education sciences

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The Impact of Teacher-Mediated Cooperative Invented Spelling on Emergent Literacy in Preschool

Liliana Salvador * and Margarida Alves Martins

EDUNOVA.ISPA—Interdisciplinary Research Centre in Education, ISPA—Instituto Universitário de Ciências Psicológicas, Sociais e da Vida, 1149-041 Lisbon, Portugal; mmartins@ispa.pt
* Correspondence: lsalvador@ispa.pt

Abstract

Learning to write begins before formal schooling through everyday interactions where children construct ideas about print. Informed by socioconstructivist theory, this quasi-experimental study evaluated the impact of naturalistic, teacher-mediated cooperative invented spelling activities in Portuguese preschools. The participants were 88 five-year-olds from six classes in three schools. Classrooms were randomly assigned within schools to an intervention group (n = 43) or a comparison group (n = 45). For two months, the intervention group engaged in weekly spelling discussions integrated into regular activities, while the comparison group followed the standard curriculum. Pre- and post-intervention spelling assessments and classroom observations were conducted. The results showed a strong positive intervention effect. The intervention group demonstrated significantly greater improvement in representing sounds in their spelling than the comparison group. Observations revealed that when teachers scaffolded discussions with open questions, and children, with varying knowledge levels, helped each other by explaining their thinking. This transformed spelling into a shared problem-solving task. The study confirmed invented spelling as a valuable classroom activity that advances alphabetic understanding. It was demonstrated that early literacy can be effectively nurtured through structured dialogue and collaboration within the regular preschool day. These findings provided a practical, theory-aligned model for supporting literacy development through social interaction.

Keywords: invented spelling; emergent literacy; preschool education; scaffolding; mediation; socioconstructivism

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Academic Editor: Vasilis Grammatikopoulos

Received: 1 February 2026
Revised: 23 March 2026
Accepted: 25 March 2026
Published: 27 March 2026

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1. Introduction

Learning to read and write is fundamental to academic success, as written language is the primary representational tool for acquiring, constructing, and communicating knowledge across the curriculum. Importantly, this ability does not start with formal schooling but is built upon a "prehistory" of everyday interactions with print—interactions that structured instruction can powerfully shape and extend (Vygotsky, 1978). This perspective sees teaching and development as deeply intertwined, with classroom activities reorganizing skills that are already emerging. Empirical research on effective writing pedagogy within such naturalistic, non-formal preschool contexts, however, remains limited. Therefore, although many studies have focused on the components of emergent literacy and children's prior writing knowledge, this study aimed to test the impact of teacher-mediated invented spelling activities on the evolution of spelling ability in preschool children and to characterize the collaborative processes that occur during those activities.

1.1. The Pillars of Emergent Literacy

Long before receiving explicit instruction, children observe others reading and writing, talk about print in their environment, and experiment with making their own marks. Through these experiences, they construct systematic and changing ideas/theories about the purposes and uses of writing (functional knowledge), how it is organized on the page (conventional/graphical knowledge), and what the marks represent (conceptual knowledge). Specifically:

(a) Functional knowledge concerns the understanding of why we write. Through authentic encounters with lists, labels, messages, and shared writing, children actively infer print's diverse social purposes and develop intrinsic motivations to use it. Effective preschool pedagogy explicitly embeds these purposes into daily routines, making literacy a meaningful tool for communication and organization rather than an abstract skill (Gerde et al., 2012). This intentional design creates a context where emergent writing attempts are purposeful and scaffolded.

(b) Conventional knowledge involves understanding how writing is organized on the page—its formal properties. Particularly, children begin to: distinguish writing from drawing; letters from numerals; learn directional rules (e.g., left-to-right or top-to-bottom); and grasp the concept of a word bounded by spaces. Teachers who consistently model and verbalize these conventions during shared writing and reading activities provide critical support for children's writing attempts. Empirical evidence confirms that such modeling is positively associated with accelerated growth in children's early writing skills (Bingham & Gerde, 2023; Zhang & Bingham, 2019).

(c) Conceptual knowledge, the most profound domain, is the deeper understanding of what writing represents. It shifts from viewing marks as direct icons of objects to grasping the alphabetic principle: that written symbols represent the sound units of speech. Children reconstruct this logic through their own hypotheses and attempts. When given opportunities to write and explain their reasoning, they actively test and refine their understanding that speech can be segmented and mapped onto a stable symbolic system. This is not a solitary act but is profoundly social. Intervention studies highlight that when this process is mediated by teachers and discussed with peers in small-group settings, it drives conceptual change, directly advancing both spelling and word reading (Alves Martins et al., 2016; Levin & Aram, 2013; Pulido & Morin, 2018). Developmental research demonstrates that these ideas/theories follow a predictable progression from early graphic representations towards phonologically informed spellings, well before conventional writing and reading emerge (Ferreiro & Teberosky, 1979; Tolchinsky, 2016).

Emergent literacy is characterized, then, by the concurrent development of these three interconnected knowledge domains, which are more than just preliminary steps. In fact, they form the essential conceptual matrix upon which alphabetic understanding is constructed, particularly through mediated activities like invented spelling (e.g., Alves Martins & Silva, 2006; Levin & Aram, 2013; Ouellette & Sénéchal, 2008).

The term invented spelling was first introduced by Chomsky (1970) and Read (1971) to describe children's early spelling attempts. These attempts are seen as a window into their emerging understanding of how spoken language is systematically represented in print, establishing a phonologically based view of children's spelling development. In essence, invented spelling serves as the vital nexus where functional purpose and conventional form converge to drive conceptual insight.

The quality and frequency of children's early experiences, particularly in preschool settings where preschool teachers can guide children's attention to print, strongly influence the sophistication of children's pre-instructional conceptions. High-quality environments

create a culture where purposeful writing, attention to print conventions, and guided sound–letter exploration are integrated. This approach, especially when focused on cooperative invented spelling, provides the supported experiences children need to connect their pre-instructional conceptions to the logic of the written code (van de Pol et al., 2010). In fact, children's cooperative activities mediated by preschool teachers and focused on invented spellings offer a generative and transformative pathway for developing early literacy, effectively bridging children's early ideas to the alphabetic principle. This progress also depends on children's ability to analyze spoken language and their knowledge of the names and sounds of letters.

1.2. Metalinguistic Awareness and Letter Knowledge

The development of those three domains is supported and propelled by a growing child's ability to consciously reflect on language itself—a capacity known as metalinguistic awareness. Three strands of metalinguistic awareness are central: phonological awareness, lexical awareness, and morphological awareness.

Phonological awareness consists of the ability to reflect on and manipulate the sound structure of words across several levels: rhyme (shared ending sounds), syllables (larger sound units), intrasyllabic units (onset and rime) and phonemes (individual sounds). The progression from larger to smaller units is well documented, with phoneme awareness emerging as the strongest predictor of early reading and spelling success (Ehri et al., 2001). For this reason, interventions in preschool facilitate later decoding—particularly when letter knowledge is integrated into training. The relation is reciprocal: a minimal level of phonological analysis supports grasping the alphabetic principle, while beginning to read further sharpens phoneme-level awareness (Bus & van IJzendoorn, 1999; Castles & Coltheart, 2004; Ehri et al., 2001). In lexical awareness, children understand that continuous speech can be segmented into words and that written words are discrete units separated by spaces in print (Tunmer et al., 1983). Morphological awareness—the ability to reflect on and manipulate the smallest units of meaning (morphemes)—contributes to spelling, word reading, and even comprehension. Effective preschool activities that discuss stems, families of words, prefixes/suffixes within preschool activities show robust effects on morphological tasks (Nunes & Bryant, 2006; Rosa & Alves Martins, 2022).

Together, these capacities enable children to understand that letters in a fixed spatial order represent phonemes in a temporal order—the core of the alphabetic principle—and to use larger meaning units (morphemes) as stable anchors in decoding and spelling. In this sense, letter knowledge serves also as an essential link that allows children to apply their metalinguistic awareness to the tasks of decoding and inventing spellings (Alves Martins et al., 2013; Ouellette & Sénéchal, 2017). Converging evidence confirms that the use of activities targeting these skills, especially when linked to graphemes, exerts a reliable causal impact on early literacy.

1.3. A Socioconstructivist Approach: Mediated and Cooperative Invented Spelling as a Pathway to the Alphabetic Code

A socioconstructivist lens places interactive, meaningful, and joint activity—between children, their peers, and an expert other—at the very center of conceptual change. Within rich literacy environments, preschool teachers guide joint attention to print, scaffolding children's attempts, and, crucially, promoting dialogue where ideas are made explicit, challenged, and refined (van de Pol et al., 2010). In this pedagogical framework, invented spelling—children's self-generated spellings prior to conventional mastery—holds special status as both a diagnostic tool and a learning mechanism. It acts like a dynamic window into children's thinking, a tool that engages them in phonemic analysis at the edge of

their Zone of Proximal Development, and a social platform for the co-construction of orthographic knowledge (Ouellette & Sénéchal, 2008).

The effectiveness of invented spelling is significantly enhanced by mediated social interaction. Effective scaffolding in this context is characterized by contingency (responsiveness to the child's idea/hypotheses), fades as the child learns, and intentionally transfers responsibility to them—principles empirically identified as core to productive mediation (van de Pol et al., 2010). This process transforms spelling from a solitary act of transcription into a collaborative, cognitively rich act of composing and problem-solving. Classroom-based research notes that an overemphasis on transcription (handwriting and correct spelling) at the expense of composing can limit growth; conversely, environments that model, scaffold, and embed meaningful composing are linked to stronger literacy outcomes (Bingham et al., 2017). This aligns with work showing how collective discussion and comparison of invented spellings among peers generate productive cognitive conflict, driving the appropriation of the writing system itself (Hofslundsengen et al., 2016; Pulido & Morin, 2018).

A sustained line of research, particularly from studies in Portuguese preschool contexts (e.g., Albuquerque & Alves Martins, 2022; Alves Martins et al., 2016), has refined and empirically validated this dialogue-rich, small-group paradigm. This body of work demonstrates that invented spelling activities are most effective when embedded within significant learning contexts characteristic of high-quality early childhood curricula. Rather than isolated drills, these are meaningful explorations that emerge from shared classroom purposes.

For instance, investigation demonstrates that when invented spelling is introduced as a cooperative activity (reaching together a consensus of how a word is spelled), it leads to significant gains in early spelling and word reading compared to control groups, with effects generalizing beyond trained items (Alves Martins et al., 2016). Crucially, these studies reveal that the interactional dynamics—how peers verbally negotiate letter–sound choices under subtle teacher guidance—are a key mechanism for individual progress. As children justify their choices and compare solutions, they articulate and refine their thinking, making the logic of the alphabetic system a shared object of inquiry. This resonates with Morin and Montésinos-Gelet's (2007) work on *orthographes approchées* (approximated spellings) in French-speaking Canada, which similarly highlights the gains from collaborative spelling problem-solving in naturalistic classroom settings. A recent systematic review further states that such peer collaboration strategies can be effectively taught and structured, providing a vital complement to teacher-led mediation (Burns et al., 2024).

The predictive and causal power of this integrated approach is well-established. Longitudinal modeling confirms that the sophistication of invented spelling in preschool predicts Grade 1 reading and spelling outcomes beyond foundational skills like phonological awareness and alphabet knowledge, acting as a mediator between emergent and conventional literacy (Albuquerque & Alves Martins, 2022; Ouellette et al., 2013). Also, a recent investigation in Grade 1 with children at risk of reading failure provided important evidence: an interactive invented spelling program was contrasted with standalone phonological awareness training and copying activities (Salvador & Alves Martins, 2024). The invented spelling group outperformed both others in word reading and spelling, while matching the phonological awareness group on phonemic tasks. Notably, children at risk, in the invented spelling group, caught up to class-average reading levels, demonstrating that spelling in peer discussion settings accelerates integrated orthographic learning more effectively than decontextualized skill practice. This finding underscores that the significant learning occurs not in practicing skills in isolation, but in their functional application and social negotiation during meaningful composing.

Translating this evidence into practice requires moving beyond isolated activities to weave a culture of cooperative inquiry throughout the preschool day. Effective strategies are those that operationalize scaffolding principles within authentic, child-initiated contexts.

A powerful starting point is, for instance, leveraging children's own names—a uniquely meaningful and stable model. Name-based explorations, such as comparing initial letters, searching for shared phonemes, or using known name letters as anchors to spell new words, allow children to build a personal repertoire of graph–phonemic connections within a deeply significant context (Puranik & Lonigan, 2011). This naturally extends into the cooperative writing and reading of new words sparked by play, stories, or projects. Here, a powerful routine involves an individual attempt, followed by a small-group discussion where children justify their spellings. The teacher's role might be to mediate, drawing on each child's partial knowledge to advance the group's collective thinking (Puranik et al., 2017). Following any writing attempt, strategic post-writing guidance is essential. The teacher may validate children's logic, ask for justification ("Why did you choose that letter?"), and model the conventional form alongside the child's attempt. This respectful juxtaposition makes core conventions—directionality, spacing, letter sequence—visible and discussable (Bingham et al., 2026; Gerde & Bingham, 2023).

In conclusion, high-quality preschool literacy provides a critical foundation for equity by mitigating disparities in early print exposure. When curricula support naturalistic, play-based opportunities for children to "have a go" at writing within a cooperative community—where their approximations are valued, publicly discussed, and gently guided—teachers do more than teach skills. They build robust conceptual bridges to formal instruction (Copp et al., 2019; Gerde et al., 2012). By fostering a classroom culture of shared linguistic inquiry, teachers enact the core socioconstructivist process: building intersubjective understanding through joint activity and gradually handing over the control of learning to the child. By doing so, teachers enable the transformation of a preschool classroom from a preparatory space into a genuine laboratory for the construction of written language, where the bases of literacy thought are collaboratively built.

To empirically investigate the outcomes and processes of this approach, the present study was designed to: (1) evaluate the impact of teacher-mediated cooperative invented spelling activities on children's early spelling abilities in a group of preschoolers comparing it to a group following the standard curriculum and (2) characterize, through illustrative examples, the collaborative processes, such as peer dialogue, negotiation, and explanation, that occur during the invented spelling activities.

2. Materials and Methods

2.1. Design

This quasi-experimental study, conducted in natural preschool settings, aimed to empirically test the impact of teacher-mediated invented spelling intervention on the spelling sophistication in preschool children. It employed a pre-test/post-test design with an intervention and comparison group.

We invited preschool teachers from three public schools to participate in a project investigating how small-group writing activities, integrated into classroom dynamics, influence early spelling development.

Each school had two preschool classrooms, attended mainly by 5-year-old children, and this, in addition to the teachers' interest in participating in the study, was the criterion used to include the classrooms in this study. The distribution of classrooms into intervention and comparison groups was random within each school, and teachers agreed to this assignment. This within-school random assignment was used to control for potential school-level confounding variables.

At the beginning of the second term, the teachers in the intervention group participated in a training course in which they were presented with several experimental studies on invented spelling in small groups carried out in Portugal and discussed various mediation strategies used in these programs to support children's understanding of the alphabetic nature of writing. The training focused on contingent scaffolding strategies to mediate children's collaborative problem-solving during invented spelling activities. In the three preschool classes of the intervention group, teachers were asked to implement writing activities in pairs or small groups, integrated into their weekly routine, at least once a week during the second term. The aim of these activities was to lead children to discuss, share knowledge, and conceptions about writing with the mediation of the teacher.

In the preschool classes of the comparison group, teachers were asked to develop, during the second term, the literacy activities they normally develop in their classrooms. These teachers attended a training course equivalent to the one described above at the beginning of the third term and implemented several writing activities during the third term, which were not analyzed in this study. The five-year-old children in both groups were assessed at the beginning and end of the second term to compare their progress in word spelling.

2.2. Participants

The participants were 6 preschool teachers and 88 five-year-old Portuguese children (47 female and 41 male) attending three public schools in the Lisbon area. These schools were attended by children from diverse socio-cultural backgrounds, mostly socioeconomically disadvantaged. All the preschool classes adopted the national curriculum guidelines for preschool education (Direção-Geral da Educação, 2016). The literacy activities normally developed in those classes consisted of storytelling, singing nursery rhymes, learning the alphabet sequence, playing oral language games, and writing their own names on drawings and other contexts.

The intervention group consisted of 43 5-year-old children (16 in school 1, 16 in school 2, and 11 in school 3), and the comparison group consisted of 45 5-year-old children (17 in school 1, 16 in school 2, and 12 in school 3). Statements of written informed consent from legally authorized guardians/parents of participants were previously obtained.

To ensure equivalence between the intervention and the comparison groups in each school, we collected data on their age and their parents' educational levels and assessed, in January, the children's cognitive ability, phonological awareness, and letter knowledge, which are relevant variables in writing acquisition. We also conducted a word dictation test on both groups at the beginning (January) and end of the intervention (March), the results of which were compared to assess the progress made.

2.3. Instruments and Measures

2.3.1. Parents Education Level

We collected information on the highest educational level attained by both parents, as parental education is a commonly used indicator of socioeconomic status. An overall parental education score was calculated by averaging the educational levels of the mother and father.

2.3.2. General Cognitive Ability

The children's abstract reasoning was assessed using the Colored Progressive Matrices of the Raven's Progressive Matrices Test (Raven et al., 1998). This non-verbal assessment requires children to select the missing element in a visual pattern from six to eight possible options. The test comprises 60 geometric items divided into three sets, with one point awarded for each correct response (maximum score = 36).

2.3.3. Phonological Awareness: Syllabic Awareness and Phonemic Awareness

The initial-syllable and initial-phoneme classification subtests of the Battery of Phonological Tests (Silva, 2002) were administered to assess children's awareness of syllables and phonemes. In each subtest, the children completed 14 trials in which they were presented with sets of four pictures. After naming each picture, the children were asked to identify the two words that began with the same sound, either at the syllabic or phonemic level. Each correct response was awarded one point (maximum score per subtest = 14).

Internal consistency was high, with Cronbach's alpha coefficients of 0.87 for the syllabic subtest and 0.81 for the phonemic subtest.

2.3.4. Alphabet Knowledge

Twenty-three flashcards in random order, each displaying an uppercase and a lowercase letter of the alphabet, were individually presented to the children, who were asked to name each letter. The letters K, W, and Y were excluded, as they are not part of European Portuguese orthography. One point was awarded for each correct response, yielding a maximum score of 23 for letter naming. The internal consistency of this measure was high (Cronbach's alpha = 0.93).

2.3.5. Word Spelling

The children's word spelling was analyzed with an 18-word dictation task using consistent words with 2 to 4 letters and frequent syllabic structures in Portuguese (cv, cvv, and cvcv). These words were presented one by one in a fixed random order, and the children were asked to write them. Writing outcomes were scored for phonetic plausibility—crediting letters that accurately represent speech sounds, irrespective of orthographic correctness (maximum score: 68 points—one per correct phonetization). For example, in the word "belo" [beautiful], the spellings, "belo" or "belu" would be assigned four points; "elo" or "bel" would be assigned three points; "be" bl", "bu". "bo" would be assigned two points; and "b" would be assigned 1 point. Following the same logic, in the word "tio", the spelling "tio" or "tiu" would be assigned three points; "ti", "tu" "iu" "io" would be assigned two points; and the spelling "t" would be assigned one point. This scoring system directly operationalizes the development of conceptual knowledge of the alphabetic principle, valuing phonemic mapping over orthographic convention. Using this scoring system, two examiners classified the children's responses separately. The inter-scorer agreement using the kappa statistic was 0.98.

2.3.6. Writing Activities

Writing activities developed by the intervention group teachers were observed weekly during the second term, and the interactions that occurred between the children with the mediation of the adult concerning writing were recorded and transcribed for a qualitative analysis of the dynamics that occurred between the children and the teachers throughout the activities.

These measures were selected to capture the key constructs underpinning the study: phonological and alphabet knowledge as foundational skills, and invented spelling sophistication as the primary outcome reflecting integrated understanding of the alphabetic principle.

Procedure

Two educational psychologists, blind to group assignment, conducted individual pre- and post-tests with all the children in January and at the end of March, respectively. The training course, in which the teachers from the intervention group participated, took place in early January for the intervention group, at the same time the pre-test was carried out, and in early April for the comparison group. There were four sessions, each lasting three

hours, which took place over a two-week period. The training course was conducted by the researchers.

3. Results

Table 1 shows the means and standard deviations for the two groups' results for the following variables: age, parents' education, cognitive ability, syllabic awareness, phonemic awareness and letter knowledge.

Table 1. Descriptive statistics for preliminary measures.

	Age Months		Parents' Education		Cognitive Ability (max. = 36)		Syllabic Awareness (max. = 14)		Phonemic Awareness (max. = 14)		Letter Knowledge (max. = 23)	
	M	*SD*	*M*	*SD*	*SD*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
IG	67.26	3.53	12.64	2.72	17.30	3.74	7.35	2.85	5.05	2.18	10.91	8.35
CG	66.80	3.24	12.38	3.13	16.87	3.84	7.16	2.95	4.29	2.25	10.78	6.41

Note: *M* = mean; *SD* = standard deviation; IG = intervention group; CG = comparison group.

As can be seen in Table 1, the two groups have quite similar results in all variables. Independent-samples *t*-tests confirmed the equivalence of the intervention and comparison groups at baseline on the following variables: age ($t(86) = 0.63$; $p = 0.529$); parents' education ($t(86) = 0.40$; $p = 0.693$); cognitive ability ($t(86) = 0.54$; $p = 0.591$); syllabic awareness ($t(86) = 0.31$; $p = 0.755$); phonemic awareness ($t(86) = 1.60$; $p = 0.113$); and letter knowledge ($t(86) = -0.12$; $p = 0.904$).

Table 2 presents the means and standard deviations of the initial and final phonetizations of the intervention and the comparison groups.

Table 2. Initial and final spelling results for the intervention and the comparison group.

	Phonetizations			
	Initial		Final	
	M	SD	M	SD
IG	12.87	11.84	41.26	13.44
CG	9.69	8.85	9.09	8.62

Note: M = mean; SD = standard deviation; IG = intervention group; CG = comparison group.

As presented in Table 2, the results of the intervention group were slightly higher than those of the comparison group at the initial spelling moment. Independent samples t-tests confirmed the equivalence of the two groups on the number of phonetizations pre-test ($t(86) = 0.53$, $p = 0.599$). At the final assessment, the results of the intervention group were clearly higher than those of the comparison group. A repeated measures ANOVA, with the group as the independent variable and the number of letters correctly written in the pre- and the post-test as the dependent variable, showed a statistically significant interaction effect between the group and the two spelling assessments ($F(1,86) = 195.58$; $p < 0.001$; $\eta_p^2 = 0.70$). This significant interaction indicates that the dialogic, mediated practice of invented spelling—which engages children's functional, conventional, and conceptual knowledge simultaneously—was far more effective in advancing alphabetic understanding than the standard curriculum.

Qualitative Analysis

To elucidate the social and cognitive processes that likely drove the quantitative gains, we conducted a qualitative analysis of classroom interactions. The following three episodes were selected as illustrative examples of the collaborative thinking and teacher mediation that characterize the intervention.

The first episode, which corresponds to one of the sessions that took place during the second week, aimed to foster the children's interactions and exchanges of viewpoints around a teacher-chosen word "Macio" ("soft", from a cotton project being developed in the classroom), without requiring agreement, before the children produced individual spellings considering their own conceptions. The second episode, in the fourth week, shows the teacher capitalizing on a spontaneous syllabic analysis of the word "dinosaur", initiated by one of the children, to guide a multi-faceted exploration (phonological, lexical, and orthographic) and collective reflection on the procedures for writing a word. The third episode, from the sixth week, had the explicit goal of achieving a consensus spelling for the word "Pato". Here, children were to negotiate and thoroughly analyze the word to arrive at a single alphabetic (though not necessarily orthographically correct) representation.

Episode 1: Writing Macio in the context of the study on cotton

Teacher: How do you think we can write the word Macio?

Manuel—Macio starts with the letter M.

Teacher: How do you know that, Manuel?

Manuel: I've known for a long time.

Maria: M is the letter in my name.

Maria Leonor: What does the letter M look like? How do you write it?

Maria: I know! I can teach you how to spell it.

Manuel: It's an M and then maci is an M and an I.

Sara: And then an O or a U.

(Each child wrote Macio)

Manuel: Look, Maria Leonor wrote an 8.

Maria Leonor: It's not an 8. I wrote soft and then cotton and then I wrote an 8 to show that cotton is round.

Sara: Mine has few letters.

Teacher: Why, Sara?

Sara: Because it's a small word.

Manuel: I wrote a 'Y' at the end because I like that letter.

Maria Leonor: Macio (Soft) is a small word because cotton is small and round.

This episode, emerging from a word chosen within an ongoing classroom study, demonstrates that when children collaboratively problem-solve a spelling without pressure for correctness, they openly share diverse hypotheses rooted in different conceptualizations of writing, creating a context for mutual learning. Maria Leonor exhibits a referential conception of writing, which is clearly reflected in the justification she gives to Manuel for using a number mixed with letters to write the word, arguing that the word 'soft' is small because cotton is small and round. Manuel, on the other hand, demonstrates analogical reasoning based on his own name knowledge by recognizing that the initial letter of the targeted word corresponds to the initial letter of his name. Also, he initiates phonemic segmentation ('M and then an I'), scaffolding his peer analysis, showing Sara how to analyze a word orally and look for the letters that correspond to the identified sounds. At the end, he pairs his writing knowledge with personal–graphic motivation (choosing 'Y' because he likes it). While Maria provides direct graphic modeling, teaching Maria Leonor the form of the letter 'M', Sara introduces a quantitative–logical principle (word length) that challenges Maria Leonor's referential conception (linking word size to object size).

Thus, this brief interaction captures the very process of co-construction, where peer dialogue weaves together graphic instruction, phonemic analysis, analogical reasoning, and conceptual challenge to advance collective literacy development.

Episode 2: Thinking about the word "dinossauro"[dinosaur]

During the day's plan. . . Who hasn't drawn the "dinossauro"[dinosaur] yet?

Beatriz S: 'Look, dinossauro has four little bits: di-no-ssau-ro.'

Teacher: Yes, Beatriz, it has four syllables. Do you know anything else about the word "Dinossauro"?

Beatriz S: I know it's big.

Teacher: Why do you think it's big?

Beatriz S: Because it has four syllables, it only needs one more to make five, and five is a lot, it's a handful!

Jorge Duarte: I think it's big, but not because it has four syllables, it's because it has more letters than syllables.

Teacher: And how many does it have, do you know?

Jorge Duarte: It has. . . (he said the syllables, spelling each one and counting the letters on his fingers) it has nine.

Teacher: And do you know anything else about the word dinosaur?

Beatriz R: I think it starts with the letter D.

Jorge Duarte: Like Diana, the first bit is the same, it has DI.

Inês M and Martim: David and Daniela also start with D.

Teacher: So if I asked you to write dinosaur, how would you do it, what would you have to do to write it?

Martim: We would write the letters, letters are for writing!

Teacher: But do we write any letters?

Martim: No, we have to think about the letter and then write it.

Teacher: But how do we know what the letter is?

Gabriel: We have to think about what the first, second, third, . . .

Inês M: Each letter has a sound, I say it and follow the sound, and write the letter for the sound.

Within the context of a dinosaur project, a child spontaneously initiates syllabic segmentation, categorizing the word as long. The teacher capitalizes on this metalinguistic opening with an open-ended prompt ("What else do you know?"), fostering further reflection and giving the children a voice to openly share their knowledge about writing. This scaffolds a collaborative dialogue where the children advance the analysis from syllables to a phonemic analysis of the word and quantitative–graphic examination by considering the number of letters, thus deepening their metalinguistic awareness.

A subsequent open question from the teacher catalyzes a peer-driven interaction regarding the initial letter. This interaction is particularly rich as it illustrates co-construction, as the children autonomously cross-reference multiple proper names to validate their hypothesis about the /d/ sound, reaching consensus without direct adult guidance.

The teacher once again encourages children to reflect together, this time posing a metacognitive question, about the writing process itself—*how* to write—prompting the group to jointly formulate procedural knowledge. Guided by this contingent scaffolding, the reflection becomes increasingly precise, culminating in Inês's explicit articulation of the alphabetic principle: "Each letter has a sound, I say it and follow the sound, and write the letter for the sound."

This episode, originating in a child's spontaneous syllabic segmentation, demonstrates how strategic teacher mediation transformed an initial observation into a structured,

peer-driven exploration that advanced the group's collective understanding of the writing system.

Episode 3: Writing "Pato" [duck]

Teacher: Shall we try to write the word "Pato"?

Marta: It starts with P.

Marta says that the first letter of Pato is P. Does anyone agree?

Everyone nods affirmatively except Tiago, who thinks for a moment and repeats quietly.

Pa, Pa, Pa and finally says: Yes, it's P... pe, pe, pe, Pato! (The teacher writes P on a sheet of paper and shows it to them.)

Teacher: So now what do you think comes next? PA (emphasizing the A).

Henrique: An A!

Teacher: Is there an A after the P? Can I write it?

Tiago: No, yes, I don't know... It's a P.

Teacher: So, shall I write the P after the first P?

Tiago: No, no, otherwise it will be PP and that's not right! It's the A, I think it's the A.

Teacher: So, it's an A?

Henrique: Yes, because it sounds like this, Aaaaa. (The teacher writes the A.)

Teacher: What have we written so far? (And shows the paper)

Marta: PA.

Teacher: And what's the other bit that's missing?

Henrique: PA-TO. TO, it's TO.

Teacher: So how can we write TO?

Marta: It's U.

Teacher: Do you all think it's U?

Diogo: No, there's something before U. I know, an N.

Tiago: It's not N, it doesn't have that sound, otherwise it would be [n]. It's... T, I think it's T.

Teacher: So, what do you want me to write first, the T or the U? What do you think, Diogo?

Diogo: It's the U.

Marta: No, it's the T, first comes the T and then the U.

Tiago: I don't think it's U, it's O.

Marta: But it's U, listen to the sound, patUuuu.

Tiago: But O is also U, like me, Tiagoooooo [u]. So it must be O.

Teacher: Sometimes at the end of words, O sounds like U.

In this episode, there is an exchange of views on the letters to use and their order. The requirement to reach a consensus on how to spell the word not only compels children to analyze sounds and possible graphemes to represent them but also fosters metacognitive awareness of their own reasoning, as they have to explain and defend their different points of view. The teacher's practice of accepting all suggestions without labeling them as incorrect creates a space for hypothesis testing. This leads Tiago to independently reject his own suggestion of a double 'P' ("PP"), revealing his emergent understanding of orthographic constraints—a concept widely evidenced in the literature wherein children construct word structure rules based on observed language patterns, considering that it is not possible to write the same letters together in a row. This thinking leads her to accept Tiago's and Henrique's subsequent proposals.

Another key moment involves analogical reasoning and peer sharing: Tiago generalizes a rule from his name ("Tiago"), explaining that the sound /u/ can be represented by the letter 'o'. Furthermore, it is important to highlight the awareness children demonstrate regarding the need to analyze the various phonemes that constitute a word and the

sequential order in which they occur when we hear it. The debate between Marta and Tiago over the syllable "-to" illustrates a developmental progression from focusing on the most salient phoneme (/u/) to conducting full sequential segmentation. Marta, initially isolating the prominent /u/ sound, is guided by Tiago's comment to identify the preceding /t/. This divergence in analysis allows the teacher to scaffold attention to the temporal order of phonemes and their corresponding letters.

4. Discussion

The findings from this study provide strong empirical support for the socioconstructivist pedagogical pathway to early literacy. The quantitative results revealed a significant and substantial interaction effect ($\eta p^2 = 0.70$), indicating that children in the intervention group made markedly greater progress in invented spelling sophistication than their peers in the comparison group. This large effect size is notable, as it shows clearly that teacher-mediated cooperative invented spelling activities, embedded within the naturalistic flow of the preschool day, can powerfully accelerate the development of alphabetic understanding.

This outcome validates the central role of invented spelling as a pivotal practice for connecting children's emergent theories to the alphabetic code, a concept highlighted in seminal developmental work (Chomsky, 1970; Read, 1971). More importantly, it extends this foundational theory by demonstrating its efficacy within a structured, socially mediated intervention. The significant gains align with contemporary intervention research that positions invented spelling not merely as a predictor, but as an active mediator of literacy acquisition that integrates phonological, orthographic, and morphological knowledge (Albuquerque & Alves Martins, 2022; Alves Martins et al., 2016; Ouellette & Sénéchal, 2017).

The mechanism behind this advancement is illustrated by the qualitative data. Progress was driven by the social and discursive process of collaborative thinking. As the episodes show, when the children negotiated spellings—for instance, debating whether the final sound in "Pato" is best represented by 'O' or 'U'—they engaged in peer-mediated hypothesis testing, which required metalinguistic reflection and explicit verbalization of their reasoning (Pulido & Morin, 2018; Puranik et al., 2017). This process sharpens phonological and orthographic analysis in ways solitary practice likely would not (Alves Martins et al., 2016). The teacher's role was essential and was characterized by contingent scaffolding—such as posing open questions ("How do you know that?"), accepting approximations, and focusing attention on sound sequences—which structured productive interactions without imposing solutions (van de Pol et al., 2010). This scaffolding effectively operationalized the Zone of Proximal Development, transforming dialogue into an engine for conceptual change (Vygotsky, 1978).

These activities succeed because they engage emergent literacy domains in an integrated manner. Tasks like analyzing "dinossauro" (Episode 2) are meaningful contexts where functional purpose, conventional knowledge, and conceptual insight converge dynamically (Gerde et al., 2012). A key practical contribution is the integration of guided linguistic inquiry into play-based projects, aligning with curricular guidelines (Direção-Geral da Educação, 2016). The observed coexistence of multiple hypotheses within interactions (e.g., Episode 1) underscores that conceptual change is a gradual process of refinement. A classroom culture that values approximations as legitimate steps in thinking provides the necessary space for this evolution (Bingham et al., 2017).

A supportive culture was crucial for leveraging the natural differences in the children's starting knowledge, which the collaborative approach used as a resource for learning. The qualitative interactions consistently show how varying levels of spelling understanding became a tool for conceptual growth. For instance, in Episode 1, Maria, who could write the letter 'M', provided direct graphic modeling for Maria Leonor, who held a referential view

of writing. Simultaneously, Manuel, who was segmenting phonemes, offered analogical reasoning ("M is from my name") and phonemic cues ("M and then an I") that scaffolded his peers' analysis. In Episode 3, Tiago's more advanced insight about letter patterns (rejecting "PP") and his analogical transfer from his name (mapping /u/ to 'o') substantially enriched the group's discussion, while Marta's initial focus on the most salient sound prompted a necessary debate on complete sound-by-sound analysis (phonemic sequencing). This heterogeneity meant that the children could act as both learners and momentary experts, ensuring that these differences fostered collective progress rather than reinforcing fixed roles. Importantly, the observed peer scaffolding—where the children like Manuel and Tiago (Episode 1) used letters from their own names, and Jorge Duarte, Inês, and Martim (Episode 2) used letters from significant others to anchor their reasoning—underscores a key principle from the emergent literacy framework (Puranik & Lonigan, 2011). Children's names serve not only as a personal entry point into the writing system but as a shared social resource that enables reasoning by analogy and collaborative problem-solving within the group.

Limitations and Future Research

While these findings highlight a promising pathway, we can point out several limitations of the present study. The sample, though carefully constructed, was drawn from a specific geographical and linguistic context (Portuguese preschools in the Lisbon area), and included a limited number of preschool classes, which may affect generalizability. Studies involving larger samples, as well as research examining the effectiveness of this type of intervention in deeper or more/opaque orthographies, are necessary. Also, longitudinal studies are needed to examine the sustainability of gains and their impact on later conventional reading and writing. Furthermore, this study relied on a global measure of spelling sophistication. Future research could employ more detailed analyses to trace the development of specific orthographic or morphological features through these collaborative activities. Investigating how to support teachers in developing and refining their contingent scaffolding skills in diverse classroom contexts remains a critical need for professional development research (Gerde & Bingham, 2023).

In conclusion, this study reinforces that early literacy development is profoundly social. It demonstrates that significant gains can be achieved through pedagogy that strategically leverages peer collaboration and expert mediation focused on the meaningful challenge that invented spelling represents. By creating a classroom culture of shared linguistic inquiry, teachers transform everyday interactions into powerful opportunities for constructing the foundations of written language.

Author Contributions: Conceptualization, L.S. and M.A.M.; methodology, L.S. and M.A.M.; validation, L.S. and M.A.M.; formal analysis, L.S. and M.A.M.; investigation, L.S. and M.A.M.; resources, L.S. and M.A.M.; data curation, L.S. and M.A.M.; writing—original draft preparation, L.S. and M.A.M.; writing—review and editing, L.S. and M.A.M.; visualization, L.S. and M.A.M.; supervision, L.S. and M.A.M. All authors have read and agreed to the published version of the manuscript.

Funding: This work was funded by national funds through the FCT—Fundação para a Ciência e Tecnologia, I.P., under the R&D Unit: UID/04853/2025—Interdisciplinary Research Centre in Education [https://doi.org/10.54499/UID/04853/2025].

Institutional Review Board Statement: This study did not require approval from an Institutional Review Board (IRB) or Ethics Committee, as it was conducted entirely within routine preschool educational practice, by the children's own educators, and involved no procedures beyond standard curriculum-based activities.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The original contributions presented in this study are included in the article. Further inquiries can be directed to the corresponding author.

Conflicts of Interest: The authors declare no conflicts of interest.

References

Albuquerque, A., & Alves Martins, M. (2022). Invented spelling as a tool to develop early literacy: The predictive effect on reading and spelling acquisition in Portuguese. *Journal of Writing Research*, *14*(1), 113–131. [CrossRef]

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. [CrossRef]

Alves Martins, M., Salvador, L., Albuquerque, A., & Silva, C. (2016). Invented spelling activities in small groups and early spelling and reading. *Educational Psychology*, *36*(4), 738–752. [CrossRef]

Alves Martins, M., & Silva, C. (2006). The impact of invented spelling on phonemic awareness. *Learning and Instruction*, *16*, 41–56. [CrossRef]

Bingham, G. E., & Gerde, H. K. (2023). Early childhood teachers' writing beliefs and practices. *Frontiers in Psychology*, *14*, 1236652. [CrossRef] [PubMed]

Bingham, G. E., Gerde, H. K., Bowles, R. B., & Zhang, X. (2026). Investigating the impact of preschool writing instruction on early writing development: Attention to instructional focus and strategy. *Scientific Studies of Reading*. [CrossRef]

Bingham, G. E., Quinn, M. F., & Gerde, H. K. (2017). Examining early childhood teachers' writing practices: Associations between pedagogical supports and children's writing skills. *Early Childhood Research Quarterly*, *39*, 35–46. [CrossRef]

Burns, S., Yu, E., Brathwaite, L., Masum, M., White, L., Dhuey, E., & Perlman, M. (2024). Improving young children's peer collaboration in early educational settings: A systematic review. *Review of Education*, *12*(2), e3484. [CrossRef]

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. [CrossRef]

Castles, A., & Coltheart, M. (2004). Is there a causal link from phonological awareness to success in learning to read? *Cognition*, *91*(1), 77–111. [CrossRef]

Chomsky, C. (1970). Reading, writing, and phonology. *Harvard Educational Review*, *40*, 287–309. [CrossRef]

Copp, S., Cabell, S., & Invernizzi, M. (2019). Kindergarten teachers' use of writing scaffolds to support children's developing orthographic knowledge. *Literacy Research and Instruction*, *58*(3), 164–183. [CrossRef]

Direção-Geral da Educação. (2016). *Orientações curriculares para a educação pré-escolar*. Ministério da Educação. ISBN 978-972-742-404-7.

Ehri, L. C., Nunes, S. R., Willows, D. M., Schuster, B. V., Yaghoub-Zadeh, Z., & Shanahan, T. (2001). Phonemic awareness instruction helps children learn to read: Evidence from the national reading panel's meta-analysis. *Reading Research Quarterly*, *36*(3), 250–287. [CrossRef]

Ferreiro, E., & Teberosky, A. (1979). *Los sistemas de escritura en el desarrollo del niño*. Siglo XXI.

Gerde, H. K., & Bingham, G. E. (2023). Using the science of early literacy to design professional development for writing. In S. Q. Cabell, S. B. Neuman, & N. Patton Terry (Eds.), *Handbook on the science of early literacy* (pp. 236–252). Guilford Press.

Gerde, H. K., Bingham, G. E., & Wasik, B. A. (2012). Writing in early childhood classrooms: Guidance for best practices. *Early Childhood Education Journal*, *40*(6), 351–359. [CrossRef]

Hofslundsengen, H., Hagtvet, B. E., & Gustafsson, J.-E. (2016). Immediate and delayed effects of invented writing intervention in preschool. *Reading and Writing*, *29*(7), 1473–1495. [CrossRef] [PubMed]

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. [CrossRef]

Morin, M.-F., & Montésinos-Gelet, I. (2007). Effet d'un programme d'orthographes approchées en maternelle sur les performances ultérieures en lecture et en écriture d'élèves à risque. *Revue des Sciences de L'éducation*, *33*(3), 663–683. [CrossRef]

Nunes, T., & Bryant, P. (2006). *Improving literacy by teaching morphemes*. Routledge. [CrossRef]

Ouellette, G., & Sénéchal, M. (2008). A window into early literacy: Exploring the cognitive and linguistic underpinnings of invented spelling. *Scientific Studies of Reading*, *12*, 195–219. [CrossRef]

Ouellette, G., & Sénéchal, M. (2017). 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. [CrossRef]

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. [CrossRef]

Pulido, L., & Morin, M. F. (2018). Invented spelling: What is the best way to improve literacy skills in kindergarten? *Educational Psychology*, *38*(8), 980–996. [CrossRef]

Puranik, C. S., & Lonigan, C. J. (2011). From scribbles to scrabble: Preschool children's developing knowledge of written language. *Reading and Writing*, *24*(5), 567–589. [CrossRef] [PubMed]

Puranik, C. S., Patchan, M. M., Lemons, C. J., & Al Otaiba, S. (2017). Using peer assisted strategies to teach early writing: Results of a pilot study to examine feasibility and promise. *Reading and Writing*, *30*, 25–50. [CrossRef]

Raven, J., Raven, J. C., & Court, J. H. (1998). *Manual for Raven's progressive matrices and vocabulary scale*. Psychologists Press.

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

Rosa, J., & Alves Martins, M. (2022). The impact of naturalistic intervention on preschool children's morphological awareness development. *Análise Psicológica*, *40*(1), 101–116. [CrossRef]

Salvador, L., & Alves Martins, M. (2024). From spelling to reading: An intervention program with children at risk of reading failure. *Journal of Experimental Child Psychology*, *244*, 105944. [CrossRef]

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

Tolchinsky, L. (2016). From text to language and back: The emergence of written language. In C. A. MacArthur, S. Graham, & J. Fitzgerald (Eds.), *Handbook of writing research* (2nd ed., pp. 144–159). Guilford Press.

Tunmer, W. E., Bowey, J. A., & Grieve, R. (1983). The development of young children's awareness of the word as a unit of spoken language. *Journal of Psycholinguistic Research*, *12*(6), 567–594. [CrossRef]

van de Pol, J., Volman, M., & Beishuizen, J. (2010). Scaffolding in teacher–student interaction: A decade of research. *Educational Psychology Review*, *22*(3), 271–296. [CrossRef]

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes* (M. Cole, V. John-Steiner, S. Scribner, & E. Souberman, Eds.). Harvard University Press.

Zhang, C., & Bingham, G. E. (2019). Promoting high-leverage writing instruction through an early childhood classroom daily routine (WPI): A professional development model of early writing skills. *Early Childhood Research Quarterly*, *49*, 131–151. [CrossRef]

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