ENHANCING CHILDREN'S LITERACY LEARNING: FROM INVENTED SPELLING TO EFFECTIVE READING AND WRITING

ANA ALBUQUERQUE & MARGARIDA ALVES MARTINS

Centro de Investigação em Educação, ISPA—Instituto Universitário, Lisboa, Portugal

Abstract

This longitudinal study aimed at testing the long-term impact of invented spelling activities conducted in kindergarten on children's literacy skills throughout primary school until the end of Grade 3. The participants were 100 Portuguese 5-year-olds that were randomly assigned into two equivalent groups and took part in 10 training sessions: invented spelling (experimental condition) or storybook reading (control condition). Writing and reading skills were tested in kindergarten, Grade 1 and Grade 3. The results showed that the experimental group outperformed the control group in kindergarten and benefited more from formal school teaching instruction. Lasting effects were found as the invented spelling condition presented statistically significant higher scores in reading and writing in primary education. These findings support empirical evidence for enhancing young children's learning in favour of their later literacy performance.

Keywords: early literacy, invented spelling, writing, reading, kindergarten

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/L1ESLL-2019.19.01.02

Corresponding author: Ana Albuquerque, Centro de Investigação em Educação (CIE-ISPA), R. Jardim do Tabaco, 34, 1149-041 Lisboa, Portugal, email: aalbuquerque@ispa.pt

1. INTRODUCTION

Reading and writing are considered valuable skills to be learned in the first years of schooling as they open the gateway to learning other curricular areas. In fact, this is one of the biggest challenges in childhood education. However, children from different languages and backgrounds sometimes struggle with literacy and so they encounter difficulties when learning other subjects throughout the school years.

Empirical evidence to date has established a significant connection between young children's early literacy skills and subsequent reading and writing (e.g., Adams, 1998; Ferreiro & Teberosky, 1982; Lonigan, Burgess & Anthony, 2000; Mann, 1993; Scarborough, 1998; Tolchinsky, 2005). In this sense, intervention studies in preschool environments are a priority as they may provide promising data regarding successful learning processes.

Stanovich (1986) presented a framework to clarify the individual differences in reading abilities, showing that the most competent readers tend to improve their reading skills and the most incapable readers tend to remain slower and with more reading difficulties along time (Matthew Effect). Several studies from kindergarten through primary school observed that children who struggled in reading in preschool and in Grade 1 kept showing difficulties in Grade 3 (Foster & Miller, 2007). Also, Utchell, Schmitt, McCallum, McGoey and Piselli (2016) studied the extent to which early literacy measures tested in kindergarten and oral reading fluency measures tested in Grade 1 are related to and predict future reading performance up to 7 years later. Their findings indicated that these two variables were related to children's performance in Grades 3 and 5. Additionally, a meta-analytic review has revealed that spelling instruction triggers word reading through the school years, particularly in primary education (Graham & Hebert, 2011; Graham & Santangelo, 2014).

Orthography, phonology and literacy achievement

Literacy learning involves several aspects of written language such as orthography and phonology. Word recognition strongly depends on the various linguistic specificities of assigning phonological codes to a certain orthographic unit, which may lead to diverse reading outcomes (Treiman, 2017). These variations produce developmental differences in lexical representations and affect the constraints in reading throughout different writing systems (Ziegler & Goswami, 2005).

In a comparative research, Seymour, Aro and Erskine (2003) aimed to explore the rates of literacy acquisition in 13 European languages and argued that differences in the process of learning to read and write may be explained by linguistic variations in syllabic structure and orthographic depth. It was hypothesised that it is more difficult to learn to read in languages with a complex syllabic structure and that literacy acquisition occurs more rapidly in shallow/transparent systems as opposed to deep/opaque orthographies. Seymour et al (2003) observed that for most European languages, children generally become fluent and accurate on a literacy foundation

level in the first primary school year, especially for shallow orthographies—e.g., Finnish, German, Greek, Italian and Spanish. Learning difficulties were found for languages with deep orthographies—e.g., Danish and English. Interestingly, although Portuguese has a fairly shallow orthographic system, Grade 1 children's reading outcomes were similar to those found in deep orthographies.

Portuguese is classified as an intermediate orthographic system with a simple syllabic structure and generally predictable grapheme-phoneme mappings (Girolami-Boulinier & Pinto, 1994; Rebelo & Delgado-Martins, 1978; Viana, Andrade, Oliveira & Trancoso, 1991). Whilst for reading, grapheme-phoneme correspondences are mostly one-to-one or guided by contextual or positional rules, for writing there are more orthographic inconsistencies. This complexity of letter-sound association and its degree of asymmetry reduces the transparency level of Portuguese (Defior, Martos & Cary, 2002; Morais, 1995), which may explain why children's reading outcomes were similar to those found in deep orthographies.

The role of early literacy on reading and writing achievement

Letters and sounds play a crucial role in young children's early literacy development (Treiman, 2006). When asked to write something down, preschoolers generally rely on their (insipient or more advanced) knowledge and metalinguistic skills to represent different speech units in print. They frequently produce recognisable symbols from their own writing system and place them along a line (Rowe, 2015). Children need to learn the visual shape of letters, their names and sounds, as well as the segmentation of words in smaller linguistic units and the understanding of grapheme-phoneme correspondences. This knowledge should be activated when learning in order to build memory connections between writing, reading and meaning. The acquisition of orthographic knowledge and decoding requires close attention to both letter order and spelling-sound mapping. In this sense, spelling provides a strong self-teaching tool in consolidating orthographic representations (Shahar-Yames & Share, 2008).

Innumerable investigations have pointed out that alphabet knowledge and phonological awareness are two solid abilities and predictors that favour the comprehension of the alphabetic principle (Adams, 1998; Ehri, 2005, 2014; Ehri et al, 2001). On the one hand, strong links have been found between successful reading and phonological awareness, i.e., the ability to consciously identify and manipulate the minor linguistic sounds of oral speech (Ball & Blachman, 1991; Ehri et al., 2001). Additionally, this metalinguistic skill has been highly connected to early spelling development (Ouellette & Sénéchal, 2008a,b; Tangel & Blachman, 1995). On the other hand, the knowledge of the alphabet, i.e., the recognition of letter names and its corresponding sounds, has also been referred as a key element to the development of early literacy (Ehri et al., 2001; Levin, Shatil-Carmon & Asif-Rave, 2006).

In a longitudinal study by Caravolas et al (2012), the researchers observed that phonemic awareness, letter knowledge and rapid naming were the strongest

predictors of reading performance in different alphabetic systems (English, Spanish, Slovak and Czech). Moreover, a causal relationship has been found between letter-sound knowledge and phonological awareness in the development of emergent literacy skills in English (Hulme, Bowyer-Crane, Carroll, Duff & Snowling, 2012). Accordingly, the acquisition of the alphabetic principle and the improvement of reading abilities are co-determined by letter knowledge and phonological awareness (Bowey, 2005).

More recently, researchers are calling attention to young children's first spelling attempts as a way of measuring early literacy performance and a valuable means of boosting their literacy learning process. These non-conventional forms of writing prior to formal literacy instruction, also known as invented spellings (Chomsky, 1970; Read, 1971), may show resemblance to the correct words depending on the children's skills and previous knowledge.

In fact, the use of partial spellings and phonologically plausible but unconventional spellings indicate that young children frequently have some knowledge regarding the connections between sounds and spellings, as found in a recent study with American and Australian kindergarteners (Treiman, Kessler, Pollo, Byrne & Olson, 2016). Furthermore, studies in Hebrew have shown that educational activities where children are invited to actively think about word spelling may enhance their own literacy learning process when supported by adults and/or more competent peers (Levin & Aram, 2013).

Invented spellings and metalinguistic skills are closely connected in a bidirectional way and help children succeed in learning the alphabetic principle and acquiring useful cognitive tools for reading and writing. As shown by Alves Martins and Silva (2006) in a study with Portuguese children, while more advanced phonological awareness skills lead to more sophisticated forms of spelling, invented spelling significant experiences also boost phonological awareness skills.

Furthermore, a recent important study by Ouellette and Sénéchal (2016) with English-speaking Canadian children suggested that the sophistication of children's invented spellings in kindergarten was predictive of subsequent reading and spelling in Grade 1. In this research, the participants were tested on multiple literacy measures (oral vocabulary, alphabetic knowledge, phonological awareness, word reading and invented spelling) in the first year of schooling and approximately one year later. Path analyses exposed a model where invented spelling contributed simultaneously to reading, alphabetic knowledge and phonological awareness. Longitudinal tests showed that invented spelling influenced subsequent reading and alphabet knowledge in mediation between phonological awareness and early reading. It also influenced subsequent spelling and phonological awareness in mediation with alphabetic knowledge. Thus, the authors argued that invented spelling added an explanatory variance to reading and writing outcomes.

Invented spelling programmes and literacy achievement

Several studies regarding invented spelling have compared different intervention approaches and mediation processes, namely with Israeli Hebrew-speaking and Spanish-speaking mother-child dyads where maternal mediation and children's literacy were analysed in two writing systems (the Semitic abjad and the European alphabet) (Levin, Aram, Tolchinsky & McBride, 2013); and also with French children where three experimental treatments were designed to simulate diverse teaching practices (invented spelling; copied spelling; invented spelling with feedback on correct orthography; drawing) (Rieben, Ntamakiliro, Gonthier & Fayol, 2005). These researches highlight the relevance of metalinguistic thinking to the development of effective early literacy skills, particularly phonological awareness and letter knowledge (Bus & van Ijzendoorn, 1999; Ehri et al, 2001).

It seems that with consistent training and appropriate feedback, invented spelling activities in preschool improve young children's metalinguistic skills and literacy knowledge (Alves Martins, Salvador, Albuquerque & Silva, 2014; Hecht & Close, 2002; Ouellette & Sénéchal, 2008b; Sénéchal, Ouellette, Pagan & Lever, 2012; Vasconcelos Horta & Alves Martins, 2011). However, its lasting effects remain unclear since only a few studies have explored the impact of these activities on literacy learning at the beginning of primary education.

Research teams in Canada (Ouellette, Sénéchal & Haley, 2013), Israel (Levin & Aram, 2013), Portugal (Albuquerque & Alves Martins, 2016) and Norway (Hofslundsengen, Hagtvet, & Gustafsson, 2016) have designed experimental longitudinal studies in different languages to analyse the effects of invented spelling skills in preschool until the end of Grade 1, where children engage in formal reading and writing teaching instruction.

Ouellette, Sénéchal and Haley (2013) developed a teaching study in Canada with 40 English-speaking kindergarteners to test whether an invented spelling programme would smooth children's literacy learning as compared to phonological awareness instruction. Children were randomly assigned into two teaching conditions (invented spelling and phonological awareness) and took part in 16 teaching sessions. The results showed that both conditions had an improvement in alphabetic knowledge and phonological awareness. However, children in the invented spelling condition revealed a higher growth in invented spelling sophistication and learned to read more words. Additionally, lasting advantages were found for the invented spelling group in follow-up tests, supporting that these invented spelling sessions with appropriate feedback contributed to the development of literacy skills in a deep/opaque language.

Levin and Aram (2013) carried out a study in Hebrew with 197 Israeli preschoolers from low socioeconomic status families to compare the effects of different mediation routines on their invented spelling attempts, as well as on spelling and other early literacy skills (letter names, letter sounds, word segmentation and word decoding). The students underwent individual invented spelling sessions for 16 weeks.

They were randomly divided into four groups: 1) process-product mediation (focus on phoneme-grapheme mapping and letter naming/word spelling); 2) product mediation (focus on letter naming/word spelling); 3) spelling with no mediation; 4) no intervention. The results suggested that the most productive routine for all children was process-product mediation both in short and long-term assessments.

Albuquerque and Alves Martins' (2016) goal was to investigate immediate and longitudinal effects of an invented spelling training programme in kindergarten on Portuguese children's spelling and reading skills until the end of the first year of primary school. The participants were 45 five-year-old children that were tested in kindergarten (pre-test, immediate post-test and delayed post-test) and at the end of Grade 1. They were randomly assigned into two groups: the experimental group took part in invented spelling sessions and the control group participated in storybook reading activities. Experimental group participants showed statistically significant higher results throughout the research for all literacy measures, suggesting that these invented spelling activities led children to learn to read and write more easily in European-Portuguese, a relatively shallow orthography.

Hofslundsengen, Hagtvet, and Gustafsson (2016) examined the impact of a 10-week invented writing programme with 105 Norwegian preschoolers on their literacy skills with three measures: pre-test, post-test and follow-up test. Children were randomly assigned into an experimental group (invented writing programme) and a control group (ordinary preschool programme) and took part in 40 sessions conducted by the classroom teacher. The invented writing group showed higher results for phoneme awareness, spelling and reading on post-test and follow-up tests. The authors argued that in Norwegian, a semi-consistent orthography, invented writing seemed to ease the development of emergent literacy skills.

The current study

Regardless of methodological and linguistic differences, these experimental studies followed children exclusively until the end of Grade 1, which strengthens the need to broaden previous researches and analyse to what extent these invented spelling activities enhance children's writing and reading effective skills along primary school.

Therefore, this study aims at testing the long-term impact of invented spelling activities in kindergarten on Portuguese children's literacy skills. In this sense, the following research question was previously set up: Will invented spelling activities conducted in the last year of kindergarten have an impact on children's reading and writing skills in Grade 1 and in Grade 3?

2. METHOD

2.1 Design

This is an experimental longitudinal study from the last year of kindergarten to the third year of primary education. In kindergarten, the children were divided into two conditions: the experimental group participated in invented spelling activities and the control group took part in storybook reading sessions.

2.2 Participants

A total of 100 Portuguese five-year-old children took part in this research (56 girls and 44 boys). At the beginning of the study their mean age was 65.08 months. Parent/guardian informed consent was obtained, and all national laws and ethical standards were conformed, as well as data confidentiality and anonymity. Children attended six kindergarten classes from two private schools and one public school in Lisbon where there was no direct literacy classroom instruction, as in Portugal the formal teaching of reading and writing does not begin until primary education. The following year, the children moved to six Grade 1 classes in the same schools. All of them adopted the standard Portuguese national curriculum where phonics instruction is the main teaching method used. Children's socioeconomic status was diverse and measured by the range of parental education stages: 3% of responding mothers and 9% of responding fathers had completed middle school; 32% of mothers and 21% of fathers had completed high school; and 62% of mothers and 68% of fathers had completed higher education (university or graduate degree) (no data was available for 3% of mothers and 2% of fathers).

When the children moved from kindergarten to primary school, they stayed in the same class from Grade 1 to Grade 3. Their primary school teacher was unaware whether the children had participated or not in the invented spelling activities the year before. Preliminary tests were carried out to assure that only children who could not read or write in kindergarten were included in the study. From an initial pool of 120 children, 20 dropped out at some point and so they were also excluded. In each class, children were randomly assigned into two groups—invented spelling condition (N=49) and storybook reading condition (*N* = 51) — that were equivalent on four initial measures: cognitive ability, syllabic awareness, phonemic awareness and alphabet knowledge.

2.3 Measures

Cognitive ability

The *Raven's Progressive Matrices Test – coloured version* (Raven, Raven, & Court, 1998) was used to assess the children's cognitive and reasoning abilities. They were

asked to look at three sets of different incomplete patterns and identify the missing element in each one. One point was given to all correct answers to a maximum of 36 points.

Syllabic and phonemic awareness

The *Battery of Phonological Tests* (Silva, 2002) was used to assess the children's phonological awareness level (initial-syllable classification and initial-phoneme classification skills). The participants were asked to look at different sets of four pictures connected to four words that were spoken aloud by the researcher and to identify two words that started with a similar sound—either syllable (e.g., girafa [giraffe]/ panela [cooking pot]/ cenoura [carrot] / palhaço [clown]) or phoneme (e.g., fivela [buckle]/ telhado [roof]/ janela [window]/ fogueira [bonfire]). One point was given to all correct answers to a maximum of 14 points in each classification test.

Alphabet knowledge

Children were asked to name the different letters of the alphabet, printed in uppercase and presented in small flashcards in a random order. One point was given to each correct letter to a maximum of 26 points.

Writing and reading assessment

Different lists of words were applied in all assessment points to control learning effects. The words included in these lists were progressively more complex along time. From kindergarten to the middle of Grade 1 the lists were previously set up by the researcher considering several specific criteria. At the end of Grade 1 and in Grade 3, two standard tests for the Portuguese population were applied: *ALEPE – "Bateria de Avaliação da Leitura em Português Europeu" (Battery for the Assessment of Reading Skills in European Portuguese)* (Sucena & Castro, 2011) for single-word oral reading accuracy and fluency and *TIL – "Teste de Idade de Leitura" (Reading Age Test)* (Sucena & Castro, 2010) for decoding and comprehension in sentence reading.

Assessment 1: in kindergarten, before the training activities

Single-word writing and oral reading accuracy. A list of 18 familiar and consistent words with 2 up to 4 letters was designed to assess the children's writing and reading ability in kindergarten at the beginning of the study. Only graphemes with one-to-one correspondences were used (3 vowels and 6 consonants) and all the words had frequent syllabic structures in European-Portuguese (CVCV and CVV) (e.g., pato [duck]; pai [father]). One point was assigned for each word correctly spelled/read, so the total score could vary between 0 and 18 points.

Assessments 2 and 3: at the end of kindergarten and in the middle of Grade 1

Single-word writing and oral reading accuracy. Two different lists of 18 familiar words were previously designed by the researcher with similar features regarding syllabic structure and length. They were selected from CORLEX, a European-Portuguese lexical database (Bacelar do Nascimento et al, 2000). Each list comprised consistent words from 2 to 4 letters and included all 5 vowels and 15 consonants — except for H, K, Q, W, X and Y (e.g., tu [you]; lua [moon]; bola [ball]). The second list was slightly more complex as compared to the first one — it had only one monosyllabic word with a less frequent structure in European-Portuguese (VC) (e.g., ar [air]). One point was given for each word correctly spelled/read, so the total score could range from 0 to 18 points in each assessment test.

Assessment 4: at the end of Grade 1

Single-word writing and oral reading accuracy and fluency. A list of 18 words from ALEPE *(Battery for the Assessment of Reading Skills in European Portuguese*) (Sucena & Castro, 2011) — suitable for Grade 1 children — was used to analyse single-word spelling and reading. The stimuli had different orthographic complexity conditions (simple, consistent and inconsistent) and ranged between 4 and 6 letters (e.g., milho [corn]; pior [worse]; têxtil [textile]). Some of these words were unfamiliar and had complex syllabic structures. All words correctly spelled/read were assigned with one point, so the final score could vary between 0 and 18 points in each test. Oral reading response times were also recorded and registered to calculate the number of words correctly read per minute.

Assessment 5: at the end of Grade 3

Single-word writing and oral reading accuracy and fluency. A list of 24 words from ALEPE (*Battery for the Assessment of Reading Skills in European Portuguese*) (Sucena & Castro, 2011) — suitable for children from Grade 2 to Grade 4 — was used to analyse single-word spelling and reading. The stimuli had different orthographic complexity conditions (simple, consistent and inconsistent) and the number of letters varied between 4 and 10, with more inconsistent and unfamiliar words than those used in the previous assessment point, as well as more complex syllabic structures (e.g., cascata [waterfall]; trânsito [traffic]). One point was given to all words correctly spelled/read, so the maximum score could range between 0 and 24 points in each assessment task. The number of correct words per minute was analysed by recording the children's oral reading response times.

Comprehension in sentence reading. Single-sentence reading and comprehension was assessed through TIL (*Reading Age Test*) (Sucena & Castro, 2010). This test lasts for 5 minutes: during that period children are presented with 40 incomplete sentences (4 training sentences and 36 experimental sentences) and their task is to

underline one of five words shown below to fill in the blanks in the correct way. The items are presented in progressive levels of difficulty and the final score is calculated by the sum of all correct items multiplied by 100 and divided by 36.

2.3.1 *Experimental condition: invented spelling*

Experimental group children were divided in small groups of four and participated in 10 invented spelling training sessions over a 5-week intervention period. Our aim was to set up heterogeneous groups according to different criteria: gender and phonological awareness skills — each group had boys and girls (2-2 or 1-3) and at least one child with a higher score on syllabic awareness or letter knowledge and another one with a low score on both measures.

The sessions were designed to promote children's thinking about the spelling of different words and to develop their understanding of the relationships between oral and written language. These activities focused on spelling and there was no direct instruction on reading. The programme consisted of 10 biweekly sessions and the stimuli were 40 words (four per session) — dissyllabic, orthographically transparent and with consistent one-to-one grapheme-phoneme correspondences, including vowels and four stop consonants (B, D, P, T).

Spelling in each session was carried out in small group dynamics and followed a specific activity structure: 1) discussion about the best way to spell a certain word and tell the researcher which letters to write down; 2) comparison of their own word with the correct version written by a fictitious group of children presented by the researcher. In the first part of the activity, the children had to search for an agreement until the final spelling was reached. The letters were written down by the researcher to facilitate the children's visual awareness of their own written production. Adult mediation was essential to encourage children's active participation and to mediate interaction dynamics about oral speech and written language. When the word was finished, the researcher would show them the correct spelling and tell that it was written by another group of children of the same age from a different school. Nothing was said whether the spelling was correct or not. In the second part of the activity, the children had to think about the two spellings of the same word (theirs and the correct one) and compare them.

The researcher acted as facilitator and played a crucial role asking questions about graphemes and phonemes produced by the fictitious group as well as the differences between the two written productions. The adult's task was to mediate the children's interactions, leading them to explain the spelling of each letter of the word and to express whether they agreed with the other group's suggestion and why. Throughout the activity, the adult boosted the children's thinking process, stressing certain relevant sounds or drawing their attention to specific letters. The sessions were recorded and transcribed for future analyses of the children's productions, speech and interactions. Below is an example of the interaction dynamics in the

experimental condition that occurred in the first training session when children were asked to think about the first letter of the word PENA (/p/e/n/a/) [feather].

[Experimental condition | Training group: Carlota, Hugo, Inês, Teresa]

Researcher	Let's think about the word PENA. How should we spell it?
Carlota	P, P, P! The letter is P.
Researcher	Does it start with P?
Carlota	Yes, yes! P, P, P!
Researcher	Carlota thinks the first letter is P. Do you all agree? What do you think, Hugo?
Hugo	I think it's… Well, I don't know.
Researcher	Try to think about it. What word is it? It's PENA, /pe/ /na/…
Carlota	P! P! P! P!
Hugo	H. I think it's H.
Researcher	Is it the letter H first?
Hugo	Yes, maybe it is.
Researcher	What about you, Teresa? What letter should we write down first?
Teresa	T!
Researcher	And you, Inês?
Inês	I!
Researcher	Let's think a little bit more about this. What letter should we write down first to spell the word PENA, /pe/ /na/? Carlota thinks it's P, Hugo thinks it's H, Teresa thinks it's T and Inês thinks it's I. And now what should we write?
Carlota	P! P! P!
Researcher	Can you explain to your friends why you think it's P, Carlota?
Carlota	It's P. I know it's true.
Researcher	Is it?
Carlota	Look! It's /pe/-/na/! PENA does not begin with I or H or T. Listen: /pe/-/na/! It's /pe/, /pe/, /pe/, /pe/, /pe/ and then /na/! The word is PENA. It's /pe/-/na/, so the first letter is P. See?
Researcher	Is it? So what letter should I write down here? What do you all think?
Teresa	Oh, I see! Now I understand: it's P.
Hugo	Yes, P!
Researcher	So, shall I write down the letter P first?
Children	Yes!!

[The researcher writes down the letter P and continues the activity]

Control condition: storybook reading

Control group children were also divided into small groups of four and took part in 10 storybook reading sessions over the same 5-week intervention period. In each session (lasting for approximately 15 minutes), a small story was read aloud to the children by the researcher. They were asked to listen carefully and then make a drawing about their favourite part of the story.

2.4 Procedure

Children's writing and reading skills were tested five times throughout the research: in kindergarten before the training activities (Assessment 1), at the end of kinder-

garten (Assessment 2), in the middle of Grade 1 (Assessment 3), at the end of Grade 1 (Assessment 4), and at the end of Grade 3 (Assessment 5).

In the writing task, the children were asked to write down a list of words dictated in a fixed random order. In the reading task, they were asked to read aloud the same words presented in small flashcards. All tests were administered individually in different days and lasted for approximately 15 minutes each. Writing was applied prior to reading to prevent possible visual memorisation effects.

Both testing and training took place in a separate spare classroom. All assessments were carried out by two examiners who were blind to the children's group assignment and performance in previous tests to control possible bias effects. The intervention sessions were conducted by a psychologist who received training and supervision within our research team.

To assure ethical principles, all kindergarten teachers were offered an invented spelling training workshop at the end of the first year of the study where they had the opportunity to gain some helpful guidelines and instructional tools for future classroom literacy games and activities.

2.5 Data analysis

Proportion scores were used to allow direct comparison measures and statistical interpretation between all tests. They were calculated by dividing the number of words correctly spelled/read by the total number of words in each test. Generalised estimating equation regression models (GEE) were performed to compare the progress of the experimental group and the control group from kindergarten to Grade 3. Preliminary measures were added as covariates. An identity link function, a normal distribution and an AR(1) working correlation matrix structure were specified. Robust estimation (Huber-White estimator) of standard errors was also used. Regression analyses were executed to test the impact of the group (experimental/control) and the four initial measures (cognitive ability, syllabic awareness, phonemic awareness and alphabet knowledge) on oral reading fluency in Grade 1 and in Grade 3, as well as on sentence comprehension at the end of Grade 3.

3. RESULTS

3.1 Preliminary measures

T-tests were performed to analyse group equivalence at the beginning of the study. All initial measures (age, number of years of parental education, cognitive ability, phonemic awareness, syllabic awareness and alphabet knowledge) were used as dependent variables and the group (experimental/control) was assumed as the independent variable. No statistically significant differences were found ($p > .21$ in all cases). Table 1 presents the means and standard deviations for these preliminary measures for both groups.

Table 1. Descriptive statistics for both groups (experimental/control) regarding parental education, cognitive ability, syllabic awareness, phonemic awareness and alphabet knowledge.

	Parental Ed.: Mother		Parental Ed: Father		Cognitive ability		Syllabic awareness		Phonemic awareness		Alphabet knowledge	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
EG	14.90	2.37	14.73	2.52	17.76	4.97	6.06	4.07	3.41	2.38	17.20	4.12
CG	14.63	2.29	14.31	2.93	17.53	4.14	5.14	3.27	3.63	2.26	16.33	4.72

Note. EG = Experimental Group; CG = Control Group; Parental Ed. = parental education (years of schooling); Cognitive ability: max.=36; Syllabic awareness: max.=14; Phonemic awareness: max.=14; Alphabet knowledge: max.=26.

3.2 Writing and reading accuracy measures

Table 2 presents the descriptive statistics for writing and reading accuracy measures.

Table 2. Descriptive statistics for both groups (experimental/control) regarding writing and reading accuracy.

		Kindergarten				Grade 1				Grade 3	
		Assessment 1		Assessment 2		Assessment 3		Assessment 4		Assessment 5	
		M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Writing accuracy	EG	.02	.05	.42	.29	.63	.27	.64	.17	.85	.10
	CG	.01	.04	.12	.16	.33	.26	.52	.22	.80	.10
Reading accuracy	EG	.02	.03	.49	.31	.73	.29	.72	.18	.92	.07
	CG	.02	.03	.19	.23	.39	.33	.49	.24	.90	.07

Note. EG = Experimental Group; CG = Control Group; Writing accuracy: proportion scores calculated from the number of words correctly spelled; Reading accuracy: proportion scores calculated from the number of words correctly read.

Single-word writing accuracy

As displayed in Table 2, both groups had similar scores in kindergarten before the training activities. In all other assessment tests, the experimental group outperformed the control group. Although there is a clear progressive approximation of their writing scores in primary school, children who participated in experimental activities seemed to show a better performance at the end of Grade 3.

GEE regression models were performed using the group, time and group X time interaction as factors and the writing scores in all assessment tests as dependent variables. After mean centering, cognitive ability, phonemic awareness, syllabic awareness and alphabet knowledge were added as covariates. Table 3 presents the results of the GEE analysis concerning writing measures.

Table 3. Generalised estimating equation analysis regarding writing accuracy.

Tests of Model Effects					
	Wald Chi Square		*df*	*p*	
(Intercept)	1669.77		1	.000	
Group	41.20		1	.000	
Time	6845.71		4	.000	
Group * Time	51.28		4	.000	
Parameter Estimates					
	b	*Std. Error*	*Wald Chi-Square*	*df*	*p*
(Intercept)	.020	.009	5.57	1	.018
Group (Exp)	-.007	.014	.23	1	.633
Time=2	.109	.020	28.91	1	.000
Time=3	.313	.035	82.21	1	.000
Time=4	.504	.030	279.24	1	.000
Time=5	.784	.015	2820.55	1	.000
Group (Exp) * Time=2	.290	.044	44.35	1	.000
Group (Exp) * Time=3	.300	.051	34.81	1	.000
Group (Exp) * Time=4	.114	.039	8.65	1	.003
Group (Exp) * Time=5	.042	.020	4.56	1	.033
Cognitive ability	.006	.002	8.98	1	.003
Syllabic awareness	.005	.003	3.86	1	.050
Phonemic awareness	-.001	.005	.08	1	.775
Alphabet knowledge	.009	.002	18.90	1	.000
(Scale)	.029				

As shown in Table 3, the value of the regression coefficient related to the experimental group showed that, in Time 1, the difference between the two groups was small and not statistically significant. The values of the regression coefficients for the interactions between the experimental group and Time 2, 3, 4 and 5 indicate that the gains of the experimental group were always significantly higher than those of the control group. Cognitive ability, syllabic awareness and alphabet knowledge had statistically significant effects, but no significant effects were found for phonemic awareness.

An additional analysis to explore whether children's prior knowledge on writing was related to their progresses in kindergarten revealed statistically significant low correlations between Assessment 1 and the progress of the experimental group (r = .28; p = .050) and quite similar correlations for the progress of the control group (r = .29; p = .042).

Single-word oral reading accuracy

As exposed in Table 2, experimental group children's reading scores were generally higher than the control group children's performance along time, except at the beginning of the experiment. From kindergarten to Grade 1 there was a significant discrepancy between groups as children from the invented spelling condition strongly increased their reading skills. Despite this rapid development, there seemed to be an improvement of the control condition at the end of Grade 1 and until Grade 3, where both groups showed approximately similar reading scores.

Table 4. Generalised estimating equation analysis regarding reading accuracy.

Tests of Model Effects					
	Wald Chi Square		*df*	*p*	
(Intercept)	1695.02		1	.000	
Group	43.06		1	.000	
Time	13426.34		4	.000	
Group * Time	43.48		4	.000	
Parameter Estimates					
	b	*Std. Error*	*Wald Chi-Square*	*df*	*p*
(Intercept)	.023	.008	7.18	1	.007
Group (Exp)	-.015	.013	1.18	1	.278
Time=2	.175	.029	35.87	1	.000
Time=3	.374	.044	72.89	1	.000
Time=4	.475	.033	211.54	1	.000
Time=5	.887	.012	5771.92	1	.000
Group (Exp) * Time=2	.303	.053	33.35	1	.000
Group (Exp) * Time=3	.341	.060	32.31	1	.000
Group (Exp) * Time=4	.230	.041	31.54	1	.000
Group (Exp) * Time=5	.014	.016	.83	1	.362
Cognitive ability	.007	.002	9.14	1	.002
Syllabic awareness	.005	.003	2.89	1	.089
Phonemic awareness	-.001	.005	.06	1	.813
Alphabet knowledge	.010	.002	21.79	1	.000
(Scale)	.037				

GEE regression models were performed using the group, time and group X time interaction as factors and the reading scores in all assessment tests as dependent

variables. After mean centering, cognitive ability, phonemic awareness, syllabic awareness and alphabet knowledge were added as covariates. These results are provided in Table 4.

As shown in Table 4, the value of the regression coefficient related to the experimental group show that, in Time 1, the difference between the two groups was short and not statistically significant. The values of the regression coefficients for the interactions between the experimental group and Time 2, 3, and 4 indicate that the gains of the experimental group were significantly higher than those of the control group. In Time 5 the gains of both groups were similar. Cognitive ability and alphabet knowledge had significant effects.

An additional analysis on whether children's prior knowledge on reading was related to their progress in kindergarten revealed no statistically significant correlations between Assessment 1 and the progress of the experimental group (r = .11; p = .439) and moderate correlations for the progress of the control group (r = .41; p = .003).

3.3 Reading fluency and comprehension measures

Single-word oral reading fluency and comprehension in sentence reading

More advanced reading skills were measured in primary school to test for the differences between children from the experimental condition and the control condition. Word reading fluency (number of words correctly read per minute) was assessed at the end of Grade 1 and at the end of Grade 3 and sentence comprehension (*Reading Age Test* score) was tested at the end of Grade 3. Table 5 presents the means and standard deviations for both groups regarding these two reading skills.

Table 5. Descriptive statistics for both groups (experimental/control) regarding word reading fluency and sentence comprehension.

		Grade 1		Grade 3	
		M	*SD*	*M*	*SD*
Reading fluency	EG	14.02	7.66	47.37	17.55
	CG	6.82	5.55	35.63	13.61
Sentence comprehension	EG			62.66	17.18
	CG			54.90	16.65

Note. EG = Experimental Group; CG = Control Group; Reading fluency: number of correct words per minute; Sentence comprehension: Teste de Idade de Leitura [Reading Age Test] score (%).

As presented in Table 5, the experimental group scored higher than the control group in both cases. After having participated in 10 invented spelling training activities in kindergarten, experimental group children's reading fluency skills were already stronger in Grade 1 — the number of words correctly read per minute was

more than the double as compared to control group children's scores. Later analyses indicated that the experimental group still outperformed the control group in Grade 3. Experimental group children's results concerning reading comprehension also showed higher scores.

Three regression analyses were performed using the group (experimental/control) and the preliminary control variables (cognitive ability, phonemic awareness, syllabic awareness, alphabet knowledge) as predictors and fluency and comprehension measures as dependent variables (reading fluency in Grade 1, reading fluency in Grade 3, reading comprehension in Grade 3). These results are provided in Table 6.

Table 6. Regression analyses for reading fluency in Grade 1 and in Grade 3 and for reading comprehension in Grade 3.

Dependent variable: Reading fluency in Grade 1				
	b	*Std. error*	*t*	*p*
Cognitive ability	.574	.181	3.174	.002
Syllabic awareness	-.263	.257	- 1.024	.310
Phonemic awareness	.154	.465	.331	.741
Alphabet knowledge	.238	.211	1.127	.264
Group (Exp. = 1; Cont. = 0)	6.542	1.732	3.776	.000
R^2: .344 ($F_{(5, 67)}$ = 7.018, p < .001)				

Dependent variable: Reading fluency in Grade 3				
	b	*Std. error*	*t*	*p*
Cognitive ability	.172	.426	.405	.687
Syllabic awareness	-1.117	.604	- 1.848	.069
Phonemic awareness	.425	1.096	.388	.699
Alphabet knowledge	1.571	.497	3.164	.002
Group (Exp. = 1; Cont. = 0)	8.935	4.079	2.190	.032
R^2: .241 ($F_{(5, 67)}$ = 4.257, p = .002)				

Dependent variable: Reading comprehension in Grade 3				
	b	*Std. error*	*t*	*p*
Cognitive ability	.724	.418	1.732	.088
Syllabic awareness	.334	.593	.564	.575
Phonemic awareness	.751	1.076	.698	.488
Alphabet knowledge	.914	.488	1.875	.065
Group (Exp. = 1; Cont.= 0)	3.489	4.005	.871	.387
R^2: .236 ($F_{(5, 67)}$ = 4.135, p = .002)				

Table 6 demonstrates a statistically significant effect of the group concerning reading fluency in both grades, even when the control variables were introduced in the models, but no statistically significant effect was obtained concerning reading comprehension

4. DISCUSSION

The current study aimed at researching whether invented spelling activities conducted in the last year of kindergarten would have an impact on children's reading and writing skills in Grade 1 and until the end of Grade 3. Data analysis demonstrated that these training sessions fostered children's emergent literacy knowledge and metalinguistic skills in the transition period from kindergarten to the onset of reading and writing formal teaching instruction. In fact, experimental group participants scored higher from Assessment 1 to Assessment 2 (before and immediately after the training activities) and the children's prior knowledge seemed to not have had a great impact on their literacy progress, as indicated by the low correlations found; also, the experimental condition seemed to have benefited more from the provision of effective classroom teaching instruction in the first year of primary school (Assessments 3 and 4).

Moreover, the present study detected significant lasting effects of these invented spelling sessions by the end of Grade 3 (Assessment 5) in what writing is concerned. As for reading accuracy and sentence comprehension, children from both groups presented quite similar results. Nevertheless, the experimental group presented statistically significant higher scores in single-word oral reading fluency, as compared to control group children, which is considered a more appropriate indicator of reading performance at this level of schooling. This is an important finding because it shows that enhancing early literacy in kindergarten led children to engage in a significant learning environment for acquiring metacognitive tools that had a positive impact on more advanced reading skills.

These findings support and add value to analogous two-year longitudinal studies carried out in Canada (Ouellette, Sénéchal & Haley, 2013), Portugal (Albuquerque & Alves Martins, 2016) and Norway (Hofslundsengen, Hagtvet, & Gustafsson, 2016), which showed the significant effective impact of early literacy training programmes to young children's written language acquisition. These studies provided meaningful evidence that promoting invented spelling leads to a better understanding of the alphabetic principle (Alves Martins et al, 2013, 2014; Ouellette & Sénéchal, 2008a,b).

Our results also expressed clear generalisation and knowledge transfer effects from spelling to reading, emphasising Ehri's view (1997, 2014) on the narrow relationship between reading and writing, since they are considered two interdependent processes with common mechanisms, in a way that they both involve grapheme-phoneme associations.

The present research offered relevant insight on how invented spelling triggered the participants' literacy learning process. It seems that it provided a "milieu for children to explore the relations between oral and written language" (Ouellette, Sénéchal & Haley, 2013, p. 261), that boosted the understanding of the alphabetic principle and the representation of speech in print. The phonological structure awareness of speech is considered the base for reading abilities and the process of word

identification is developed due to a self-learning mechanism that relies on phonological procedures (Alegria, 2006).

As children apply their growing knowledge and awareness of the alphabet, they become more efficient in matching sounds with letters and decoding printed words. Thus, they begin to identify words more promptly and with less conscious cognitive resources. In this developmental pathway, there seems to be a "progress from sounding out words to being able to more effortlessly recognise and spell print, implicating the importance of orthographic learning" (Ouellette & van Daal, 2017, p. 2).

The consolidation of the connections between the visual form of words and its corresponding sounds facilitates the access to the meaning of the word with no phonological mediation directly through its orthographic form (Morais, 1995). The mastery of grapheme-phoneme correspondences allows us to read and acquire orthographic representations of new unknown words (Share, 1995; Share & Stanovich, 1995). This led children to develop their decoding skills and the ability to read words accurately and rapidly, which also plays a crucial role in linguistic comprehension.

Another interesting finding is that the children's scores were slightly higher for reading than for writing. This can be explained by the specific aspects and features of Portuguese orthography where reading is more consistent than writing: while for reading, grapheme-phoneme correspondences are mostly one-to-one or guided by contextual or positional rules, for writing, there are more orthographic inconsistencies.

An additional crucial variable that may have caused these individual differences in children's performance in primary school turning it into a strong bootstrapping mechanism is the volume of their reading and writing experience. Empirical evidence suggests that more skilled readers will also read more, gain more vocabulary, learn more word meanings, and hence develop their reading skills. Similarly, children who are less proficient readers, tend to read slower and have a poorer reading performance. Accordingly, reading expertise provides a larger literacy knowledge base allowing children to develop greater reading proficiency at a faster rate.

Finally, our data are in line with recent correlational and predictive studies showing that there seems to be a strong predictive role of early emergent literacy skills to subsequent reading and writing in primary school (Ouellette & Sénéchal, 2016; Treiman, et al, 2016). Thus, as it expands the development of memory connections that link phonological units to orthographic representations, invented spelling measures should be considered along with phonological awareness and letter knowledge as a valuable means of enhancing children's literacy learning (Caravolas et al, 2012; Lonigan et al, 2000).

Conclusions, implications, limitations and future research

This experimental study presents valid empirical support for enhancing young children's literacy learning in favour of their later reading and writing performance. In a preliminary approach, invented spelling training was used as a trigger to gradually

progress children's writing attempts into correct alphabetic conventional spellings in kindergarten. More importantly, it seemed that through this process, children acquired more advantages in literacy learning along with the teacher's regular classroom instruction in primary school until the end of Grade 3. In this sense, it is argued that with scaffolding and developmentally appropriate feedback on invented spelling, kindergarten children gain the opportunity to analyse the phonological and orthographic structure of words and may benefit from this knowledge to develop their future reading and writing skills.

These findings are helpful to clarify the foundation of the literacy learning process and to upgrade the teaching methods and techniques used by kindergarten teachers. This brings important valuable educational implications considering that combining invented spelling in classroom activities and integrating them as reading curricular benchmarks may be a potential way to optimise children's literacy acquisition aiming their success in the first years of schooling. It may also be beneficial to prevent reading and writing specific problems and to increase our understanding of children's difficulties.

However, it should be noted that there are some limitations to this research, which strengthens the need for study replication. Due to the constraints of participant selection and the longitudinal nature of the study design, we experienced experimental mortality issues as certain children dropped out at some point throughout the years and so they were excluded from the initial pool. Also, the restrict sample of this study limits the boundaries of generalisation of our results. Future research should include a larger number of schools, classes and students to increase the reliability of these results and mainly to allow a more rigorous variable control. A more diverse sample will allow the researchers to control and examine different socioeconomic backgrounds, different school curricula and different teaching instruction methods and practices. Moreover, assessing children's reading and writing outcomes with larger follow-up samples could provide more insight to the significance of early literacy activities and its specific contents and methods.

Similarly, in our study we did not assess children's family literacy practices and home resources. There is evidence that these informal experiences play a crucial role in children's linguistic skills, namely oral language, vocabulary increase, letter knowledge and literacy acquisition itself. Therefore, forthcoming researches should also consider exploring the relevance of the participants' home literacy environment and their writing/reading achievement.

Lastly, all training activities in this research were administered by a psychologist/researcher, which withdraws the naturalistic framework of the study. For future experimental studies, we suggest an authentic environment including school staff, namely the children's regular teacher as trainer in the experimental and control conditions, after having received previous training and guidance. This view would provide empirical interesting data on how these findings could be implemented in kindergarten curricula educational activities.

ACKNOWLEDGEMENTS

This research was supported by FCT – Fundação para a Ciência e a Tecnologia (Grant ID: SFRH/BD/112133/2015).

REFERENCES

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

Albuquerque, A. & Alves Martins, M. (2016). Promotion of literacy skills in early childhood: a follow-up study from kindergarten to Grade 1. *Infancia y Aprendizaje: Journal for the Study of Education and Development, 39*(3), 592-625. https://doi.org/10.1080/02103702.2016.1196913

Alegria, J. (2006). Por un enfoque psicolingüístico del aprendizaje de la lectura y sus dificultades - 20 años después [Support for a psycholinguistic approach to reading acquisition and reading difficulties: 20 years later]. *Infancia y Aprendizaje, 29*(1), 99-111. https://doi.org/10.1174/021037006775380957

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. https://doi.org/10.17239/jowr-2013.05.02.3

Alves Martins, M., Salvador, L., Albuquerque, A., & Silva, C. (2014). Invented spelling activities in small groups and early spelling and reading. *Educational Psychology: An International Journal of Experimental Educational Psychology, 36*(4), 738-752. https://doi.org/10.1080/01443410.2014.950947

Alves Martins, M. & Silva, C. (2006). The impact of invented spelling on phonemic awareness. *Learning and Instruction, 16*(1), 41–56. https://doi.org/10.1016/j.learninstruc.2005.12.005

Bacelar do Nascimento, M. F., Casteleiro, J., Marques, M. L., Barreto, F., Amaro, R., & Veloso, R. (2000). *CLUL – Léxico Multifuncional Computorizado do Português Contemporâneo* [CLUL – Multifunctional computational lexicon of contemporary Portuguese]. Lisboa, Portugal: Centro de Linguística da Universidade de Lisboa.

Ball, E. W. & Blachman, B. A. (1991). Does phoneme awareness training in kindergarten make a difference in early word recognition and developmental spelling? *Reading Research Quarterly, 26*(1), 49-49. https://doi.org/10.1598/RRQ.26.1.3

Bowey, J. A. (2005). Predicting individual differences in learning to read. In M. J. Snowling & C. Hulme (Eds.), *The science of reading: A handbook* (pp. 155-172). Oxford, UK: Blackwell. https://doi.org/10.1002/9780470757642.ch9

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

Caravolas, M., Lervåg, A., Mousikou, P., Efrim, C., Litavsky, M., Onochie-Quintanilla, E., Salas, N., S. Schöffelová, M., Defior, S., Mikulajová, M., Seidlová-Málková, G., & Hulme, C. (2012). Common patterns of prediction of literacy development in different alphabetic orthographies. *Psychological Science, 23*(6), 678-686. https://doi.org/10.1177/0956797611434536

Chomsky, C. (1970). Reading, writing and phonology. *Harvard Educational Review, 40*(2), 287-309. https://doi.org/10.17763/haer.40.2.y7u0242x76w05624

Defior, S., Martos, F., & Cary, L. (2002). Differences in reading acquisition development in two shallow orthographies: Portuguese and Spanish. *Applied Psycholinguistics, 23*(1), 135–148. https://doi.org/10.1017/S0142716402000073

Ehri, L. C. (1997). Learning to read and learning to spell are one and the same, almost. Em C. Perfetti, L. Rieben, & M. Fayol (Eds.), *Learning to spell—research, theory and practice across languages* (pp. 237–269). Mahwah, NJ: Erlbaum.

Ehri, L. C. (2005). Learning to read words: Theory, findings, and issues. *Scientific Studies of Reading, 9*(2), 167–188. https://doi.org/10.1207/s1532799xssr0902_4

Ehri, L. C. (2014). Orthographic mapping in the acquisition of sight word reading, spelling memory, and vocabulary learning. *Scientific Studies of Reading, 18*(1), 5–21. https://doi.org/10.1080/10888438.2013.819356

Ehri, L. C., Nunes, S. R., Willows, D. M., Schuster, B. V., Yaghoub-Zadeh, Z., & Shanahan, T. (2001). Phoneme awareness instruction helps children learn to read: Evidence from the National Reading Panel's meta-analysis. *Reading Research Quarterly, 36*(3), 250–287. https://doi.org/10.1598/RRQ.36.3.2

Ferreiro, E. & Teberosky, A. (1982). *Literacy before schooling*. New York, NY: Heinemann.

Foster, W. A., & Miller, M. (2007). Development of the literacy achievement gap: A longitudinal study of kindergarten through third grade. *Language, Speech, and Hearing Services in Schools, 38*(3), 173-181. https://doi.org/10.1044/0161-1461(2007/018)

Girolami-Boulinier, A., & Pinto, M. C. (1994). A ortografia em crianças francesas, inglesas e portuguesas [Orthography in French, English and Portuguese children]. *Línguas e Literaturas – Revista da Faculdade de Letras da Universidade do Porto, 11*, 115–129.

Graham, S., & Hebert, M. (2011). Writing to read: A meta-analysis of the impact of writing and writing instruction on reading. *Harvard Educational Review, 81*(4), 710–744. https://doi.org/10.17763/haer.81.4 .t2k0m13756113566

Graham, S., & Santangelo, T. (2014). Does spelling instruction make students better spellers, readers, and writers? A meta-analytic review. *Reading and Writing: An Interdisciplinary Journal, 27*(9), 1703-1743. https://doi.org/10.1007/s11145- 014-9517-0

Hecht, S. A., & Close, L. (2002). Emergent literacy skills and training time uniquely predict variability in responses to phonemic awareness training in disadvantaged kindergartners. *Journal of Experimental Child Psychology, 82*(2), 93–115. https://doi.org/10.1016/S0022-0965(02)00001-2

Hofslundsengen, H., Hagtvet, B. E., & Gustafsson, J. E. (2016). Immediate and delayed effects of invented writing intervention in preschool. *Reading and Writing: An Interdisciplinary Journal, 29*(7), 1473-1495. https://doi.org/10.1007/s11145-016-9646-8

Hulme, C., Bowyer-Crane, C., Carroll, J. M., Duff, F., & Snowling, M. J. (2012). The causal role of phoneme awareness and letter-sound knowledge in learning to read: Combining intervention studies with mediation analyses. *Psychological Science, 23*(6), 572-577. https://doi.org/10.1177/0956797611435921

Levin, I. & Aram, D. (2013). Promoting early literacy via practicing invented spelling: A comparison of different mediation routines. *Reading Research Quarterly, 48*(3), 221–236. https://doi.org/10.1002/rrq.48

Levin, I., Aram, D., Tolchinsky, L., & McBride, C. (2013). Maternal mediation of writing and children's early spelling and reading: the Semitic abjad versus the European alphabet. *Writing Systems Research, 5*(2),1-22. https://doi.org/10.1080/17586801.2013.797335

Levin, I., Shatil-Carmon, S., & Asif-Rave, O. (2006). Learning of letter names and sounds and their contribution to word recognition. *Journal of Experimental Child Psychology, 93*(2), 139–165. https://doi.org/10.1016/j.jecp.2005.08.002

Lonigan, C. J., Burgess, S. R., & Anthony, J. L. (2000). Development of emergent literacy and early reading skills in preschool children: Evidence from a latent-variable longitudinal study. *Developmental Psychology, 36*(5), 596–613. https://doi.org/10.1037/0012-1649.36.5.596

Mann, V. A. (1993). Phoneme awareness and future reading ability. *Journal of Learning Disabilities, 26*(4), 259-269. https://doi.org/10.1177/002221949302600404

Morais, J. (1995). Do orthographic and phonological peculiarities of alphabetically written languages influence the course of literacy acquisition? *Reading and Writing: An Interdisciplinary Journal, 7*(1), 1-7. https://doi.org/10.1007/BF01026944

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/10.1080/10888430801917324

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.1467-8624.2008.01166.x

Ouellette, G., Sénéchal, M., & Haley, A. (2013). Guiding children's invented spellings: a gateway into literacy learning. *Journal of Experimental Education, 81*(2), 261–279. https://doi.org/10.1080/00220973.2012.699903.

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. & van Daal, V. (2017). Introduction to the special issue. Orthographic learning and mental representations in literacy: striving for a better understanding of a complex lead role. *Scientific Studies of Reading, 21*(1), 1-4. https://doi.org/10.1080/10888438.2016.1254635

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

Read, C. (1971). Preschool children's knowledge of English phonology. *Harvard Educational Review, 41*(1), 1-34. https://doi.org/10.17763/haer.41.1.91367v0h80051573

Rebelo, D., & Delgado-Martins, M. R. (1978). *Linguagem oral e ortografia* [Oral language and orthography]. Lisboa, Portugal: INIC.

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. https://doi.org/10.1207/s1532799xssr0902_3

Rowe, D. W. (2015). The development of a descriptive measure of early childhood writing: Results from the Write Start! writing assessment. *Journal of Literacy Research, 47*(2), 245–292. https://doi.org/10.1177/1086296X15619723

Scarborough, H. S. (1998). Early identification of children at risk for reading disabilities: Phonological awareness and some promising predictors. In B. K. Shapiro, P. J. Pasquale, & A. J. Capute (Eds.), *Specific reading disability: A view of the spectrum* (pp. 75–119). Timonium, MD: York Press.

Seymour, P., Aro, M., Erskine, J. (2003). Foundation literacy acquisition in European orthographies. *British Journal of Psychology, 94*(2), 143-174. https://doi.org/10.1348/000712603321661859

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: An Interdisciplinary Journal, 25*(4), 917–934. https://doi.org/10.1007/s11145-011-9310-2

Shahar-Yames, D. & Share, D. L. (2008). Spelling as a self-teaching mechanism in orthographic learning. *Journal of Research in Reading, 31*(1), 22-39. https://doi.org/10.1111/j.1467-9817.2007.00359.x

Share, D. L. (1995). Phonological coding and self-teaching: Sine qua non of reading acquisition. *Cognition, 55*(2), 151-218. https://doi.org/10.1016/0010-0277(94)00645-2

Share, D. L., & Stanovich, K. E. (1995). Cognitive processes in early reading development: Accommodating individual differences into a model of acquisition. *Issues in Education: Contributions from Educational Psychology*, *1*, 1-57.

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

Stanovich, K. E. (1986). Matthew effects in reading: Some consequences of individual differences in the acquisition of literacy. *Reading Research Quarterly, 21*(4), 360-407. https://doi.org/10.1598/rrq.21.4.1

Sucena, A., & Castro, S. (2010*). Aprender a ler e avaliar a leitura. O TIL: Teste de idade de leitura* [Learning to read and assessing reading. TIL: Reading age test]. (2nd ed.). Coimbra, Portugal: Edições Almedina.

Sucena, A. & Castro, S. (2011). *ALEPE: Bateria de Avaliação da Leitura em Português Europeu* [ALEPE: Battery for the Assessment of Reading Skills in European Portuguese]. Lisboa, Portugal: CEGOC.

Tangel, D. M. & Blachman, B. A. (1995). Effect of phoneme awareness instruction on the invented spelling of first grade children: A one-year follow-up. *Journal of Reading Behavior, 27*(2), 153–185. https://doi.org/10.1080/10862969509547876

Tolchinsky, L. (2005). The emergence of writing. In C. MacArthur, S. Graham, & J. Fitzgerald (Eds.), *Handbook of writing research* (pp. 83-96). New York, NY: Guilford.

Treiman, R. (2006). Knowledge about letters as a foundation for reading and spelling. In R. M. Joshi & P. G. Aaron (Eds.), *Handbook of orthography and literacy* (pp. 581-599). Mahwah, NJ: Erlbaum.

Treiman, R. (2017). Learning to spell words: findings, theories, and issues. *Scientific Studies of Reading*, 21(4), 265-276. https://doi.org/10.1080/10888438.2017.1296449

Treiman, R., Kessler, B., Pollo, T. C., Byrne, B., & Olson, R. K. (2016). Measures of kindergarten spelling and their relations to later spelling performance. *Scientific Studies of Reading, 20*(5), 349-362. https://doi.org/10.1080/10888438.2016.1186168

Utchell, L. A., Schmitt, A. J., McCallum, E., McGoey, K. E., & Piselli, K. (2016). Ability of early literacy measures to predict future state assessment performance. *Journal of Psychoeducational Assessment, 34*(6), 511-523. https://doi.org/10.1177/0734282915621221

Vasconcelos Horta, I. & Alves Martins, M. (2011). Invented spelling programmes and the access to the alphabetic principle in kindergarten. *L1–Educational Studies in Language and Literature, 11*, 1-23. https://doi.org/10.17239/L1ESLL-2011.01.01

Viana, M. C., Andrade, E., Oliveira, L. C., & Trancoso, I. M. (1991). Ler português europeu: um utensílio para o estudo da ortografia do português [Reading European Portuguese: a tool for the study of Portuguese orthography]. *Actas do VII Encontro da Associação Portuguesa de Linguística* (pp. 474-489). Lisboa, Portugal: APL.

Ziegler, J. C. & Goswami, U. (2005). Reading acquisition, developmental dyslexia, and skilled reading across languages: a psycholinguistic grain size theory. *Psychological Bulletin, 131*(1), 3-29. https://doi.org/10.1037/0033-2909.131.1.3