“With a little help from my friends”: Effects of a self-reflection tool and social interaction on orthographic performance

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Abstract: This study investigates the impact of peer orthographic revision using a self-reflection tool on orthographic performance in order to improve the understanding and applying of phonological, contextual and morphological rules in third-grade students. Children were assigned to one of three groups: two experimental groups (individual group, dyadic interaction group) and a control group. In the experimental training programme, a self-correction orthographic rubric was used, but while children in the individual group self-corrected the words, children in the dyadic interaction group did it in pairs and interacted in a way such that they should always reach an agreement on the correct spelling. The results showed that although both experimental groups decreased the number of misspellings in the post-test, the dyadic interaction group had the best results, differing significantly from the others, suggesting that self-correction strategies based on rubrics that explicitly display orthographical rules along with collaborative peer learning have a very positive impact on orthographic.

Keywords: spelling acquisition, orthographical rules, social interaction, explicit orthographic representations

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1. Introduction

Writing correctly and according to conventional spelling rules is one of the greatest achievements in the early years of formal school learning. The processes underlying this ability are crucial to understand its functioning as a way of accessing its mastery and automatization and have been the subject of much psycholinguistic related research. In fact, the development of orthographic representations has clear implications in terms of both reading, specifically reading fluency, and writing, since the accuracy of orthographic representations has obvious effects on the way children correctly spell a given word (Linnemann, et. al. 2022)

To spell a word efficiently can be decisive for writing in a fluent, organized, and structured way, since mastering the formal processes of language allows the child to focus on the basic ideas of the text and expand it. Therefore, according to data from national literacy assessments conducted with second-grade students (IAVE, 2018), intervention in this area is absolutely necessary.

Recently, Silva et al. (2021) assessed the impact of a self-correction rubric based on orthographic revision procedures on third-grade students' orthographic performance. This rubric displayed explicit contextual, phonological and morphological rules so that children could correct their own spelling errors. The findings of the study showed that this tool significantly increased students' orthographic performance, lowering the number of spelling errors not only in frequent but also in less frequent words. Since the spelling rules were explicitly displayed on the rubric, Silva et al. (2021) suggested that this decrease was mainly due to the fact that children started using procedures related to more explicit spelling rules knowledge, and thus easier to access, rather than an implicit and less elaborated knowledge.

The purpose of the present study is to evaluate the effects of the same self-correction rubric on the orthographic performance of third-grade students by comparing its effect when it is used in dyads (social interaction) or individually. Studies focused on social interaction in different learning contexts and subjects have been keen to show how cooperation between students can promote academic success (Kumpulainen & Wray, 2002; Monteiro, 2013; Pontecorvo et al., 2005); however, very few investigations have used this paradigm in the orthographic learning field using a self-correction tool.

2. The Development of Orthographic Skills and Intervention Strategies

Learning how to write is a linguistic activity (Treiman & Kessler, 2006; Treiman et al., 2006) that requires not only awareness of phonetic segments, morphemes and their relationships with graphemes, but also orthographic letters—that is, letter groups whose sequence depends on contextual or positional restrictions. In fact, orthographic representation implies awareness of various types of linguistic unit as well as active strategies of information processing. In this context, children are not merely reproducing orthographic rules; instead, they are actively seeking to comprehend how these rules function and are reevaluating their role within the writing system. Through this process,

they gradually enhance their ability to explicitly articulate the constraints and nuances of these rules. (Bousquet et al., 1999).

Being aware and able to explain orthographic restrictions is a critical issue for the development of orthographic skills, namely in what concerns spelling irregular or inconsistent words (Morais & Teberosky, 1994). Critten et al. (2007, 2013) conducted several studies with the objective of analysing how the level of orthographic explicitness affects children's orthographic performance. These investigations were grounded in Karmiloff-Smith's (1992) theoretical model of representations redescription (RR). In this model, the author states that the development of any type of knowledge implies a 'redescription' of representations, meaning that children would evolve from implicit levels of representation, where they do not access the representations consciously, to a level of conscious understanding which, in case of orthographic representations, would mean full comprehension of the orthographic units present in the writing system and its restrictions. Thus, inferior levels of redescription would consist of mere copies or duplication of representations, while superior levels imply a growing explicitness and accessibility to more sophisticated information. Applied to orthographic representations (Critten et al., 2007, 2013), this implies an understanding of how to use phonology and morphology rules effectively and the ability to articulate them explicitly.

Based on Karmiloff-Smith's RR model, Critten et al. (2007, 2013) sought to identify the nature of children's orthographic representations and their explicitness level. Using both a writing task and a recognition task, children had to choose the correct spelling of words from three options and justify their choice. The authors sorted children's performance into different RR levels (E1A, E1B, E2, E3) according to the level of orthographic knowledge explicitness presented in their justifications. Critten et al. (2013, p. 203) defined those RR levels in the following terms:

E1A – focus on aspects of phonology while morphological units, for example -ed, are not recognized;

E1B – focus on the morphological theory, for example, related to the rule of -ed that is consistently and sometimes inappropriately referred to;

E2 – more explicit verbal explanations of phonological and morphological knowledge, with some inconsistency in explaining why words were correct;

E3 – complete understanding of the appropriate use of aspects of phonology and morphology rules and the ability to fully verbalize these.

The authors confirmed that children who scored higher in writing tasks showed higher explicitness levels regarding the way they justify their choices in recognition tasks.

In this line of research, Morais and Teberosky (1994) conducted a study where third-grade Brazilian students were asked to misspell a number of words deliberately. The authors found that children who disregarded orthographic rules but then explained their misspellings scored better on a dictation task. This research did not focus on analysing the explicit levels of orthographic representation in children, but the authors assumed that success in orthographic performance was linked to more explicit orthographic

representations. On the other hand, the authors demonstrated not only that contextual and morphological rules differed in explicitness awareness but also that contextual rules were easier to explain than morphological ones. The results of these studies (Critten & Pine, 2009; Critten et al. 2016; Morais & Teberosky, 1994; Silva, 2009; Silva et al., 2021) confirmed that the ability to explicit the orthographic rules shapes orthographic representations' acuity and is linked to orthographic performance improvement.

In this realm, the ability to comprehend and elucidate orthographic restrictions holds significant value. Children's acquisition of more explicit orthographic representations and its impact on their writing strategies are areas warranting comprehensive investigation. One avenue of exploration is metalinguistic awareness training programmes, particularly those designed to enhance grapho-phonemic correspondence awareness (Hatcher et al., 2004; Lundberg et al., 1988) and morphologic structure awareness (Lyster, 2002; Nunes & Bryant, 2006). The integration of such programmes could potentially pave the way for improved explicitness of orthographic rules in young learners.

There are a few studies focused on strategies relying on rubrics, displaying the orthographic rules of a given language, a methodology that could facilitate awareness of various types of orthographic restriction. In one of these studies, focusing on writing tasks, Silva (2013) employed this strategy to improve the orthographic performance of fourth-grade students. After a writing task, children from the experimental group were asked to revise not only their text's consistency and cohesion but also their spelling, relying on a rubric displaying a number of Portuguese orthographic rules. Although the focus of this study was writing production, there was a significant decrease in the number of misspelled words among children from the experimental group compared to the performance of children in the control group, who only carried out the writing task. Moreover, children's verbal output during the revision procedure (e.g. "I did it wrong because it has two ss and I only wrote one"; "The *r* is in the wrong place because it is *empregado*, not *empergado*") suggests the possibility of this method improving orthographic rules' explicitness, and thus orthographic representations.

In a more recent study, Silva et al. (2021) assessed the effect of a self-correction rubric tool based on orthographic revision procedures of third-grade students' orthographic performance. In this research, rubrics displaying explicit contextual, phonological and morphological rules were used. Children from the experimental group underwent a training program consisting of nine sessions. They spelled words dictated by an adult, who then underlined their misspellings in a specific colour (a different colour was assigned to each rule) and asked them to self-correct the misspellings using the rubric. After the training programme, experimental group children presented an average number of phonological and contextual misspellings close to zero and a significant decrease in misspellings linked to morphological rules, with no significant differences concerning high or low frequency words. There were significant differences, though, between these results and the ones obtained by the control group. Given the significant improvement in the three aspects of orthographic performance for children in the experimental group, the authors

assumed, based on the nature of the strategies involved, that this improvement was based on the greater explicitness of contextual and morphological orthographic restrictions and phonological recoding rules.

Another type of intervention research on orthographic performance improvement involves self-correction processes wherein individuals correct their own writing errors. Several studies (Cordewener et al., 2018; Gaintza & Goikoetxea, 2016; Turner et al., 2017; Wirtz et al., 1996) have demonstrated the positive impact of this approach across different languages, including English, Spanish and Dutch. By encouraging children to correct their misspellings promptly after being provided with the correct spelling by their teacher, noticeable improvements in writing acuity have been observed.

The active engagement of children in scrutinizing their writing, letter by letter, and comparing it with conventional writing appears to be a key factor contributing to these favourable outcomes. Despite the demonstrated effectiveness of the self-correction method compared to traditional teaching approaches, there remains a gap in our understanding regarding its influence on the construction strategy of orthographic representations.

3. Interaction as a Way to Promote Knowledge

The educational value of social interactions in learning has been shown in a number of research studies in different domains, from mathematics to art (Peixoto & Monteiro, 1999; Howe & Mercer, 2007; Kumpulainen & Wray, 2002; Monteiro, 2013; Tenenbaum et al., 2020). Indeed, learning activities that enable children to collaborate and interact while sharing potential solutions, explaining their understanding of the task, and striving to reach agreements through explicit communication of their points of view foster learning and comprehension processes, ultimately enhancing children's cognitive development (Tenenbaum et al., 2020; Pontecorvo et al., 2005).

Tenenbaum et al. (2020) conducted a meta-analysis to explore the potential benefits of collaborative work with peers on learning outcomes. The authors analysed results from 62 articles with 71 studies and found that, compared with other learning conditions, the learning of children in peer interaction groups improved. The effects of peer interaction were stronger if students were instructed to reach a consensus. Research about the benefits of social interaction for learning has shown that the advantages of interaction settings are not restricted to situations where children face explicit social and cognitive conflicts. According to Gilly (1988, 1995), children also benefit from interactive dynamics in groups during problem-solving tasks characterized as co-construction (one child initially makes a proposal to the group which is then seamlessly continued by another child, culminating in the joint construction of a solution through collaborative efforts) or concurrent collaboration (where a child suggests a solution that is explicitly accepted by the other, not in a passive manner, but rather following a reflective process that indicates cognitive understanding and acceptance).

The literature about social interactions supports the idea that tutorial processes, either by intervention from the most proficient children or by adult mediation, both encouraging metalinguistic reflection processes in less proficient children (Pontecorvo et al., 2005; Tenenbaum et al., 2020). Following this line of thought, a number of studies involving writing tasks showed that interactions between children may facilitate understanding of the writing code's alphabetic nature or improve writing quality. Most of the research about collaborative writing focuses on the production of texts (Elabdali, 2021). In general, these studies try to compare the quality of texts produced individually or in collaboration (groups or dyads). In a meta-analysis, Elabdali (2021) showed that collaborative writing produces more accurate texts than individual writing. However, the impact of collaborative writing on subsequent individual assignments is not always clear. Also, it has been demonstrated that interactions are a way to improve children's representations of the alphabetic code's nature (Alves Martins et al., 2014, 2015). These last studies showed the impact of group-invented spelling activities on kindergarten children's spelling performance, with the help of an adult who just mediated the interactions with minimal intervention. Children were encouraged to think about their own spelling and to discuss it with others in relation to correspondences of sounds and letters. Adults' mediations and peer interaction during collaborative spelling tasks have also been analysed. It was noticed that children began to adopt behaviours of explicitness and procedure verbalization, giving inferential cues to peers, trying to simulate the role of the adult in the teaching-learning process (Albuquerque & Alves Martins, 2020).

Although there are few studies focusing on orthographic performance that use interaction as a strategy to improve spelling, they all point to the benefits of peer collaborative writing (Almeida et al., 1998; Turner et al., 2017). For instance, Almeida et al. (1998) compared the effect that collaborative working and individual working have on an orthographic task. This study corroborates the positive effect of interaction, since children in the collaborative condition decreased the number of orthographic errors at the post-test. The analysis of children's interaction showed the use of metalinguistic analysis of words while discussing how to write them.

4. Current Study

As stated before, research centred on social interactions has provided evidence that collaborative work leads to greater cognitive achievement compared to individual work (Peixoto & Monteiro, 1999; Monteiro, 2013; Tenenbaum et al., 2020). These studies have also demonstrated that working with peers prompts verbal explanation, strategic indications, and reflection on one's actions, thus enabling reformulations of task representation and/or resolution procedures. In a previous study, Silva et al. (2021) confirmed the positive effect of a self-correction rubric on the orthographic performance of third-grade students. Therefore, it is relevant to compare the effects of the same self-correction rubric on the orthographic performance of children when used within dyadic interactions or individually.

Based on the principle that peer correction of spelling errors provides children with a context that facilitates their understanding of the rules, as they are required to explain the spelling rules explicitly to their peers (each child using the rubric has to correct their colleague's errors and explain why the word was misspelled), we expect that the number of errors will decrease more significantly in the dyads than among children who perform this correction individually. It is anticipated that both experimental groups will show a greater decrease in spelling errors compared to children in the control group. In the control group, children are only asked to correct their misspellings by copying down the correct word. Given the greater complexity of morphological rules in the orthographic system (Morais & Teberosky, 1994), the effect is expected to be greater in words related to morphological rules than in words related to contextual and phonological rules.

5. Method

5.1 Participants

Sixty third-grade school children participated in this study (25 boys and 35 girls), from three different classes of two schools in the Lisbon area; they belonged to the same school grouping, meaning that they were under the same school administration and shared the same pedagogical guidelines. Children were 8.85 years old on average, with a standard deviation of 0.213. The average ages for the two experimental and one control groups were 8.88, 8.81 and 8.86, respectively. Every child had European Portuguese as their native language.

Participants were assigned to three groups (experimental 1, experimental 2 and control), with equivalent scores in terms of cognitive level and spelling performance. As an exclusion criterion, children with cognitive ability scores according to the Raven's Coloured Progressive Matrices score (Simões, 1995) equivalent to the 25 per cent lowest of the Portuguese population were excluded, as well as those with dyslexia. All selected children were fluent readers according to their teachers. Children in the experimental groups belonged to two different classes in the same school, where part of the class was assigned to experimental group 1 and the other part to experimental group 2 using a matched pairs design (Cohen et al., 2018)—i.e. matching one participant in experimental group 1 to a participant in experimental group 2 and to a participant in control group whose scores were similar for cognitive ability and spelling performance.

The comparison for group gender, age and scores on Raven's Progressive Matrices (Table 1) showed no significant differences between the groups; χ^2 (2) = 0.55, p = .760 for gender; $F(2, 57) = 0.50$, p = .607 for age; and $F(2, 57) = 0.21$, p = .812 for the Raven's scores. Teachers from all classes were interviewed on their pedagogical practices regarding teaching spelling methods, which consisted mainly in target words analysis, dictation tasks, copying words, sentences or texts, and filling word gaps in sentences.

Table 1. Frequencies and mean values for each group on gender, age and Raven's matrices scores

	Gender		Age	Raven's Matrices scores
	Girls	Boys	*M* (*SD*)	*M* (*SD*)
CG	13	7	8.86 (.19)	33.70 (1.30)
ICG	11	9	8.88 (.25)	33.55 (1.23)
SIG	11	9	8.81 (.21)	33.80 (1.15)
Total	35	25	8.85 (.21)	33.68 (1.21)

Note. CG – control group, ICG – individual correction group, DIG – dyadic interaction group

All of them shared these pedagogical strategies and followed the same textbook. Moreover, the copy the correct word strategy without any questioning is one of the most used strategies to correct orthographic misspelling in Portuguese schools (Gaitas, 2013).

5.2 Tasks and Procedures

Evaluating Children's Cognitive Ability

Children's cognitive ability was evaluated using the coloured version of Raven's Progressive Matrices test (Raven et al., 1998; Simões, 1994), because it does not rely on verbal aspects. One point was given for each correct answer, so the results could vary from 0 to 36 points.

Orthographic Performance Evaluation

Evaluation and training tools—dictation task and self-correction rubric—were created according to Portuguese language structure, including contextual rules, complex syllables, digraphs and morphological rules described above. Before we present these tools, we ought to describe Portuguese orthographic system.

Portuguese orthographic system. Portuguese written language comprises 39 phonemes which are represented by 67 simple or complex graphemes. Portuguese is considered to be a semi-transparent system, more difficult than Finnish or Spanish but easier than English or French (Seymour et al., 2003).

Regarding consonants, there are univocal letter/sound relationships (phoneme [p] is represented by <p> or phoneme [t] is represented by <t>), but there are also a number of cases where a phoneme is represented by more than one letter (e.g. phoneme [s] can be represented by <s>, <ss>, <ç> or <c>, this last when it is followed by <i> or <e>). Additionally, there are letters that have different phonetic values (e.g. <s> has both phonetic values [ʃ] or [ʒ]) that may depend on the consonant that follows (e.g. <pisco>/[p'iʃku] or <musgo>/[mˈuʒgu]) (Freitas et al., 2012). There are also consonants represented by digraphs: nasal consonant [ɲ] is represented by <nh>, lateral consonant [ʎ] by <lh>, and fricative consonant [ʃ] by <ch>. While digraphs <nh> and <lh> are considered to be consistent, digraph <ch> is inconsistent because, depending on the context, the same sound may be

represented by other letters (e.g. <x>, <s> or <z>). Other digraphs, such as <rr>, <ss>, <gu> and <qu>, also follow contextual rules: <rr> and <ss> represent the sounds [R] and [s] when they are between vowels. These graphemes never appear at the beginning or the end of the words. On the other hand, digraphs <gu> and <qu> represent phonemes [g] and [k] whenever they are followed by <u> and <e> or <u> and <i>, where the letter <u> represents a mute phoneme.

Of the 14 vowels in the Portuguese language, nine are oral (represented by the letters <a>, <e>, <i>, <o>, <u> and digraph <ou>), while five are nasal (represented by vowels followed by <m> or <n>, or by tilde in <ã>, as in *rã* – "frog"). It should be noted that the orthographic representation of vowels might be complex. For example, we can represent [i] with <e> in the word '*elefante*', <i> in '*tipo*' or <í> in '*íman*'. Regarding nasal vowels, we can only use the grapheme <m> when the vowel is followed by <p> or <b>; otherwise we use <n> (Cunha & Cintra, 2013).

If we analyse the syllable structure of Portuguese, a high percentage of syllables have a consonant-vowel (CV) structure (e.g. ga-to), consonant-vowel-vowel (CVV) (e.g. lei), or vowel (V) structure (e.g. a-nel). Other common syllable structures are consonant-vowel-consonant (CVC) syllables (e.g. por-ca) and consonant-consonant-vowel (CCV) syllables (e.g. pra-to). The other syllable structures are relatively infrequent (Vigário et al., 2006). The nature of syllables has consequences when learning how to spell (Alves Martins & Silva, 2009), and it is common, at least in the early stages of learning, for errors to be made in more complex syllabic patterns, such as CVC and CCV syllables, as learners tend to represent them with the logic of more frequent structures, such as CV. Thus, there is a tendency among children to reduce the onset of CCV to a single consonant and to omit some consonant in the rime of the CCV syllable (Alves Martins, 2021).

Some grapho-phonemic relationships are determined by context and comply with universal restrictions. In such cases, a specific phoneme is represented by one particular grapheme depending on the vowel following; in other cases, the option for a particular grapheme is given by the phoneme's position in the word. Many of these restrictions rely on consistent rules that allow us to predict the correct grapheme within the framework. Therefore, it is necessary that children's orthographic processing goes beyond targeted phonemes, taking into account the letters next to those phonemes.

Another type of restriction is that related to thew grammatical category of morphemes and words, which can also constitute a definition criterion for grapho-phonemic relations—e.g. <eza> is a morpheme that is used when an adjective turns into an abstract noun: <belo> (beautiful) / <beleza> (beauty), where the contextual rule stating that <s> between vowels reads as [z] is dismissed. In such cases, in order to spell correctly, children must bear in mind morphological cues and have a certain degree of morphological awareness (Nunes & Bryant, 2014). Morais and Teberosky (1994) demonstrated that in the Portuguese language, contextual and morpho-syntactic restrictions differ in difficulty level, children finding it easier to explain the former than the latter. Therefore, the number of misspellings made by children is often greater in words linked to morpho-syntactic

restrictions. Moreover, words' etymology (whether they have a Greek, Latin or Arabic root) might affect spelling and give way to exceptions in orthographic rules.

Pre- and post-test dictation task. When selecting the words' features for the dictation task, we followed a linguistic approach of error analysis developed by Bahr et al. (2012), nonetheless complying with the Portuguese orthographic system's specificities. We selected 32 words in which children had to address letter patterns' legality in respect of positional or contextual restrictions; 32 words in which grapho-phonemic relations could pose a problem because of their complex syllable structure, as the phonemes did not correspond to only one letter or could be pronounced differently and thus create confusion; and 12 words that included flexional or derivational morphemes. It is important to underline that every word used in the pre- and post-test had a segment that referred to one of the rules in question and that the words selected were meant to emphasize the efficacy of the training programme. The words in the pre- and post-test used the same types of rule described in the rubric.

Pre- and post-test evaluation consisted of a 76-word dictation task (Appendix A), of which:

- 32 words involved contextual rules awareness (r/rr, s/ss, ce/ci, que/qui, gue/gui/ge/gi, and *m* before *b* and *p*)—e.g. the letter <s> has both phonetic values [ʃ] or [ʒ]—that may depend on the consonant that follows: ***S**ino* [sˈinu] (bell); *va**s**o* [vˈazu] (vase); *mas**s**a* [mˈasɐ] (mass); ***s**anidade* [sɐnidˈadi] (sanity); *defe**s**a* [difˈezɐ] (defence); *o**ss**ada* [ɔsˈadɐ] (bone).
- 32 words presented a specific phonological structure (words with the structure CCV and CVC using the consonant R or L – CRV; CVR, CLV, CVL) with words beginning with voiced or voiceless consonants—e.g. *pata* [pˈatɐ] (duck); *bata* [ˈbatɐ] (gown); and words including the digraphs lh, nh and ch—e.g. *chão* [ʃˆɐ̃w] (floor); *pinha* [pˈiɲɐ] (pinecone); *pilha* [ˈpˈiʎɐ] (battery).
- 12 words related to flexional and derivational morphological rules:
  - □ Using '*ice*' and '*eza*' when turning an adjective into a noun – two words for each morpheme (e.g., Beleza [biɬˈezɐ] / (beauty).
  - □ Verbs in the third person plural of the past and future tense – four words (e.g. Ontem, eles *comeram* [kumˈerɐ̃w] um bolo / (Yesterday, they ate a cake); Amanhã, eles *acharão* [ɐʃɐrˈɐ̃w] um tesouro / (Tomorrow, they will find a treasure).
  - □ Verbs in the third person singular of the present tense (indicative mode), where the reflexive personal pronoun '*se*' is present (e.g., come-se [kˈomi-si] / (eat).
  - □ Verbs in the third person singular of the past imperfect tense (conjunctive mode) – four words (e.g., comesse [kumˈesi] / eat).

In the last two cases, which were related to morpho-syntactic rules, the words were presented in a sentence, as the comprehension of variations in person and tense is much facilitated by the sentence context.

Each misspelling (e.g. <carra> [kˈaʁɐ] instead of <cara> [kˈaɾɐ]; <gulodisse> [guɫudˈisi] instead of <gulodice> [guɫudˈisi]) scored 1 point and only misspellings linked to the orthographic rules that were included in the training programme were accounted for. If a word had more than one misspelling, only the errors related to the rules were scored. For example, in the word 'Guitarra' [gitˈaʁɐ], if a child wrote the word as 'gitara' (failing two contextual rules that would later be addressed in the intervention), two errors would be marked, resulting in a score of two points. However, if the child wrote 'guetarra' instead of 'guitarra' (in Portuguese, the vowel "i" is sometimes noted as "e"), it would not be scored, because this type of error was not the focus of the intervention. This methodological decision stems from the need to concentrate the assessment solely on the errors associated with the intervention, thus evaluating the effectiveness of the intervention with greater precision.

To avoid a ceiling effect, half of the words used in the pre- and post-test for each category of rules—contextual, phonological and morphological rules—were low-frequency words and the other half were high-frequency words, according to the CORLEX database (Centro de Linguística da Universidade de Lisboa, 2019). The CORLEX database provides three different options to identify word frequency: 1) two groups: frequencies below (low frequency) and above (high frequency) the 50th percentile; 2) three groups: frequencies below the 25th percentile (low frequency), between the 26th and the 75th percentiles (medium frequency), and above the 76th percentile (high frequency); or 3) four groups: where cut-points are the 25th (very low frequency), the 50th (low frequency), the 75th (high frequency), and above 76th percentiles(very high frequency). We used the second option, selecting words below the 25th percentile and above the 75th.

The same procedure was adopted with the words used in the intervention programme. Furthermore, since the frequency criteria in this database derive from an analysis of adult texts, we made sure that all high-frequency words were selected from school textbooks or children's books. By incorporating low-frequency and unfamiliar words into the dictations, we enhance the assessment of the intervention programme's impact, as it is improbable that the children have encountered these words before. A previous study by Silva et al. (2021) revealed a positive effect of reviewing misspellings using the rubric in an individual setting. This effect became evident as the children in the experimental group showed a greater decrease in errors, especially in infrequent words to which they had no prior exposure. None of the words used in the pre- and post-test dictation task were used in the training sessions.

6. Training Programme

Self-correction rubric (Appendix B). As a self-correction tool, a rubric was developed displaying the most relevant Portuguese contextual orthographic rules, a list of a number of common misspellings due to a poor analysis of the phonological structure of the word (Baptista et al., 2011), and a number of morphological and morpho-syntactic rules. From

these, we selected morphological rules and morpho-syntactic rules linked to verbs' tense and flexion.

The rubric displayed simple language according to the children's age group and consisted of three sheets of paper (Appendix, Part B). On the first page, contextual rules, such as <r>/ <rr>, <s>/ <ss>, <ce>/<ci>/ <que>/ <qui>, <gue>/ <gui>/ <ge>/ <gi>, and <m> before <b> and <p> were displayed in simple language, accompanied by clear examples for each of the rules. For instance, for the rule <gue> / <gui>/ <ge>/ <gi >, it was explained that the phoneme [g] is written with the grapheme <g> before the letters a, o, or u, or with the grapheme <gu> before the letters e and i; in turn, grapheme <g> followed by e and i represents the phoneme [ʒ]. Nasal vowels [ã], [ẽ], [ĩ], [õ] and [ũ] are represented by <m> before <p> (e.g. <campo> [kˈɐ̃pu] – field) or <b> (e.g. <pomba> [pˈõbɐ] – dove) or with <n> in other contexts (e.g. <canto> [kˈɐ̃tu] – song; <concha> [kˈõʃɐ] – shell, etc.). On the second page, some phonological rules and corresponding examples were displayed, such as consonant clusters' reduction in CCV syllables or adding a vowel in CVC syllables, confusion in the representation of phonemes that only differ in voicing, and confusion between digraphs <nh>, <lh> and <ch>. On the third page, morphological rules were explained, such as the use of <ice> and <eza> when turning an adjective into a noun, distinction between the past tense and the future tense of verbs in the third-person plural, and between the subjunctive mode and the use of the reflexive personal pronoun for verbs in the third-person plural. In this case, the target morphemes within the words were displayed in bold. For every rubric page, there were pictures of a coloured pencil next to each rule definition, with one colour for each rule.

The rules were written in a simple manner. Understanding of these rules was evaluated in a group of third-grade students who were not part of the experiment.

Experimental groups training programme. The training programme consisted of a session zero followed by nine sessions in the classroom. At a pace of two sessions per week, the whole programme lasted for five weeks. It started in January and lasted three months (including the pre- and post-test comprising individual assessments of children). Each session lasted 30 to 40 minutes. The order of the sessions was the same for all the groups.

Experimental group 1 (self-correction with the use of a rubric and metalinguistic reflexion on the rules).

In session zero, children were instructed on how to use the rubric. Each child got one rubric and was told it contained a number of rules pertaining to spelling the words correctly. They were also told they were to take dictation tasks and that their misspellings were to be signalled with the colour pencil linked to the target rule, and that they were expected to correct their spelling after reading the rule. During this procedure the research assistant read aloud all the rules the children had access to in the rubric but no instructions to read by themselves were given. During this session, we aimed to prepare the children to use the

rubric, specifically concerning how to detect the relationship between the colour that would be used to mark a potential error and its corresponding rule.

Sessions 1, 2 and 3 consisted of a dictation task of 32 words per session whose spelling relied on contextual rules. After the dictation task, the researcher underlined the misspellings with the colour linked to the targeted rule and asked the children to self-correct their misspelling. Whereas in most of the studies relying on this method children are presented with the correct spelling (Cordewener et al., 2018; Gaintza & Goikoetxea, 2016; Turner et al., 2017; Wirtz et al., 1996), in this case children were asked to read the rule linked to the targeted misspelling. In order to facilitate the use of the rubric, children were given the following instructions: "Look at the colour underlining the misspellings. Look carefully at each word, read the rule linked to that colour and try to correct the spelling." Whenever children were in doubt, the same instructions were given individually. No further feedback from the researcher was provided.

Sessions 4, 5 and 6 also consisted of a dictation task of 32 words in each session whose spelling relied on complex syllables, digraphs <nh>, <lh> and <ch>, and words that begin with voiced or voiceless consonants. After the task, the researcher underlined the misspellings with the colour linked to the targeted rule and asked the children to self-correct their spelling. The instructions were similar to the ones given in previous sessions.

Sessions 7, 8 and 9 consisted of a dictation task of 12 words whose spelling relied on morphological and morpho-syntactic rules awareness. Eight of the words relied on awareness of morpho-syntactic rules and were presented in a sentence where only the misspellings within the target words were signalled. After the task, the researcher underlined the misspellings with the colour linked to the targeted rule and asked the children to self-correct their spelling. The instructions were similar to those given in previous sessions.

Use of the rubric requires an actively engaged cognitive attitude on the part of the child, as this self-correction procedure, associated with spelling rules, demands awareness and understanding of the rules to be applied during the correction of each word (Silva et al., 2021).

Experimental group 2 (correction in dyads with the use of a rubric and metalinguistic reflexion on the rules).

The training programme for experimental group 2 was identical to the one for experimental group 1 regarding session zero and use of the rubric. The main difference was in the self-correction tasks, which took place in dyads, the same pairs of children being maintained throughout the sessions. Children were instructed to correct their peer's dictation and then to reach an agreement on the correct spelling for each word after reading the targeted rule. In order to do so, they had to explain the rule to their peer regarding the word they were correcting. This procedure was done word by word and alternately for each child's misspelling. They were given these same instructions for the three types of misspelling targeted throughout the nine sessions. The instruction given was

the following: "Look at the colour of your colleague's misspellings, read the rule linked to that colour, and try to correct your colleague's misspellings. Afterwards, explain to your colleague based on the rule why it was wrong. Both should reach an agreement on the correct spelling based on the rule. Whenever there was a disagreement not based on the rule, the researcher intervened, asking both children to read the rule. No further feedback from the researcher was provided.

Control group training programme (self-correction with the correct spelling provided: direct corrective feedback).

The training programme for the control group lasted the same time, with a session zero followed by nine sessions. In session zero, children listened to various contextual and morphological rules read out from the rubric and were informed that they were to take dictation tasks that relied on those rules. The purpose of this session was to balance the number of sessions for the children in the experimental and control groups. Since the experimental groups required a session focused on learning how to use the rubric, a similar session was necessary for the children in the control group. In both the experimental and control groups, the reading of the rules aloud by the adults, in a relatively decontextualized way, does not seem to have been a significant learning factor, particularly because the concentration span of children at this age is relatively short.

This procedure follows a strategy of self-correction. As said before, it has been demonstrated for several languages—English, Spanish, Dutch—that as a pedagogical strategy, asking children to correct their spelling immediately after the teacher has provided them with the correct spelling has a positive impact on their writing accuracy (Cordewener et al., 2018; Gaintza & Goikoetxea, 2016; Turner et al., 2017; Wirtz et al., 1996). This strategy is one of the most frequent pedagogical strategies used in Portuguese classrooms.

In sessions 1, 2 and 3, children undertook a dictation task of the same 32 words used in the experimental groups. The misspellings were signalled, and each child was presented with a sheet of paper containing the correct spelling for each word. They were asked to copy those words three times. In sessions 4, 5 and 6, children undertook a dictation task of the same 32 words used in the experimental groups. The misspellings were signalled, and each child was given a sheet of paper containing the correct spelling for each word. They were asked to copy those words three times. In sessions 7, 8 and 9, children undertook a dictation task with the same 12 words used in the experimental groups. The misspellings were signalled, and each child was presented with a sheet of paper containing the correct spelling for each word. They were asked to copy those words three times.

For both training and control groups, considering the list of words used for each session, half were high-frequency words while the other half were low-frequency words, according to the CORLEX database (Centro de Linguística da Universidade de Lisboa, 2019). In

addition, the ratio of high- and low- frequency words within each rule was the same in training, pre- and post-test (Appendix B).

No additional feedback was given to any group regarding the correction of errors during the sessions. From the point of view of the feedback provided, we can assume that the two experimental groups received indirect feedback since the misspellings were pointed out by the researcher combined with self-correction using the rubric, whereas the control group received direct feedback, given that the researcher provided the students with the correct spelling.

Table 2. Summary of the main characteristics of the intervention for each group

Instruction focus	Instruction mode	Learning activities	Researcher role
Orthography	Revision procedures for correct spelling of words based on rubrics with spelling rules	Individual revision of spelling correction of words based on rubrics with spelling rules	Teaches how to use the rubrics and points out errors
		vs.	
		Revision with a peer of the spelling correction of words based on rubrics with spelling rules	
	vs.	vs.	vs.
	Revision procedures based on being confronted with the correct word	Individual revision procedures based on being confronted with the correct word	Marks the errors and presents the words correctly spelt

Adapted from Koster and Bower (2018)

The dictation task and the training programme took place in a classroom and were led by a research assistant trained in the procedure. The research assistant strictly followed the protocol described in the training procedure and the steps presented in Table 1 and the instructions described above. The pre-test dictation task was performed one week before the training programme and the post-test dictation task occurred a fortnight after its end.

7. Data Analysis

The number of errors was computed for each of the rules used in the pre- and post-test dictation tasks and for the total. Preliminary analyses were made to ensure the equivalence of the groups in regard to gender, age and scores in the Raven's Progressive Matrices. To compare the age and the Raven's scores of the groups, analyses of variance were used, while the composition of the groups was compared through use of the chi-squared test.

To analyse the effects of each of the experimental conditions on the total number of errors, a repeated measures analysis of variance was conducted with time (pre- and post-test) as the within factor and group (control, individual correction and dyadic interaction) as the between factor. To analyse the effects of the three experimental conditions on the number of errors for each of the rules, a mixed-design ANOVA was carried out considering the 2x3 within factors (two times—pre- and post-test x three rules—context, phonological and morphological), and the three groups (control, individual correction, and dyadic interaction) as between factors. Post-hoc analyses were made using Scheffé test. All analyses were conducted using SPSS version 25 and Jamovi version 1.6.7 (The Jamovi Project, 2021).

8. Results

The results of the repeated measures ANOVA on the total number of errors showed main effects of time, $F(1,57) = 2576.9$, $p < .001$, $\eta^2_p = .978$, group, $F(2,57) = 113.3$, $p < .001$, $\eta^2_p = .799$, and an interaction effect between time and group, $F(2,57) = 394$, $p < .001$, $\eta^2_p = .931$. The main effect of time is the decrease in the number of errors in the three groups (Table 3), whereas the effect of group derives from differences in the post-test, taking into account that the number of errors in the pre-test is pretty similar. The interaction effect is due to the different degrees of decrease in the groups (Figure 1).

Table 3. Variables' means and standard deviations for each group in pre- and post-test

	Pre-Test								Post-Test							
	CG		ICG		DIG		Total		CG		ICG		DIG		Total	
	M	(*SD*)	M	(*SD*)	M	(*SD*)	M	(*SD*)	M	(*SD*)	M	(*SD*)	M	(*SD*)	M	(*SD*)
NE – Total	34.70^{x}	(2.87)	34.50^{x}	(3.71)	34.45^{x}	(3.14)	34.55	(3.20)	29.20^{w}	(3.07)	9.90^{y}	(5.03)	1.60^{z}	(1.73)	13.57	(12.20)
NE – Context	14.00^{a}	(2.27)	13.75^{ab}	(3.31)	13.30^{ab}	(2.58)	13.68^{q}	(2.72)	11.50^{b}	(2.33)	3.10^{ce}	(2.67)	0.65^{c}	(0.93)	5.08^{t}	(5.139)
NE - Phonological	10.95^{d}	(1.54)	11.05^{ad}	(1.61)	11.20^{ad}	(1.15)	11.07^{r}	(1.43)	9.70^{bd}	(1.30)	2.60^{e}	(2.28)	0.35^{ec}	(0.67)	4.22^{t}	(4.30)
NE - Morphological	9.75^{d}	(1.12)	9.70^{fd}	(0.80)	9.95^{fd}	(0.69)	9.80^{s}	(0.88)	8.00^{g}	(1.08)	4.20^{e}	(1.91)	0.60^{c}	(0.68)	4.27^{t}	(3.31)

Notes. CG – control group, ICG – individual correction group, DIG – dyadic interaction group, NE – number of errors. Means within a row or a column with the same letter are not significantly different at $p < 0.05$. Results based on post-hoc analyses use the Scheffé test.

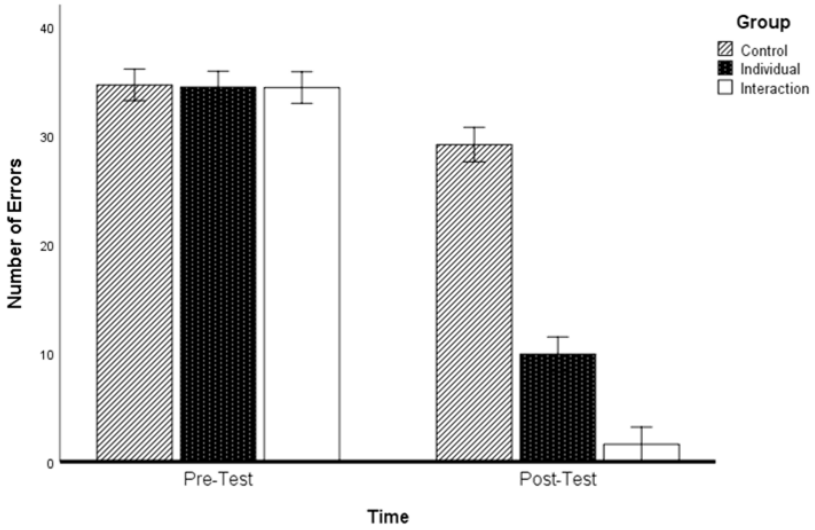

Figure 1. Interaction effect of time x group for total number of errors. Error bars represent 95% confidence interval.

Post-hoc analyses showed that all groups significantly decreased the number of errors from pre- to post-test, and that the groups differed in post-test (Table 3). The social interaction group showed the lowest number of errors in post-test, followed by the individual correction group, the control group presenting the highest number of spelling errors in post-test. Time and interaction effects are the strongest amongst the described effects.

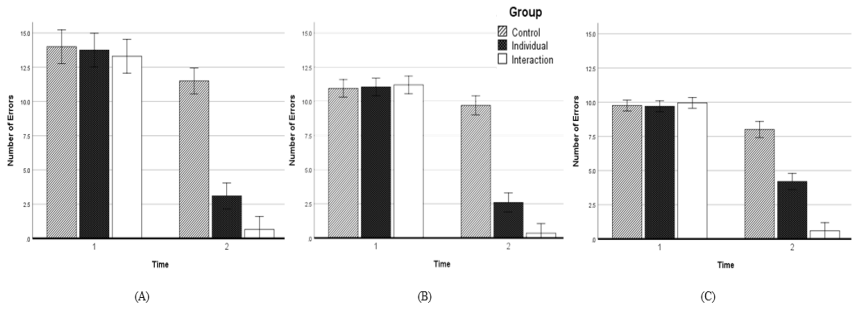

Figure 2. Interaction effects for time x group for contextual rules (A), phonological rules (B) and morphological rules (C). Error bars represent 95% confidence interval.

The mixed design ANOVA analysis of the number of errors for the rules used in the training showed main effects of group: $F(2,57) = 113.3$, $p < .001$, $\eta^2_p = .799$, time, $F(1,57) = 2576.9$, $p < .001$, $\eta^2_p = .978$; and rule, $F(2,114) = 44.6$, $p<.001$, $\eta^2_p = .439$. Besides these main effects, interaction effects arose between time and group, $F(2,114) = 41.5$, $p < .001$, $\eta^2_p = .421$, rule and group, $F(4,114) = 4.6$, $p = .002$, $\eta^2_p = .140$, time and rule, $F(2,114) = 41.5$, $p < .001$, $\eta^2_p = .421$, and group, time and rule, $F(4,114) = 7.9$, $p < .001$, $\eta^2_p = .217$. The main effect of time and the interaction effect between time and group are strongest and replicate the effects found in the analysis of the total number of errors: a decrease in the number of errors from pre- to post-test and different numbers of errors in the three conditions of the intervention (Figure 2). The main effect of rule was due to the highest number of errors in contextual rules compared with the number of errors in phonological ($p_{Scheffé} < .001$) and morphological rules ($p_{Scheffé} < .001$). The difference between phonological and morphological rules is not significant ($p_{Scheffé} = .067$). The interaction effect between rules and group derives from the different patterns in morphological rules. Whereas for contextual and phonological rules the number of errors for the control group was significantly different from the other two groups, and no differences appeared between the group in individual correction and the group in dyadic interaction correction, for morphological rules no differences were seen between the control and individual correction groups ($p_{Scheffé} = .051$). The interaction effect between time and rule is due to the inexistence of post-test differences between the three rules, whereas in pre-test the number of errors is significantly different depending on the rule (Table 3). The interaction effect between time, rule and group is due to the post-test results for the individual and interaction resolution groups. For contextual and phonological rules, the number of errors does not differ significantly between the individual correction group and the group correcting the errors in interaction with a peer (Table 3). However, for morphological rules, the dyadic interaction correction group presents a significantly lower number of errors (Figure 2) than the group in individual correction ($p_{Scheffé} = .002$).

9. Discussion

This study aimed to assess the impact of a self-correction spelling tool when used individually or in dyads on the orthographic performance of third-grade students, in comparison to the performance of students exposed to a traditional self-correction strategy. The results support our hypothesis, as children in both experimental groups demonstrated a significant decrease in the number of orthographic misspellings from pre- to post-test compared with the performance of the control group. These results are in line with those obtained by Silva et al. (2021), suggesting that an intervention programme that integrates the analysis of spelling rules within the framework of using a rubric as a means of correcting spelling errors (in very frequent and infrequent words) favours spelling performance more than strategies in which the child is only given the correct word to copy. According to Karmiloff-Smith's (1992) theoretical model, the development of any knowledge implies a redescription of representations. According to this model, in the initial

stages, aspects of development that can be redescribed in representations are partially influenced by sequential constraints. However, as development progresses, knowledge is represented in a more flexible form, enabling the establishment of relationships between different representations (Karmiloff-Smith, 1992). The application of this model to orthographic learning is grounded on the notion that orthographic representation entails comprehending the proper utilization of phonological and morphological rules and the capacity to articulate them explicitly. Therefore, it becomes relevant to develop metalinguistic activities in teaching situations so that children become aware of the contextual, phonological and morpho-syntactic constraints associated with correct spelling.

This is what this intervention procedure seems to achieve, considering the confirmatory data from this study in comparison to the previous study in 2021, which also demonstrated that this effect was observed for less frequent words. Indeed, the active comparison between the misspelling and the underlying rule guiding its correct writing, resulting in its correction, leads us to propose that this approach promotes the formation of more explicit orthographic representations. Consequently, spelling revision strategies employing rubrics that display orthographic rules appear to stimulate metalinguistic reflection on contextual and morpho-syntactic rules, as well as on the phonological structure of words.

The findings of this study seem to contradict the results of some studies indicating that self-correction of one's own writing might also improve orthographic performance (Cordewener et al., 2018; Gaintza & Goikoetxea, 2016; Turner et al., 2017; Wirtz et al., 1996). The control group significantly reduced the number of misspellings from pre- to post-test, but both experimental groups substantially outperformed the control group. According to the study by Cordewener et al. (2018), the effect of self-correction strategy is boosted when children are asked to reflect on the spelling of the word at the same time as they write the word. The rationale behind the choice of this methodology, which is inherently less motivating and does not involve children confronting the spelling rules within words, in the control group stems from the fact that the strategy of simply copying the correct word without further questioning or engagement with the underlying rules is a widespread approach in Portuguese schools (Gaitas, 2013).

The dyadic interaction group (experimental group 2) showed a significant improvement compared to the individual correction group (experimental group 1) using the self-correction rubric. Children in the dyadic interaction group presented an average of fewer than one misspelling error across all word categories. Although children from this group performed better than the individual correction group in words whose spelling relies on contextual and phonological rules, their overall improvement was not significantly better. However, in relation to words whose spelling relies on morphological rules, considered to be more difficult than the previous ones (Morais & Teberosky, 1994; Nunes & Bryant, 2006), the orthographic performance of the dyadic interaction group revealed significant improvement compared with that of the individual correction group. These results may

indicate that dyadic correction—where a child is instructed to explain the rules to another child—helps build a more explicit representation of the rule. This is especially important in the case of morphological rules, since several data demonstrated that many children from third to fifth grade still have difficulty spelling words that imply awareness of base words and affixes (Nunes & Bryant, 2006, 2014). Indeed, for more complex rules such as the morphological, children seem to benefit from interactive settings where they must share and explain their understanding of the rule and reach an agreement in relation to the correct spelling. This interactive setting, in which children discussed the spelling of each word, generating explicit speech based on information displayed in the rubric, might have facilitated metalinguistic reflective processes on morphological rules, leading to higher orthographic performance improvement for the dyadic interaction group. The significant difference between the results for the two experimental groups, whereby the dyadic interaction group scored better on words related to morphological rules, strengthens the importance of collaborative peer learning, something that has been pointed out in many other studies focusing on different types of knowledge (Peixoto & Monteiro, 1999; Howe & Mercer, 2007; Kumpulainen & Wray, 2002; Monteiro, 2013).

As mentioned before, children involved in the dictation task exhibited similar average spelling performance. However, it is noteworthy that the pre-test results for the dictation task across all groups indicated higher levels of spelling errors in all categories, particularly in words regulated by morphological rules. These findings imply that the dyads comprised children with significant deficits in spelling performance, as phonographic knowledge and comprehension of contextual rules were expected to be well-established by the third year of schooling, which was not the case. This observation regarding the pre-test performance of the children in the dyads reinforces the effectiveness of this intervention methodology, especially for more complex spelling rules.

10. Educational Implications and Limitations

The training programme, comprising ten relatively short sessions (three sessions for each word category), with an average duration of 40 minutes, was conducted within children's classrooms. This programme's flexibility suggests its potential for effortless implementation in various classroom settings. Given the data regarding the struggles of many Portuguese children to acquire spelling skills (IAVE, 2018), the confirmation of this tool's effectiveness and its applicability across schools is pertinent.

The educational impact of this study may not only apply to children but also to teachers' pedagogical practices if we consider the benefits of using a tool with the same features as the one used in this study and if appropriate training is provided. As mentioned before, the main teaching and remediation strategies for orthographic errors in the Portuguese educational context seem to revolve around copying and dictation (Gaitas, 2013).

Daffern and Mackenzie (2020) and Meneses and Campelo (2012) highlighted that many teachers lack the ability to distinguish between different types of spelling error and are

unaware of the specific learning needs of their students to address these errors effectively. Consequently, the pedagogical approach tends to remain similar and undifferentiated regardless of the nature of the error. To enhance their teaching practices, teachers would greatly benefit from understanding the phonological, contextual or morphological dimensions of children's misspellings and expanding their repertoire of pedagogical strategies. By providing teachers with information about this rubric, their knowledge about the nature of children's misspellings can be broadened, ultimately fostering more effective student learning (Adoniou, 2014; Moats, 2014).

One of the main limitations of this study is that we did not carry out interviews to evaluate the children's explicitness level of orthographic rules at pre- and post-test. In future studies, we aim to analyse in greater detail orthographic representations' explicitness level using the orthographic choice task by Critten et al. (2007, 2016) and Critten and Pine (2009), and then proceed to correlate children's explicitness level of orthographic rules with their orthographic performance. Moreover, our aim is to expand this type of study to naturalistic settings, relying only on teachers' intervention, and focusing on larger samples and a greater number of sessions. Furthermore, since the focus of the study was to create a setting that induced the explicitness of the rules and not to study the interactions themselves, an analysis of the characteristics of the interactions was not carried out, but this could give us more information about the nature of the most effective interactions. To assess the impact of this type of methodology by contrasting the nature of dyads, replicating the study with symmetrical and asymmetrical pairs concerning orthographic performance in the pre-test is of the utmost importance. This type of analysis will need to be conducted in future studies to inform which dynamics are more effective in the process of learning orthographic rules. Another aspect to keep in mind for future studies is the counterbalancing of the words order of presentation used in dictation and the rules trained (contextual, phonological and morphological).

Despite these limitations, this research provides clear evidence that this paradigm of revision focusing on words' orthography supported by rubrics improves orthographic performance and presents a great advantage in a natural classroom setting. Moreover, spelling revision using rubrics in interaction with a classmate seems to boost the learning potential of self-reflection and is particularly effective for more complex rules such as morphological ones.

11. Conclusion

Taking into account the significant improvement in orthographic performance for the three categories of rules, we may infer, based on the methodology of the strategies involved, that such improvement is linked to a greater explicitness of contextual and morphological orthographic restrictions and phonological recoding rules. Through the processing and articulation of information concerning contextual restrictions, phonological recoding, and morphological rules, children actively corrected their misspellings, leading to clear improvements in their orthographic performance. On the

other hand, the control group, having performed a traditional self-correction procedure, evolved over time in their performance, but significantly less than those in both experimental groups. Thus, the types of self-correction strategy tested in this study seem to be linked to target awareness and comprehension of orthographic rules, in line with Critten et al.'s (2007, 2013, 2016) perspective. This perspective argues that greater explicitness of orthographic rules is linked to improved orthographic performance.

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Appendix A: Pre and post-test dictated words

Contextual rules (32 words)
terra [tˈeʁɐ] – *cara* [kˈaɾɐ] – *rato* [ʁˈatu] – *torresmo* [tuʁˈɐʒmu]– *vara* [vˈaɾɐ] – *rosbife* [ʁuʒbˈifi] / (earth - face - rat - crackling - stick - roast beef)
Sino [sˈinu] – *vaso* [vˈazu] – *massa* [mˈasɐ] – *sanidade* [sɐnidˈadi] – *defesa* [difˈezɐ] – *ossada* [ɔsˈadɐ] / (bell - vase - mass - sanity - defense – bone)
Gelo [ʒˈɛlu] – *girafa* [ʒiɾˈafɐ] – *gesticular* [ʒiʃtikułˈaɾ] – *giratório* [ʒiɾɐtˈɔɾju] / (ice - giraffe - gesticulate – rotating)
Guitarra [gitˈaʁɐ] – *guerra* [gˈɛʁɐ] – *guinada* [ginˈadɐ] – *guelra* [gˈɛłʁɐ] / (guitar - war - yaw-gill)
Cegonha [sigˈoɲɐ] – *cinema* [sinˈemɐ] – *celulose* [silulˈozi] – *cisterna* [siʃtˈɛɾnɐ] / (stork - cinema - cellulose – cistern)
Queque [kˈɛki] – *quilo* [kˈilu] – *quebradiço* [kibɾɐdiˈsu] – *esquina* [iʃkˈinɐ] / (muffin - kilo - brittle – corner)
Campo [kˈɐ̃pu] – *pomba* [pˈõbɐ] – *lombriga* [łõbˈɾigɐ] – *compaixão* [kõpajʃˈɐ̃w] / (field - dove - roundworm – compassion)

Phonological rules (32 words)
Pata [pˈatɐ] – *bata* [ˈbatɐ]– *padiola* [pɐdjˈɔlɐ] – *bonomia* [bunumˈiɐ] / (paw - gown - stretcher – bonomy)
Vaca [vˈakɐ] – *faca* [fˈakɐ] – *dente* [dˈẽti] – *vandalismo* [vɐ̃dɐlˈiʒmu] – *fanatismo* [fɐnatˈiʒmu] – *tenente* [tinˈẽti] / (cow - knife - tooth - vandalism - fanaticism – lieutenant)
Chão [ʃˈɐ̃w] – *pinha* [pˈiɲɐ] – *pilha* [ˈpˈiʎɐ] – *charanga* [ʃɐɾˈɐ̃gɐ] – *pinhata* [piˈɲatɐ] – *pilhagem* [piʎˈaʒɐ̃j] / (floor - pine cone - pile - brass band – piñata - plunder)
Prato [pɾˈatu] – *parque* [pˈaɾki] – *preto* [pɾˈetu] – *perto* [pˈɛɾtu] – *pranto* [pɾˈɐ̃tu] – *partitura* [pɐɾtitˈuɾɐ] – *preservar* [pɾizivˈaɾ] – *perfil* [pirfił] / (plate - park - black - close - crying - score - preserve – profile)
Calmo [kˈałmu] – *claro* [kłˈaɾu] – *flauta* [fłˈawtɐ] – *falta* [fˈałtɐ] – *calvário* [kałvˈaɾju] – *clave* [kłˈavi] – *flamingo* [flɐmˈĩgu] – *falcatrua* [fałkɐtɾˈuɐ] / (calm - clear - flute - lack - plight - clef - flamingo – fraud)

Morphological rules
tolice [tułˈisi]– *gulodice* [gułudˈisi] / (nonsense – gluttony)
beleza [biłˈezɐ] – *firmeza* [fiɾmˈezɐ] / (beauty – firmness)
Ontem, eles *comeram* [kumˈeɾɐ̃w] um bolo. / (Yesterday, they ate a cake.)
Ontem, eles *caiaram* [kɐjaˈɾɐ̃w] a casa. / (Yesterday, they whitewashed the house.)
Amanhã, eles *acharão* [ɐʃɐɾˈɐ̃w] um tesouro. / (Tomorrow, they will find a treasure.)
Amanhã, eles *avistarão* [ɐviʃtɐɾˈɐ̃w] um navio. / (Tomorrow, they will sight a ship.)
A maçã *come-se* [kˈomi-si] lavada. / (The apple is eaten washed.)
O gato *enreda-se* [ẽɾˈedɐ-si] no novelo. / (The cat gets tangled up in the ball of wood.)

Se ela *levasse* [ɬivˈasi] o casaco não tinha frio. / (If she took her coat she wouldn't be cold.)
Se ele *cavasse* [kɐvˈasi] o terreno, plantava cenouras. / (If he dug the ground, he'd plant carrots.)

Appendix B

1.Examples of words used in the intervention sessions regarding contextual rules (sessions 1, 2, 3)
<r>/<rr>:
S*erra* [sˈɛʀɐ] – *rara* [ʀˈaɾɐ] – *ramo* [ʀˈɐmu] / (saw - rare – branch)
<s>/<ss>:
Sala [sˈalɐ] – *rosa* [ʀˈozɐ] – *passa* [pˈasɐ] / (Room - pink – pass)
<gue>/<gui>/<ge>/<gi>:
Gelatina [ʒilɐtˈinɐ] – *girassol* [ʒiɾɐsˈoɬ] – *guizo* [gˈizu] – *guedelha* [gɨdˈɐʎɐ] / (gelatine - sunflower- rattle – guedelle)
<*m*> before <*b* >and <*p*>:
Tempo [tˈẽpu] – *pombal* [põbˈaɬ] / (time – pigeonhole)

2. Examples of words used in the intervention sessions regarding phonological rules (sessions 4, 5, 6)
Pairs of words whose initial consonant differs in voicing
Pote [pˈɔti]– *batata* [bɐtˈatɐ] – *vala* [vˈalɐ] – *fala* [fˈalɐ] / (pot – potato – ditch – speaks)
Words with digraphs
chá [ʃˈa] – *ninho* [nˈiɲu] – *filho* [fˈiʎu] / (tea – nest – son)
Words with a syllable CRV or CVR
prata [pɾˈatɐ] – *parte* [pˈaɾtɨ] / (silver – part)
Words with a syllable CLV or CLV
floco [flˈɔku] – *falcão* [fałkˈɐ̃w] / (flake – falcon)

3. Examples of words used in the intervention sessions regarding morphological rules (sessions 4, 5, 6)
Use of '*ice*' and '*eza*' when turning an adjective into a noun
palermice [pɐlɛɾmˈisɨ] – *chatice* [ʃɐtˈisɨ] / (nonsense – annoyance)
certeza [sɨɾtˈezɐ] – realeza [ʀjɐlˈezɐ] / (certainty – royalty)
Difference in the third-person plural of past and future tenses
Ontem, eles *viram* [vˈiɾɐ̃w] um filme. / (Yesterday, they saw a film.)
Amanhã, eles *pintarão* [pĩtˈaɾɐ̃w] um desenho / (Tomorrow, they will paint a drawing.)
Difference in the third-person singular of present tense (indicative mode), in which the reflexive personal pronoun '*se*' is present, and verbs in the third-person singular of past imperfect (conjunctive mode)
O prato *lava-se* [lˈavɐ-sɨ] na máquina. / (The dish is washed on the machine.)
Se ele *comesse* [kumˈesɨ] a sopa, era saudável. / (If he ate the soup, he was healthy.)