RESEARCH ARTICLE

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Primary Teachers' Perceptions, Knowledge, and Attitudes Regarding Teaching Early Literacy Skills Incorporating the Science of Reading (SoR)

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Abstract: Reading instruction in primary schools has been at the center of attention for decades. Teachers are expected to be qualified and capable literacy teachers in order to produce proficient readers who are able to identify letters, understand the relationship between letters and sounds, decode the words on the page with automaticity, and fluently read the text while simultaneously comprehending. In order for students to be successful, proficient, and confident readers, teachers must understand the science of teaching beginning reading. The Science of Reading (SoR) is a collection of objective and reliable evidence about how humans learn to read, and ultimately, includes evidence-based instructional approaches that provide learning opportunities for all readers. The purpose of this research was to explore primary grade US teachers' perceptions, attitudes, and knowledge regarding early literacy skills incorporating the SoR. The researchers employed a QUAN descriptive design and analyzed the data using Statistical Package for the Social Sciences. A sample of 126 kindergarten through second grade teachers' teaching self-efficacy and early literacy knowledge were analyzed with descriptive statistics and revealed that the majority of participants believed in their ability to teach reading effectively, yet possessed low early literacy knowledge ($M = 60\%$) but had average self-efficacy beliefs. Of significance, respondents may believe they can teach reading effectively yet do not have the knowledge to do so.

Keywords: inservice teachers, Science of Reading (SoR), early literacy, self-efficacy, professional development

1. Introduction

Reading is an essential component to becoming a lifelong learner, contributing member of society, as well as a pathway to endless opportunities in today's global society, and despite that, reading achievement in the United States continues to be a major concern. According to the The Nation's Report Card [1], US fourth graders had the lowest reading scores since 2005, and 66% failed to score at a basic reading level. The reading crisis in the United States has reached a crucial point while the reading wars continue to burn in the middle of the American educational system. Brown posits that the debate between whole language and phonics remains, yet critics of phonics instruction continue to tout balanced literacy instruction as effective for young readers[1]. Dr. Reid Lyon of the National Institute of Health (NIH) determined that phonics and phonemic awareness are critical components of reading instruction, which was supported by the National Reading[2]. Snow et al. [2] report that young readers must possess skills in letter recognition, language structures, letter-sound correspondence, and decoding. Ultimately, the U.S. Department of Health and Human Services surmised that children need instruction in all five major reading components: phonological awareness, phonics, fluency, vocabulary, and comprehension[3].

Since the pivotal work of the U.S. Department of Health and Human Services, the emphasis on early literacy skills such as phonological awareness, phonetics, and morphology has become increasingly important [3–5]. Likewise, works by Wagner et al. [6], Juel [7], and Joseph [8] also find that young children, who are able to accurately apply phonemic awareness skills, were better equipped readers and spellers. These findings were compelling, and, although until recently, evidence-based practices in phonics were rarely realized in classrooms. Through several decades of debate, phonics has remained a key component in early literacy instruction to help children build a foundation for reading [9–11]. Because foundational reading skills are subsequently vital in elementary schools, it is imperative inservice and preservice teachers have the ability to successfully teach young readers to effectively attack text to become proficient readers.

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[1]Elizabeth Brown, "History of Reading Instruction", 2024, https://www.thephonicspage.org/historyofreading.html

[2]Cardinal Reading Strategies, "The National Reading Panel", 2020, https://cardinalreading.com/the-national-reading-panel/

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[3]U.S. Department of Health and Human Services, "Findings and Determinations of the National Reading Panel by Topic Areas", 2000, https://www.nichd.nih.gov/publications/pubs/nrp/findings

1.1. Science of reading

The Science of Reading (SoR) is defined as "a corpus of objective investigation and accumulation of reliable evidence about how humans learn to read and how reading should be taught" [12]. The SoR includes all evidence-based instructional approaches that potentially provide children a learning advantage in reading [13, 14]. The SoR explains the importance and understanding of how the brain learns to read. According to Dehaene [15], the brain creates an interaction between the vision system and the spoken language system. In creating this interaction, the brain makes connections between speech sounds and the sounds that letters and letter combinations make. For this to happen, the first step in learning to read includes a strong foundation in phonological awareness, phonemic awareness, and explicit and systematic phonics instruction [16]. This means teaching in a sequential order, beginning with the simplest concepts first then moving on to the more difficult, complex tasks. Additionally, children need to understand simple sound-symbol correspondences. According to Schwartz and Sparks [17], beginning readers must be able to recognize various sounds in spoken language while also having the ability to connect those sounds to written letters in order to decode words. The most effective time for this instruction spans between kindergarten and second grade.

Effective phonemic awareness and phonics instruction will allow children to develop the word-recognition and comprehension strategies necessary to develop as proficient readers [18]. The International Literacy Association explained that phonemic awareness is the most complex level of phonological awareness and plays a direct role in all facets of literacy development[4]. When a child's literacy foundation includes phonological awareness and explicit and systematic phonics instruction, the other three elements of reading: vocabulary, fluency, and comprehension can follow. Spira et al. [19] suggest that when a student struggles to read, the underlying cause is often a deficit in a foundational skill such as phonics or phonological awareness.

The majority of children can learn to read when reading instruction is based on research evidence that focuses on how reading develops. The SoR establishes scientifically supported reading methods that support children in becoming successful readers. Lyon and Chhabra [20] express "reading is a skill that is not learned naturally", and children who experience reading difficulties may demonstrate a lack of effort, reduced motivation and self-efficacy, and may exhibit behavior problems [21].

Teachers should have access to science-based research that focuses on the five components of reading since literacy acquisition depends on the integration of skills, and the development of these pedagogical skills in teachers is essential to produce competent and skilled readers for the 21st century.

1.2. Teachers' self-efficacy

Teaching reading requires considerable knowledge in language development, brain development, and essential early literacy skills. Studies have found that a vast number of inservice teachers lack the basic knowledge to address the foundational building blocks of language and reading [22–24]. Additionally, effective professional development and training can support and improve teachers' knowledge and, in turn, improve pedagogy and improve student achievement. One's belief in their ability to be successful in the classroom is referred to as teacher self-efficacy, which is a term used to describe a teacher's belief in their own ability to affect student outcomes such as execution of instructional strategies, behavior/classroom management, and student engagement. Once teachers feel confident in their ability to teach literacy-related skills, students benefit [25]. More specifically, reading teacher self-efficacy (RTSE) is the belief in the ability to teach reading effectively to all students in the classroom whether they are gifted, average, or at-risk readers [26]. Moreover, reading teacher outcome expectancy (RTOE) is "the belief that effective teaching will have a positive impact on students' learning regardless of outside factors".

For teachers of reading to be effective and produce student outcomes, they must possess the skills and the beliefs in their skills to be successful.

2. Research Problem

The importance of effective early literacy instruction and student achievement cannot be overstated. Teachers are expected to be capable of producing proficient readers [27, 28]. According to the research, knowledgeable reading teachers, particularly those with influence in the early grades, have the ability to prevent reading failure through effective teaching practices [29, 30]. Unfortunately, the number of third grade children in Pennsylvania not reading on grade level is 44.2%[5]. Students deserve teachers who can help them become proficient readers. Teachers must enter the field with a thorough understanding of the SoR in order to be effective in teaching reading [31]. Also, teachers should continue to pursue professional development to remain effective. Throughout the past decade, research has claimed that many teachers are not knowledgeable in the SoR and also do not feel adequate to teach early literacy [29, 32, 33].

3. Methodology

The purpose of this study was to explore primary teachers' (grades K-2) RTSE, knowledge of early literacy skills, and professional development opportunities incorporating the SoR. The research questions were: what are the perceptions of K-2 teachers' reading self-efficacy? and what is the level of knowledge of basic literacy skills of K-2 teachers? The researchers employed a QUAN descriptive method design and data were analyzed using Statistical Package for the Social Sciences (SPSS). The questionnaire was comprised of three sections to gauge self-efficacy utilizing the reading teacher efficacy instrument (RTEI), which was created by Szabo and Mokhtari [26], participant knowledge, and professional development opportunities related to early literacy instruction incorporating the SoR.

To ensure consistency in the research, a high degree of validity and reliability was found within the data collection, analysis, and interpretation. The researchers used Cronbach's alpha to determine if the instrument had internal consistency. Also, item difficulty and item discrimination were considered for part two of the questionnaire. The methods used helped to ensure internal and external validity as well as reliability and objectivity [34].

Part one of the questionnaire that measured RTSE, RTEI, was an existing instrument with established reliability and validity. The reliability and validity of parts two and three of the instrument were conducted through consistent edits and test–retest methods. Collingridge and Gantt [35] explain this can be accomplished by establishing face validity which involves the questionnaire instrument being reviewed by different parties who are experts in

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[4]International Literacy Association, "Phonological Awareness in Early Childhood Literacy Development", 2019, https://www.literacyworldwide.org/docs/default-source/where-we-stand/ila-phonological-awareness-early-childhood-literacy-development.pdf

[5]Commonwealth of Pennsylvania, "Assessment Reporting", 2024, https://www.pa.gov/agencies/education/data-and-reporting/assessment-reporting.html#accordion-83586ef055-item-323b87cfec

the topic of early literacy. The researcher used the SPSS to test for statistical significance.

4. Results

4.1. Questionnaire sample

Primary teachers (grades K-2) from Southwestern Pennsylvania public schools served as a convenience sample and included 13 school districts and a total of 33 elementary schools. The questionnaire was distributed to 212 teachers and 126 completed the survey in its entirety, which was a 59% response rate. The instrument consisted of demographic information, teachers' self-efficacy, knowledge of early literacy skills, and literacy professional development opportunities.

4.2. Sample demographics

Frequency distributions and descriptive statistics were used to analyze the demographic data (see Table 1). Female teachers comprised the majority of the sample ($n = 92$, 73.6%). Males ($n = 16$, 12.7%) and those who did not wish to identify ($n = 18$, 14.2%) were a smaller portion of the sample. The grade levels of teachers were fairly evenly distributed: 29 kindergarten teachers (23.2%), 30 first grade teachers (24%), and 31 second grade teachers (24.8%). Additionally, some participants teach multiple grades, for example, 18 special education teachers (14.4%) and 16 reading specialists (13%). Two teachers (1.6%) reported other primary teaching positions, which could possibly include academic intervention teachers, life skills teachers, or literacy coaches. The highest level of education possessed resulted in the greatest percentage of respondents earning a master's degree ($n = 65$, 51.5%). Several respondents reported teaching in the same position for 16 years or more ($n = 45$, 35.7%). Also, respondents' total teaching experience with 16 years or more was the highest percentage at ($n = 55$, 43.7%).

4.3. Questionnaire internal consistency and reliability

Cronbach's coefficient alpha was 0.764 with a sample size of 112 responses and 15 items. This research instrument produced reliable internal consistency. Next, item difficulty was calculated as 0.48. Finally, item discrimination was determined when the researchers calculated the p value (item difficulty) for both the high and low groups. Then, the discrimination index for this questionnaire was created by subtracting the high group p value minus the low group p value. The items in part two of the questionnaire showed all positive values and none of the items are considered "poor items" as described by Ebel and Frisbie [36]. Although four items, question 3, question 10, question 13, and question 15, were considered "marginal items," the questionnaire would still have validity and reliability since all items are in adequate range.

5. Findings

Research question 1: What are the perceptions of K-2 teachers' reading self-efficacy?

Data collected from part one of the questionnaire, which measured K-2 reading teachers' self-efficacy using the RTEI, were analyzed using descriptive statistics. Part one of the questionnaire included 16 statements where participants rated their beliefs about teaching reading using a five-point Likert scale response which ranged from one (strongly disagree) to five (strongly agree). A high

Table 1
Demographic characteristics of questionnaire participants

Characteristics	n	%
Gender		
Female	92	73.6%
Male	16	12.7%
Do not wish to identify	18	14.2%
Current primary teaching role		
General education teacher – kindergarten	29	23.0%
General education teacher – first grade	30	23.8%
General education teacher second grade	31	24.6%
Reading specialist	16	12.7%
Special education teacher	18	14.3%
Other	2	1.6%
Highest level of education possessed		
Bachelor's degree	15	11.9%
Bachelor's degree plus master's level coursework	20	15.8%
I have a master's equivalency	2	1.5%
I have a master's degree	65	51.5%
I have a master's degree plus additional coursework	22	17.4%
I have a doctoral degree	2	1.6%
When highest level of education possessed was earned		
Within 5 years	22	17.5%
5–10 years	30	23.8%
11–15 years	34	27.0%
16 or more years	40	31.7%
Current teaching certification status		
Pre K-4	39	31.0%
Elementary education K-6	93	73.8%
Special education K-12	33	26.2%
Reading specialist K-12	32	25.4%
Teaching experience in current position		
1–5 years	24	19.0%
6–10 years	30	23.8%
11–15 years	27	21.4%
16 years or more	45	35.7%
Teaching experience in total		
1–5 years	18	14.3%
6–10 years	26	20.6%
11–15 years	27	21.4%
16 years or more	55	43.7%

score on the RTEI indicates that a teacher is highly confident about their ability to identify students with reading difficulties and provide appropriate interventions [26]. Before completing all or part one of the questionnaire, five participants withdrew from the questionnaire. The total respondents who completed part one of the questionnaire was 121.

1) Reading teacher efficacy instrument

Part one of the questionnaire included 16 statements where participants rated their beliefs about teaching reading and their ability to produce proficient readers. The RTEI score is the total score of all the questions. There were 126 participants that began the RTEI and five dropped out by the end of part one, so the total that completed part one was 121.

2) Reading teacher self-efficacy and reading teacher outcome expectancy

Szabo and Mokhtari [26] explain that as this score contains both constructs, it is difficult to interpret. So, the RTEI is broken down into two subscales: RTSE and RTOE.

3) Reading teacher self efficacy

Table 2 illustrates the RTSE scores from the sample. Based on the results of the questionnaire, 99% ($n = 120$) of respondents reported positive motivation, particularly, questions 2, 5, and 8. Additionally, 79% ($n = 95$) of participants agreed that they will seek help from the community to heighten the literacy support in the classroom. Moreover, 72% ($n = 90$) of participants disagreed they do not teach reading as well as other subjects. Questions 12 and 14 focused on teaching students with high needs in reading and 62% ($n = 77$) of teachers found it difficult to meet the needs of their students, especially struggling readers.

4) Reading teacher outcome expectancy

RTOE is the second construct presented in the RTEI. A high score indicates the teacher believes that effective literacy teaching would have a positive effect on student learning regardless of the environmental factors involved. Table 3 displays the results of the questionnaire items regarding the RTOE. These questions focus on teachers' abilities to effectively create positive learning outcomes based on belief in oneself. Based on the results of the

questionnaire, the majority of teachers, 75% ($n = 94$), believe that their level of effectiveness relates directly to the teacher's actions. Questions 1, 4, and 7 focused on the teachers' extra effort in the classroom and how it will enhance positive student outcomes. Also, question 9 relates to the teacher being the person responsible for learning outcomes in reading. A majority of participants, 80% ($n = 100$), strongly agreed or agreed that the teacher is responsible for their students' reading outcomes. This signifies that participants believe that outside factors should not be a barrier for their students learning how to read.

As displayed in Table 4, the results of the questionnaire regarding the Reading Teacher Self-Efficacy Instrument (RTEI) included the total score from the instrument, and also the subscales, of the RTSE and RTOE. The sample fell in the average range on the RTEI. The mean (m) for the RTSE was 39.65 and the standard deviation (SD) was 6.46. The sample fell in the average range on the RTSE. Lastly, the mean (m) for the RTOE was 23.06 and the SD was 3.64. The sample fell in the average range on the RTOE. When considering the overall RTEI score and subscale RTSE and RTOE scores, this sample scored average, meaning the participants feel

Table 2
Participants responses for reading teacher self-efficacy (RTSE)

Item	Strongly agree n (%)	Agree n (%)	Undecided n (%)	Disagree n (%)	Strongly disagree n (%)
2. I will continually look for better ways to teach reading	108 (85.7%)	17 (13.5%)	0 (0%)	0 (0%)	1 (0.8%)
3. Even if I try very hard, I will not teach reading as well as I teach other subjects	3 (2.4%)	21 (16.8%)	11 (8.8%)	59 (47.2%)	31 (24.8%)
5. I know several ways to teach reading effectively	33 (26.4%)	61 (48.8%)	5 (4%)	25 (20%)	1 (0.8%)
6. I am not very effective in monitoring reading activities	0 (0%)	7 (5.6%)	14 (11.2%)	85 (68.0%)	19 (15.2%)
8. I understand the process of reading well enough to be effective in teaching reading	31 (24.8%)	62 (49.6%)	6 (4.8%)	25 (20%)	1 (0.8%)
12. I find it difficult to teach students with reading problems	4 (3.2%)	34 (27.2%)	10 (8%)	57 (45.6%)	20 (16%)
13. When teaching reading, I usually welcome students' questions	82 (65.6%)	38 (30.4%)	1 (0.8%)	3 (2.4 %)	1 (0.8%)
14. I find it difficult to explain to students how to improve their reading	1 (0.8%)	28 (23.2%)	9 (7.2%)	60 (48%)	26 (20.8%)
15. I do not know what to do to turn students on to reading	1 (0.8%)	28 (23.1 %)	13 (10.7%)	52 (43.0%)	27 (22.3%)
16. I use community resources to help get support for literacy in my classroom	56 (46.3%)	39 (32.2%)	17 (14.0%)	7 (5.8%)	2 (1.7%)

Table 3
Participants responses for reading teacher outcome expectancy (RTOE)

Item	Strongly agree n (%)	Agree n (%)	Undecided n (%)	Disagree n (%)	Strongly disagree n (%)
1. When a student does better than usual in reading, it is often because the teacher exerted a little extra effort	41 (32.5%)	48 (38%)	20 (15.9%)	15 (11.9%)	2 (1.6%)
4. When the reading performance of students improves, it is often because that teacher has found a more effective way to support reading	32 (25.6%)	75 (60%)	13 (10.4%)	3 (2.4%)	2 (1.6%)
7. When a low achieving student progresses in reading, it is usually due to extra support offered by the teacher	25 (20.2%)	83 (66.9%)	12 (9.7%)	3 (2.4 %)	1 (0.8 %)
9. The teacher is generally responsible for the achievement of students in reading	21 (16.8%)	79 (63.2%)	15 (12 %)	9 (7.2%)	2 (1.6%)
10. Students' achievement in reading is directly related to their teachers' effectiveness in the teaching of reading	18 (14.4%)	76 (60.8%)	16 (12.8%)	14 (11.2%)	1 (0.8%)
11. If parents comment that their child is showing more interest in reading, it is probably due to the performance of the child's teacher	7 (5.6%)	63 (50.4%)	32 (25.6%)	22 (17.6%)	1 (0.8%)

Table 4
Reading teacher efficacy instrument results

Scale	N	M	SD	Scoring interpretation	Med	25th	75th
RTEI	121	62.71	7.58	Average	63	57	68
RTSE	121	39.65	6.46	Average	41	34	44
RTOE	121	23.06	3.64	Average	24	21	25

Note: When analyzing the results, the researchers used the overall scale score (RTEI) in the analysis. In summary, when considering the total score for the self-efficacy (RTEI), 82.7% ($n = 100$) of participants scored either high ($n = 29$, 24%) or average ($n = 71$, 58.7%) and low ($n = 21$, 17.4%). This analysis concluded that the respondents feel confident about their ability to identify students with reading difficulties, and they are confident in their ability to create positive change in students' reading abilities.

confident most of the time about their ability not only to identify students with reading difficulties but also to devise interventions to create positive change in students' reading abilities.

When considering the overall self-efficacy of the participants, Table 5 represents how many participants scored high, average, and low. In this particular study, participants that scored high or average are considered to be confident in their ability to create positive reading outcomes. Overall, when considering self-efficacy and creating positive outcomes (RTEI), 82.7% ($n = 100$) of

participants scored either high or average and 17.4% ($n = 21$) of participants scored low. When considering self-efficacy (RSTE), 74.4% ($n = 90$) of participants scored either high or average and 25.6% ($n = 31$) of participants scored low. When considering just outcome expectancy (RTOE), 90.9% ($n = 110$) of participants scored either high or average and 9.1% ($n = 11$) of participants scored low. In all scales, the majority of the sample believed in their ability to positively affect student reading outcomes.

Research question 2: What is the level of knowledge of basic literacy skills of K-2 teachers?

Data ($n = 112$) were analyzed from 15 researcher-created multiple choice questions that focused on five components of reading: phonological awareness and phonemic awareness, phonics, comprehension, vocabulary, and fluency. The average score was 60%, and Table 6 indicates the number and percentage of correct responses to each item. The correct responses are italicized.

According to the responses, participants had difficulty with defining the components of reading (67% accuracy). Questions 1, 2, 3, 6, 7, 9, and 14 focused on the definitions of the five components of reading. Respondents also had difficulty with questions that pertained to application of reading instruction (56% accuracy). Two questions pertained to Scarborough's [37] reading rope (questions 12 and 13) and involved vocabulary instruction. Respondents understood how to teach vocabulary in an explicit manner (70%), but only half knew the skills needed for word recognition (45%

Table 5
Scoring range outcomes of self-efficacy

Scale	Scoring range	High level		Scoring range	Average level		Scoring range	Low level	
		n	%		n	%		N	%
RTEI	69–80	29	24.0%	56–68	71	58.7%	16–55	21	17.4%
RTSE	46–50	15	12.4%	36–46	75	62.0%	10–35	31	25.6%
RTOE	25–30	47	38.8%	18–24	63	52.1%	6–17	11	9.1%

Table 6
Early literacy knowledge question results

Question	Response	n	%
1. SoR (Science of Reading) is:	The way a student reads	11	9.8%
	Reliable evidence about how humans learn to read and how reading should be taught	85	75.9%
	How a teacher teaches reading	8	7.1%
	When the idea of reading originated	2	1.8%
	Not sure	6	5.4%
2. Phonological awareness is:	The ability to use letter-sounds correspondence to decode	26	23.4%
	The understanding of how spoken language is broken down and manipulated	70	63.1%
	A teaching method for decoding skills	10	9.0%
	The same as phonics	5	4.5%
3. Phonics is:	The ability to recognize spoken words as a sequence of individual sounds	45	40.5%
	A method in which basic phonetics, the study of human speech sounds, is used to teach beginning reading	44	39.6%
	The smallest sound units of a language	14	12.6%
	The study of human speech sounds	8	7.2%
4. A combination of two or three consonants pronounced so that each letter keeps its own identity is called:	Silent consonant	1	0.9%
	Consonant digraph	16	14.4%
	Diphthong consonant	8	7.2%
	Consonant blend	85	76.6%
	Not sure	1	0.9%

(*Continued*)

Table 6
(*Continued*)

Question	Response	n	%
5. Which of the following words contains a digraph?	Fly	10	9.0%
	Bring	56	50.5%
	Blond	24	21.6%
	Home	15	13.5%
	Not sure	6	5.4%
6. The smallest sound unit of language that distinguishes one word from another is:	Consonant blend	0	0.0%
	Grapheme	23	20.7%
	Macron	8	7.2%
	Phoneme	79	71.2%
	Not sure	1	0.9%
7. Phonemic awareness is:	The understanding of how letters and sounds are put together to form words	17	15.3%
	The ability to break down and manipulate individual sounds	60	54.1%
	The individual sounds in spoken language	21	18.9%
	The ability to use sound-symbol correspondences to read new words	13	11.7%
8. What type of task would the following be: "Say the word 'cat.' Now say the word without the /k/ sound."	Blending	2	1.8%
	Rhyming	1	0.9%
	Phoneme segmentation	19	17.1%
	Phoneme deletion	89	80.2%
9. Comprehension:	Can be improved with instruction	76	68.5%
	Cannot be improved with instruction	8	7.2%
	Occurs naturally in a child's reading development	19	17.1%
	None of the above	6	5.4%
	Not sure	2	1.8%
10. To reach reading comprehension, a reader must have:	Language comprehension	4	3.6%
	Word recognition and language comprehension	32	28.8%
	Decoding and language comprehension	59	53.2%
	Vocabulary acquisition and decoding	14	12.6%
	Not sure	2	1.8%
11. Which is NOT a comprehension strategy:	Metacognition	12	10.8%
	Question-answer relationship	4	3.6%
	Graphic organizers	13	11.7%
	Morphology	69	62.2%
	Not sure	13	11.7%
12. _____ is a way of teaching vocabulary in a direct manner.	Testing students on words they already know	8	7.2%
	Providing students with strategies for learning words	78	70.3%
	Asking students to identify which words rhyme	14	12.6%
	Giving students a passage to read out loud	7	6.3%
	Not sure	4	3.6%
13. The skills needed for word recognition are:	Language structures and verbal meaning	4	3.6%
	Decoding, fluency, and comprehension	31	27.9%
	Background knowledge and vocabulary	25	22.5%
	Phonological awareness, sight recognition, and decoding	50	45.0%
	Not sure	1	0.9%
14. Automaticity and fluency:	Both mean, "reading with speed and accuracy"	25	22.5%
	Are not necessary for reading success	9	8.1%
	Are different, but related processes	67	60.4%
	None of the above	8	7.2%
	Not sure	2	1.8%
15. The following are ways to increase reading fluency:	Extra practice writing complex phonic elements	10	9.0%
	Repeated readings of instructional level text	54	48.6%
	Using good decoding strategies	17	15.3%
	Both extra practice writing and reading complex	30	27.0%

correct). Moreover, most were aware of how to improve comprehension (questions 9 and 12), but, consequently, respondents were mostly unaware of that decoding and language comprehension is key to comprehension according to the simple view of reading [38]. Lastly, respondents were mostly aware of questions that assessed their knowledge of phonics but could not define it.

5.1. Discussion

The current study uncovered that respondents exhibited low early literacy knowledge with a 60% average score while also exhibiting high ($n = 29$, 24%) or average ($n = 71$, 58.7%) self-efficacy ($n = 100$, 83%). In particular, 99% of respondents scored high on topics such as continually looking for better ways to teach reading, knowing several ways to teach reading effectively, and understanding the reading process. Teachers have the primary responsibility to teach literacy because learning to read by third grade sets students up for success for the rest of their educational careers [39–44]. If teachers feel confident in their ability to teach reading, they will experience some success. Learning how to read is not a natural process [45], and teachers must understand the complex way in which children learn. Self-efficacy assessments assess teachers' confidence in their own abilities [46] and reveal areas where they rate themselves low in efficacy, perhaps revealing areas for professional improvement. Varghese et al. [47] find a connection between higher teacher self-efficacy and higher student achievement. If early literacy teachers are familiar with the SoR, then in turn they can help their students become proficient readers, and Bandura [48] as well as Schwarzer [49] posit that teachers with high self-efficacy choose to take on more difficult activities.

School districts must invest in teacher training to use the curriculum effectively and with fidelity. Research indicates that teachers are ill-equipped and not knowledgeable in the SoR [29, 32, 33]. Using professional development dollars to better prepare inservice teachers in the implementation of evidence-based literacy instruction has the potential to close the reading gap. Effective professional development provides teachers the opportunity to add knowledge and skills to their toolbox and ultimately lead to better student outcomes [50]. Professional development is a means for teachers to collaborate with their colleagues, and one avenue through which administrators can support their teachers. According to Castles et al. [51], the goal of reading is to ultimately understand what is being read while the goal of reading development should be to incorporate a system that allows children to construct meaning from print. Teachers must then understand this connection to better equipped students to be proficient and successful readers.

The term "Science of Reading" is somewhat inaccurate because those adopting it tend to misunderstand the purpose and goal such as prescribed instruction [52]. According to these studies, the conversation must shift from the science of reading to a science of reading instruction and teaching. Seidenberg et al. [53] also address issues regarding existing attempts to apply this knowledge to improve reading outcomes. School districts must support literacy teachers and use the science as a catalyst for change.

Professional development criteria for teachers in many states do not mandate an in-depth training outline to follow. According to the Act 48 Professional Education Plan Guidelines[6] established by the Pennsylvania Department of Education, "all certified holders must earn 180 hours of professional development related to an area of professional educator's assignment or certification every five years". The document explains allowable professional education activities, whereas content area including literacy practice is mentioned. The criteria do not list mandatory hours for content areas, more so it is a professional's choice of what type of professional development is completed.

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[6]Commonwealth of Pennsylvania, "Act 48 Approved Provider Guidelines", 2020, https://www.pa.gov/agencies/education/programs-and-services/educators/continuing-education-and-professional-development/act-48-approved-providers/act-48-approved-provider-guidelines.html

McCutchen et al. [24] examine teachers' instructional approaches to improve students' reading achievement after 1 year of training, and the results indicate that when teachers have evidence-based professional development, students' reading scores improved. When teachers implemented explicit and systematic phonological awareness and phonics instruction, students' reading scores increased. To this point, Cunningham et al. [23] find that primary teachers' knowledge of early literacy skills was lacking, and these teachers felt as though their literacy knowledge appeared to be substantial. These findings imply that teachers tend to exaggerate their reading-related subject matter expertise and are frequently unaware of what they do and do not know. Likewise, McCutchen et al. [24] find that when teachers are taught how to teach synthetic phonics, students' reading scores increased in decoding unfamiliar words. This study uncovered two significant findings: teachers' knowledge can be strengthened with training and changes in teachers' knowledge and classroom practices can enhance student learning. These findings suggest that some inservice reading teachers are unfamiliar with the instructional strategies required to effectively teach early literacy.

Similarly, Podhajski et al. [54] compare teacher knowledge and student outcomes. A sample of teachers completed a 34-hour course on scientifically based reading instruction. In the absence of mandated or required content-area professional development, inservice reading teachers must rely on information from teacher manuals to learn about spoken and written language principles and build techniques for teaching children to read. According to Moats [31], novice teachers require intensive, content-driven professional development based on reading science breakthroughs. This includes knowledge of how children develop reading skills, the basic and systematic processes of reading, how the English language is structured in spoken and written form, and the ways that these concepts are related.

Moreover, university teacher preparation programs have the unique opportunity to train preservice teachers to be effective teachers of literacy that is situated in current literature. According to Tortorelli et al. [55], lack of instruction focused on code-related skills in teacher preparation programs has produced ill-equipped teachers graduating from teacher preparation programs who are not adequately preparing teachers to teach students how to read. Gewertz [56] uncover that the majority of elementary schools and teacher preparation programs still favor the whole language movement. Likewise, Hikida et al. [57] find that preservice teachers come into the field of teaching lacking scientifically based knowledge related to reading pedagogy. One way to solve this issue is to provide preservice teachers with opportunities in the field situated in the SoR.

5.2. Limitations and delimitations of the findings

The study was limited to data gained from the questionnaire and the only criteria required to be part of this sample were to be a kindergarten, first grade, or second grade teacher of literacy. This included classroom teachers, reading specialists, special education teachers, and academic intervention teachers. All of the data were self-reported and raw data had the potential to be skewed by the participants. Items were not timed so teachers may have taken advantage of the opportunity to search for answers to the knowledge questions. Also, Likert-scale statements from the self-efficacy questionnaire may have not been answered honestly based on the teacher's desire to perform. Another limitation was that data of student achievement were not collected.

Delimitations in this study include geographical convenience for the researchers and the examination of teachers' responses

through the lens of Bandura's work [48]. This study does not incorporate references to the post COVID-19 context and the set of phenomena raised from this pandemic related to teacher training or classroom reading instruction.

6. Conclusion

The research questions this dissertation focused on were what are the perceptions of K-2 teachers' reading self-efficacy, what is the level of knowledge of basic literacy skills of K-2 teachers, and in what ways do K-2 reading teachers report integrating the SoR into their literacy lessons? Significant findings included low early literacy knowledge (60% average score) from the sample while having average self-efficacy beliefs. Also, low professional development opportunities were offered to participants from school districts.

Primary reading instruction is so important in helping children become proficient readers. Teachers are supposed to be qualified, successful, knowledgeable, capable, literacy instructors [27, 28]. According to the research, knowledgeable reading teachers, particularly those with influence in the early grades, have the ability to prevent reading failure through good training [29, 30]. Unfortunately, the number of third grade children in Pennsylvania not reading on grade level is 44.2%. Students deserve teachers who can help them become proficient readers.

Teachers must enter the field with a thorough understanding of the SoR in order to be very effective in teaching reading [58] and continue to pursue professional development to remain effective reading teachers. Lyon and Chhabra [20] contend that in order to prevent reading failure, educators must understand and implement evidence-based pedagogy. Teachers need to not only know the scientific strategies to teach literacy effectively but also must be able to act. Participants may have only a conceptual understanding of the SOR. Simply understanding the concept of the SOR and how it can be incorporated into early literacy instruction is different than successfully implementing strategies that elicit positive reading outcomes.

Ethical Statement

This study does not contain any studies with human or animal subjects performed by any of the authors.

Conflicts of Interest

The authors declare that they have no conflicts of interest to this work.

Data Availability Statement

The data that support this work are available upon reasonable request to the corresponding author.

Author Contribution Statement

Kathryn Davis: Conceptualization, Methodology, Formal analysis, Investigation, Data curation, Writing – original draft, Visualization, Project administration. **Carianne Bernadowski:** Conceptualization, Formal analysis, Writing – review & editing, Supervision.

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