention to the number of letters you need to write down this word and to the letters you need to write it down.*
- (1) Participant: Writes AFTU.
- (2) Researcher: *Good! Look at the word you have written. Can you read it down and point to it with your finger?*
- (2) Participant: Reads PÊRA and points to the word AFTU.
- (3) Researcher: *Excellent! There was a boy (girl) of your age, from another school, that wrote down PÊRA like PAFTU. So, look at the letters you used, and at the letters used by the other boy (girl) and which letters do you think are needed to write down [PÊRA]?*
- (3) Participant: *I do not know!*
- (4) Researcher: *How would you name the letters you have written?*
- (4) Participant: *A, Fê, Tê e U.*
- (5) Researcher: *Let us look at the name of the letters the other child wrote. How would we name them?*
- (5) Participant: *Pê and an A, Fê, Tê e U!*
- (6) Researcher: *Which of the two words is best written down? Your own, or that of the other child? Can you repeat the word out loud and think about it?*
- (6) Participant: repeats [PÊ], [RA]. [PÊ], [PÊ]. *It starts with a pê. The other child was right. To write [PÊRA] we need a P.*
- (7) Researcher: *Very, very good! Let us now look at another word! (the same procedure is repeated for each dictated word).*

### *Control group*

We asked the children of the control group to do two draws per session. We chose these activities because they did not involve a linguistic activity that could interfere with the invented spelling programmes. We used this activity as Alves Martins and Silva (2006a) used in previous studies with good results as a control activity.

## Results

All groups were statistically equivalent in all the variables considered at the pre-test, and the number of total phonetizations was 0. To examine whether the groups were equivalent at pre-test, we carried out ANOVAs using groups as the independent variable and children's age, number of letter names and sounds known, level of intelligence, and phonemic awareness, as dependent variables (Table 1). The results showed that there were no statistically significant differences for age  $F(2,87)=0.65, p=0.53$ , number of letter names known  $F(2,87)=1.71, p=0.19$ , number of letter sounds known  $F(2,87)=2.11, p=0.13$ , level of intelligence  $F(2,87)=0.33, p=0.72$ , initial-phoneme classification  $F(2,87)=1.41, p=0.25$ , phonemic segmentation  $F(2,87)=1.48, p=0.23$ .

Table 1

*Means and standard deviation for age, raven, initial phonetic classification, phonetic analysis, letters known by name and letters known by sound for all groups at the pre-test*

	Age		Raven		IPC		PA		LKN		LKS	
	<i>M</i>	<i>SD</i>										
Control	65.93	3.97	22.40	2.13	4.33	1.21	.20	.55	20.73	1.82	16.73	1.91
EEC	65.27	3.57	21.97	2.61	4.47	3.49	.10	.31	20.40	2.55	17.63	1.97
IEG	66.33	3.44	22.40	2.46	5.47	3.30	.33	.66	21.47	2.42	17.93	3.02
Total	65.84	3.65	22.26	2.39	4.76	2.87	.21	.53	20.87	2.30	17.43	2.39

*Notes.* EEC=Explicit Experimental Group; IEG=Implicit Experimental Group; IPC=Initial Phoneme Classification; PA=Phonemic Analysis; LKN=Letters Known by Name; Letters Known by sound.

The first analyses conducted were related with the invented spelling task. Table 2 displays the post-test results on the number of correct total phonetisations, number of correct phonetisations of the initial consonant and number of correct phonetisations of the vowel of the first syllable, by group at post-test.

Table 2

*Means and standard deviations for the number of correct total phonetisations, number of correct phonetisations of the initial consonant and number of correct phonetisations of the vowel of the first syllable, by group at post-test*

<i>Group</i>	Total phonetisations				Initial consonants				Vowels in the first syllable			
	<i>M</i>	<i>SD</i>	Min.	Max.	<i>M</i>	<i>SD</i>	Min.	Max.	<i>M</i>	<i>SD</i>	Min.	Max.
Control group	006.40	01.43	04	008	03.53	04.94	0	14	02.93	06.09	0	24
Explicit experimental group	021.33	17.62	08	066	05.93	05.93	0	23	05.23	07.58	0	31
Implicit experimental group	109.70	35.69	78	160	28.37	14.42	0	40	27.53	14.56	0	40

One ANOVA was computed to analyse whether there were significant differences in the total number of correct phonetizations (DV) as a function of the experimental group (IV). Statistically significant group differences were found  $F(2,87)=176.83, p<0.001; \eta^2=0.80; \pi=1.00$ . Games-Howell Post Test showed a significant superiority of implicit conditions. Group 2 performed significantly higher than group 1 ( $p<0.001$ ). Explicit Experimental group scored significantly higher than control group ( $p=0.034$ ).

We further added two additional analyses. First, we analysed whether there would be a group effect for the number of correct phonetisations of the initial consonant (Table 2). A significant

group effect was found,  $F(2,87)=64.70$ ,  $p<0.001$ ,  $\eta^2=0.60$ ;  $\pi=1.00$ . Post-hoc Games-Howell showed that the “implicit experimental group” scored significantly higher than the “explicit experimental group” ( $p<0.001$ ). Between the “explicit experimental group” and control group, no differences were found.

The second analysis examined group effects for correct use of initial vowels. Similarly, significant group differences were also found  $F(2,87)=54.25$ ,  $p<0.001$ ,  $\eta^2=0.56$ ;  $\pi=1.00$ . Post-hoc Games-Howell analysis revealed that “implicit experimental group” performed significantly better than all other conditions ( $p<0.001$ ). Between the “explicit experimental group” and control group, no differences were found.

The second analysis conducted was regarding the phonemic awareness (Table 3). For this analysis we used an ANOVA with repeated measures with initial phoneme classification and phonemic analysis as within-subjects variables and the group as between-subjects factor. A group effect was also found for progress on initial phoneme classification  $F(2,87)=8.56$ ,  $p=0.00$ ;  $\eta^2_p=0.16$ ;  $\pi=0.96$  and phonemic analysis  $F(2,87)=8.10$ ,  $p<0.001$ ;  $\eta^2_p=0.16$ ;  $\pi=0.95$ , with Bonferroni post-hoc tests showing that implicit experimental group improved significantly ( $p<0.001$ ) in both phonemic measures. All other groups showed no significant differences between pre-and post-test results.

Table 3

*Initial phoneme classification and phonemic analysis: Pre- and post-test means and standard deviations, by experimental group*

Group	Initial phoneme classification				Phonemic analysis			
	Pre-Test		Pre-Test		Pre-Test		Post-test	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Control group	4.33	1.21	5.33	1.99	0.20	0.55	0.20	0.55
Explicit experimental group	4.47	3.49	5.20	3.59	0.10	0.31	0.33	0.71
Implicit experimental group	5.47	3.30	9.77	3.32	0.33	0.66	2.10	2.94

## Discussion

The pattern of results founded confirms that both intervention programmes are effective in enhancing invented spellings. Both the experimental groups improved spelling sophistication relative to the control group, being able to spell more letters correctly in the post-test dictation than the control group. However, the results suggest a higher impact of implicit instruction intervention on the invented spelling development level. The implicit experimental group showed higher levels than “explicit experimental group” and control groups. The “explicit experimental group” was only superior to the control group in what concerns the number of correct letters that are used by children to represent sounds.

There is a high probability that, when confronted with words written by a hypothetical child with a more developed spelling, children belonging to the “implicit instruction group” come up with new hypotheses about the nature of the written code (Alves Martins & Silva, 2006a; Silva et al., 2010). This methodology seems to have the ability to promote reflection and provide children with an insight into how the alphabetic code underpins written language (Alves Martins et al., 2013, 2015, 2017). Thus, it seems that the mobilization of new letter, used as a support for dialogue and reflection about segments of the spoken word, introduces a metalinguistic word-analysis practice that can lead to improvements in the process of becoming aware of phonemic entities.

In this approach, written language is explored within a pedagogical setting that actively involves children in discussions about how to write. We think that our results are promising for their pedagogic value because they identify facilitating procedures of how preschool children may understand the alphabetic principle. In line with the results obtained by Alves Martins et al. (2017), it is possible to think that enhancing children within discussions about spelling is an excellent strategy to improve their knowledge about written language. By the other hand, it seems that explicit teaching of letters phonemic value and their sound correspondences alone is of less value in children whose writing is still very incipient.

The performance of “explicit instruction group” (Experimental Group 1) is better than the control group but not as good as the “implicit instruction group” (Experimental Group 2). It seems that teaching the letter names and the corresponding graph-phonetics is not sufficient to induce the child into changing his conception of written code and therefore be able to use letters correctly according to the sounds of a given word. Thus, explicit instructions about correct letters to represent sounds, *per se*, do not appear as sufficient to reconfigure children’s ideas about written language and the enunciation of graph-phonetic correspondences is likely to make no sense to them. Cardoso-Martins and Batista (2005; Cardoso-Martins et al., 2011) proposed that the facilitating effect of letter names is the starting point for grasping letter sound. However, results obtained do not appear to support this viewpoint, even though some of the children looked as if they were using the letter name strategy. In the post-test of the explicit instruction experimental group, the extent to which the standard deviations concerning the total numbers of correct letters used to not sounds of words varied supports the idea that some children probably employed this strategy, but not by others. This strategy seems to be effective with some children, but not others. Letter knowledge tends to be good predictors of literacy (McBride-Chang, 1999); however, it seems that is a necessary condition, but not sufficient to improve the quality of invented spelling.

Similarly, to what Silva (2002) and Ouellette and Sénéchal (2008a) have stated, results on phonemic measures strengthen the belief that there is a close relationship between the level of spelling and phonemic awareness. However, the number of correct letters mobilized by children of the implicit instruction experimental group does reflect better results children in the two phonemic tests got (notwithstanding the somewhat weak results obtained in phonemic segmentation task at post-test).

The relevance of invented spelling to enhance early literacy (Alves Martins & Silva, 2006b; Ouellette et al., 2013) is well established but is not systematic used as a teaching tool in the preschool educational setting. So, the results of our study support that specific practices in the preschool classroom settings, namely activities of invented spelling where during those activities the teacher involves children, induces clarification of points of view, utilizes argumentative questioning and provides personalized feedback. The majority of the curriculum in preschool focus on intensive, individual, or small group phonological training. There have been fewer curriculums focusing on activities with invented spelling even though has been proved that the participation in spelling activities in kindergarten allows children to explicitly reflect on the oral elements of words and their matching letters. i.e., to explore the connection between graphemes and phonemes, which promotes their general understanding of the alphabetic principle and improves phonological awareness (Adams, 1998; Alves Martins & Silva, 2006a; Levin et al., 2006; Mann, 1993; McBride-Chang, 1998; Ouellette & Sénéchal, 2008a; Richgels, 1995; Shatil et al., 2000; Treiman, 1998).

The relevance of invented spelling activities in preschool curriculum increases when we look to recent studies that establish a causal link between the improvement of invented spelling with intervention programmes and early reading (Alves-Martins et al., 2013, 2016; Ouellette et al., 2013). Recent studies that support the value of kindergarten invented spelling intervention to the formal acquisition of reading and writing in first grade (Albuquerque & Alves Martins, 2017; Ouellette & Sénéchal, 2016) suggest that they are a valid strategy to be used in preschool contexts and promoted by ECE Teachers.

The present study adds to the literature the merit of discriminating the favourable effect of an intervention based on Vygotskian principles and in which the children ashore induced to reflect on the written code. However, we do not claim for generalization of the results since this research was developed with a modest sample of kindergarten children and factors as family literacy practices or level of language development were not controlled. Even more, one of the most critical limitations of this study is the fact that no delay post-test was delivered to confirm if children's evolution in the quality of invented spelling remains. Another limitation is the fact that we did not look at the effects of both intervention procedures in early reading. In the context of this study would be interesting to check if the differences found between the two types of intervention would be the same if they have a different duration. Besides, it would be relevant to check whether these differences were in children with levels of invented spelling slightly more evolved. Alongside, we think that it would be relevant to do a qualitative analysis of the interactions between experimenter and the children.

Undoubtedly, further studies are necessary to prove the efficiency of a methodological approach based on questioning and reflection in natural educational settings in preschool where preschool teachers should be used as instructors. Also, it is necessary, in natural preschool settings, to investigate different early literacy programmes to test for the specific effect of this approach in invented spelling as compared to other interventions. In general, we can say that this study provides some important clues to improve learning instruction practices in what concerns invented spelling.

## References

- Adams, M. (1998). *Beginning to read: Thinking and learning about print*. MIT Press.
- Albuquerque, A., & Alves Martins, M. (2017). Habilidades iniciais de alfabetização em português: Pesquisa transcultural em Portugal e no Brasil. *Psico-USF*, 22(3), 437-448. <https://doi.org/10.1590/1413-82712017220305>
- Albuquerque, A., & Alves Martins, M. (2018). Escrita inventada no jardim-de-infância: Contributos para a aprendizagem da leitura e escrita. *Análise Psicológica*, 36, 341-354. <https://doi.org/10.14417/ap.1308>
- Albuquerque, A., & Alves Martins, M. (2019). Enhancing children's literacy learning: From invented spelling to effective reading and writing. *L1 Educational Studies in Language and Literature*, 19, 1-24. <https://doi.org/10.17239/11esll-2019.19.01.02.10.17239/11esll-2019.19.01.02>
- Almeida, T., & Silva, C. (2019). Escritas inventadas no jardim-de-infância: Comparando dois programas de intervenção. *Psicologia Escolar e Educacional*, 23, 1-15. <https://doi.org/10.1590/2175-35392019012948>
- Alvarado, M. (1998). Consciencia fonológica y escritura en niños preescolares: La posibilidad de omitir el primer segmento. *Lectura y Vida*, 3, 42-50. [http://fundacionzorrojo.org/publicaciones/MoAl/19\\_03\\_Alvarado.pdf](http://fundacionzorrojo.org/publicaciones/MoAl/19_03_Alvarado.pdf)
- 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., Almeida, T., Silva, A. C., Salvador, L., Rato, L., & Santos, A. (2020). *Práticas de literacia em jardim-de-infância em Portugal: O que dizem os educadores*. ISPA – Instituto Universitário.
- 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, 215-237. <https://doi.org/10.17239/jowr-2013.05.02.3>
- Alves Martins, M., Albuquerque, A., Salvador, L., & Silva, C. (2015). Escrita inventada e aquisição da leitura em crianças de idade pré-escolar. *Psicologia: Teoria e Pesquisa*, 31, 137-144. <https://doi.org/10.1590/0102-37722015021639137144>
- Alves Martins, M., Salvador, L., Albuquerque, A., & Montanero Fernández, M. (2017). "Otro niño lo escribió así". Ayuda educativa y resultados de actividades de escritura inventada. *Revista de Educación*, 377, 161-186. <https://doi.org/10.4438/1988-592X-RE-2017-377-357>

- Alves Martins, M., Salvador, L., Albuquerque, A., & Silva, C. (2016). Invented spelling activities in small groups and early spelling and reading. *Educational Psychology: An International Journal of Experimental Educational Psychology*, 36, 738-752. <https://doi.org/10.1080/01443410.2014.950947>
- Alves Martins, M., & Silva, C. (2006a). The impact of invented spelling on phonemic awareness. *Learning and Instruction*, 16, 41-56. <https://doi.org/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. <https://doi.org/10.1007/BF03173575>
- 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.
- Bus, A. G., & van IJzendoorn, M. H. (1999). Phonological awareness and early reading: A meta-analysis of experimental training studies. *Journal of Educational Psychology*, 91(3), 403-414. <https://doi.org/10.1037/0022-0663.91.3.403>
- Cardoso-Martins, C., & Batista, A. (2005). O conhecimento do nome das letras e o desenvolvimento da escrita: Evidência de crianças falantes do português. *Psicologia, Reflexão e Crítica*, 18, 330-336. <https://doi.org/10.1590/S0102-79722005000300006>
- Cardoso-Martins, C., Mesquita, T. C., & Ehri, L. (2011). Letter names and phonological awareness help children to learn letter-sound relations. *Journal of Experimental Child Psychology*, 109, 25-38. <https://doi.org/10.1016/j.jecp.2010.12.006>
- Clark, R. E. (2009). How much and what type of guidance is optimal for learning from instruction. In S. Tobias & T. Duffy (Eds.), *Implicit theory applied to instruction: Success or failure* (pp. 158-183). Routledge.
- Cunningham, A. E. (1990). Explicit versus implicit instruction in phonemic awareness. *Journal of Experimental Child Psychology*, 50(3), 429-444. [https://doi.org/10.1016/0022-0965\(90\)90079-N](https://doi.org/10.1016/0022-0965(90)90079-N)
- Dean Jr, D., & Kuhn, D. (2006). Direct instruction vs. discovery. *Science Education*, 91, 384-397. <https://doi.org/10.1002/sce.20194>
- Ferreiro, E. (1988). L'écriture avant la lettre. In H. Sinclair (Ed.), *La production des notations chez le jeune enfant* (pp. 18-69). Presses Universitaires de France.
- Ferreiro, E. (2002). Escritura y oralidad: Unidades, niveles de análisis y consciencia metalinguística. In E. Ferreiro (Ed.), *Relaciones de (in)dependencia entre oralidad y escritura*. Geddisa Editorial.
- Foorman, B. R., Francis, D. J., Shaywitz, S. E., Shaywitz, B. A., & Fletcher, J. M. (1997). The case for early reading intervention. In B. A. Blachman (Ed.), *Foundations of reading acquisition and dyslexia: Implications for early intervention*. Erlbaum Associates.
- Kirschner, P. A., Sweller, J., & Clark, R. E. (2006). Why minimal guidance during instruction does not work: An analysis of the failure of implicit, discovery, problem-based, experiential, and inquiry-based teaching. *Educational Psychologist*, 41(2), 75-86. [https://doi.org/10.1207/s15326985ep4102\\_1](https://doi.org/10.1207/s15326985ep4102_1)
- Kuhn, D. (2005). *Education for thinking*. Harvard University Press.
- Kuhn, D. (2007). Is direct instruction an answer to the right question?. *Educational Psychologist*, 42(2), 109-113. <https://doi.org/10.1080/00461520701263376>
- Kuhn, D. (2011). What is scientific thinking and how does it develop? In U. Goswami (Ed.), *The Wiley-Blackwell handbook of childhood cognitive development* (2<sup>nd</sup> ed., pp. 497-523). Wiley-Blackwell.
- Levin, I., Shatil-Carmon, S., & Asif-Rave, O. (2006). Learning of letter names and sounds and their contribution to word recognition. *Journal of Child Psychology*, 93, 139-165. <https://doi.org/10.1016/j.jecp.2005.08.002>
- Mann, V. A. (1993). Phoneme awareness and future reading ability. *Journal of Learning Disabilities*, 26, 259-269. <https://doi.org/10.1177/002221949302600404>
- McBride-Chang, C. (1998). The development of invented spelling. *Early Education and Development*, 9, 147-160. [https://doi.org/10.1207/s15566935eed0902\\_3](https://doi.org/10.1207/s15566935eed0902_3)
- McBride-Chang, C. (1999). The ABCs of the ABCs: The development of letter-name and letter-sound knowledge. *Merrill-Palmer Quarterly*, 45(2), 285-308.

- Nie, Y., & Lau, S. (2010). Differential relations of implicit and didactic instruction to students cognition, motivation, and achievement. *Learning and Instruction, 20*, 411-423. <https://doi.org/10.1016/j.learninstruc.2009.04.002>
- 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. <https://doi.org/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. <https://doi.org/10.1111/j.1467-8624.2008.01164.x>
- Ouellette, G., & Sénéchal, M. (2016). Invented spelling in kindergarten as a predictor of reading and spelling in grade 1: A new pathway to literacy, or just the same road, less known?. *Developmental Psychology, 53*(1), 77-88. <https://doi.org/10.1037/dev0000179>
- 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. <https://doi.org/10.1080/00220973.2012.699903>
- Pontecorvo, C., & Orsolini, M. (1996). Writing and written language in children's development. In C. Pontecorvo, M. Orsolini, B. Burge, & L. Resnick (Eds.), *Children's early text construction* (pp. 3-23). Lawrence Erlbaum.
- Pulido L., & Morin M. F. (2017). Invented spelling: What is the best way to improve literacy skills in kindergarten?. *Educational Psychology, 38*, 980-996. <https://doi.org/10.1080/01443410.2017.1414155>
- Quinteros, G. (1994). El uso y función de las letras en el período pre-alfabético. *Lectura y Vida, 15*, 28-38. [http://www.lecturayvida.fahce.unlp.edu.ar/numeros/a15n4/15\\_04\\_Quinteros.pdf](http://www.lecturayvida.fahce.unlp.edu.ar/numeros/a15n4/15_04_Quinteros.pdf)
- Raven, J., Raven, J. C., & Court, J. H. (1998). *Manual Raven matrices progressivas* (3<sup>a</sup> ed.). TEA Ediciones, S.A.
- Read, C. (1971). Pre-school children's knowledge of English phonology. *Harvard Educational Review, 41*, 1-34. <https://doi.org/10.17763/haer.41.1.91367v0h80051573>
- Richardson, V. (2003). Implicit pedagogy. *Teacher College Record, 105*(9), 1623-1640. <https://doi.org/10.1046/j.1467-9620.2003.00303>
- Richgels, D. (1995). Invented spelling ability and printed word learning in kindergarten. *Reading Research Quarterly, 30*, 96-109. <https://doi.org/10.2307/747746>
- Rieben, L., Ntamakiliro, L., Gonthier, B., & Fayol, M. (2005). Effects of various early writing practices on reading and spelling. *Scientific Studies of Reading, 9*(2), 145-166.
- Santos, A. I., & Alves Martins, M. (2011). Literacy practices in Portuguese kindergartens and children's conceptualizations about written language. *Revue les Dossiers des Sciences de l'Éducation, 25*, 125-141. <https://doi.org/10.4000/dse.1043>
- Shatil, E., Share, D. L., & Levin, I. (2000). On the contribution of kindergarten writing to grade 1 literacy: A longitudinal study in Hebrew. *Applied Psycholinguistics, 21*, 1-21. <https://doi.org/10.1017/S0142716400001016>
- Silva, C. (2002). *Bateria de provas fonológicas*. ISPA – Instituto Universitário.
- 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. <https://doi.org/10.1007/s11145-008-9157-3>
- Sweller, J. (2004). Instructional design consequences of an analogy between evolution by natural selection and human cognitive architecture. *Instructional Science, 32*(1), 9-31. <https://doi.org/10.1023/B:TRUC.0000021808.72598.4d>
- Sweller, J. (2012). Human cognitive architecture: Why some instructional procedures work and others do not. In K. Harris, S. Graham, & T. Urdu (Eds.), *APA educational psychology handbook: Theories, constructs, and critical issues* (Vol. 1, pp. 295-325). American Psychological Association. <https://doi.org/10.1037/13273-011>
- Sweller, J., Kirschner, P. A., & Clark, R. E. (2007). Why minimally guided teaching techniques do not work: A reply to commentaries. *Educational Psychology, 42*(2), 115-121. <https://doi.org/10.1080/00461520701263426>

- Tolchinsky, L. (2005). The emergence of writing. In C. MacArthur, S. Graham, & J. Fitzgerald (Eds.), *Handbook of writing research* (pp. 83-96). Guilford.
- Tolchinsky, L., & Teberosky, A. (1998). The development of word segmentation and writing in two scripts. *Cognitive Development, 13*(1), 1-24. [https://doi.org/10.1016/S0885-2014\(98\)90018-1](https://doi.org/10.1016/S0885-2014(98)90018-1)
- Treiman, R. (1994). Use of consonant letters names in beginning spelling. *Developmental Psychology, 30*(4), 567-580. <https://doi.org/10.1037/0012-1649.30.4.567>
- Treiman, R. (1998). Why spelling? The benefits of incorporating spelling into beginning to reading instruction. In J. L. Metsala & L. C. Ehri (Eds.), *Word recognition in beginning literacy* (pp. 289-313). Lawrence Erlbaum Associates Publishers.
- Vigário, M., Martins, F., & Frota, S. (2006). A ferramenta FreP e a frequência de tipos silábicos e de classes de segmentos no Português. In F. Oliveira & J. Barbosa (Orgs.), *Textos seleccionados do XXI Encontro Nacional da Associação Portuguesa de Linguística* (pp. 675-687). APL.
- Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Harvard University Press.

## Appendix 1

### *Participants selection and initial evaluation task and procedures*

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#### **Words used in the spelling test for initial assessment**

gato/gata/gatinho/cavalo/formiga (cat, female cat, kitten, horse, ant)

#### **Battery of phonemic awareness**

Initial-phoneme classification test

Cards with drawings representing:

Examples:

colher/chave/chuva/bola (spoon/key/rain/ball)

jóia/nó/jipe/pá (jewel/knot/jeep/shovel)

Items:

alce/urso/arca/ovo (moose/bear/arch/egg)

orelha/alface/árvore/igreja (ear/lettuce/tree/church)

raposa/regador/viola/boneca (fox/watering-pot/guitar/doll)

mala/peixe/chucha/mota (bag/fish/ [baby's] dummy/motorcycle)

sumo/gola/leite/gato (juice/collar/milk/cat)

buzina/cegonha/vassoura/veado (horn/stork/broom/deer)

serra/copo/cama/lupa (saw/glass/bed/magnifying glass)

fiveira/telhado/janela/fogueira (buckle/roof/window/bonfire)

boca/ tigre/selo/tacho (mouth/tiger/stamp/saucepan)

pato/pêra/ milho/chuva (duck/pear/corn/rain)

tijolo/bolacha/seringa/banana (brick/biscuit/syringe/banana)

cebola/toalha/gaveta/cigarro (onion/towel/drawer/cigarette)

lata/luva/roda/fita (can/glove/wheel/ribbon)

desenho/camisado/dominó/novelo (drawing/shirt/domino/ball of wool)

#### **Phonemic segmentation test**

Cards with drawings representing:

Examples:

chá (tea)

osso (bone)

Items:

asa (wing)

avó (grandfather)

rua (street)

mar (sea)

gorro (cap)

via (road)

carro (car)

figo (fig)

taça (cup)

pá (shovel)

bule (teapot)

sol (sun)

lã (wool)

dia (day)

---

## Appendix 2

### *Words spelled at pre- and post-tests, correspondent International Phonemic Alphabet*

Word	BABA	PAGO	DADO	TABU	RATO	VACA	MATA	FADA	NADO	RABO
IPA	[babɑ]	[pagu]	[dadu]	[tabubu]	[Ratu]	[vakɑ]	[matɑ]	[fadɑ]	[nadu]	[Rabu]
Word	BICO	PIPA	DIGO	TITO	RICO	VIDA	MITO	FITA	NICO	RICA
IPA	[biku]	[pipɑ]	[digu]	[titu]	[Riku]	[vidɑ]	[mittu]	[fitɑ]	[niku]	[Rikɑ]
Word	BOTA	PODA	DOTA	TOTA	RODO	VOTA	MODA	FOCA	NOTA	RODA
IPA	[botɑ]	[podɑ]	[dotɑ]	[totɑ]	[Rodu]	[votɑ]	[modɑ]	[fokɑ]	[notɑ]	[Rodɑ]
Word	BUDA	PULO	DUDA	TUBO	RUGA	VUDU	MUDO	FUMO	NUCA	RUMO
IPA	[budɑ]	[pulu]	[dudɑ]	[tubu]	[Rugɑ]	[vudu]	[mudu]	[fumu]	[nukɑ]	[Rumu]

*Note.* IPA = International Phonemic Alphabet.

### **Programas de intervenção de escrita inventada: Comparando instruções explícitas e implícitas**

Este estudo tem como objetivo comparar a eficácia de dois programas de intervenção de escrita inventada, um com instrução explícita de correspondências grafo-fonéticas e outro baseado no questionamento e reflexão sobre as correspondências grafo-fonéticas (designadas como instruções implícitas). Noventa crianças em idade pré-escolar, cujas escritas inventadas não mobilizavam letras convencionais para representar os sons, foram distribuídas por três grupos, dois experimentais e um de controlo. Todos os grupos eram equivalentes na idade, inteligência, conhecimento de letras e consciência fonológica. Manipulámos o tipo de instruções (implícitas *vs.* explícitas) entre os pré e pós-testes nos dois grupos experimentais onde as crianças participaram num programa de intervenção de escrita inventada. As crianças que participaram no programa de intervenção implícita mostraram uma melhoria significativa no número de letras mobilizadas corretamente nas suas produções escritas e na consciência fonémica em comparação com as crianças dos grupos de controlo e com instrução explícita. As crianças do grupo de instrução explícita mostraram melhorias significativas relativamente às crianças do grupo de controlo. Estes resultados sugerem que o questionamento e a reflexão aplicados aos programas de escrita inventada parecem potenciar um conhecimento mais significativo sobre as relações entre o código oral e o escrito.

**Palavras-chave:** Instrução explícita, Instrução implícita, Escrita inventada, Programas de intervenção, Pré-escolar.

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