education sciences

MDPI

Article

The Effects of Invented Spelling Instruction on Literacy Achievement and Writing Motivation

Katie Schrodt [1,*], Erin FitzPatrick [2], Sungyoon Lee [1], Debra McKeown [3], Alexis McColloch [1] and Kimberly Evert [1]

[1] Elementary and Special Education and Womack Educational Leadership, Middle Tennessee State University, Murfreesboro, TN 3713, USA; sungyoon.lee@mtsu.edu (S.L.); mccollocha@warrenschools.com (A.M.); kimberly.evert@mtsu.edu (K.E.)
[2] Special Education and Child Development, The University of North Carolina at Charlotte, Charlotte, NC 28223, USA; erin.fitzpatrick@charlotte.edu
[3] Teaching, Learning, and Culture, Texas A&M University, College Station, TX 77840, USA; debramckeown@tamu.edu
* Correspondence: katie.schrodt@mtsu.edu

Abstract: Early writing performance strongly predicts long-term literacy performance. It follows that early underachievement in writing is highly correlated with early underachievement in reading. One strategy teachers and students can use to approach writing in the kindergarten classroom is invented spelling. Invented spelling is children's spontaneous or self-directed attempts to represent words in print by matching sounds to known letters or phonics patterns. A quasi-experimental study was used to evaluate the impact of invented spelling on foundational literacy skills and writing motivation in 63 kindergarten students at a rural school in the Mid-South. The research questions focused on the impact of invented spelling instruction on a variety of literacy outcomes, including foundational skills, spelling, and motivation. The results indicate the significant main effects of invented spelling instruction on students' invented spelling ($p < 0.001$), conventional spelling ($p < 0.001$), complex vocabulary use ($p < 0.001$, writing motivation ($p = 0.040$), and writing achievement ($p < 0.001$). Other outcomes as well as implications and future directions are reported. The invented spelling intervention encouraged low-stake risk taking when writing and removed barriers to writing entry. Allowing time and space for invented spellings means students can focus on communicating their ideas in print without being hindered by the expectation to conform to conventional spellings.

Keywords: early childhood writing; writing; invented spelling; quasi-experimental

Citation: Schrodt, K.; FitzPatrick, E.; Lee, S.; McKeown, D.; McColloch, A.; Evert, K. The Effects of Invented Spelling Instruction on Literacy Achievement and Writing Motivation. *Educ. Sci.* **2024**, *14*, 1020. https://doi.org/10.3390/educsci14091020

Academic Editor: Dongbo Zhang

Received: 1 June 2024
Revised: 12 September 2024
Accepted: 13 September 2024
Published: 18 September 2024

1. Introduction

Early writing performance strongly predicts long-term literacy performance [1]. It follows that early underachievement in writing is highly correlated with early underachievement in reading [2,3]. Similar to reading performance, without intentional interventions, writing performance is alarmingly stable over time [4,5]. This stability of underachievement in writing is reflected in national data of students at fourth, eighth, and twelfth grade in writing exams; the percentages of students who performed below proficiency for each of these grade levels were 72%, 73%, and 73%, respectively [6].

Schools often respond to underachievement in early literacy with a substantial focus on reading instruction and interventions, neglecting its expressive counterpart—writing; indeed, in some cases, there is little or no writing instruction occurring in early childhood classrooms [7]. While most classrooms include materials necessary for writing, little writing is completed by children [8]. While spelling supports were more common in early childhood classrooms, letter dictation—which fails to provide the student with a generalizable strategy beyond the current lesson—was the most prevalent [9].

2. What Is Invented Spelling?

One strategy teachers and students can use to approach writing in the kindergarten classroom is invented spelling. Invented spelling is children's spontaneous or self-directed attempts to represent words in print by matching sounds to known letters or phonics patterns [10]. While detractors—often untrained adults—may see invented spelling as simply inaccurate spelling, it is a child's first effort to master the relationship between spoken and written language [7]. According to Sénéchal et al. [11], invented spelling is an experimental process that incorporates phoneme and orthographic representations and can help children's literacy development. For example, a student attempting to spell the word "water" might use their phonetic knowledge to produce "wr" and as their knowledge of phonemic awareness and letter–sound correspondence increases, they might produce "wodr", moving increasingly closer to the correct spelling. In this way, young writers use invented spelling to attempt writing before being able to formally read and write.

Seminal works by Chomsky [12] and Read [10] have led to several studies of invented spelling and how it intertwines with the acquisition of early literacy skills. Invented spelling has a positive impact on the development of reading skills [11,13–17].

3. Invented Spelling Builds Foundational Literacy Skills

We write so others will read, and we read what others write [18]. Writing and invented spelling have a positive impact on the development of early reading skills [11,13–17]. Frith [19] proposed that these early spelling attempts provide children with insight into the role of the alphabet in representing sounds in words, and this knowledge is later transformed into word reading. The act of writing encompasses a multitude of crucial literacy skills that must be seamlessly integrated [20]. For emergent writers, the process of writing itself slows down the complex literacy processes as their focus is drawn towards the fundamental elements of the written form [20]. Other researchers have found explicit connections between emergent writing skills and phonological awareness, knowledge of the alphabet, spelling, decoding, fluency, and comprehension [21–23].

3.1. Phonological and Phonemic Awareness

Phonological awareness is positively correlated with the capacity for phonetic spelling and future literacy performance [23,24]. Ball and Blachman [14] evaluated the effects of training in phonemic segmentation and instruction for letter names and letter sounds in kindergarten students. Phonemic awareness instruction combined with instruction on letter–sound correspondence significantly improved students' early reading and spelling skills. Thus, the students who received the segmentation intervention and the letter name and letter sound intervention spelled significantly better than the other groups [14].

3.2. Alphabet Knowledge, Phonics, Decoding, and Spelling

Children's early reading skills are substantially and simultaneously connected with their invented spelling skills. Invented spelling can serve as a demonstration of a student's progressive understanding of the alphabetic principle [7] and as a good predictor of reading acquisition [25]. In a study with 160 kindergarteners, those taught invented spelling demonstrated greater results on spelling and word reading posttests [25]. Similarly, Pulido and Morin [26] showed growth for each condition, with the invented spelling condition showing the most improvement in decoding, spelling, letter–name knowledge, syllable awareness, and phoneme awareness. In comparison to those who do not, kindergarteners who use phonetic spelling in first and second grades perform better in reading and spelling [11], indicating inventive spelling might be a useful technique for enhancing basic early literacy skills.

3.3. Fluency

Albuquerque and Martins [27] discovered that, with adult direction, invented spelling exercises can enhance children's understanding of the alphabetic coding system and sup-

port the development of metalinguistic skills more than storybook reading activities. Albuquerque and Martins [28] looked at the effects of invented spelling exercises on young children's reading and writing abilities through third grade. Spelling specifically improved single-word oral reading fluency scores, which are thought to be a more accurate measure of reading skill at this level of education [28]. Students who received the invented spelling intervention significantly outperformed their peers in the storybook reading condition in reading and writing tests, even demonstrating longitudinal lasting effects in third grade.

3.4. Vocabulary

Word length can reflect word complexity. The frequency of longer words has been used as a measure of academic language in previous studies of writing (e.g., [29–31]). The TEWL-3 standardized test uses word length as one part of its narrative rubric measurement, using words with five or more intended letters as an indicator of writing complexity. Schrodt and colleagues [32] implemented an intervention that included invented spelling. At posttest, students used 240 unique words with more than five letters significantly more than the control group. This could be because the students were more fluent in both their handwriting skills and their confidence to sound out words from their diverse vocabulary.

3.5. Comprehension

Beyond phonological awareness and decoding, Hofslundsengen and colleagues [24] found that invented spelling was positively connected to reading comprehension. Children who received the spelling intervention had enhanced invented spelling abilities, which helped them read more effectively [24].

4. Longitudinal Effects

In longitudinal work, invented spelling was found to be effective at improving students' decoding skills and demystifying the abstractness of phonemes in contrast to instruction in conventional spelling, spontaneous spelling, or phonological awareness training alone [26,33]. By pretesting students' performance in oral vocabulary, alphabetic knowledge, phonological awareness, word reading, and invented spelling in kindergarten and following them through first grade, Ouellette and Senechal [33] found that use of invented spelling predicted reading performance [33].

In another longitudinal experiment, instruction in invented spelling with supportive feedback actively facilitated early literacy development in kindergarten children more than phonological awareness instruction alone [17]. The experimental group showed greater growth in invented spelling sophistication and read more words at posttest than those in the control group [17]. Thus, there were longitudinal advantages for the invented spelling groups that promoted early literacy development by providing a milieu for children to actively explore the relations between oral and written language [17].

5. Addresses Call from the Field

Beyond demonstrated effectiveness, the writing research community has called for a more intentional integration of reading and writing instruction, as reading and writing are connected and supportive of one another [18]. There are three theoretical perspectives that support the integration of reading and writing. They are shared knowledge, rhetorical relations, and functional theory [18]. According to the shared knowledge theory, readers draw on their knowledge while reading, which overlaps with the knowledge they draw on when writing [34]. While reading and writing are different from one another, they share the knowledge and cognitive systems that are incorporated into early literacy development [18]. The rhetorical relations theory focuses on the idea that reading and writing are connected as both are forms of communication and offer a conversation between readers and writers [18]. The functional theory also supports the idea that reading and writing should be integrated by proposing that reading can be used to facilitate writing, and writing can be used to facilitate reading [18].

In a meta-analysis focused on the integration of reading and writing, researchers found that reading and writing instruction improve the reading performance of students through Grade 12; sentence construction and spelling instruction yielded an effect size of 0.66 for reading fluency on both research-created and norm-referenced measures [35]. An analysis of the cumulative research data reveals a consistent effect whereby the teaching of writing skills strongly promotes measurable gains in reading proficiency. Out of the studies synthesized, a near consensus (96%) demonstrates that explicit writing instruction can produce meaningful positive impacts on students' reading ability [18]. However, little is known about how teachers bring reading and writing together in the classroom for instructional purposes [18].

6. More Writing Should Increase Quality and More Authentic Writing Should Increase Motivation

An increase in writing motivation and invented spelling instruction can play a significant role in kindergarten students' developing foundational literacy skills that will follow them in first grade [16,32]. Writing is a complex task, especially for young children balancing the cognitive load of transcription, phonics, and idea generation [32]. Writing is particularly difficult when students enter a kindergarten classroom with a lack of motivation [32]. Adopting a growth mindset can help young writers understand that one's writing ability can be improved through practice [36]. Creating a culture of *brave spellers* through invented spelling instruction is one strategy for helping students engage in authentic writing and increase motivation by writing any words they can imagine [36]. When invented spelling instruction was combined with instruction on having a growth mindset to develop the strategy of brave spelling, both motivation and independence increased [36].

While there is little research on the mindset of kindergartners during emergent writing [32], children's behaviors could affect their mindset during writing. Clarke [15] found that first grade children using traditional spelling spent 18 percent of their time waiting for the teacher's help while children using invented spelling spent 1.2 percent of their time waiting for assistance. This led to the traditional spellers spending more time conversing with their teacher over exact spellings instead of writing, while the children using invented spelling spent that time writing. Traditional spellers also spent 25 percent of their time looking for help while writing; they engaged with materials and behaviors such as dictionaries, readers, wall charts, and asking friends, whereas children using invented spelling spent four percent of their time looking for aid. By implementing the brave spelling strategy in kindergarten, students could boost their self-confidence, change their mindset, be actively involved in the process of writing more, and engage in more independence during emergent writing [36]. In the most recent meta-analysis of elementary writing instruction [37], authors evaluated the effects of increasing how much students wrote. The average weighted effect size of additional writing on writing quality was 0.30. That is, invented spelling increases the amount of time students spend writing which increases writing quality, and the independence attained through invented spelling has positive effects on motivation [15,36,37].

7. The Present Study

The intent of this quasi-experimental study is to evaluate the impact of invented spelling on foundational literacy skills and writing motivation in kindergarten students at a rural school in the Mid-South. Our research questions are as follows: Does the invented spelling intervention increase students' (a) invented and conventional spelling achievement; (b) foundational literacy skills as measured by letter name assessment and nonsense word fluency assessment; (c) use of more complex vocabulary words in writing; (d) writing motivation; and (e) overall writing achievement?

8. Method

8.1. Setting

This study took place at one elementary school in the rural Mid-South. There were four total kindergarten classrooms in the school. All four kindergarten classrooms participated in the study.

8.2. Participants

This study included teachers, students, and researchers.

8.2.1. Students

Participants were 63 kindergarteners from four kindergarten classrooms. Student demographics can be found in Table 1.

Table 1. Demographic characteristics for kindergarten participants.

	Intervention	Control
Male/Female	23/9	21/10
Race		
White	25	21
Black or African American	0	3
Asian	2	0
Hispanic or Latino	3	4
Other	2	3
Free/Reduced Lunch	6	5
Emergent Bilingual	4	4
SPED	4	0

8.2.2. Teachers

Four classroom teachers participated in the study. Two of the teachers have a Master's degree and over eight years of teaching experience. One teacher had two years of teaching experience and was in the last semester of a Master's program. One teacher had five years of teaching experience and a Bachelor's degree. Three of the teachers were white, monolingual women and one was a Hispanic, bilingual woman.

8.2.3. Researchers

The research team consisted of one principal investigator and ten doctoral candidates specializing in literacy studies.

8.3. Measures

Student growth was measured across writing, spelling, reading, and motivation outcomes. An overview and description of measures can be found in Table 2 below.

Table 2. Overview of assessments.

	Assessment	Administration	Type of Test	Time	Construct(s) Measured
Day 1					
	Writing sample	Group	RC		Writing quality
	Invented spelling	Group	Val		Invented spelling
	Writing challenge	Individual	Val		Writing motivation
	Nonsense word fluency	Individual	Stz		Phonics, alphabetic principle
	Letter names	Individual	Bmk		Letter names
	Letter sounds	Individual	Bmk		Alphabetic principle
	Vocabulary	Word Count Analysis Post Assessment	Val		5-word invented spelling

Table 2. *Cont.*

	Assessment	Administration	Type of Test	Time	Construct(s) Measured
Day 2					
	Conventional spelling	Group	Val		Phonological awareness, decoding, encoding, spelling
	Handwriting fluency	Group	RC		Handwriting fluency
	Phonological awareness	Individual	Bmk	<20 m	Phonological awareness

Note: RC = Researcher-created; Stz = standardized; Bmk = Benchmark; Grp = Group delivery; Ind = Delivered one-on-one, Val = validated

8.4. Writing Measures

Writing Sample and Scoring Rubric. A researcher-created assessment was used to evaluate overall writing quality. Students were asked to write a story about something that is important to them. Students were given a pencil, crayons, and a writing test page with space for the student's name, a blank box for a picture, and lines for writing. The lines on the paper contained only a bottom line, with no middle or top lines. They were given five minutes to plan the story by drawing a picture and ten minutes to write the story. The same prompt was used in pre- and posttesting.

Responses were scored with a rubric previously used in a randomized control trial with kindergarten writers [32]. The rubric included the following: invented spelling, conventional spelling, word form, organization, voice/word choice, conventions (capitalization, end punctuation, spaces, spelling of high-frequency words, and writing left to right), quantity of letters, and quantity of words. Each area was scored on a scale of 1–4, except for conventions, which had a scale of 1–20 (see Appendix A).

Ten members of the research team gathered together to score the writing samples; they were distributed equivalently among them. Each person scored their respective pile at the same time and brought questions to the group. Any questions were addressed through consensus of group discussion. Interrater reliability was computed by having 25% of the test protocols rescored by a second trained researcher. The interrater reliability was calculated by percent agreement. Agreement was 92%. Disagreements resulted from a scoring error (n = 5). Once the errors were corrected, agreement was 100%. The scorers were blind to condition but not to pre and posttesting.

8.5. Handwriting Fluency

Handwriting fluency is associated with writing quality [38–41]. In the handwriting fluency task, students were asked to write as many letters of the alphabet (in order from A to Z) as they could in one minute. If they wrote all 26 letters, they were instructed to start over from the beginning.

Fluency was scored by counting the number of correctly formed letters. Correct formation was judged through legibility. Backwards letters were counted as correct, as long as they were legible.

The first author scored 100%, and 30% were randomly selected and rescored for interrater reliability by two doctoral candidates. IRR was 100%.

8.6. Written Vocabulary

Written vocabulary was evaluated by counting the number of words included in the student writing sample that were intended to be five or more letters. Frequency of longer words has been used as a measure of academic language in non-fiction writing [30]). Also, the TEWL-3 standardized test [42] includes a writing quality rubric that includes word length as one part of its narrative rubric measurement, indicating words with five or more intended letters as important to writing complexity.

Using the previously collected student writing samples, assessors counted all the words written by students that would have five or more letters if spelled correctly (duplicate

words count once). A word was defined as a string of letters separated by a space on either side. We used a finger space as the measure, taking into account little fingers. The first author scored all of these; 30% of each test was re-scored by two doctoral candidates. IRR was 100%.

8.7. Spelling Measures

Student spelling was measured through both invented and conventional spelling measures. It is important to measure both invented and conventional spelling at this age. The invented spelling assessment employs a nuanced scoring method, enabling it to detect small developmental progressions in children's spelling abilities. For emergent spellers, such a measure is crucial for capturing the varied linguistic knowledge bases kindergarteners draw upon when attempting to spell words [43]. Conventional spelling tests often fail to reveal children's developing use of these underlying language sources like phonology and morphology, so it is important to measure both [43].

Invented Spelling Test. The participant's level of invented spelling sophistication was measured using a 10-word spelling test from previous research by Ouellette and Sénéchal [33,44]. The following words were read aloud to the children as they wrote down their most sophisticated spelling attempt: no, lap, day, boot, sick, lady, train, elephant, pretty, and ape. These words present a range of articulatory characteristics known to influence invented spelling.

"This scoring system reflects the extent of phonemic and orthographic representation on a 7-point scale, wherein a score of 0 denotes a random series of characters, a score of 1 indicates the presence of a letter marking of a salient phoneme in the word (e.g., lady as A), a score of 2 if the initial sound is represented (e.g., lady as L), a score of 3 if more than one properly sequenced phonetic marking is present (e.g., lady as LA), a score of 4 for spellings that have all phonemes of the word represented either through phonetic or conventional spellings (e.g., lady as LAD), a score of 5 for representing all consonants with conventional spelling but only representing vowels phonetically (e.g., lady as LADE), and a score of 6 for complete conventional spelling (e.g., lady as LADY). Multisyllabic words and those with consonant clusters had slightly different criteria for scoring but followed the same developmental rationale of initial and salient consonant sounds being represented correctly before vowels are mastered" [33] (p. 80).

The assessments were distributed equivalently among ten members of the research team. Scoring criteria were displayed. Each person scored their respective pile at the same time, and questions were addressed to the group, which reached a consensus through discussion. Then, 30% were randomly selected and rescored for IRR, which was 100%.

Conventional Spelling Test. The conventional spelling assessment was a 12-word spelling assessment taken from Weekes et al. [45] and Ouellette and Sénéchal [33]. The measure included 12 words that differed in letter–sound consistency: six of the words were classified by Weekes et al. [45] as phonologically and orthographically inconsistent (i.e., variability in the possible spelling of the phonology such as/e/being spelled EA or EE) and the other six words were phonologically and orthographically consistent (i.e., no variability in plausible spellings, such as ING and ISH). The words for this assessment were (a) craft, fish, spring, ring, rust, and wing, which are phonologically and orthographically consistent; and (b) boat, cheek, coat, deal, heap, and rail, which are phonologically and orthographically inconsistent.

This word set taps both their phonological and orthographic knowledge. Children first heard each word in isolation and then in context of a sentence, and then it was repeated. No time limit was imposed, and feedback was not given. Spelling accuracy was scored by allotting 1 point for every correctly spelled word [33] (p. 81).

The assessments were distributed equivalently among ten members of the research team. Each person scored their respective pile at the same time. Thirty percent were randomly selected and rescored for IRR, which was 100%.

8.8. Reading Measures

Letter Names. In this EL Education [46] letter name assessment, the administrator showed the participant a letter and asked the participant to name the letter. Letters were shown on a computer and students responded orally. The teacher scored them within the benchmark program. Students were asked to identify all 26 uppercase letters and all 26 lowercase letters for a max total score of 52. The assessments were ten minutes or less depending on the student's fluency with the skill.

Letter sounds. In this EL Education [46] letter sound assessment, the administrator shows the student a letter on a computer screen and students were asked to provide the letter sound orally. The teacher scored it within the benchmark program. Students were asked to identify the most common sound associated with the 26 letters of the alphabet for a maximum total score of 26. The assessments were ten minutes or less depending on the student's fluency with the skill.

Phonological Awareness. The EL Education [46] phonological awareness (PA) assessment for kindergarteners was used to assess students' PA skills. The test assesses nine skills: rhyme production, phoneme isolation, identifying final phonemes, identifying medial phonemes, adding initial phonemes, deleting initial phonemes, substituting initial phonemes, counting and segmenting phonemes, and blending phonemes. Each of the nine skills are tested using six questions. Questions for Skills 4 and 8 include two parts. Skill 4 (identify medial phonemes) was broken down into two 6-point scores, one for the phoneme identification and one for the vowel identification. Skill 8 (count and segment phonemes) was also broken down into two 6-point scores, one for counting and one for segmenting the phonemes in the given word. Hence, a student could earn up to 12 points for each of Skills 4 and 8. The remaining skills were scored as six points for each skill. The max score for this assessment was 66 points.

These data were collected through benchmark assessments administered one-on-one with the classroom teacher via a paper assessment. Students were provided an oral prompt and responded orally, and the teacher scored their performance on the paper. The assessments were 20 min or less depending on the student's fluency with the skill.

Nonsense Word Fluency. The 2011 Acadience Learning Inc.© (Eugene, OR, USA) Nonsense Word Fluency (NWF) assessment was used to test basic phonics. NWF assesses knowledge of basic letter–sound correspondences and the ability to blend letter sounds into consonant–vowel–consonant (CVC) and vowel–consonant (VC) words. The test items used for NWF are phonetically regular nonsense or pseudo words. To successfully complete the NWF task, students must rely on their knowledge of letter–sound correspondences and how to blend sounds into whole words. There are two separate scores reported for NWF: Correct Letter Sounds (CLS) is the number of letter sounds produced correctly in one minute; and Whole Words Read (WWR) is the number of nonsense words read correctly as a whole word, one time and only one time, without first being sounded out.

The first author scored all the assessments. Thirty percent of all assessments were then rescored by two doctoral candidates in a literacy program. Interrater reliability was 100% between the two doctoral candidates and 100% with the first author.

9. Writing Motivation Assessment

The Writing Challenge Task (WCT) is a task-oriented assessment created to measure writing motivation in young children [47]. The WCT takes students through nine levels of increasingly difficult writing tasks. These levels start at the least complex task of drawing a picture and move to writing names, CVC words, and words with digraphs; for the most difficult task, they write a sentence. At each stage, the students are asked if they would like to try a more challenging task or continue with a task at the same difficulty level. We used the scoring system created by Schrodt and colleagues [47].

The assessment is scored based on the number of levels the student progressed through, with possible scores ranging from one to eight. Although there are sublevels (i.e., 1.1 and 1.2 in level 1), the student's score is the level score, in this case 1, if they quit the

test anywhere within that level. If the student progresses to 5.2 and then stops the test, according to the directions, the student is given a score of 5. Accuracy is not considered in this assessment. That is, if the student writes a word incorrectly, but has the desire and determination to continue the test, the test continues without a penalty for inaccurate spelling. The WCT was used in a previous mixed methods design study with a small sample (n = 27) of kindergarteners (reliability a. 0.93) [32]. The assessment was created intentionally to address multiple factors of motivation theory (e.g., interest, perseverance, and self-regulation).

The first author and a doctoral candidate in literacy scored all the assessments. Thirty percent of all assessments were then rescored by two other doctoral candidates in a literacy program. Interrater reliability was 100% between the doctoral candidates and 100% with original scorers.

10. Procedures

10.1. Research Team Training

Before administering the tests, ten research assistants were trained by the first author on the administration of each assessment. Five hours of training were provided across two sessions: three hours in-person and two hours virtually. In the first session, the trainer and research assistants met in person. The trainer provided an overview of the tasks, then modeled the first assessment to be administered. They read the script provided and demonstrated how to use relevant materials associated with the assessment. Then, the research assistants were asked to practice administering the same assessment to a partner while the trainer circulated and provided guidance or answered questions. This process continued for each assessment required. For those requiring administrators to record a response or to monitor time, the activities were modeled and practiced during training. For standardized tests, the standardized administration instructions were used. The trainer led the assistants in reflection on success and watched each pair administer each assessment. Prior to administering the tests in the schools, the second training session was held, which focused on a review of each assessment and an open question and answer period.

All assessments were de-identified. Scorers were blind to condition but not time point of collection as pre- and posttests were scored separately. The research team practiced and came to an agreement on multiple assessments all together, and then they went on to independently score the tests but stayed in the same room. Then each test was re-scored by another researcher on the same day for agreement. The same process was repeated for the posttests.

10.2. Assessment Administration

Eight members of the research team administered writing sample, invented spelling, conventional spelling, and handwriting fluency assessments to each classroom as a whole group, with two research team members per classroom. Assessments were administered to each class over the course of three days. The first day of data collection included the writing sample and invented spelling data. These assessments were given as a whole group in a 40 min window of time. One researcher gave instructions; another researcher insured that students were completing the assessment.

Students were then pulled into a one-on-one assessment over the course of two hours to complete the Writing Challenge Task, the nonsense word reading, and the letter and sound assessments. Students took one test at a time with breaks in between. The second day, the students were given the conventional spelling test and the handwriting fluency test as a whole group in a 40 min window of time. Students were then pulled into a session to complete the phonemic awareness assessment one-on-one. On the 3rd day, any students who were absent or did not get their test completed were pulled into a one-on-one session to complete assessments. Students were provided response pages and a pencil.

The classroom teachers supported assessment administration and were present in each room for help. The classroom teachers collected the letter and sound data during the pretest only.

To deliver the writing prompt, assessors passed out the test page and read the following script, "Today we are going to write about something that is important to you. It can be anything! You can write about your family, about your favorite sports, about animals, anything! Take five minutes to draw the picture to think of your story idea". After five minutes, assessors said, "Now, write the words to go with your picture. Do the best you can for ten minutes".

To measure invented spelling and conventional spelling, one member of the research team gave instructions and called out the list of nonsense words one-by-one. Another member of the team insured that students were completing the assessment. Thirty minutes were allotted for each assessment, but less time was necessary.

The handwriting fluency assessment was administered in the classroom as a group.

The letter name and sound assessments were administered one-on-one by the classroom teacher via a computer.

The nonsense word fluency assessment was administered one-on-one in a quiet hallway by a member of the research team. Students were provided a list of nonsense words and responded orally. Researchers documented responses on a score sheet.

To measure writing motivation, a member of the research team administered the assessment one-on-one in a quiet hallway. A researcher prompted students following the standard directions. Students responded orally and by writing/drawing. The assessment typically took less than 15 min, depending on the student's choice to continue taking on a more challenging task or not.

10.3. Instruction

The classroom teachers in both the control and the intervention groups taught systematic phonics instruction using the EL Education curriculum [46]. Each classroom had two dedicated hours for literacy instruction. These two hours included knowledge and skills instruction from the EL curriculum and five differentiated literacy center rotations. These literacy stations included independent reading, writing, phonics-based word work, fluency, and letters and blending practice through computer-based technology. The teachers provided small group phonics instruction during this time using the Heggerty Phonemic Awareness Curriculum [48].

Intervention Condition. The first author delivered the intervention instruction to each class in the treatment condition. The instruction consisted of 30 min invented spelling lessons provided for a total of 12.5 h across five weeks. Each session included an eight-minute teacher-directed explicit mini-lesson, 15 min for students to write individually and continuously, five minutes for students to share their work, and two minutes of reflection.

The intervention took place in a separate 30 min block dedicated to schoolwide response to intervention. The intervention group replaced the Heggerty Phonemic Awareness Curriculum [48] with the invented spelling intervention. The first author and respective classroom teacher provided instructions. The invented spelling intervention was provided five days a week for five weeks. The researcher and the classroom teacher taught using the one teach, one assist co-teaching model. The researcher served as the lead teacher, preparing for specific writing instruction from the intervention lesson plans. Operating as an engaged support, the co-teacher circulated to oversee student progress, responded to any conduct needing redirection, fielded student inquiries requiring input, disseminated necessary resources, and sought clarification from the lead instructor around potential learner misunderstandings requiring feedback. A description for each section can be seen below.

10.4. Mini-Lessons

Each mini-lesson was completed with the whole class. The teacher gave explicit instructions with scripted materials on the mini-lesson topics. The mini-lessons followed a gradual release model, first starting with the teacher explicitly modeling the mini-lesson objective in front of the children. Then, the teacher and student practiced collaboratively in shared writing experiences before moving to independent writing. The mini-lessons focused on both the individual word level and the larger contextual level. See Table 3 for mini-lesson descriptions.

Table 3. Mini-lessons for invented spelling intervention.

Name of Mini-Lesson	Number of Sessions	Definition
Stretching out sounds (word level)	3	Students practiced slowly saying and hearing all the sounds in a word while writing.
Example Teacher Script "When you come to a word you want to write, but do not know how to spell it, you can say the word sllloooowwlllyyy llliiikke a tttuurrrtttlllee. You can streeeetttccch out the word, so it's easier to hear all of the sounds. Let me show you. I would like to spell the word "octopus", but it is pretty long and challenging. I can stretch out the sounds in the word and write each letter as I go. I can also segment the letters by tapping my fingers for each sound or tapping my arms for each syllable". (Teacher models stretching out a few words first independently as an explicit model and then collaboratively with students on a large piece of chart paper or the interactive smartboard.)		
Brave Spelling (word level)	3	Students bravely spell words greater than 3 letters long using invented spelling.
Example Teacher Script Each child has an individual brave speller's notebook. In the notebook, there are color photos of 60 different things with two boxes next to each photo. For example, basketball, caterpillar, rainbow, chair, planet, etc. "This brave speller's notebook is for you to practice getting really brave at spelling long words! If you know your sounds, you can spell any word bravely. Then, you can write about anything you want. Let me show you! This is a picture of a basketball. I can bravely spell basketball by slowly stretching out our sounds bbbaaasskkkeetttbbaalll". As the teacher models sounding out the words, she writes the corresponding letters on the board in front of the students. After explicitly modeling a few of the words in the notebook, the teacher and student collaboratively sound out words together. For example, "Ok, let's try to bravely spell this word together. This is a picture of a spider, let's bravely spell this word together". Then the teacher and the students sound out the word together. Each child has a small white board. The brave spelling notebook is an essential part of the scaffolded feedback provided in this intervention. The notebook has one box for the first spelling attempt. The students write down their first attempt at spelling the word in the box next to the photo. The students are instructed in small groups and through explicit modeling and shared practice to reflect on the initial spelling attempt, sound it out again very slowly, and see if any letters are extra or missing. The second box will be used to make a second, more sophisticated spelling attempt. See [37] for more details.		
Brave Spellers Chart (word level)	2	Students document bravely spelled words on a publicly displayed class chart. The teacher uses this chart for reflection and celebration.
Example Teacher Script "Today we are going to make a big graph that shows us just how many brave words we have spelled. You all are such BRAVE spellers. You used your sounds to attack words and spell any word you want. I went around during your writing time today and counted how many long words (over 3 letters) you all spelled today. Today we spelled 27 words bravely together! Let's graph that on our chart and celebrate being brave spellers. Next time you might spell even MORE words". After this, the teacher provides direct, scaffolded feedback saying, "Let's look at a few of the words you wrote today and see if we can make the spellings even better. Then, I will show you how it is spelled".		
Individual Brave Speller Graph (word level)	1	Graph the number of words spelled bravely.
Example Teacher Script This mini-lesson is an individual record of how many words they have spelled bravely. This is a sheet of paper glued into the front of their writer's notebook. One mini-lesson was spent modeling how to graph the number of words in the chart. More scaffolded feedback is provided as these charts are then used in small group instruction to choose words for reflection. This included sounding out the word again and adding and taking away letters to make more sophisticated spellings.		

Table 3. *Cont.*

Name of Mini-Lesson	Number of Sessions	Definition
Heart Words (word level)	2	Using orthographic mapping techniques to sound out and spell high-frequency words with an irregular sound spelling.
"Today we are going to talk about spelling your heart words. Many of these words are a little tricky to spell, but you can still use your sounds to spell MOST of the word. Then, there might be one or two parts you must learn by heart. For example, in the word "said". When we slowly stretch out the word said, you can hear the beginning and ending sounds easily when you stretch it out. That means you already know mostly how to spell this word. The part you need to "learn by heart" is in the middle. It sounds like an/e/, but it is really spelled with an "ai"". The teacher explicitly models examples of spelling heart words first and then spells some collaboratively with the students. The heart words coincide with those offered in the schoolwide phonics program.		
Rapid Writing (word level and contextual)	2	Students write down as many words as they can in 5 min.
"Every day you all are writing more and more words bravely. When you get really fast at sounding out words, you can write down more ideas. Today we are going to practice quickly coming up with ideas and writing them down. We are going to make a list of as many foods as you can think of in five minutes. You are going to write for the whole five minutes, thinking of foods and sounding them out bravely to add to your list. For example, one food is "pizza". I will sound out the word pizza and add it to my list. Then, I will think of another food, like "cookies" and sound that one out and add it to my list. You keep going for the whole five minutes. At the end we will count the number of foods we wrote today"!		
Invented Spelling Reflection and Revision (word level)	3	Students reflect on a word they spelled bravely and make a revision to the spelling to make a more sophisticated invented spelling.
"Good writers go back and check their spelling. Sometimes we can go back and look at the words we have spelled and make them even better! Let me show you. I wrote the word "flamingo" yesterday like this: flamego". I am going to run my finger back over my spelling, saying the word very slowly and ask myself, *is there a letter sound I can add to make this spelling even better? A letter sound I can take away to make this spelling even better?* As I am sounding out this word, I am remembering a new group of letters that make one sound/ing/. I am hearing the sound/ing/in the word flamINGo. I am going to make this spelling even better now". The teacher then rewrites an even more sophisticated spelling of flamingo. It is important to note that the focus here is on revision and increased sophistication, which may or may not lead to a conventional spelling yet. This scaffolded feedback is an important step in kindergarten spelling development. Eventually, the teacher leads students to progressively more conventional spellings.		
Adding More Labels and Words (contextual)	1	During writing time, students drew pictures and/or used labels and words to describe their pictures. One mini-lesson was used to explicitly teach this concept, but this was also modeled throughout.
"Drawing pictures can help us plan and brainstorm what story we want to tell. When I draw a picture of my story, I can add in lots of details that will help me when it is time to write my words. For example, today I am going to write about the time I saw a spider in the gym during my workout. I am going to draw a picture first". (Teacher draws a picture in front of the children, modeling the thought process out loud). "Ok, now that I have drawn my picture, I can write some labels. I am going to label the word spider right over the picture of my spider. Let's sound it out together".		
Peer-to-peer Word Evaluation (word level)	3	Students were taught to give peer feedback, helping themselves and each other make more sophisticated invented spellings.
"We have been working hard on making our brave spellings even better. Today you are going to get to work with a partner to help your friends make brave spellings. Today, your teacher and I are going to show you how we can work together to make great spellings." In order to follow a gradual release with explicit modeling, two teachers then offer a model of the process. "Ms. Crouch, I have a word that I want to spell even better. It is the word *chair*. Right now I have it spelled c-h-a-r". The teachers then modeled slowly saying the /ai/sound within the word and adding in an i to the spelling. Then, the students practice peer-to-peer feedback as a collaborative process, receiving feedback from the teacher.		
Model Writing (contextual)	3	The teacher modeled writing on large chart paper in front of the class.
Throughout the entire intervention, writing was explicitly modeled in front of the students. Three specific times, the students watched the teacher model the entire writing process, including generating the idea, drawing a picture, writing labels, and bravely writing words. All of this was demonstrated in front of the students in real time on a large piece of chart paper or the interactive smart board. Other models included only pieces of the process.		

Table 3. *Cont.*

Name of Mini-Lesson	Number of Sessions	Definition
Oral Storytelling with Picture Cues (contextual)	2	Students added details to their story through picture cue cards and 'turn and talk' discussions.
"We are going to practice adding more details to our story today by making sure our stories have a character, setting, what happened, and a feeling. We are going to use these picture cards to plan out our story and make sure it includes all four of these parts". The teacher models an oral story using the picture cards. Then, the students practice telling their own stories, which include a character, setting, what happened, and a feeling. To read a more detailed description of this process, please see [32].		

The intervention condition also included small-group instruction that integrated word-level instruction with scaffolded spelling feedback. This small-group instruction focused heavily on the following described intervention components: heart words' orthographic mapping; reflection and revision of spelling; and stretching out sounds to write words. Words were drawn from a brave spelling notebook as well as the students' own writing to explicitly teach students how to increase the sophistication of their first attempts at spelling. The small-group instruction took place during student writing time and rotated on a conferencing schedule so each student met with the teacher at least two times per week. Here is an example of the scaffolded feedback the students received in small groups: "Let's take a look at the word planet that you bravely spelled today. You did an amazing job using your sounds to spell this word. I can tell that you slowly stretched out the sounds and wrote the letters with it. Let's put your finger under your spelling and slowly sound out the word again together, moving your finger with the sounds./p//l//a//n//e//t/. You have a p for the/p/sound at the beginning. Great job". The teacher then continued to go through each sound until they find a mistake. "Here, at the end of planet (segmented). . .I heard the/e/sound. You have a letter i written here. An i makes the/i/sound. Watch my mouth when I say/i/like itch. When I say planet very slowly, I hear an/e/sound. Planet. Look at my mouth now when I say/e/. It is different than/i/that you wrote. What letter makes the/e/sound? Like essay and egg? Yes, good job! It is an e. So let's make this spelling of planet even better by changing the i to an e".

10.5. Writing Time

The students were given 15 min to draw and write. During this time, students worked individually on writing topics of their choice while the teacher circled the room for writing conferences.

10.6. Share Time

Students were given five minutes at the end of the session to share their work. The share time included kindergarten authors sharing one-on-one with as many writers as they could in five minutes, mixing and mingling in multiple one-on-one conversations until the timer went off.

10.7. Reflection Time

In the last two minutes of class, students were asked to reflect on themselves as writers. Students were guided orally through reflection questions that included "what did I do great as a writer today"? and "what do I want to work on next time"?

10.8. Control Group

The business-as-usual control group continued to dedicate two hours of the school day to literacy instruction. These two hours included knowledge and skills instruction from the EL curriculum and five differentiated literacy center rotations. These literacy stations included independent reading, writing, phonics-based word work, fluency, and letters and blending practice through computer-based technology. The teachers pulled students for small-group phonics instruction during this time. The control group did not do any of the

invented spelling interventions. The interventions took place in a separate 30 min block dedicated to schoolwide response to interventions. During this time, the control group received instruction using the Heggerty Phonemic Awareness curriculum [48].

10.9. Research Design and Data Analysis

This study is a quasi-experimental design of four kindergarten classrooms at one elementary school in the Mid-South. The intervention group participated in an invented spelling intervention for 12.5 h across five weeks. Each session lasted for 30 min and included an eight-minute teacher-directed explicit mini-lesson, 15 min for students to write individually and continuously, five minutes for students to share their work, and two minutes of reflection.

Descriptive statistics were examined to check the distribution of the variables. To ensure the homogeneity in pretest performance between groups, multiple independent sample t-tests were conducted with all pretest scores. To answer the research questions, a series of ANCOVAs were conducted with condition (i.e., intervention or control) as an independent variable, posttest score of each measure as a dependent variable, and pretest score of each measure as a covariate.

11. Results

Descriptive statistics, such as the means and standard deviations for all measures by condition, are reported in Table 4. Because the two conditions were not randomly assigned, homogeneity in pretest performance was established before conducting further analyses with the posttest results. To check the baseline equivalence, we conducted a series of independent sample t-tests with the pretest results. In most of the measures, baseline equivalences were well established ($p > 0.10$).

Table 4. Pretest and posttest means for intervention and control groups.

	Intervention (N = 32)		Control (N = 31)	
	Pretest	**Posttest**	**Pretest**	**Posttest**
Invented Spelling	33.10 (13.43)	44.52 (10.11)	30.84 (12.86)	28.55 (14.29)
Conventional Spelling	0.29 (0.74)	1.48 (1.59)	0.48 (0.89)	0.87 (0.99)
Letter Name	48.39 (6.00)	49.58 (5.33)	46.23 (10.17)	48.68 (5.57)
Letter Sound	23.48 (4.15)	24.68 (2.41)	22.68 (4.38)	23.55 (3.61)
PA	43.29 (17.75)	48.74 (14.15)	33.45 (17.07)	42.16 (13.32)
NWF (CLS)	17.29 (11.46)	19.48 (11.34)	14.00 (12.08)	22.35 (10.69)
NWF (WWR)	3.32 (4.63)	4.90 (4.53)	3.52 (3.23)	6.39 (4.10)
Vocabulary	1.10 (0.199)	3.03 (0.364)	1.06 (0.236)	1.23 (0.216)
Handwriting Fluency	10.48 (5.80)	18.55 (7.61)	15.74 (6.15)	18.68 (9.39)
WCT	5.10 (2.79)	6.26 (2.72)	4.29 (2.81)	4.65 (2.55)
Writing Sample	24.06 (5.35)	32.61 (7.75)	25.71 (7.70)	26.19 (6.94)

Note. PA = phonological awareness; NWF (CLS) = nonsense word fluency (correct letter sound); NWF (WWR) = nonsense word fluency (whole-word reading); WCT = Writing Challenge Task.

However, we found significant group differences in students' pre-intervention performances of phonological awareness ($p = 0.03$) and handwriting fluency ($p = 0.001$). Students in the intervention scored significantly higher on measures of phonological awareness at pretest and continued to grow throughout the intervention. Following explicit phonemic awareness instruction for the duration of the intervention, students in the control group nearly reached the intervention group's pretest average. On measures of handwriting fluency, students in the intervention scored significantly below students in the control at pretest, and they were statistically equivalent at posttest. Due to the lack of equivalence between groups at pretest, these measures were not further examined and have been removed from the research questions.

11.1. Intervention Effects

To investigate the intervention effects, a series of ANCOVAs were conducted. We included the condition as an independent variable, the student posttest score as a dependent variable, and the pretest score as a covariate (see Table 5).

Table 5. ANCOVA results.

	InSp	ConSp	LN	LS	CLS	WWR	T2Vocab	WCT	WS
F	43.33	9.6	0.00	1.51	2.2	1.91	23.27	4.61	20.23
p value	0.00	0.00	0.98	0.23	0.14	0.17	0.00	0.04	0.00
Partial η^2	0.42	0.14	0.00	0.03	0.04	0.03	0.28	0.07	0.26
Hedge's g	1.09	0.6	−0.23	0.11	−55	−0.29	5.81	0.3	1.08

Note. InSp = invented spelling; ConSp = conventional spelling; LN = letter name; LS = letter sound; CLS = correct letter sound reading; WWR = whole-word reading; T2Vocab = Tier 2 vocabulary use; WCT = Writing Challenge Task; WS = writing sample.

11.2. Invented and Conventional Spelling Results

As shown in Table 5, we found a significant main effect of the intervention on both invented spelling ($F[1, 59] = 43.33$, $p < 0.001$, partial $\eta^2 = 0.42$) and conventional spelling ($F[1, 59] = 9.60$, $p < 0.001$, partial $\eta^2 = 0.14$). The results suggest, after the intervention, both invented and conventional spelling abilities were significantly improved among students in the intervention group. The Hedge's *g* values also show large intervention effects (1.09 and 0.60, respectively).

11.3. Foundational Reading Skills Results

For the foundational reading skills, the students' letter name, letter sound, correct letter sound reading, and whole-word reading skills were measured. As shown in Table 5, the invented spelling intervention had no main effect on these foundational reading skills (letter name: $F[1, 59] = 0$, $p = 0.98$, partial $\eta^2 = 0$, letter sound: $F[1, 59] = 1.51$, $p = 0.23$, partial $\eta^2 = 0.03$, correct letter sound reading: $F[1, 59] = 2.20$, $p = 0.14$, partial $\eta^2 = 0.04$, and whole-word reading: $F[1, 59] = 1.91$, $p = 0.17$, partial $\eta^2 = 0.03$). It should be noted that, on three of the four foundational reading skill measures, the Hedge's g effect sizes were negative, meaning the students in the control group improved more than the intervention group on these measures.

11.4. More Complex Vocabulary Use Results

There was a significant main effect of the intervention on more complex vocabulary use among the students in the intervention group ($F[1, 59] = 23.27$, $p < 0.001$, partial $\eta^2 = 0.28$). The result suggests that students in the intervention group more frequently used more complex vocabulary words in their writing after the invented spelling intervention. The large effect size (g = 5.81) of the intervention is worth noting for this measure.

11.5. Writing Motivation

The ANCOVA results for writing motivation revealed that the main effect of the intervention was significant ($F[1, 59] = 4.61$, $p = 0.04$, partial $\eta^2 = 0.07$), suggesting that after adjusting for the pre-intervention writing motivation, students in the intervention group have more increased writing motivation than the control group students. We found a medium effect size (g = 0.30) for writing motivation.

11.6. Writing Achievement Results

The ANCOVA results suggest that there was a main effect of the intervention on writing achievement ($F[1, 59] = 20.23$, $p < 0.001$, partial $\eta^2 = 0.26$). This suggests that writing achievement significantly improved among students in the intervention group. The large effect size (g = 1.08) also corroborates this finding.

12. Discussion

The goal of this study was to evaluate the impact of an invented spelling intervention on kindergarten students' performance in terms of invented and conventional spelling, foundational writing skills, vocabulary, writing motivation, and overall writing achievement. Due to inequivalent group performance at pretest, measures of phonological awareness and handwriting fluency were removed from further analysis.

Our analysis revealed significant differences between the control and intervention groups at pretest in terms of their phonological awareness skills, which precluded further statistical analysis. However, the means of the phonemic awareness assessments increased in both the control and intervention groups by the end of the study. This aligns with previous research conducted by Sénéchal and Ouellette [33] on invented spelling, which has demonstrated that invented spelling practice can enhance phonemic awareness to a degree comparable to that achieved through an explicit phonemic awareness curriculum.

In the current study, the control group participated in Heggerty Phonemic Awareness instruction, while the intervention group engaged in invented spelling. Both groups exhibited improvements in their phonemic awareness skills. This finding suggests that invented spelling positively impacts phonological awareness skills similar to dedicated phonemic awareness programs. Combining invented spelling with explicit phonemic awareness instruction may not result in greater phonological awareness gains than either approach alone. This raises intriguing questions about the most effective and efficient ways to develop phonological awareness in young learners and, thus, warrants further research.

Since the invented spelling intervention positively impacted other literacy skills, such as writing, as well as demonstrated improvements in phonemic awareness, the use of invented spelling instruction merits further consideration for the improvement of the complex web of early literacy skills. Beyond improving phonological skills, invented spelling instruction offers multifarious benefits, such as supporting the development of spelling skills, increasing more complex vocabulary use in writing, improving writing motivation, and advancing overall writing achievement.

At posttest, students in the intervention group significantly outperformed their peers in the control group on measures of invented spelling, conventional spelling, the use of more complex vocabulary, writing motivation, and overall writing quality. Students in the control group who received daily instruction through the Heggerty Phonemic Awareness [48] kindergarten curriculum for an equivalent amount of time as the intervention group outperformed the intervention group on foundational literacy measures of letter naming, correct letter sounds, and whole words read, while students in the intervention slightly outperformed them on measures of identifying letter sounds. It is interesting that the overall performance for correct letter sounds and letter sounds diverged between the two groups considering the overlap of skills that is demonstrated between these two assessments.

12.1. Invented and Conventional Spelling

The first research question "Does the invented spelling intervention increase invented and conventional spelling achievement?" was measured by the invented spelling and conventional spelling assessments. The invented spelling intervention increased both invented and conventional spelling achievement. These findings align with prior research demonstrating the value of this approach for early literacy development. As noted by Sénéchal et al. [11], "With guidance and developmentally appropriate feedback, invented spelling provides a milieu for children to explore the relation between oral language and written symbols" (p. 917). By allowing kindergarteners to engage in the active process of analyzing sounds and mapping them onto symbols, even if non-conventional at first, invented spelling helps build critical foundational skills for both increasingly complex phonetic spellings and conventional spellings.

The children in the invented spelling intervention were taught skills for using their knowledge of letters and sounds to spell increasingly complex words. The invented spelling measure was sensitive in its scoring, allowing for the detection of specific developmental

changes in spelling. For young children, it is important to have an assessment that captures the many linguistic knowledge sources kindergarten students are using to spell [43]. Typically, traditional spelling assessment procedures do not capture the development and use of these linguistic knowledge sources [43]. However, in this study, the children scored significantly higher in both the invented spelling assessment with the sensitive scoring system and the conventional spelling assessment with the traditional correct/incorrect scoring system. The students therefore increased their spelling complexity in terms of linguistic resources used, but also increased the number of words they spelled conventionally accurately.

There are lasting benefits of early phonetic spelling instruction. Systematic engagement with spelling in the early years can have enduring positive effects [28]. As children's phonological awareness and understanding of the alphabetic principle are strengthened through invented spelling practices, they gain knowledge that can then transfer to more accurate conventional spelling abilities over time. The significant gains seen in both invented and conventional spelling measures underscore how providing kindergarten students with productive spelling opportunities can help students proficiently draw upon multiple domains of linguistic knowledge, encompassing an understanding of individual speech sounds (phonemic knowledge), the conventions for representing those sounds in writing (orthographic knowledge), and the patterns of meaningful word parts (morphological knowledge) [43].

12.2. Foundational Reading Skills

The second research question was "Does the invented spelling intervention increase foundational literacy skills as measured by letter name assessment and nonsense word fluency assessment"? While students in the intervention group improved in all measures across the course of the intervention, the invented spelling intervention did not increase foundational literacy skills, such as letter naming, correct letter sounds, and whole words read to a greater degree than the Heggerty Phonemic Awareness Kindergarten [48] curriculum. It is important to note that these differences were not significant. Understanding that new interventions cannot be continually added to a finite school day, one goal was to determine how incorporating a greater focus on writing—word-level practices like brave spelling and contextual-level practices such as rapid writing and revision—would impact students' performance in early literacy skills. Guided by implementation science, we must always remain sensitive to the external and social validity of interventions, especially their time cost in proportion to the instructional day as a whole. While we were not disappointed that a writing-focused intervention was commensurate in student reading progress to a well-known and broadly used phonemic awareness program, in future studies, researchers might consider extending the duration of the intervention or increasing its frequency to determine how increased dosage might impact outcomes.

Researchers have historically studied children's spellings as a window into the underlying cognitive mechanisms and developmental progression involved in acquiring spelling abilities [43]. They have also studied spelling as a way to investigate how it relates to other burgeoning literacy skills, such as reading [43]. Previous research has found that invented spelling "adds explanatory variance to literacy outcomes not entirely captured by well-studied code and language-related skills" [33] (p. 77). Measures such as the invented spelling measure with scoring that is sensitive to the child's increased linguistic complexity could show a more well-rounded picture of the multitude of literacy skills that are growing over time.

Handwriting fluency is a predictor of writing quality among elementary students [41]. Students in the intervention condition demonstrated growth in average letters per minute (M = 10.48; SD = 5.80 to 18.55; SD = 7.61) across the length of the intervention in contrast to students in the control condition (M = 15.74; SD = 6.15 to 18.68; SD = 9.39). The students in the intervention group were writing faster and writing more. In previous research, this meant that students were spending more time actually writing and less time looking for

writing assistance from their teacher [15]. Writing fluency achievement has shown lasting effects into third grade [28].

12.3. More Complex Vocabulary Use

The third research question was "Does the invented spelling intervention increase the use of more complex vocabulary words in writing"? The invented spelling intervention increased students' use of more complex vocabulary words in their writing as measured by a count of words with five or more letters in the students' writing samples. Word length can reflect word complexity. The frequency of longer words has been used as a measure of academic language in nonfiction writing [30]. The kindergarten students in the intervention group wrote significantly more long words than the control group. The intervention group went from 34 to 94 words, over five letters from pretest to posttest in contrast to students in the control who moved from 33 to 38. This aligns with a previous study using the same method and measurement, in which kindergarten students wrote 237 unique words with five or more letters across nine weeks of an invented spelling writing intervention [32]. This could be because the students were more fluent in both their handwriting skills and their confidence to sound out words from their diverse vocabulary. The students were able to lighten their cognitive load, focusing more on using the full repertoire of their vocabulary and linguistic knowledge to write their ideas.

12.4. Writing Motivation

The fourth research question, "Does the invented spelling intervention increase writing motivation?", was measured by the Writing Challenge Task [47]. The students in the intervention group scored significantly higher on the Writing Challenge task, a validated behavioral writing task to measure motivation [47]. This behavior task requires students to choose whether or not to complete increasingly difficult writing tasks. Students in the intervention group chose to do more difficult writing tasks than those in the control group. This aligns with prior kindergarten research [47].

During the intervention, writing became accessible to the kindergarten writers by celebrating approximations and lowering the barrier to writing entry. Seeing their invented spelling attempts as steps toward conventional forms built up their confidence and facilitated a growth mindset. Children's attitudes toward writing predict writing quality [49]. A child's beliefs about writing can foster or hinder writing in many ways and can determine "whether one engages in writing, how much effort is committed, and what resources are applied" [50] (p. 285). Some research suggests that having a positive identity as a writer is paramount to writing success [50]. This positive identity increases the likelihood that students will write more and enjoy it.

The intervention group gained confidence and fluency by writing every day. The more time spent on writing and writing instruction, the more students write [50] (p. 285). Writing generates its own feedback loop—each writing experience enhances skills that can then be transferred to more sophisticated future writing, a self-perpetuating cycle of practice expanding overall writing proficiency.

12.5. Writing Achievement

The last research question, "Does the invented spelling intervention increase overall writing achievement", was measured by the children's writing samples scored with a rubric. The invented spelling intervention increased overall writing achievement. The students in the intervention group wrote every day on meaningful topics of their choice. The teachers gave explicit writing instruction in multiple genres of writing and guided the students through a process writing approach. The students collaborated with their peers and shared their writing with authentic audiences apart from the teacher. All of these factors are hallmarks of effective writing instruction and could have contributed to the students' increased writing achievement [37].

12.6. Limitations and Future Research

Due to existing class rosters, students were not randomly assigned at the student level. Hence, measures of phonological awareness and handwriting fluency had to be removed from the analysis as groups were not equivalent at pre-assessment. The rubric used to score the writing sample has not been validated, although it has been used in previous research [32]. Future studies would benefit from a validated kindergarten-specific rubric measure.

13. Conclusion and Implications for Practice

Writing is a complex task, especially for young children balancing the hard work of transcription and letter sounds. The invented spelling intervention encouraged low-stakes writing risk taking and removed barriers to students' writing. Allowing time and space for invented spellings means students can focus on communicating their ideas in print without being hindered by the expectation to conform to conventional spellings. This can boost confidence, creativity, spelling complexity, and ideation through word choice.

Encouraging students to use the sounds and symbols they know to write independently promotes orthographic mapping. As students attempt to map the sounds they hear onto letters, even in non-conventional ways initially, they are analyzing the phonemic components of words. This explicit attention to phonemes reflects key foundational literacy skills. Teachers can also use children's invented spelling as a formative assessment tool. Examining kindergarteners' invented spellings allows teachers to identify strengths, misconceptions, and instructional needs regarding sound–symbol relationships and spelling patterns. Recognizing invented spelling as a natural and important developmental phase helps position spelling as an incremental skill to be scaffolded over time through explicit instruction and authentic writing practice.

Prolific writing researchers have called for greater integration in the science of reading and the science of writing [18]. Historically, reading and writing instruction have been treated as separate domains, with more emphasis placed on reading than writing instruction in the early grades. However, the processes of reading and writing are deeply interconnected. Both require mapping phonemes to graphemes, understanding orthographic patterns, building word recognition skills, and using semantic and syntactic knowledge to construct meaning from text. Their cognitive and linguistic underpinnings significantly overlap. By segregating reading and writing instructional practices, educators miss opportunities to capitalize on the reciprocal relationships between the two. For example, engaging young students in invented spelling can reinforce phonics and decoding skills valuable for reading. Likewise, reading a variety of texts provides critical exposure to conventions, text structures, vocabulary, and background knowledge that can then support students' writing development across genres.

Author Contributions: Writing Original Draft—K.S., E.F., D.M. and S.L.; Writing Revision/Editing—E.F., D.M. and K.S.; Visualization—K.S. and E.F.; Supervision—K.S.; Project Administration—K.S.; Funding Acquisition—D.M.; Methodology—K.E. and S.L.; Formal Analysis—S.L.; Resources—K.E.; Project Curation and Data Administration—A.M. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki, and approved by the Institutional Review Board (or Ethics Committee) of Middle Tennessee State University (protocol ID 22-2027 7im, approved on 8 September 2021).

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

Data Availability Statement: The raw data supporting the conclusions of this article will be made available by the authors on request.

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

Appendix A

Table 1. Rubric to Evaluate Student Writing.

	1 **Skills Are Limited, Frequent Support Is Needed.** **This Is Difficult for Me, and I Need Help.**	**2** **Moving toward End-of-Grade Level Expectations with Assistance.** **I Can Do This with Help.**	**3** **Meet the End-of-Grade Level Standard Independently.** **I Can Do This on My Own.**	**4** **Exceeds the End-of-Grade Level Standard.** **I Can Do This on My Own, and Can Do More Challenging Things like It.**
Invented Spelling	Count all the words in the child's writing that would have 5 or more letters if spelled correctly (duplicated words count once).			
	1 Zero words	**2** 1–2 words	**3** 3–4 words	**4** 5 or more words
Spelling	Count the number of correctly spelled words with 5 or more letters (duplicated words count once) in the child's writing			
	1 Zero words	**2** 1–2 words	**3** 3–4 words	**4** 5 or more words
Word Form	Analyze all words in the child's writing for all phonemes, indicating which are recorded with correct letter or letters. Specify initial phonemes, blends, short vowels, long vowels, intrusions, deletions.			
	1 Records some correct initial phonemes, and includes phonetically incorrect letters OR only draws a picture with no words or letters.	**2** Records multiple correct phonemes within the word, but may include phonetically incorrect letter intrusions or deletions.	**3** Records every phoneme, including blends. Words are represented with a mix of phonetically related and conventional letters. May include intrusions or deletions.	**4** Records every phoneme, including blends. Most phonemes are recorded with the correct letter representation. Writer uses the correct short vowel and attempts to mark long vowels. Intrusions and deletions are limited.
Organization	**1** The illustration does not match the writing. There is no organization of events.	**2** The illustration supports the writing. There is one meaningful statement	**3** The illustration supports the writing. There are two meaningful statements.	**4** The illustration supports the writing. There is a sequence of events with three or more meaningful statements.
Voice/Word Choice	Evaluate the child's writing for the following demonstrations of voice or word choice: -Uses vocabulary from oral language when writing. -Uses some descriptive language. -Expresses feelings. -Demonstrates awareness that someone else will read his/her writing.			
	1 One of the demonstrations	**2** Two of the demonstrations	**3** Three of the demonstrations	**4** Four of the demonstrations
Conventions				
Capital Letters	Analyze student writing for capital letters at the beginning of sentences and of proper nouns			
	1 Zero	**2** Some	**3** Most	**4** All

Table 1. *Cont.*

	1 **Skills Are Limited, Frequent Support Is Needed.** **This Is Difficult for Me, and I Need Help.**	**2** **Moving toward End-of-Grade Level Expectations with Assistance.** **I Can Do This with Help.**	**3** **Meet the End-of-Grade Level Standard Independently.** **I Can Do This on My Own.**	**4** **Exceeds the End-of-Grade Level Standard.** **I Can Do This on My Own, and Can Do More Challenging Things like It.**
Punctuation	Analyze each sentence in student writing for end punctuation.			
	1 Zero	**2** Some	**3** Most	**4** All
Spacing	Analyze student writing for spaces between words.			
	1 Zero	**2** Some	**3** Most	**4** All
Spelling	Analyze student writing for each high frequency word present. Determine if each is spelling correctly.			
	1 Zero	**2** 1–3 correctly spelled	**3** 4–6 correctly spelled	**4** 7 or more correctly spelled
Left to Right	**1** Does not write left to right.		**4** Writes left to right.	
Quantity	Count the total number of recognizable letters, words (including articles, prepositions, and proper nouns), and sentences the student produced.			
Number of Letters	**1** 0–4 letters	**2** 5–15 letters	**3** 16–24 letters	**4** 25 or more letters.
Number of Words	**1** 0–2 words.	**2** 3–5 words.	**3** 6–7 words.	**4** 7 or more words.
Number of Sentences	**1** 0 sentences	**2** 1 sentence	**3** 2 sentences	**4** 3 or more sentences

References

1. National Early Literacy Panel. *Developing Early Literacy*; National Institute for Literacy: Washington, DC, USA, 2008.
2. Hooper, S.R.; Roberts, J.; Nelson, L.; Zeisel, S.; Kasambira Fannin, D. Preschool predictors of narrative writing skills in elementary school children. *Sch. Psychol. Q.* **2010**, *25*, 1–12. [CrossRef]
3. Katusic, S.K.; Colligan, R.C.; Weaver, A.L.; Barbaresi, W.J. The forgotten learning disability: Epidemiology of written-language disorder in a population-based birth cohort (1976–1982). *Pediatrics* **2009**, *123*, 1306–1313. [CrossRef]
4. Abbott, R.D.; Berninger, V.W.; Fayol, M. Longitudinal relationships of levels of language in writing and between writing and reading in grades 1 to 7. *J. Educ. Psychol.* **2010**, *102*, 281–298. [CrossRef]
5. Graham, S.; Harris, K.R.; Santagelo, T. Research-based writing practices and the common core: Meta-analysis and meta-synthesis. *Elem. Sch. J.* **2015**, *115*, 498–522. [CrossRef]
6. National Center for Education Statistics. *The Nation's Report Card: Writing 2011*; Institute of Education Sciences, U.S. Department of Education: Washington, DC, USA, 2012.
7. Gerde, H.K.; Bingham, G.E.; Wasik, B.A. Writing in Early Childhood Classrooms: Guidance for Best Practices. *Early Child. Educ. J.* **2012**, *40*, 351–359. [CrossRef]
8. Bingham, G.E.; Quinn, M.F.; Gerde, H.K. Examining early childhood teachers' writing practices: Associations between pedagogical supports and children's writing skills. *Early Child. Res. Q.* **2017**, *39*, 35–46. [CrossRef]
9. Rowe, D.W.; Davis, Z.G.; Piestrzynski, L. Adult supports for preschool writers during learning centers. *Read. Res. Q.* **2023**, *58*, 539–560. [CrossRef]
10. Read, C. Pre-school children's knowledge of English phonology. *Harv. Educ. Rev.* **1971**, *41*, 1–34. [CrossRef]
11. Senechal, M.; Ouellette, G.; Pagan, S.; Lever, R. The Role of Invented Spelling on Learning to Read in Low-Phoneme Awareness Kindergartners: A Randomized-Control-Trial Study. *Read. Writ. Interdiscip. J.* **2012**, *25*, 917–934. [CrossRef]
12. Chomsky, C. Approaching reading through invented spelling. In *Theory and Practice of Early Reading*; Resnick, L., Weaver, P., Eds.; Lawrence Erlbaum Associates, Inc.: Hillsdale, NJ, USA, 1979; Volume 2, pp. 43–64.
13. Awramuik, E. Invented spelling—A window on early literacy. *EDUKACJA Q.* **2014**, *128*, 112–123.
14. Ball, E.W.; Blachman, B.A. Does phoneme awareness training in kindergarten make a difference in early word recognition and developmental spelling? *Read. Res. Q.* **1991**, *26*, 49–66. [CrossRef]
15. Clarke, L.K. Invented versus traditional spelling in first graders' writings: Effects on learning to spell and read. *Res. Teach. Engl.* **1988**, *22*, 281–309. [CrossRef]
16. Ouellette, G.P.; Senechal, M. A Window into Early Literacy: Exploring the Cognitive and Linguistic Underpinnings of Invented Spelling. *Sci. Stud. Read.* **2008**, *12*, 195–219. [CrossRef]
17. Ouellette, G.; Senechal, M.; Haley, A. Guiding children's invented spellings: A gateway into literacy learning. *J. Exp. Educ.* **2013**, *81*, 261–279. [CrossRef]
18. Graham, S. The Sciences of Reading and Writing Must Become More Fully Integrated. *Read. Res. Q.* **2020**, *55*, S35–S44. [CrossRef]
19. Frith, U. Beneath the surface of developmental dyslexia. In *Surface Dyslexia*; Patterson, K., Coltheart, M., Marshall, J., Eds.; Lawrence Erlbaum: London, UK, 1985.
20. Rowe, D.W.; Shimizu, A.Y.; Davis, Z.G. Essential Practices for Engaging Young Children as Writers: Lessons from Expert Early Writing Teachers. *Read. Teach.* **2022**, *75*, 485–494. [CrossRef]
21. Puranik, C.S.; Lonigan, C.J.; Kim, Y.-S. Contributions of emergent literacy skills to name writing, letter writing, and spelling in preschool children. *Early Child. Res. Q.* **2011**, *26*, 465–474. [CrossRef]
22. Shatil, E.; Share, D.L.; Levin, I. On the contribution of kindergarten writing to grade 1 literacy: A longitudinal study in Hebrew. *Appl. Psycholinguist.* **2000**, *21*, 1–21. [CrossRef]
23. Zhang, C.; Bingham, G.E.; Quinn, M.F. The associations among preschool children's growth in early reading, executive function, and invented spelling skills. *Read. Writ.* **2017**, *30*, 1705–1728. [CrossRef]
24. Hofslundsengen, H.; Hagtvet, B.E.; Gustafsson, J.-E. Immediate and Delayed Effects of Invented Writing Intervention in Preschool. *Read. Writ. Interdiscip. J.* **2016**, *29*, 1473–1495. [CrossRef]
25. Martins, M.A.; Salvador, L.; Albuquerque, A.; Silva, C. Invented spelling activities in small groups and early spelling and reading. *Educ. Psychol.* **2016**, *36*, 738–752. [CrossRef]
26. Pulido, L.; Morin, M.F. Invented spelling: What is the best way to improve literacy skills in kindergarten? *Educ. Psychol.* **2018**, *38*, 980–996. [CrossRef]
27. Albuquerque, A.; Martins, M.A. Invented spelling activities in kindergarten: The role of instructional scaffolding and collaborative learning. *Int. J. Early Years Educ.* **2021**, *29*, 96–113. [CrossRef]
28. Albuquerque, A.; Alves Martins, M. Enhancing children's literacy learning: From invented spelling to effective reading and writing. *L1-Educ. Stud. Lang. Lit.* **2019**, *19*, 1–24. [CrossRef]
29. Lee, Y.; De La Paz, S. Science Writing Intervention Research for Students with and at Risk for Learning Disabilities, and English Learners: A Systematic Review. *Learn. Disabil. Q.* **2021**, *44*, 261–274. [CrossRef]
30. Sarmiento, C.M.; Truckenmiller, A.; Cho, E.; Wang, H. Academic Language Use in Middle School Informational Writing. *PsyArxiv* **2022**. [CrossRef]
31. Uccelli, P.; Phillips Galloway, E.; Barr, C.D.; Meneses, A.; Dobbs, C.L. Beyond Vocabulary: Exploring Cross-Disciplinary Academic-Language Proficiency and Its Association with Reading Comprehension. *Read. Res. Q.* **2015**, *50*, 337–356. [CrossRef]

32. Schrodt, K.E.; Elleman, A.M.; FitzPatrick, E.R.; Hasty, M.M.; Kim, J.K.; Tharp, T.J.; Rector, H. An examination of Mindset Instruction, self-regulation, and Writer's workshop on Kindergarteners' writing performance and Motivation: A MIXED-METHODS STUDY. *Read. Writ. Q.* **2019**, *35*, 427–444. [CrossRef]
33. Ouellette, G.; Sénéchal, M. 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? *Dev. Psychol.* **2017**, *53*, 77–88. [CrossRef]
34. Tierney, R.J.; Shanahan, T. Research on the reading-writing relationship: Interactions transactions, and outcomes. In *Research on the Reading-Writing Relationship: Interactions Transactions, and Outcomes*; Martha L. King Language and Literacy Center: Columbus, OH, USA, 1990.
35. Graham, S.; Hebert, M. Writing to read: A meta-analysis of the impact of writing and writing instruction on reading. *Harv. Educ. Rev.* **2011**, *81*, 710–744. [CrossRef]
36. Schrodt, K.; FitzPatrick, E.; Elleman, A. Becoming brave spellers. *Read. Teach.* **2020**, *74*, 208–214. [CrossRef]
37. Graham, S.; McKeown, D.; Kiuhara, S.; Harris, K.R. A meta-analysis of writing instruction for students in the elementary grades. *J. Educ. Psychol.* **2012**, *104*, 879–896. [CrossRef]
38. Graham, S. Handwriting and spelling instruction for students with learning disabilities: A review. *Learn. Disabil. Q.* **1999**, *22*, 78–98. [CrossRef]
39. Kim, Y.G.; Petscher, Y.; Wanzek, J.; Al Otaiba, S. Relations between Reading and Writing: A Longitudinal Examination from Grades 3 to 6. *Read. Writ.* **2018**, *31*, 1591–1618. [CrossRef]
40. Limpo, T.; Alves, R.A.; Connelly, V. Examining the transcription-writing link: Effects of handwriting fluency and spelling accuracy on writing performance via planning and translating in middle grades. *Learn. Individ. Differ.* **2017**, *53*, 26–36. [CrossRef]
41. Skar, G.B.; Graham, S.; Huebner, A. The Long-Term Effects of the COVID-19 Pandemic on Children's Writing: A Follow-Up Replication Study. *Educ. Psychol. Rev.* **2023**, *35*, 15. [CrossRef]
42. Hresko, W.P.; Herron, S.R.; Peak, P.R.; Hicks, D.L. *Test of Early Written Language*, 3rd ed.; Pro-Ed: Austin, TX, USA, 2012.
43. Masterson, J.J.; Apel, K. The Spelling Sensitivity Score: Noting Developmental Changes in Spelling Knowledge. *Assess. Eff. Interv.* **2010**, *36*, 35–45. [CrossRef]
44. Ouellette, G.; Sénéchal, M. Pathways to Literacy: A Study of Invented Spelling and Its Role in Learning to Read. *Child Dev.* **2008**, *79*, 899–913. [CrossRef]
45. Weekes, B.; Castles, A.; Davis, R. Effects of consistency and age of acquisition on reading and spelling among developing readers. *Read. Writ.* **2006**, *19*, 133–169. [CrossRef]
46. EL Education. *K-2 Reading Foundations Skills Block: Resource Manual*; EL Education: New York, NY, USA, 2016.
47. Schrodt, K.; FitzPatrick, E.; Brown, M.; Hover, A. Examining the Validity of the Writing Challenge Task: An Assessment Tool for Measuring Writing Motivation in Kindergarteners. *Read. Writ. Q.* **2022**, *39*, 334–349. [CrossRef]
48. Heggerty, M. *Phonemic Awareness: The Skills That They Need to Help Them Succeed!* Michael Heggerty: Oak Park, IL, USA, 2003.
49. Skar, G.B.; Lei, P.; Graham, S.; Aasen, A.J.; Johansen, M.B.; Kvistad, A.H. Handwriting fluency and the quality of primary grade students' writing. *Read. Writ.* **2021**, *35*, 509–538. [CrossRef]
50. Graham, S. Changing How Writing Is Taught. *Rev. Res. Educ.* **2019**, *43*, 277–303. [CrossRef]