Chapter

Ludus Reading and RoboKind™ Robots Increase Early Literacy Rates

Jessica Redcay

Abstract

The research study aimed to examine the influence of a new model for reading instruction combining Ludus Reading and RoboKind™ Robots on first-grade students' phonics skills and attitudes toward reading. Ludus Reading phonics instruction involves explicit and systematic lessons with underpinnings in play-based, technology, and multisensory techniques. RoboKind™ Robots are facially expressive, assistive humanoid robots that can be coded to talk, move, and display images on their chest screen. The RoboKind™ Robots were programmed to act as teaching assistants and help the teacher during the Ludus Reading phonic lesson. A quasi-experimental pre-post design was used to examine three research questions comparing the differences between pre-and post-scores when using Ludus Reading and RoboKind™ Robots in terms of the Dynamic Indicators of Basic Early Literacy Skills (DIBELS®) Correct Letter Sound (CLS), DIBELS® Whole Words Read (WWR), and Elementary Reading Attitude Survey [ERAS] scores between the group receiving Ludus Reading and RoboKind™ Robots instruction and the control group. The null hypotheses for Research Questions 1–3 were rejected. The results supported the use of Ludus Reading and RoboKind™ Robots to teach phonics because the experimental group demonstrated a statistically significant increase in their ability to decode and a positive attitude toward reading.

Keywords: early literacy, humanoid robots, science of reading, phonics, decoding, multisensory learning, early intervention, play-based learning

1. Introduction

Visualize this … a first-grade teacher brings five first-graders with the lowest reading scores in her class to the cafeteria to receive a new kind of reading tutoring. Each student is greeted by a pre-service teacher with a table set up with hands-on learning materials and a humanoid robot as a teaching assistant throughout the lesson. The student receives explicit, systematic, and one-on-one phonics instruction for the next half-hour. At one table, a student, Sophie, is looking at the image of a mouth on the chest screen of the robot and listening to the robot state, "The letter a is a vowel, and the short sound is /ă/. Look at my mouth. Now you try it." At another table, a student, Davin, is writing closed-syllable words with an invisible ink pen and shining the light on the letters to decode the different phonemes. As the half-hour unfolds, students practice their phonics skills using various multisensory strategies across the various learning modalities, also known as I-VAKT (Interactive Technology, Visual, Auditory, Kinesthetic, and Tactile) strategies. Students are eager to participate in the lesson as they self-select materials from a choice menu to practice the targeted skill for the lesson. Students giggle as they receive rewards and praise from the robots throughout the lesson. Students activate the four literacy domains (speaking, listening, writing, and reading) as they complete various interactive activities. After practicing sound and word recognition in isolation, students apply it as they write their own dictated sentences and decode a passage. Instead of appealing to the teacher, as they read the passage, students attend to the words and tap out the sounds in them until they figure it out on their own. After reading a passage, a student smiles confidently and states, "Wait? I didn't know that I could read." Then the teacher returns to take the students back to class, and the students sigh and ask if they can stay longer because they are enjoying learning to read.

The previous scenario occurred 11 times at an elementary school in Fayetteville, North Carolina, United States. Pre-service teachers at Methodist University enrolled in a reading foundation course and helped facilitate the tutoring. The pre-service teachers learned to bridge the Science of Reading (body of research about how students learn to read) and practice. The students learned how Ludus Reading is aligned with the Science of Reading and how to use RoboKind™ Robots as teaching assistants. Ludus Reading was developed by the instructor of the course, Dr. Jessica D. Redcay. Ludus is a Latin word that means play; subsequently, students learn phonics through explicit and systematic lessons using technology, play-based, and multisensory strategies. Ludus Reading and RoboKind™ partnered to create an app used by the pre-service teacher that prompts the robots to deliver content and rewards 10 times throughout the half-hour lessons.

2. Literature review

2.1 Illiteracy and alliteracy issues

In 1955, Rudolph Flesch explained the crisis of illiterate Americans stemmed from a lack of phonics instruction in schools [1]. Thirty years later, Jonathan Kozol continued recognizing the problem by publishing "Illiterate America" [2]. Seventeen years later, The Reading First Initiative provided $1 billion to schools to teach phonics, and 5 years later, a research study demonstrated that regardless of funding, students did not improve in learning to read [3]. Sixty-seven years after Flesch identified an illiteracy crisis in America, 65 percent of U.S. fourth graders scored below grade level in reading [4], and more than 43 million adults in the United States cannot read or write above a third-grade level [5].

Further, of the 43 million adults in the U.S. who are literate, only 23% read a book or a part of a book over the last year [6]. In addition to having a culture of illiteracy (an illiterate person is unable to read), the U.S. has an issue with aliteracy (an aliterate person can read but does not select to read). Illiteracy rates span beyond the United States. In the world, 781 million people are illiterate (cannot read a single word) or functionally illiterate (with a basic or below basic ability to read) [7].

The high illiteracy rates in adults still need to reflect the impact COVID-19 in 2020 will have on future adult literacy rates. A Stanford study found that second and third graders in the United States are 30 percent behind the expected typical year of learning due to the pandemic. The researchers explained that teachers need to find practices that will accelerate learning for the students who have fallen behind [8].

A new approach to teaching phonics is needed to accelerate students' learning. The effectiveness of new reading programs needs to be examined. The research study explored the effectiveness of the new reading approach that combined Ludus Reading and RoboKind™ Robots in terms of the students' phonics scores before and after the intervention between an experimental and control group. In addition to creating literate students, students need to develop positive attitudes toward reading, so the students' attitudes were also considered.

2.1.1 Early intervention

Early Interventions need to be implemented because research has demonstrated that 75% of third graders who struggled with reading continued to struggle in the subsequent years in schools [9]. Research has shown that children need intervention (systematic, structured, and explicit teaching focusing on a targeted area of need) early (first 2 years of school). Essentially, students need explicit, systematic phonics instruction before age six because 95% of students will learn to read by the end of first grade with proper instruction. The remaining 5% of students will need additional reading support in the future [10]. Out of the students identified with learning disabilities, 80% have reading disabilities [11]. With effective Early Intervention, most reading problems could have been prevented [12]. The research study focused on supporting first-grade students identified by the teacher as having the greatest reading need. If students are provided with targeted, Early Intervention before the end of first grade, it is possible to offset future reading problems for the student.

2.1.2 Neuroplasticity and improving reading performance

The risk of future reading struggles decreases when students receive effective instruction in kindergarten and first grade. The good news exists for struggling readers, regardless of age, because the brain is pliable. Neuroplasticity is the idea that explains that students' brains can change for the better or worse. The brain can be re-wired when an effective teacher can create new neuropathways that help change students' attitudes and knowledge about reading [13].

Reading research demonstrates that reading performance increases for students when students are provided with an increase in books and opportunities to read. In addition, reading performance increases when students receive quality reading instruction from a well-trained teacher and a quality program [14]. According to the National Reading Panel Report reading instruction needs to include the five pillars of reading: Phonemic Awareness, Phonics, Vocabulary, Fluency, and Comprehension. Further, research has demonstrated that programs are effective when the phonics instruction is taught in a systematic (sequential) and explicit (direct) manner [15]. The findings are consistent with the recommendations by the International Dyslexia Association that students need to participate in programs based on Structured Literacy. Structured Literacy involves teaching students to decode words explicitly and systematically. Students learn systematically, so the content follows a logical order that builds from the easiest and most basic concepts and builds based on the previous concepts learned. Explicit instruction involves directly teaching concepts between the student-teacher instead of naturally learning concepts [16].

School leaders sometimes equate explicit, systematic phonics instruction with the need to adopt a scripted reading program. However, research has demonstrated that scripted reading programs have a negative impact on teachers because it often undermines their ability to teach. Further, studies have shown that students who received instruction from scripted programs lagged behind their peers who did not use a scripted program [17]. A need exists for a program to provide teachers with guidelines and prompts systematically and explicitly without telling teachers what to say and without taking away differentiated learning opportunities for students. Further, the program needs to provide clear directions to be implemented with fidelity. Ludus Reading is crafted to provide teachers with clear guidelines to ensure that the instruction is delivered explicitly, and the program is sequential or systematic. The lesson plans are structured using a Gradual Release of Responsibility Model for teachers because scaffolds (supports) are provided if the teacher needs the information. Still, the teachers are not told what to say. Even though the program is not scripted, there are a couple of embedded scripts for the robot or teacher to ensure the instruction is taught with fidelity and accuracy. When Ludus Reading was used in combination with RoboKind™ Robots, then explicit instruction was provided by the teacher and robot. Whereas the robot was programmed with a script, the teachers were treated as professionals who were provided with targets and guidance but not told what to say.

2.2 Science of reading and Ludus reading

Ludus Reading has underpinnings in the Science of Reading. The Science of Reading (SoR) refers to the body of research about students learning to read. The research consists of thousands of studies, billions of dollars, and at least five decades of research. The research helps informs teachers about the best practices for helping students learn to read. The researchers have developed similar ideas about how students learn and do not learn to read. Even though thousands of studies can inform teaching practices, students are still not learning to read. Therefore, the goal of Ludus Reading is to use existing research and implement it in better ways to help students learn to read and enjoy learning to read.

2.2.1 Reading theory and research

Various Functional MRIs of the brain have demonstrated how students are learning to read. People naturally learn to speak but reading has to be taught. Reading occurs within the Four-Part Processor on the left hemisphere of the brain. The Phonological Processor and Orthographic Processor work together for students to decode words. The phonological Processor uses sounds (phonemes) to process words. Orthography refers to the writing system. Orthographic Processors involve recognizing the letters and combinations of letters within the written language. After decoding the word, the word moves to the meaning and context processors [18]. Tolman's Hourglass further explains the two processors (phonology and orthography from the Four-Part Processor. The top of Tolman's Hourglass is referred to as phonological awareness. The levels range from early (syllable, alliteration, onset-rime), basic (segmenting, blending), and advanced (deleting, substituting, and reversing). Phonological Awareness directly connects to phonics and transitions learning into orthographic processing (the ability to understand the spelling system) [19].

In 1986, Gough and Tunmer introduced The Simple View of Reading (SVR) formula. The formula is used to explain the two basic components of reading. The SVR is word reading (decoding) x language comprehension = reading comprehension. If one part of the equation is zero when you multiply, you will not successfully have a student comprehend the text [20]. Scarborough's Reading Rope is a visual representation that expands upon The Simple View of Reading. Scarborough's Reading Rope states that reading consists of language comprehension (background knowledge, vocabulary, language structure, verbal reasoning, literacy knowledge) and word recognition (phonological awareness, decoding, and sight recognition). The two parts come together to help develop skilled readers [21].

In 1995, Linnea Ehri introduced the concept that students' progress through four phases of language development. The Pre-Alphabetic Phase involves students understanding the general concepts of print and incidental visual cues. The Partial-Alphabetic Phase involves students developing phonological and phonemic awareness skills. Students recognize syllables, onsets-rimes, initial phoneme matching, letter names, and some letters. The Full-Alphabetic Phase involves students segmenting and blending 3–4 phonemes. Students understand an initial set of phoneme-grapheme correspondences and start to recognize words automatically. During the Consolidated-Alphabetic Phase, students develop advanced phonemic awareness skills. In addition, students focus on orthographic mapping of words, phoneme-grapheme links, phonograms (word families), syllable patterns, and morphemes, and increase automatic word recognition [18]. Ludus Reading has a systematic approach, and the lessons help students progress through Ehri's Phases.

2.2.2 Phonics

Orthography means writing system. English uses a deep morphophonemic (opaque) orthographic system. English includes morphemes (meaningful parts) and speech sounds (phonemes). The English writing system has evolved over time. It started with the earliest form of writing (pictograms) from the Egyptians (5000 BCE). It developed with the Phoenician Alphabet in 2000 BCE; 19 of our 26 letters are from it. Over time the language evolved with the Greek (800 BCE), Ancient Roman (600 BCE), and Modern Roman (1840 CE) [22]. Since English uses a deep morphophonemic orthographic system, it takes readers time to develop skills to read sentences like: "It can be understood through tough thorough thought though."

There are 26 letters in the English language alphabet and 44 different phonemes (sounds). A grapheme is the smallest writing unit to represent phonemes [23]. Phonics instruction involves matching phonemes and graphemes. Approximately 84% of English language words follow phonetic patterns [24]. There are two types of letters: Vowels and Consonants. Vowels are open, unobstructed speech sounds. There are 18 vowel phonemes. The vowels are a, e, i, o, and u. Sometimes y and w. The schwa is a lazy, unstressed sound commonly occurring in unstressed syllables. Examples of a schwa include a, the, of, and away. Students learn the vowels best when they are organized within the Vowel Valley. The Vowel Valley refers to the arrangement of vowels to match the formation of the mouth and jawline [25]. Vowels are short or long based on the type of syllable. Short vowel sounds are denoted with a curve above them. This symbol is called a breve. The long line above the vowel is referred to as a macron and represents a long vowel sound. A consonant is an obstructed sound with teeth, tongues, or lips. When two consonants keep their sound but blend together, we refer to this as a consonant blend (ex., bl, cr). When two consonants come together to make a new sound, called a consonant digraph, and three letters together are called a trigraph. Ludus Reading involves explicitly teaching the students the different phonemes and graphemes. Students focus on their mouth and jaw positioning when pronouncing the sounds. Further, Ludus Reading includes the Vowel Valley technique to help students pronounce the sounds. The RoboKind™ Robots were used throughout the lesson to display images of how the mouth looks connected to the different sounds.

Students learn best when the six syllable types are introduced. Closed Syllables end in a Consonant (C), and the Vowel (V) is short (CVC, VC). Open syllable words end in a vowel, which is long (CV). The silent e makes the vowel long (CVCe). A vowel team makes the long vowel sound in the word (CVVC). R-Controlled vowels do not allow the vowel sound to be heard in the word. The [le] comes after a consonant for the final syllable type. Teachers start with closed syllable types and short vowel sounds before moving on to long ones [26]. Students learn the concept best when a closed door represents the consonant at the end of a word. The consonant closes the door, and the vowel is short in the word. The vowel makes a long sound when the door opens (no consonant). Ludus Reading involves teaching the different syllable types, and the students learn the closed and open-door techniques. The RoboKind™ Robots displayed different syllable types on the chest screen and explained them further to the students.

2.2.3 Play-based learning

The idea for "Ludus" emerged from Huizinga's Homo Ludens: A Study of Play Element in Culture. Huizinga described play (Ludus is Latin for play) as essential to human life [27]. Research has demonstrated that guided play yields superior learning retention and academic achievement in young children [28]. Meaningful play opportunities are spontaneous and not scripted, and students find that play is enjoyable [29]. Ludus Reading includes a focus for the lesson, and students use play-based activities to practice the content. Play-based activities should help students retain information.

2.2.4 Gradual release of responsibility model

In 2008, Fisher and Frey developed the Gradual Release of Responsibility (GRR) Instructional Framework that involves shifting the responsibility from the teacher to the student throughout a lesson. The GRR model was developed further from the work of Pearson and Gallagher in 1983. There are four components of the GRR model. This first component is often called "I do." Explicit skills are taught during the first component of the lesson. Guided Instruction includes the teacher and student's responsibility, and the component is referred to as "We do." The next component involves Collaborative Work, and the final component involves Independent Work or "You do it alone." The lesson transitions from the teacher's responsibility to the student's responsibility [30]. Students benefit from using the GRR model because they develop control and ownership over their work, and scaffolds are provided to help students transition into independent learners [31]. The lesson plans for Ludus Reading use the GRR Instructional Framework. The lessons start with the teacher and RoboKind™ Robots explicitly teaching the targeted phonics skill. The teacher interacts with and guides the students through activities to practice the lesson's focus. The students transition into practicing the skill independently using different self-selected, play-based activities.

2.2.5 Student choice

Universal Design for Learning (UDL) is a framework to create a classroom environment that accommodates the needs and abilities of all learners. Teachers present information in multiple ways, and students are provided with numerous ways to demonstrate their learning [32]. A Choice Menu is an approach that aligns with the UDL framework. Teachers organize learning activities in rows and columns. The students are given choices about which activities they want to complete to practice the targeted skill or demonstrate their learning in different ways. A Choice Menu gives students more ownership over their work, and students are more intrinsically motivated [33]. Ludus Reading is centered upon the UDL framework, and a choice menu is used for students when self-selecting play-based activities during independent practice. The RoboKind™ Robots displayed the targeted words on the chest screen and described the different options on the choice menu to the students during the lesson.

2.2.6 Repetition of practice

Repetition is needed to strengthen neuropathways. Synaptic connections occur when a person learns something. Practice needs to happen to transfer learning from short-term to long-term memory. Everyone needs a different number of opportunities to practice something before retaining new knowledge. Gifted students can learn a new letter or sound after 1–4 repetitions. Typical students can learn a new letter or sound after 4–14 repetitions. Students struggling can learn a new letter or sound after 14–40 repetitions. Students with dyslexia or learning disabilities can learn a new letter or sound after 40–200 repetitions [34]. Ludus Reading considers the importance of repetition in learning new letters and sounds. Each phonics lesson includes 40 opportunities for students to practice different letters and sounds. Additional practice is provided to students if needed as well. In addition, when Ludus Reading was combined with the RoboKind™ Robots, students could practice the letters, sounds, and syllable types more often because the robot could continue to repeat the instruction.

2.2.7 Multisensory input

As previously stated, Various Functional MRIs of the brain have demonstrated how students learn to read using Four-Part Processor within the brain's left hemisphere [18]. Students need to strengthen various brain areas to activate the left hemisphere for reading. Students benefit from active participation [35] and the use of VAKT (Visual, Auditory, Kinesthetic, and Tactile) strategies [36]. In 2014, Dr. Jessica Redcay coined the term I-VAKT and expanded further upon the VAKT strategies. The letter I placed in front of VAKT represents Interactive Technology. Students do not use technology in passive ways; instead, students interact within the lesson [37]. The I-VAKT strategies are integrated throughout the lessons. Throughout the lesson, students interact with embedded features in the slides, and they interact with the RoboKind™ Robots. During each lesson, the students practice across the various modalities as they: 1. See It 2. Hear It 3. Do It 4. Touch It. Specifically, during the independent practice, the students self-select from a choice menu one of the play-based I-VAKT strategies to practice the target skills. For example, the students might select a Kinesthetic Activity that involves bouncing a ball to the different words. Another student might choose a Tactile Activity of making the syllable type out of Play Dough.

2.2.8 Assessment and effective feedback

Research has demonstrated that students benefit when feedback is provided to a learner throughout a lesson. The student should use the feedback to improve performance [38]. In the Ludus Reading lesson plans, instructional coaching notes are provided to offer suggestions to teachers on what to say when students demonstrate different common articulation errors. The comments were added as pre-service teachers asked questions when working with students. For example, if a student makes the /f/ sound instead /th/, then you prompt the students to look in the mirror to see that their tongue pushes slightly through your teeth when you make the /th/ sound. We call the /th/ sound naughty because you stick out your tongue a little. These instructional coaching notes help teachers provide specific and clear feedback throughout the lessons.

Research has demonstrated that clear learning targets aligned with the assessments help determine if students have shown mastery before moving on to the following target skills [38]. Assessment is included after each lesson within Ludus Reading. If students still need to demonstrate mastery, additional lessons are provided so the student can continue to practice the targeted skill. However, only 11 sessions were included in the research study, so remediation was unavailable. However, feedback throughout the lessons was used.

2.2.9 Previous research supporting Ludus reading

In 2014, a research study with 75 kindergarten students demonstrated that students in the experimental group scored higher on the Dynamic Indicators of Basic Early Literacy Skills (DIBELS®), Nonsense Word Fluency (NWF), Correct Letter Sounds (CLS) with a mean of 53 compared to the control with a mean of 32. Essentially, the students in the control group could identify 32 letter sounds per minute, and the students in the experimental group could identify 53 letter sounds per minute. In addition, the students in the experimental group increased their overall reading level score to a mean of nine compared to the control group, with a mean of five on the Developmental Reading Assessment, Second Edition (DRA-2®). Further, the students in the experimental group retained the reading scores at the beginning of first grade. The embedded qualitative analysis of the study demonstrated that students in the experimental group showed higher levels of enjoyment in reading compared to the control group [37]. In the subsequent years, two additional teachers used the program to provide feedback about enhancing and improving it.

2.3 Ludus reading and RoboKind™ robots

In 2022, Ludus Reading partnered with RoboKind™ to create an app allowing teachers to prompt the robots to act as teaching assistants with 11 existing Ludus Reading lessons. Richard Margolin created the RoboKind™ Robots. RoboKind™ is an educational technology company that creates assistive, facially expressive humanoid robots used as teaching assistants to engage students in new ways while delivering research-based and quality lessons. The RoboKind™ Robots include four facially expressive humanoids (Milo, Veda, Carver, and Jemi), and the assistive robots help students learn. The humanoids can smile, laugh, walk, speak, and display images on a chest screen [39].

RoboKind™ has a CASE®-Endorsed Social Emotional Learning (SEL) Curriculum that addresses four key areas (Emotional, Conversational, Situational, and Calm Down). Refer to **Figure 1** for a picture of the RoboKind™ Robots. The curriculum helps students (1) tune in on emotions; (2) express empathy; (3) act more appropriately in social situations; (4) self-motivate; (5) generalize in the population. Research

Figure 1.
RoboKind™ robots. The image is published with permission from Methodist University and Christian Naranjo (photographer).

has demonstrated that students using the program achieve mastery of the concepts and generalize those skills to human interactions at a 90% rate [40]. One research study demonstrated that children on the Autism Spectrum engaged with Milo 87.5% of the time compared to 2–3% of the time with a human therapist alone [39]. In addition, to the research studies demonstrating increased outcomes for students and higher levels of student engagement, RoboKind™ has received various awards, including the Super Choice SEL Program of the Year by the Institute for Education Innovation [40].

Since previous research supported the effectiveness of using Ludus Reading [37] and RoboKind™ Robots [39, 40], the two programs collaborated to determine if the combination of both would help improve early literacy scores for students and influence students' perceptions of reading. Eleven lessons from Ludus Reading were combined with 10 prompts from the RoboKind™ Robots. Five of the prompts related to the instructional content. The robot would display an image on the chest screen and talk—five of the prompts related to rewards. Different images of rewards were displayed on the chest screen, and the robot would provide specific praise to the student. A total of 55 RoboKind™ Robots prompts were developed within an app to be used in combination with 11 Ludus Reading lessons.

2.4 Measures of reading

After receiving signed permission from the school, parents of the students, and approval from the IRB, the researcher for the current study obtained the achieved Dynamic Indicators of Basic Early Literacy (DIBELS®) and The Elementary Reading Attitude Survey (ERAS) data from the fall of 2022. Five pre-service teachers implemented Ludus Reading and RoboKind™ Robots tutoring sessions. The pre-service teachers completed assessments for the students receiving tutoring and five students who were staying in the classroom who were randomly selected by the classroom teacher. The archived data were not analyzed to determine the effectiveness of tutoring. Archived quantitative data were available and necessary to evaluate the effectiveness of a new way to teach phonics. The researcher used pre-existing, archived data. The researcher did not want to interfere with what had already naturally occurred within the classroom setting. Further, the assumption is made that the pre-service teachers used the correct techniques to administer and score the archived data.

2.4.1 DIBELS®

Dynamic Indicators of Basic Early Literacy Skills (DIBELS®) is a standardized assessment tool to monitor kindergarten through third-grade students' progression in becoming a reader. The tests are timed and last about 1 minute each [41]. The DIBELS® used standardized administration and scoring procedures. The pre-service teachers read directions from scripted directions and used the directions in the manual to score the results. The research study used DIBELS® NEXT, which has been renamed to Acadience®. However, for the research study, the test will be referred to as DIBELS®.

The raw scores fell within a corresponding score range that reflected a recommendation category: intensive, strategic, or benchmark. Students were considered at risk if they scored within the lowest 20th percentile of the norm across the country; these students were categorized as intensive. Students were considered at some risk if they performed between the 20th percentile and 40th percentile of the norm across the country; these students were categorized as strategic. Students were considered at low risk if they performed above the 40th percentile of the norm across the country; these students were categorized as benchmark or core [41].

The DIBELS® Nonsense Word Fluency (NWF) Correct Letter Sound (CLS) measures student ability to recognize letter sounds within 1 minute [41]. The students were allotted 1 minute to read as many letters sounds as possible. The raw score consisted of the total number of sounds correctly produced within 1 minute. The researcher for the current study used DIBELS® NWF CLS scores recommended benchmarks for the beginning of Grade 1. Students scoring 0–17 were considered below the norm; students scoring 18–26 were considered equivalent to the norm, and students scoring 27+ were considered above the norm [41]. The pre-post data on DIBELS® NWF CLS between the experimental and control group provides information about students' ability to sound out individual phonemes (sounds) automatically and accurately within 1 minute.

The DIBELS® Nonsense Word Fluency (NWF) Whole Words Read (WWR) measures student ability to read an entire Vowel-Consonant (VC) and CVC nonsense words, make-believe words within 1 minute [41]. Nonsense words were used instead of real words because it measures students' ability to decode an unknown word [42]. The students were presented with a paper with Vowel-Consonant (VC) and CVC nonsense words. The students were allotted 1 minute to read as many whole words as possible. The raw score consisted of the total number of whole words read correctly within 1 minute. The researcher for the current study used DIBELS® NWF WWR scores recommended benchmarks for the beginning of Grade 1. Students scoring 0 were considered below the norm; students scoring 0 were deemed equivalent to the norm, and students scoring 1+ were considered above the norm [41]. The pre-post data on DIBELS® NWF WWR between the experimental and control group provides information about students' ability to decode and read whole words with closed syllable (VC and CVC) patterns automatically and accurately within 1 minute.

2.4.2 ERAS

Dennis J. Kear developed the Elementary Reading Attitude Survey (ERAS) in 1989. In 1990, McKenna and Kear completed a research study of 18,000 students across the United States to establish percentile ranks at each grade level to be converted from the raw data. The ERAS is a reading attitude survey that includes pictures for students to self-report their feelings toward recreational and academic reading. Twenty questions are included on the survey that starts with "How do you feel …" Jim Davis and Paws Incorporated® approved the use of Garfield® within the survey. The students select a very upset through a very happy Garfield® in response to the question. Very happy is scored with four points, each with a consecutive declining number. The highest raw score a student can earn is a total of 80 points [43]. When the pre-service teachers administered the test, they read aloud the questions to the students, and the students selected the different pictures. The pre-service teachers reported the raw data scores.

According to McKenna and Kear, the developers of percentile scores, when analyzing the data, the raw scores should be used and converted into percentiles later. Further, for any pre-post score difference to be considered a real change for students, the change must be at least seven points when data is in the raw form [43]. After analyzing the raw data, convert the scores to percentiles. Percentile ranks range from 1 to 99, and 50 is considered average. The results can be interpreted from a norm-referenced test that the percentile demonstrates that the student performed better than the total percental of their peers. For example, a student who scores in the 85 percentile performed better than 87% of their peers [44]. Research has demonstrated that attitudes toward reading influence the reading performance of students [44]. The pre-post data on the ERAS between the experimental and control group provides information about students' attitudes toward reading.

3. Research questions and hypotheses

RQ1: What, if any, is the difference in the pre-and post-DIBELS® (Dynamic Indicators of Basic Early Literacy Skills) CLS (Correct Letter Sound) scores between the group who used Ludus Reading and RoboKind™ Robots and the control group?

$H1_0$: There is no difference in the Pre-and post-DIBELS® CLS scores between the group who used Ludus Reading and RoboKind™ Robots and the control group.

H1a: There is a difference in the Pre-and post-DIBELS® CLS scores between the group who used Ludus Reading and RoboKind™ Robots and the control group.

RQ2: What, if any, is the difference in the pre-and post-DIBELS® (Dynamic Indicators of Basic Early Literacy Skills) WWR (Whole Words Read) scores between the group who used Ludus Reading and RoboKind™ Robots and the control group?

$H2_0$: There is no difference in the Pre-and post-DIBELS® WWR scores between the group who used Ludus Reading and RoboKind™ Robots and the control group.

H2a: There is a difference in the Pre-and post-DIBELS® WWR scores between the group who used Ludus Reading and RoboKind Robots™ and the control group.

RQ3: What, if any, is the difference in the pre-and post-Elementary Reading Attitude Survey (ERAS) scores between the group who used Ludus Reading and RoboKind Robots™ and the control group?

H3$_0$: There is no difference in the pre-and post-ERAS scores between the group who used Ludus Reading and RoboKind™ Robots and the control group.

H3a: There is a difference in the pre-and post-ERAS scores between the group who used Ludus Reading and RoboKind™ Robots and the control group.

4. Research design and procedures

The research study used a convenience sample of 10 first-grade students. It is assumed that the sample can be generalized to all other first-grade students within the United States, with certain limitations. The researcher for the current study did not use anything specific to North Carolina; instead, the research study involved using nationally-normed DIBLES® and ERAS tests. A sample size of 10 participants was used. The test would demonstrate statistically significant results with an alpha score of .05. In social science research, an alpha of .05 is a common standard score, meaning that the risk of being wrong is five times out of 100 [45]. The researcher only had access to four robots during the study; two students shared a robot. Further, only five pre-service teachers were in the class to participate in the assessment and tutoring sessions during the fall of 2022. The 11 tutoring sessions were administered one-on-one for a half-hour 11 different times. The tutoring sessions occurred during the same time that the teacher was teaching phonics in the classroom to the whole class.

The quasi-experimental pre-post retrospective design used archived data from 10 first-grade students in the fall of 2022. The research design is depicted in **Figure 2**. The research study contained one independent variable with two levels (control and experimental group) across three dependent variables (PostDIBELS® NWF-CLS, PostDIBELS® NWF-WWR, and ERAS). The covariates (PreDIBELS® NWF-CLS, PreDIBELS® NWF-WWR, and Pre ERAS Score) controlled for the natural differences between the control and experimental groups. A quasi-experimental pre-post design is the most appropriate design to use in an educational setting to test the

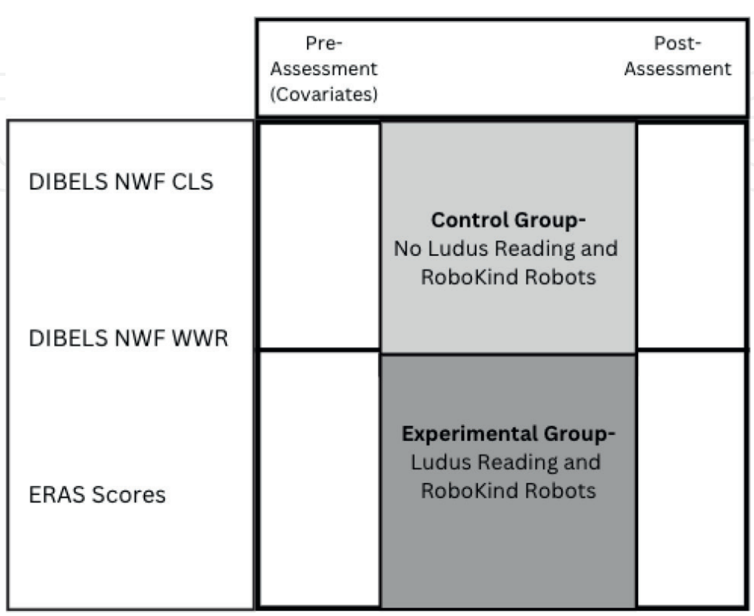

Figure 2.
Quasi-experimental pre-post design.

effectiveness of a new program [45]. The best way to compensate for a convenience sample is to include a pre-post assessment, control, and experiential group [46].

Five pre-service teachers were enrolled in a reading foundations course at Methodist University. The pre-service teachers went to a local elementary school to tutor five first graders identified by the teacher as having the greatest need in reading. The five pre-service teachers completed pre-post assessments for five students who the teacher randomly selected who remained in the classroom for reading instruction; these students represented the control group in the study.

The five pre-service teachers completed pre-post assessments for five students in the experimental group. In addition, the students in the experimental group completed 11 tutoring sessions with the pre-service teachers using Ludus Reading and RoboKind™ Robots. The 11 lessons focused on short vowel sounds and closed syllable words (2 Lessons-Short A, 2 Lessons-Short E, 2 Lessons-Short I, 2 Lessons-Short O, 2 Lessons Short U, and 1 Review). Every student was absent from at least one of the 11 lessons. The assumption is that every student in the experimental group received at least 10 full lessons. When a student was absent, the pre-service teacher did a quick review before starting the new lesson.

The research study included three quantitative research questions. Each research question had a supporting null and alternative hypothesis. After analyzing the data, the research accepted or rejected the null hypothesis. If the null hypotheses were rejected, then the Ludus Reading and RoboKind™ Robots improved the reading performance of the experimental group. If the null hypotheses were accepted, then the Ludus Reading and RoboKind™ Robots program did not improve the reading performance of the experimental group.

5. Data analysis

The quantitative data were analyzed using Analysis of Covariance (ANCOVA) to examine three dependent variables (DIBELS® NWF-CLS, DIBELS® NWF-WWR, ERAS Scores) between the independent variables (control and experimental groups). The ANCOVA tests were used to examine Hypotheses 1–3. The ANCOVA was analyzed through a computer statistical software program called Statistical Package for the Social Sciences Version 28 (SPSS).

Analysis of covariance (ANCOVA) was used for the control and treatment participants on their post-test scores after adjusting their pretest achievement level. Adjusted means with 95% confidence intervals were reported and interpreted for each ANCOVA analysis. The assumptions of normality, homogeneity of variance, linearity, and homogeneity of regression slopes were assessed before model interpretation. Partial eta-squared was reported as a measure of effect size, and post hoc statistical power was also reported for each test.

6. Data results

There was a statistically significant difference between the treatment groups in terms of the adjusted means and 95% confidence intervals for DIBELS® CLS, $F(1,7) = 6.93$, $p = 0.034$, partial eta-squared = 0.50, power = 0.62. For DIBELS® WWR, another significant difference was detected between the groups on their adjusted values, $F(1,7) = 78.97$, $p < 0.001$, partial eta-squared = 0.92, power = 1.00. Finally, for the

ANCOVA analyses			
Test	Control*	Treatment*	p-value
DIBELS CLS	30.60 (21.86–39.34)	45.60 (36.87–54.34)	0.034**
DIBELS WWR	1.82 (−0.68–4.31)	15.18 (12.69–17.68)	<0.001**
ERAS	58.07 (54.71–61.44)	72.73 (69.36–76.10)	<0.001**

*Values are adjusted means with (95% CI).
**Statistical significance, $p < 0.05$.

Table 1.
Adjusted values for each comparison.

ERAS, a significant difference was found between the control and treatment arms on the adjusted values, $F(1,7) = 45.64$, $p < 0.001$, partial eta-squared = 0.87, power = 1.00. The adjusted values for each comparison can be found in **Table 1**.

6.1 Hypothesis 1 results using ANCOVA

$H1_0$: There is no difference in the Pre-and post-DIBELS® CLS scores between the group who used Ludus Reading and RoboKind™ Robots and the control group.

H1a: There is a difference in the Pre-and post-DIBELS® CLS scores between the group who used Ludus Reading and RoboKind™ Robots and the control group.

The ANCOVA yielded a main effect for the control and experimental group, $F(1,7) = 6.93$, $p = 0.0341$, such that the average mean was significantly higher post-DIBELS® CLS mean score for the experimental group (M = 46) than the control group (M = 31), after controlling for pretest scores (partial eta-squared = .17, power = 0.62). After analysis, the raw data can be compared to the national norms. The students in the control group had an average of 31, and the cutoff score was 27, so the students were considered low risk for reading struggles. The students in the experimental group had a mean of 45, and the cutoff score was considered 27, so the students were regarded as having a low risk for reading struggles. The results for Hypothesis 1 are reflected in **Tables 2** and **3**. Accordingly, the null hypothesis for Research Question 1 was rejected.

6.2 Hypothesis 2 results using ANCOVA

$H2_0$: There is no difference in the Pre-and post-DIBELS® WWR scores between the group who used Ludus Reading and RoboKind™ Robots and the control group.

Estimates				
Dependent variable: DIBELS CLS posttest				
Group	Mean	Std. Error	95% confidence interval	
			Lower bound	Upper bound
Control	30.597[a]	3.696	21.858	39.335
Treatment	45.603[a]	3.696	36.865	54.342

Covariates appearing in the model are evaluated at the following values: DIBELS CLS Prettest = 20.60.

Table 2.
Hypothesis 1: DIBELS® CLS posttest.

Tests of between-subjects effects					
Dependent variable: DIBELS CLS posttest					
				Partial Eta	**Observed**
Source	**df**	**F**	**Sig.**	**Squared**	**Power**[b]
Corrected model	2	3.474	0.090	0.498	0.460
Intercept	1	29.086	0.001	0.806	0.995
DIBELSCLSPre ttest	1	2.604	0.151	0.271	0.287
Group	1	6.925	0.034	0.497	0.619
Error	7				
Total	10				
Corrected total	9				
Computed using alpha = 0.05.					

Table 3.
Hypothesis 1: Tests of between-subjects effects DIBELS® CLS posttest.

H2a: There is a difference in the Pre-and post-DIBELS® WWR scores between the group who used Ludus Reading and RoboKind™ Robots and the control group.

The ANCOVA yielded a main effect for the control and experimental group, $F(1,7) = 78.97$, $p < 0.001$, such that the average mean was significantly higher post-DIBELS® WWR mean score for the experimental group (M = 15) than the control group (M = 2), after controlling for pretest scores (partial eta-squared = .92, power = 1.00). After analyzing the raw data, the scores were compared to the norm-referenced criteria. The norm-referenced criteria are for students to benchmark if they can read one whole word, so both groups benchmarked. The results for Hypothesis 2 are reflected in **Tables 4** and **5**. Accordingly, the null hypothesis for Research Question 2 was rejected.

6.3 Hypothesis 3 results using ANCOVA

H3₀: There is no difference in the pre-and post-ERAS scores between the group who used Ludus Reading and RoboKind™ Robots and the control group.

H3a: There is a difference in the pre-and post-ERAS scores between the group who used Ludus Reading and RoboKind™ Robots and the control group.

Estimates				
Dependent variable: DIBELS WWR posttest				
			95% confidence interval	
Group	**Mean**	**Std. Error**	**Lower bound**	**Upper bound**
Control	1.816[a]	1.056	−0.681	4.313
Treatment	15.184[a]	1.056	12.687	17.681
Covariates appearing in the model are evaluated at the following values: DIBELS WWR Prettest = 1.10.				

Table 4.
Hypothesis 2: DIBELS® WWR posttest.

Tests of between-subjects effects					
Dependent variable: DIBELS WWR posttest					
Source	**df**	**F**	**Sig.**	**Partial Eta Squared**	**Observed Power[b]**
Corrected Model	2	40.605	<0.001	0.921	1.000
Intercept	1	65.253	<0.001	0.903	1.000
DIBELSWWRPr ettest	1	8.949	0.020	0.561	0.728
Group	1	78.970	<0.001	0.919	1.000
Error	7				
Total	10				
Corrected Total	9				

Computed using alpha = 0.05.

Table 5.
Hypothesis 2: Tests of between-subjects effects DIBELS® WWR posttest.

Estimates				
Dependent variable: ERAS post				
			95% confidence interval	
Group	**Mean**	**Std. Error**	**Lower bound**	**Upper bound**
Control	58.072[a]	1.424	54.705	61.440
Treatment	72.728[a]	1.424	69.360	76.095

Covariates appearing in the model are evaluated at the following values: ERAS pre = 56.70.

Table 6.
Hypothesis 3: ERAS posttest.

Tests of between-subjects effects					
Dependent variable: ERAS post					
				Partial Eta	**Observed**
Source	**df**	**F**	**Sig.**	**Squared**	**Power[b]**
Corrected Model	2	101.822	<0.001	0.967	1.000
Intercept	1	7.536	0.029	0.518	0.655
ERASPrettest	1	51.085	<0.001	0.879	1.000
Group_B	1	45.637	<0.001	0.867	1.000
Error	7				
Total	10				
Corrected Total	9				

Computed using alpha = 0.05.

Table 7.
Hypothesis 3: Tests of between-subjects effects ERAS.

The ANCOVA yielded a main effect for the control and experimental group, $F(1,7) = 45.64$, $p < 0.001$, such that the average mean was significantly higher post-ERAS mean score for the experimental group (M = 73) than the control group (M = 58), after controlling for pretest scores (partial eta-squared = .87, power = 1.00). After analyzing the raw data, it was converted to percentiles. The experimental group mean was 73, increasing by 16 points. A change is notable when the increase is at least seven points [43]. The raw score of 73 is converted to the 84th percentile. The treatment group mean was 58, increasing by two points. The change is not notable because a notable difference is at least seven points [43]. The raw score of 58 is converted to the 40th percentile. The results for Hypothesis 2 are reflected in **Tables 6** and 7. Accordingly, the null hypothesis for Research Question 3 was rejected.

7. Discussion

The research study results added to the existing body of knowledge in the area of reading, phonics instruction, assistive humanoids, and the Science of Reading. Previous research demonstrated that Ludus Reading increased kindergarten students' reading scores and perceptions of reading [37]. Previous research studies have shown that RoboKind™ Robots increase students' engagement and transferability of academic skills [39, 40]. However, previous research did not exist on the impact of using assistive humanoids as teaching assistants to help students learn essential phonics skills. The effectiveness of combining Ludus Reading and RoboKind™ Robots needed to be examined. The three null hypotheses for the research study were rejected, demonstrating that when Ludus Reading and RoboKind™ Robots were combined, first-grade students could identify more letters and decode words better in 1 minute. Further, the students in the experimental group demonstrated higher levels of enjoyment with reading. Both of these aspects attempt to address issues in America with illiteracy and aliteracy. Further, early intervention provided before the end of first grade can help offset further reading difficulties for students.

Several key aspects of Ludus Reading and RoboKind™ Robots appeared to be helpful for students in the research study, and the aspects and findings are consistent with previous research studies. Students benefit from programs that use the Gradual Release of Responsibility Model [30, 31]. Students benefit from explicit and systematic instruction [15. 16] with embedded play-based centers [28, 29], multisensory strategies [35, 36], and student choice [32, 33]. Repetition helps students retain information [34], and Ludus Reading and RoboKind™ Robots provided students with at least 40 opportunities to practice the target letter sounds or syllable type. Throughout the lessons, teacher tips are provided to help teachers provide improved and immediate feedback to students [38].

7.1 Discussion of Hypothesis 1

The null hypothesis for Research Question 1 for DIBELS® NWF-CLS was rejected. The DIBELS® NWF-CLS is a sub-test of reading used to measure students' ability to recognize letter sounds within 1 minute [41]. The students in the experimental group scored an average (M = 46) that was higher than the average (M = 31) of the students in the control group. The results indicated that the students in the experimental group were better able to recognize letter sounds than the students in the control group. Both groups were above the cutoff score of 27, so both groups are considered low-risk and performed above the 40th percentile of the norm across the country [41]. Notably, the experimental scores met the goal for the beginning of first grade and surpassed the goal for the middle of first grade with a goal of 43. In addition, the mean pre-test score was 21, so the experimental more than doubled their score with a post-test mean score of 45.

7.2 Discussion of Hypothesis 2

The null hypothesis for Research Question 2 for DIBELS® NWF-WWR was rejected. The DIBELS® NWF-WWR is a sub-test of reading used to measure students' ability to read an entire Vowel-Consonant (VC) and CVC nonsense words, make-believe words within 1 minute [41]. The students in the experimental group scored an average (M = 15) that was higher than the average (M = 2) of the students in the control group. The results indicated that the students in the experimental group were better able to decode words than the students in the control group. Both groups were above the cutoff score of one, so both groups are considered low-risk and performed above the 40th percentile of the norm across the country [41]. Notably, the experimental scores surpassed the goal for the beginning of first grade with a goal of 13. So, the students in the experimental had scores that jumped to the next grade level. In addition, the mean pre-test score was 1, so the experimental group progressed to being able to read 15 words, whereas the control group only increased by one word.

7.3 Discussion of Hypothesis 3

The null hypothesis for Research Question 3 for ERAS was rejected. The Elementary Reading Attitude Survey (ERAS) is a reading attitude survey that includes pictures for students to self-report their feelings toward recreational and academic reading [43]. The students in the experimental group scored an average (M = 73 and 40th percentile) that was higher than the average (M = 58 and 84th percentile) of the students in the control group. The results indicated that the students in the experimental group developed better attitudes toward reading than the control group. Notably, the original researchers of norm-referenced criteria explained that a minimum of seven points differences in the raw score between the pre-post data signify a change in perception of reading [43]. Accordingly, the control group showed a change with two points, which is not considered notable. However, the experimental group increased by 16 points, signifying the students in the experimental group shifted their attitudes and perceptions of reading. Further, the students in the control group scored within the 40th percentile or below the average. The experimental group scored above 84% of their peers across the nation. The students in the experimental group demonstrated better attitudes toward reading.

8. Future research

The results were significant, but the study was limited because it only included 10 students and 11 lessons. The students in the experimental group demonstrated a lot of growth in a short amount of time. Future studies are needed that include more students from various schools. In addition, additional lessons (beyond 11) should be explored to develop a complete picture of the effectiveness of combing Ludus Reading and Reading and RoboKind®. Other reading assessments or Various Functional MRIs of the brain are different aspects to explore in future studies. In addition, a qualitative researcher might look for emerging themes to describe students' experiences learning to read. Additional studies might expand beyond kindergarten and first grade to see if the program is effective for students in older grades with dyslexia or learning disabilities.

9. Conclusion

The quasi-experimental pre-post research study added to the existing body of reading and humanoid research because it tested the effectiveness of combining Ludus Reading and RoboKind™ Robots. Ludus Reading phonics instruction involves explicit and systematic lessons that include play-based, technology, and multisensory techniques. RoboKind™ Robots are facially expressive, assistive humanoid robots, and the robots were programmed to act as teaching assistants and help the teacher during the Ludus Reading phonic lesson. Previous research demonstrated that Ludus Reading increased kindergarten students' reading scores and perceptions of reading [37]. Previous research studies have shown that RoboKind™ Robots increase students' engagement and transferability of academic skills [39, 40]. However, previous research did not exist on the impact of using assistive humanoids as teaching assistants to help students learn critical phonics skills. Three research questions were explored, and the null hypotheses were rejected, demonstrating that students in the experimental were able to identify sounds and decode words better than the control group. Further, the students in the experimental showed higher levels of enjoyment toward reading.

Null Hypothesis 1 was rejected: **$H1_0$:** There is no difference in the Pre-and post-DIBELS® CLS scores between the group who used Ludus Reading and RoboKind™ Robots and the control group. The ANCOVA yielded a main effect for the control and experimental group, $F(1,7) = 6.93$, $p = 0.0341$, such that the average mean was significantly higher post-DIBELS® CLS mean score for the experimental group (M = 46) than the control group (M = 31), after controlling for pretest scores (partial eta-squared = .17, power = 0.62). The students in the experimental group more than doubled their score with a post score of 45 and a pretest score of 21. Further, the experimental scores met the goal for the beginning of first grade and surpassed the goal for the middle of first grade with a goal of 43.

Null Hypothesis 2 was rejected: **$H2_0$:** There is no difference in the Pre-and post-DIBELS® WWR scores between the group who used Ludus Reading and RoboKind™ Robots and the control group. The ANCOVA yielded a main effect for the control and experimental group, $F(1,7) = 78.97$, $p < 0.001$, such that the average mean was significantly higher post-DIBELS® WWR mean score for the experimental group (M = 15) than the control group (M = 2), after controlling for pretest scores (partial eta-squared = .92, power = 1.00). The mean pre-test score was 1, so the experimental group progressed to being able to read 15 words, whereas the control group only increased by one word. The experimental scores surpassed the goal for the beginning of first grade with a goal of 13. So, the students in the experimental had scores that jumped to the next grade level.

Null Hypothesis 3 was rejected: **$H3_0$:** There is no difference in the pre-and post-ERAS scores between the group who used Ludus Reading and RoboKind™ Robots and the control group. The ANCOVA yielded a main effect for the control and experimental group, $F(1,7) = 45.64$, $p < 0.001$, such that the average mean was significantly higher post-ERAS mean score for the experimental group (M = 73 and 40th percentile) than the control group (M = 58 and 84th percentile), after controlling for pretest scores (partial eta-squared = .87, power = 1.00). The students in the control group scored within the 40th percentile or below the average. The experimental group scored above 84% of their peers across the nation. The students in the experimental group demonstrated better attitudes toward reading.

Acknowledgements

I acknowledge using the following resources for the tutoring sessions: Ludus Reading and RoboKind™. I acknowledge using the following assessments: Elementary Reading Attitude Survey (ERAS), DIBELS® NEXT Nonsense Word Fluency (NWF) Correct Letter Sound (CLS), and DIBELS® NEXT Nonsense Word Fluency (NWF) Whole Words Read (WWR). The pre-service teachers for the studies were from Methodist University, and the first-grade students were from Cumberland County Schools in Fayetteville, North Carolina.

Notes/thanks/other declarations

I would like to thank my supportive family: My mom, dad, brother, sister-in-law, Uncle Jim, Aunt Anna, and children (Sophie and Davin). Sophie and Davin-I hope you never give up and pursue your passions. Live your life fully and fill the chapters with a fantastic story. I would like to thank Alexis Baxter, Mrs. Conrad, and Mrs. Poore, who encouraged me to live my best life. I would like to thank the school staff and teachers who helped us implement the tutoring sessions. I would like to thank Maryanne Hickson and the ROTC for helping transport materials between the university and the school setting. The pre-service students who implemented the tutoring session, and I hope they continue to impact their students positively. I would like to thank the amazing RoboKind™ team who collaborated and supported the research, especially Richard Margolin, Joshua Jach, Jimmy Delaney, Jack Morrison, and Dwayne Koonce. Further, it was incredible collaborating with the talented engineer from RoboKind™, Joshua Jach, who helped translate my vision into a reality, helped troubleshoot, set up platforms, and provided on-site support. Jimmy Delaney helped create the app to connect the robots and lessons. Jimmy Delaney and Jack Morrison helped with the speech articulation of the robots and troubleshooting throughout the process. Dwayne Koonce helped organize the images to be displayed on the robot's chest. In addition, Richard Margolin took countless hours to meet with me to help me create a plan for my research study and reading program. In addition, I appreciated the motivation and support from Brian Baggs, Marissa Moyer, Souphia Leng, Rocky Barajas, and all of the RoboKinders. RoboKind™ is filled with passionate and outstanding people, and I am grateful that I had the opportunity to collaborate with everyone. I appreciate the support from KTI Family, especially Scott Snyder, Ann Noonen, Tom Tancin, Laura Fragassi, Sue Allen, Hollie Woodard, and so many more. In addition, I would like to dedicate this study in memory of Rosie Parmigiani, who said, "This is the work you are meant to do. No one is doing this yet, and you need to go for it. The kids and teachers need this." Most importantly, I hope this research helps teachers teach reading in better ways and helps students learn to read and love reading!

DOI: http://dx.doi.org/10.5772/intechopen.110603

Author details

Jessica Redcay
Methodist University, Fayetteville, North Carolina

*Address all correspondence to: redcaysresources@gmail.com

References

[1] Flesch R. Why Johnny Can't Read. New York: HarperCollins; 1955

[2] Kozol J. Illiterate America. New York: Library of Congress; 1985

[3] Toppo G. Study: Bush's Reading First Program Ineffective. 2008. Available from: http://usatoday.com

[4] The National Children's Book and Literacy Alliance. Statistics. 2022. Available from: https://thencbla.org/literacy-resources/statistics/#:~:text=In%20addition%2C%2064%20percent%20of,were%20reading%20below%20grade%20level

[5] ProLiteracy. Adult Literacy Facts. 2022. Available from: https://www.proliteracy.org/Adult-Literacy-Facts

[6] Gelles-Watnick R, Perrin A. Who Doesn't Read Books in America? 2021. Available from: https://www.pewresearch.org/fact-tank/2021/09/21/who-doesnt-read-books-in-america/

[7] Bernard M. How Serious is America's Literacy Problem? 2022. Available from: https://www.readingkingdom.com/blog/how-serious-is-americas-literacy-problem/

[8] Spector C. New Stanford Study Finds Reading Skills Among Young Students Stalled During the Pandemic. 2021. Available from: https://news.stanford.edu/2021/03/09/reading-skills-young-students-stalled-pandemic/

[9] ProLearning. Why Early Intervention Matters for Struggling Readers. 2019. Available from: https://www.prolearningservices.com/blog/2019/8/14/why-early-interventions-matters

[10] Nessy Learning. Why Early Intervention is Important. 2022. Available from: https://www.nessy.com/en-gb/dyslexia-explained/how-to-help-dyslexia/what-is-early-intervention

[11] Joseph L. Best Practices in Planning Interventions for Students with Reading Problems. 2022. Available from: https://www.readingrockets.org/article/best-practices-planning-interventions-students-reading-problems

[12] Reading Rockets. Helpieng Struggling Readers. 2022. Available from: https://www.readingrockets.org/helping

[13] Cleary MF. Reading Can Grow Students' Brains: Neuroplasticity, Literacy, and Hope for Struggling Readers. 2021. Available from: https://www.ace-ed.org/reading-can-grow-students-brains-neuroplasticity-literacy-hope-for-struggling-readers/

[14] Gao Q, Mo D, Shi Y, Wang H, Kenny K, Rozelle S. Can Reading Programs Improve Reading Skills and Academic Performance in Rural China? 2017. Available from: reap.fsi.standford.edu

[15] Teaching Children to Read. Report of the National Reading Panel Report. 2022. Available from: https://www.nichd.nih.gov/publications/pubs/nrp/findings

[16] International Dyslexia Association. Structured Literacy Instruction: The Basics. 2018. Available from: https://www.readingrockets.org/article/structured-literacy-instruction-basics

[17] Dresser R. The Impact of Scripted Literacy Instruction on Teachers and Students. 2012. Available from: http://www.caddogap.com

[18] TX Reads. The Science of Reading is a Vast Interdisciplinary Body of Scientfiically-Based Research About Reading and Issues Related to Reading and Writing. 2022. Available from: https://literacysanantonio.com/about-the-science-of-reading

[19] Tolman C. Introduction to the Tolman Hourglass Figure. 2022. Available from: https://youtu.be/9uGm7r3JdyY

[20] Reading Rockets. The Simple View of Reading. 2022. Available from: https://www.youtube.com/watch?v=BhpHr3SC7hk

[21] International Dyslexia Association. Scarborough's Reading Rope. 2018. Available from: https://dyslexiaida.org/scarboroughs-reading-rope-a-groundbreaking-infographic/

[22] Davies S. Typos, Tricks, and Misprints. 2022. Available from: https://aeon.co/essays/why-is-the-english-spelling-system-so-weird-and-inconsistent

[23] Fox BJ. Phonics for the Teacher of Reading. New York: Pearson Education; 2005

[24] Hiebert EH, Martin LA. The Texts of Beginning Reading Instruction. New York: Guilford Press; 2003

[25] The Dyslexia Classroom. What is vowel valley? 2022. Available from: https://youtu.be/W5gftHaxGGo

[26] The Reading Mama. The Six Syllable Types. 2022. Available from: https://youtu.be/tqf8QsM_2YM

[27] Huizinga J. Homo Ludens: A Study of the Play Element in Culture. Boston: Beacon Press; 1950

[28] Jacobs G, Crowley K. Play, Projects, and Preschool Standards: Nurturing Children's Sense of Wonder and Joy in Learning. Thousand Oaks, California: Corwin Press; 2007

[29] Nell M, Drew WF. Five Essentials to Meaningful Play. NAEYC for Families. 2013. Available from: http://families.naeyc.org

[30] Wisconsin Department of Public Instruction. Gradual Release of Responsibility (GRR) Instructional Framework. 2022. Available from: https://dpi.wi.gov/ela/instruction/framework

[31] The Literacy Nest. 7 Techniques for Building Independence. 2022. Available from: https://www.theliteracynest.com/2019/09/7-techniques-for-building-independence-with-orton-gillingham-lessons.html

[32] Cornell University. Universal Design for Learning. 2022. Available from: https://teaching.cornell.edu/teaching-resources/designing-your-course/universal-design-learning

[33] Daly L. How I Use Choice Boards to Increase Student Engagement. 2019. Available from: https://www.weareteachers.com/choice-boards/

[34] Harrison C. Why Repetition is Important in Reading Instruction. 2022. Available from: https://www.thedyslexiaclassroom.com/blog/why-repetition-is-important-in-reading-instruction

[35] Jensen E. Teaching with the brain in mind. Association for Supervision and Curriculum Development. 2005:60-67

[36] Stahl SA. Teaching Phonics and Phonological Awareness. New York: Guilford Press; 2003

[37] Redcay J. Ludus Reading: A Mixed Method Study. 2014. Available from: https://www.proquest.com/openview/f92c66c8a6dc938a04e5535027817307/1?pq-origsite=gscholar&cbl=18750

[38] Brookhart SM. How to Give Effective Feedback to Your Students. Alexandria, Virginia: ASCD; 2017

[39] RoboKind. Facially-Expressive, Assistive Robots. 2022. Available from: https://www.robokind.com/

[40] RoboKind. Robots4Autism. 2022. Available from: https://www.robokind.com/about-robots4autism

[41] University of Oregon. DIBELS. 2012. Available from: https://dibels.uoregon.edu/

[42] Howard P. Dynamic Indicators of Basic Early Literacy Skills. 2005. Available from: https://dibels.uoregon.edu

[43] McKenna MC, Kear DJ. Measuring Attitudes toward Reading: A New Tool for Teachers. The Reading Teacher. 1990. DOI: 10.1598/RT.43.8.3

[44] Logsdon A. Test percentile rank scores in education. 2022. Available from: https://www.verywellfamily.com/what-is-a-percentile-in-educational-tests-2162657

[45] Creswell JW. Research Design: Qualitative, Quantitative, and Mixed Methods Approaches. Thousand Oaks, California: Sage; 2014

[46] Rovai AP, Baker JD, Ponton MK. Social Science Research Design and Statistics: A Practitioner's Guide to Research Methods and SPSS Analysis. Chicago, Illinois: SPSS; 2013