EVALUATION OF *IMAGINE LEARNING ENGLISH*, A COMPUTER-ASSISTED

INSTRUCTION OF LANGUAGE AND LITERACY

FOR KINDERGARTEN STUDENTS

by

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ABSTRACT

As computer assisted instruction (CAI) becomes increasingly sophisticated, its appeal as a viable method of literacy intervention with young children continues despite limited evidence of effectiveness. The present study sought to assess the impact of one such CAI program, *Imagine Learning English* (ILE), on both the receptive vocabulary and early literacy skills of 284 kindergarten students, including English language learners using a 2 x 2 cross-over research design over a period of a full school year. In each semester, students received either the ILE treatment or "other" treatment (integrated core curriculum including science, social studies, art, music, physical education). Specifically, the study sought to answer two questions: (a) How do the literacy skills of kindergarten students, including English language learners and monolingual children, who receive instruction using ILE compare with the literacy skills of kindergarten students who receive "other" classroom instruction; (b) how do the vocabulary skills of the same kindergarten students who receive instruction using ILE compare with the vocabulary skills of those who receive "other" classroom instruction? Results of the *t*-tests from this within-subjects design showed no treatment differences on outcome measures (PPVT-4 for receptive vocabulary and DIBELS Next for early literacy) between students when they participated in the ILE program and when they participated in "other" classroom activities, regardless of amount of time spent on this CAI program. These same results held true for English language learners for whom the program was originally designed. A strong period effect, however, was detected, with the treatment administered during

period 1 (i.e., either ILE or "other" instruction) having a more positive effect on student language and literacy learning than the treatment that was administered during period 2. Possible explanations for this significant period effect are provided as well as cautions for the ongoing use of CAI programs such as ILE in early literacy education. Finally, recommendations for future research are set forth.

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CHAPTER 1

INTRODUCTION

Overview

Early reading success is essential to later academic achievement regardless of the language students speak when they enter the classroom. Children who see themselves as readers by the end of first grade maintain a more positive attitude about learning and experience greater educational benefit throughout their academic careers than children who do not (Cunningham & Stanovich, 1997). Critical to early reading success is the development of proficiency in both decoding and vocabulary acquisition through a comprehensive literacy program (Lesaux & Siegel, 2003). Included in such a program are explicit phonemic awareness and phonics instruction as well as extensive opportunities to read, write and discuss connected text to build fluency, vocabulary, and comprehension (National Institute of Child Health and Human Development [NICHHD], 2000).

Such a comprehensive program of literacy instruction is not only important for mono-lingual students but also for the increasing number of language minority students in classrooms across the United States (National Center for Educational Statistics, 2010; Shin & Kominski, 2007). For English language learners entering school in the primary grades, comprehensive literacy instruction in either bilingual or English immersion programs results in equally positive outcomes when well implemented (Slavin, Madden, Calderon, Chamberlain, & Hennessy, 2010). Furthermore, English language learners tend

to benefit from the same strategies in the process of learning to read as their monolingual peers, with targeted oral language development one of the most essential to academic success (Gottardo & Mueller, 2009).

Despite efforts to provide comprehensive literacy instruction once students enter school, an increasing number of English language learners (L2 learners) and English speaking learners (L1 learners) start school with such impoverished literacy pre-requisites, particularly in oral language skill, that without intensive support, they struggle indefinitely to catch up with their more linguistically fortunate classmates (Juel, 1988; Vaughn, Mathes, Linan-Thompson, & Francis, 2005; Vellutino, Scanlon, Small & Fanuele, 2006). When students show signs of dis-fluency in literacy activities, intervention support often takes the form of small group instruction with either a specialist or paraprofessional. Torgesen (2004) suggests that group sizes of one adult to three children deliver the most powerful intervention results; yet the cost of such kinds of intervention often precludes its use in many schools.

As economic winds shift and teacher-student ratios increase, the use of computers as tutors to both supplement teachers' literacy instruction and provide intervention support for struggling readers is on the rise. Education software companies scramble to design programs to provide the next solution to accelerate achievement, yet most evidence of success for such programs is taken from research conducted by the software companies themselves. In 2000, the National Reading Panel (NRP) report reviewed the research on computer-assisted instruction (CAI) and concluded that even though there is much interest in and use of technology in the classroom we have very little systematic

research on computer programs with respect to early literacy issues—especially among at-risk students (NICHHD, 2000).

In their widely cited meta-analysis of early literacy support through CAI, Blok, Oostdam, and Otter (2002) found that CAI programs generally tend to be effective, but because most studies had small sample sizes with an average of only 28 participants and overall effect sizes averaging just .19, their general endorsement of effectiveness was tentative at best. In research on CAI conducted since 2002, sample sizes have generally increased, but study length continues to limit the ability to show significant effects as viable literacy intervention support—particularly when compared to individual or small group tutoring with a teacher (Lewandowski, Begeny, & Rogers, 2006; Mioduser, Tur-Kaspa, & Leitner, 2000; Regtvoort & Van der Leij, 2007; Wood, 2005). At a minimum, however, CAI appears to be more helpful for ELLs and other struggling readers than use of practice worksheets during seatwork time (Wild, 2009) or the activity of silent reading (Poulsen, Hastings, and Allbritton, 2007). In fact, Macaruso and Walker (2008) observed that CAI benefits at-risk readers the most because of the extra practice it provides.

Of particular importance for the development of literacy in young children is vocabulary learning in support of reading comprehension. Segers and Verhoeven (2003) show how targeted vocabulary instruction in the context of stories via CAI has the potential for increasing overall vocabulary knowledge of young children, though there are no comparable studies of vocabulary development through CAI. Experiments of CAI effects on comprehension with young children compare electronic "talking books" with teacher read-aloud or use of other print-based texts with mixed results (Boling, Martin, & Martin, 2002; Jong & Bus, 2002; Kerr & Symons, 2006; Korat & Shamir, 2007;

Matthews, 1997; Trushell, Burrell, & Maitland, 2001; Underwood, 2000). Studies of computer effects on the development of specific literacy skills are simply incomplete and not conclusive.

The purpose of the present study is to further CAI literacy intervention research by conducting an evaluation of a comprehensive computer program, *Imagine Learning English* (ILE)*,* developed to support the language and literacy acquisition of English language learners and other struggling readers in the primary grades in multiple literacy skill areas at once (e.g., vocabulary, decoding, comprehension). Generally known as integrated learning systems (ILS), comprehensive CAI programs such as ILE provide sequential instruction in multiple skill areas for students over several grades while keeping extensive records of their progress. Kulik (2003) found no significant effects from students' use of integrated learning systems during the 1990s, but more recent data suggest that when well implemented and monitored carefully by teachers, ILS programs can be highly beneficial—especially for at-risk students (Cassady & Smith, 2005).

This study seeks to find evidence regarding the effectiveness of a specific ILS, known as ILE, in delivering comprehensive CAI to young students. Specifically, it considers whether daily use of ILE promotes the early literacy achievement of children in kindergarten classrooms along two important dimensions: decoding skill and vocabulary acquisition. The first question to answer is: how do the decoding skills for English language learners and monolingual children who receive instruction using ILE compare with the decoding skills of learners who receive other classroom instruction? A second, but equally important question is: how do the vocabulary skills for the same populations

of students who receive instruction using ILE compare with the vocabulary skills for those who receive other classroom instruction?

Though computer programs such as ILE are increasingly used in schools with the hope that they are making an educational difference, it is only through scientifically-based research independent of the program developers that such claims can either be confirmed or discounted. Knowing how ILE addresses the language and literacy development of a range of kindergarten students allows educators to make informed decisions whether to integrate such programs into their instructional curriculum.

In this introduction to this study, three bodies of literature in early literacy education will be described: literacy development and intervention framed by the Simple View of Reading theoretical model, specific interventions for English language learners, and computer assisted instruction. Emphasis will be given to decoding and vocabulary in each of these three sections as these components are critical to the development of reading comprehension and are primary components of the ILE program. Following the literature review, the stage will be set for an introduction to the ILE program with its instructional components and research base. This section ends with a statement of the specific research questions to be addressed in this study.

<u>Early Literacy Education and Intervention</u>

Three bodies of literature in early literacy education inform the present study: literacy development, intervention for English language learners, and computer assisted instruction. A thorough understanding of the research base in each of these areas guides my evaluation of the *Imagine Learning English* program. Inasmuch as these three areas vary widely in their scope and research base, I will not attempt to provide an exhaustive

review of the literature in each of them; rather, I will survey only the most significant findings in each area that relate to early literacy education and that contribute to an evaluation of ILE. The review of the literature begins with a description of the theoretical framework for the study, the Simple View of Reading, which highlights the two strands of instruction under investigation, decoding and vocabulary learning, followed by a review of the most widely known and globally accepted principles of effective early literacy instruction and intervention. Next, consideration is given to recent research in decoding and vocabulary intervention that specifically targets English language learners in the process of learning to read. Finally, this review provides an extensive examination of current and salient computer assisted instruction experiments in an effort to discern specific ways that CAI has been used to enhance early literacy development for at-risk populations.

Simple View of Reading Theoretical Framework

Reading research has had an extensive and controversial history, with divergent conceptual frameworks and models of the reading process being promoted and disputed among a variety of research camps for many decades. Despite the call to come together around the research base and let empirical evidence guide the reading profession (see Stanovich, 2000), no one framework as of yet guides the ongoing research efforts in reading. Nonetheless, the Simple View of Reading framework has emerged from research in the United Kingdom (UK) in recent decades to become increasingly popular world-wide as a legitimate and efficient conceptual model of reading development because it highlights two critical reading processes, word recognition or decoding, and oral language comprehension, rather than addressing the components of reading separately. In

the UK, the Simple View has now replaced prior models of reading development and continues to grow in popularity throughout the world as a viable framework to describe the essential processes of reading (Stuart, Stainthorp, & Snowling, 2008). The Simple View of Reading, therefore, is the theoretical framework for the present study as it links together in powerful ways both the written (decoding) and the oral (vocabulary) forms of language that are fundamental to reading success and that are emphasized in the ILE program.

In essence, the Simple View contends that reading comprehension is the product of both decoding, including orthographic and phonological processes, and language comprehension, including semantic, syntactic, morphologic, and pragmatic processes (Gough & Tunmer, 1986). Strong reading comprehension is dependent upon both variables. The Simple View relates to the widely accepted Adams model of reading which holds that reading involves the relationships among the orthographic, phonological, meaning, and context processors working together to comprehend text (Adams, 1990). Though the Simple View may appear too simple to explain the complex process of reading, research to date suggests otherwise. In fact, many experts now argue that the beauty of the Simple View is that it highlights the important processes involved in language comprehension, promoting them as prominent variables in literacy development from early years on (Stuart, Stainthorp, & Snowling, 2008).

A highly useful aspect of the Simple View framework is that the variables of decoding and language comprehension can literally be taught and assessed separately, which means that weakness in either area can be addressed with the ultimate goal of increasing reading achievement in the process (Roberts & Scott, 2006). At one extreme,

weak decoding but strong language comprehension is dyslexia or word level reading

disability. At the other extreme, weak language comprehension but strong decoding is

hyperlexia. Those who have relative weaknesses in both areas generally fall in the

category of "garden variety" learning disability (Gough & Tunmer, 1986; Fletcher, Lyon,

Fuchs & Barnes, 2007). English language learners typically lag behind in the language

comprehension side of the Simple View equation, and they often become proficient

decoders but poor comprehenders as a result. Consequently, early intervention must

target the specific weak areas of at-risk learners, whether decoding, language

comprehension or both.

In essence, the Simple View framework serves two functions: It not only

provides a thorough description of the two important processes involved in reading

development (i.e., decoding and comprehension), it provides an instructional prescription

to address the literacy strengths and weaknesses of a range of learners. Because ILE

primarily focuses on both decoding and vocabulary, and provides instruction in these two

areas in an effort to accelerate overall literacy achievement, the Simple View is a solid

match in terms of a guiding theoretical framework for the present study. This study will

investigate the extent to which ILE instructs and assesses both decoding and language

comprehension (via vocabulary) and contributes to young children's ongoing reading

development. Let us now turn to a detailed description of each of the variables delineated

in the Simple View of Reading framework.

Decoding variable. The ability to decode text results when phonology (the

spoken sounds of language) links with orthography (the printed text itself) in the

recognition of written words. Much of the reading research in the past two decades has

been built upon the work of Adams (1990) who emphasizes the orthographic processor as the foundation of written language and the phonological processor as the connecting system between orthography and meaning. Orthography is the print code that must be unlocked for reading to occur but phonology is the sound code that must be linked to print in order for decoding to occur. Together, orthography and phonology make up the decoding variable in the Simple View.

Inasmuch as children learn to speak before they learn to read, we will first consider the phonological component that contributes to decoding success. The development of phonological awareness begins with the recognition that streams of oral language can be separated into whole words. Next, children learn to orally distinguish the parts within words themselves (i.e., onset-rime, syllables). Finally, they are ready to begin identifying the individual letter sounds (phonemes) at the beginning, end, and within the words they hear. Phonemic awareness activities and games with preschool and kindergarten children who lack this foundational phonological knowledge have been helpful in preparing them for the more formal reading instruction that connects those sounds to print (Ehri, Nunes, Willows, Schuster, Yaghiub-Zadeh, & Shanahan, 2001). Such activities include blending individual sounds to form words, identifying objects beginning with a given sound, and manipulating sounds in spoken words, to name just a few.

In addition to developing phonological awareness through targeted activities with sounds, children must be read to from a wide range of texts so they begin to acquire the idea that the squiggles on a page represent the oral language that they hear. Ideally, a child is learning about the relationship between print and spoken language by being read

to from birth so that formal reading instruction, when it occurs, becomes a natural extension of all the child has already discovered about written language. Only when the phonological processor is activated are children ready to begin the formal process of learning to read.

The orthographic processor is the next piece to activate in the work of decoding. Before children can learn to read they must be able to unlock the alphabetic principle which begins with being able to identify and use fluently all the letters of the orthographic code. To this end, learning letters and sounds is a primary focus of instruction in early kindergarten classrooms. Though debatable the extent of alphabet mastery needed prior to beginning formal phonics instruction, such instruction links the alphabet (orthography) to sounds (phonology) and becomes the connecting system in decoding.

The goal of phonics instruction, then, is to ensure that students can identify letters and letter patterns (e.g., ow, str, ing) with speed and accuracy to support further reading tasks. Word study tasks, particularly those designed for young readers, support orthographic knowledge by assisting readers in recognizing and using increasingly complex spelling patterns and word families as they read (see Bear, Invernizzi, Templeton, & Johnston, 2003). Recent studies also show the importance of regular guided practice with just-learned phonics principles through the reading of decodable text so that they can be automatically recognized and produced in other written texts (Moats, 1998). Such practice, particularly when prior decoding instruction is explicit and systematic, supports young children with phonological weaknesses so that they can also learn to read.

Foorman, Francis, Fletcher, Schatschneider, and Mehta (1998) examined three types of reading programs for first and second grade children who were eligible for Title I services. Students and their program of instruction were followed over a period of two years. Specifically, they found that children who were taught the alphabetic principle through direct code instruction followed by explicit practice in decodable text were significantly more advanced in their word reading skill than students who learned the alphabetic principle through embedded code instruction using predictable text or through exposure to quality literature alone. Their conclusion was that phonemically explicit instruction produces the most significant word reading growth in early readers. A later meta-analysis (Ehri, et al., 2001) confirmed that systematic phonics instruction is most beneficial when taught in the primary grades—particularly for students at risk of learning disabilities—in order to prevent and remediate reading difficulties.

From Adams (1990) we learn that it is the over-learning and automatic processing of the letters and sounds that makes the difference between skilled and unskilled decoders. According to the NRP (NICHHD, 2000), meta-analyses revealed that explicit phonics instruction is critical to reading success with the impact being strongest in kindergarten and first grade. Until children can manipulate the phonologic and orthographic realms with fluency and ease, reading and writing remain virtually locked to them. Hence, the faster orthography and phonology can work in tandem through phonics knowledge, the greater the speed and accuracy of decoding.

Language comprehension variable. Oral language is the foundation of written language and as such must take a prominent place in the development of early literacy (see Snow, Burns, & Griffin, 1998). Children learn to speak long before they learn to

read, first producing babbling sounds that imitate human speech, then single words, sentences, and finally coherent discourse. At the same time children are learning to produce language they are also building an ever expanding network of receptive understandings about the world through their sensory experiences. Comprehension of spoken language emerges somewhat before the ability to produce words and expands quickly during early preschool years. Young children learn new words easily when the words are mapped to the developing conceptual structures of the world that support them; hence, building conceptual understandings about the world is essential to early language development and is a precursor to early literacy (Anderson & Nagy, 1991).

In learning to read, children transition from comprehension of oral language to comprehension of print. For beginning readers the texts they are exposed to must reflect their level of oral language ability so that children focus on decoding the text and NOT on trying to understand the language of the text (Kamil & Hiebert, 2005). Young readers must learn that what they decode in reading should make sense just like what they would say orally. Once the decoding skill is established, a shift takes place from "learning to read" to "reading to learn" and students start to see a huge increase in number of unique words in text that are not part of their oral vocabularies. From this time on, academic vocabulary learning becomes critical to future reading success for all children. Of course, texts designed to support beginning readers with language that is reflective of children's oral vocabulary may be too difficult for children who arrive at school with impoverished oral language skills. These children not only must overcome the decoding barrier, but the vocabulary barrier simultaneously.

Multiple studies confirm that children's levels of oral language skill significantly impact overall reading achievement. Roth, Speece, and Cooper (2002), conducting a longitudinal study of primary grade children, found a strong connection between oral language ability and early reading success. A longitudinal study by Hemphill and Tivnan (2008) identified first grade vocabulary scores as the best predictor of later reading comprehension success for children in second and third grades. Spira and colleagues (2005) found similar results in their longitudinal study, as did Cunningham and Stanovich (1997) who followed a group of children from first grade to eleventh grade and found a strong connection between speedy first grade reading acquisition and long-term academic success. Thus, not only are phonological and orthographical processing important to develop in young children in order to unlock the reading code, but semantic ability (the ability to derive meaning from printed words) is an important contributor to early reading success.

In the NRP report (NICHHD, 2000), vocabulary was identified as a major subset of comprehension, confirming the important role that vocabulary learning plays in reading. The NRP report further recognized the difficulty in accurately assessing vocabulary knowledge but found that measures of receptive and productive vocabulary knowledge are critical indicators of both oral and written language development. However, of the fifty studies identified for inclusion in the report, very few involved research with children in primary grades where the transition from oral to written language occurs. In essence, while oral vocabulary is critical to the transition from oral to written forms of language and reading vocabulary is crucial to the processes of

comprehending increasingly more difficult text, there is much to be learned about how these processes can be developed and measured.

Research evidence demonstrates that vocabulary learning proceeds in roughly the same, predictable order for all children though it is unclear exactly how many words students must know to have sufficient language comprehension for academic success (Beck, McKeown, & Kucan, 2002; Biemiller & Slonim, 2001; Nagy & Anderson, 1984). In addition, it is clear that direct and systematic teaching of vocabulary is both essential and possible. In a meta-analysis of studies examining the effects of vocabulary learning on comprehension, Stahl and Fairbanks (1986) showed that multiple exposures to taught words and engagement in deep processing were essential to comprehensive vocabulary learning. For young children, the activity of reading aloud has been demonstrated to boost vocabulary knowledge as students are exposed to words in trade books that are well beyond their current vocabulary knowledge (Barrentine, 1996; Klesius & Griffith, 1996; Mason, Peterman & Kerr, 1989). Such benefits occur whether read aloud is conducted in large group, small group, or one-to-one settings. Important elements of read-aloud are the use of fiction and non-fiction, reading text above instructional level for the students (Cunningham, 2005), and discussing ideas and words throughout the reading event (Stahl, 2005). Though challenging to implement and sustain over time, when vocabulary instruction incorporates multiple research-based elements, empirical studies demonstrate that the reading comprehension side of the Simple View equation is positively affected.

Simple view and comprehension. Reading is not merely the act of decoding words on a page; nor is it the ability to understand the language of text read by others. To read, one must combine multiplicatively both the process of decoding and the process of

understanding the language of the text such that meaning is the product. Early literacy instruction needs to address both processes simultaneously so that ongoing reading comprehension is assured. In the successful kindergarten classroom, decoding skill develops through systematic instruction in the phonological and orthographical elements of written language. Such instruction proceeds through phonemic awareness activities to fluency building with letter and sound correspondences. Once the alphabetic principle is established, decodable text is introduced to target beginning phonics skills. All the while, students are immersed in the language of good literature that promotes ongoing vocabulary learning through discussion and interaction at read-aloud time. Such instruction around children's literature is essential to building the language comprehension that children need to further their reading achievement. When both decoding and language comprehension are the primary targets of early literacy instruction, students have the greatest opportunity to develop strong reading comprehension ability.

Early Literacy Intervention

Historically, the success of children in formal schooling has been entirely dependent upon how much children have learned about reading before they ever get there (Snow, Burns, & Griffin, 1998). Struggling students come to school with significant gaps in their learning. As shown by Juel (1988), students who do not receive deliberate and specific interventions to bridge these gaps by the end of first grade fall further and further behind. Beginning reading experts have also long declared that early intervention is the optimal way to bring more children to grade level appropriate literacy levels quickly and efficiently so that long-term struggles do not continue (Adams, 1990; Clay, 1991). More

recently, Mathes (2003) found that small group targeted instruction in the primary grades (even when peer-led) is helpful for at-risk learners due to the added academic attention it provides.

To be effective, intervention programs must be comprehensive in covering all five components identified as evidence-based and essential by the NRP (NICHHD, 2000) (i.e., phonemic awareness, systematic phonics, fluency, vocabulary, and reading comprehension). Vellutino, Scanlon, Small, and Fanuele (2006) found that early identification and intervention for struggling readers at the beginning of kindergarten significantly reduced the number of students needing later intervention as well as reduced the number of referrals to special education. In fact, many if not most children who receive small group remediation during kindergarten no longer require such intervention in first grade. Those who do require ongoing intervention, if done effectively, graduate from such assistance by the end of first grade.

Among early intervention programs, Reading Recovery (Clay, 1991) is widely known and implemented across the United States with first grade students in one-to-one settings with highly qualified teachers; however, due to the expense of such a program many variations are currently in use that appear equally effective but are much less costly (Elbaum, Vaughn, Hughes, & Moody, 2000; Iverson, Tunmer, & Chapman, 2005; Torgesen, 2004).Typically, interventions take place daily for not less than 30 minutes with group sizes varying from one-on-one to small groups of three to six students per teacher. In addition, intervention programs that reflect different theoretical perspectives appear to be equally effective as long as they are of sufficient intensity and duration. Mathes, Denton, Fletcher, Anthony, Francis, and Schatschneider (2005) experimented

with two theoretically different intervention models for first grade, one aligned with cognitive theory and one aligned with behavioral theory. Both interventions had similar outcomes due to their consistent emphasis on word recognition strategies and other components of beginning reading instruction; yet each approach was consistent with the personal instructional philosophies of the teachers who implemented them.

More important than instructional design that aligns with instructional philosophy, however, is intervention tailored to each child's specific deficits. Two categories of difficulty for students are in oral language and/or phonological knowledge. Some children are weak only in phonological knowledge while others are weak in both categories, requiring teachers to recognize and intervene appropriately and early to avoid ongoing difficulties over time. For example, Bowyer-Crane and colleagues (2008) compared two intervention programs for entry level children and found that the decoding intervention fostered improved decoding but the oral language intervention improved vocabulary and grammar skills. Intervention in one area does not preclude the need for intervention in the other as both decoding and oral language development are crucial for reading success. In this section, early intervention instruction will be explored in each of the processes that affect reading—decoding and vocabulary.

Intervention in decoding. Early intervention that targets phonological and orthographic processing (i.e., decoding) is essential to reading success for at-risk learners but it cannot substitute nor compensate for poor-quality classroom instruction (Snow, Burns, & Griffin, 1998). Both strong teaching and explicit and intensive intervention are critical to the acceleration of decoding skill in beginning readers (Torgesen, 2004). Such targeted instruction is particularly helpful for children who enter school without the

prerequisite phonological understanding. Foorman and Breier (2003) conducted a meta-analysis of a range of intervention studies over time to examine the value of explicit instruction in phonics through early and intense intervention. They concluded that intensity, duration, and supportiveness are critical to successful decoding intervention and that interventions must include the same pieces as regular instruction, namely, explicit instruction in the alphabetic principle integrated with reading for meaning, and opportunities to read and write.

Torgesen, Wagner, Rashotte, Lindamood, Roe, Conway, et al. (1999) examined three experimental intervention conditions: (a) one that supported regular classroom instruction, (b) one that taught embedded phonics within the context of stories and writing, and (c) one that explicitly taught phonics using decodable text and later used trade books with emphasis on comprehension and teaching of high frequency words. Each condition involved 88 hours of one-on-one instruction from trained teaching assistants beginning the second half of kindergarten and extending through second grade. Of the three conditions, the one that explicitly taught phonics produced the most word reading growth in at-risk readers due to the increased attention to word level instruction (80% of total instructional time) over text level activities.

A recent experimental study by Simmons, Kame-enui, Harn, Coyne, Stoolmiller, Santoro, et al. (2007) involved placing students in one of three experimental conditions, each with a varying instructional design. All interventions were for 30 minutes daily in small group with focus on phonemic, alphabetic, and orthographic skills and strategies with varying degrees of attention on each one. The results demonstrated the importance of carefully orchestrating interventions according to the specific needs of students. For

example, those who were the most at-risk (three or fewer letters upon entrance) benefitted from increased instructional time in alphabetic skills (30 minutes vs. 15); however, more advanced students made more substantive improvements when they spent less time working on alphabet skills and more time on phonics. This study demonstrates that pedagogical precision is the most critical element of effective intervention in the decoding variable of the Simple View. Unless at-risk students receive carefully constructed and targeted decoding instruction, their success in learning to read is in jeopardy.

Intervention in vocabulary. From the longitudinal research of Hart and Risely (1995), we know there is a tremendous gap between students who enter school from homes where oral language is richly prevalent and students whose homes are linguistically impoverished. In addition, Stanovich (1986) introduced the "Matthew Effect" in reading, which shows the tendency of the rich to get richer and the poor to get poorer in terms of language exposure, vocabulary, and reading opportunity. White, Graves, and Slater (1990) note that low achievers' vocabulary tends to grow one fifth as much as high achievers—a distinct learning gap. Students who arrive in school with limited vocabularies tend to remain behind indefinitely. Yet, all too often the critical vocabulary variable that impacts reading comprehension goes unattended in schools, particularly in the early grades as teachers focus intently on the decoding process. The question, then, is what can schools do to close the vocabulary gap so that these linguistically deprived students have an opportunity for long-term academic success in a system where reading comprehension is essential?

Stanovich (1986) and Nagy and Anderson (1984) report that vocabulary acquisition grows as students at an early age ingest large amounts of text through wide reading. Their findings suggest that children who read more have larger vocabularies and children who read less have smaller vocabularies. Generally, students with limited vocabularies have been found to be at least 2 years behind their more linguistically capable peers. Optimistically, researchers argue that by teaching three to six root words per day beginning in early elementary years, limited vocabulary students could actually catch up with their more capable peers (Biemiller & Slonim, 2001). Biemiller (2005) further discovered that 840 root word meanings are learned each year by average students in primary grades. However, children in the lowest quartile add just 570 word meanings per year during the same time period. This means that several hundred words per year would need to be added to the vocabularies of the most at-risk students in order to accelerate their learning. But what does targeted intervention look like to promote accelerated vocabulary growth for such identified struggling learners?

As discussed earlier, the act of reading aloud to children in quality literature and expository text supports the development of vocabulary. In fact, findings to date suggest that oral language and vocabulary can be boosted within the context of read-aloud time as students are exposed to vocabulary in trade books that is well beyond their current vocabulary knowledge. Anderson and Nagy (1991) suggest that getting the gist of a story is as likely, or more likely, to assist in learning meanings of unfamiliar words than pre-teaching vocabulary before reading a selection. Important elements of read-aloud are the use of fiction and nonfiction, reading text above instructional level for the students (Cunningham, 2005), and discussing ideas and words throughout the reading event

(Stahl, 2005). Students with limited vocabularies need to participate in read-aloud or shared book reading for at least 30 minutes daily to build oral vocabulary (Graves, 2008).

Studies of children in grades K-2 conducted by Biemiller and Boote (2006) found that teaching many word meanings with teacher-provided explanations during repeated reading (two or four times) of specific read-aloud stories prompted retention of more words by more children (up to 41% of word meanings taught). Their results imply that it may be possible for children to learn 400 word meanings per year if 1000 word meanings are taught at an average of 25 meanings per week through read-aloud. Interestingly, children in first and second grade had similar gains in word meanings whether the books were read twice or four times each as different word meanings were taught with each successive reading of the text. Their research also suggests that it may be equally valuable to teach many word meanings briefly during read-aloud as it is to teach fewer word meanings more intensely. This is because different children know different meanings, and the more word meanings introduced the more likely that all children will learn at least some new words.

Text Talk is an instructional method of teaching vocabulary with rich and focused instruction following the reading of a trade book. Beck and McKeown (2007) developed and studied the effects of this strategy on low-income kindergarten and first grade students. In Study 1, they measured the difference in vocabulary learning between groups of students who participated in Text Talk instruction and groups that did not. In general, students in the Text Talk groups learned three new words for every one learned by the control groups. Study 2 sought to determine if more encounters with new words in multiple contexts would lead to greater retention. Six words were taught per week (5

encounters per word) with three of them being emphasized with "more rich" targeted instruction (20 encounters per word). Overall gains for the "more rich" groups were twice as large as the rich instruction groups. Though the numbers of words learned in the Text Talk approach was much less than what Biemiller and Boote (2006) obtained, Beck and McKeown argue that the words they taught were more sophisticated and useful across contexts once learned. They further openly admitted that vocabulary learning is a complex, time-consuming undertaking—even in kindergarten.

Silverman (2007) showed through two read-aloud studies that attention to a semantic analysis of new words anchored in spoken and written forms was significantly more powerful to ensure retention of vocabulary in kindergarten students than a focus on contextual information alone. Children were divided into three instructional approaches: (a) contextual—connecting instructed vocabulary to both the books and children's own experiences; (b) analytical—adding semantic analysis of words in other contexts similar to the Text Talk method of Beck and McKeown (2007); and (c) anchored—adding both the spoken and written forms to the semantic analysis of the taught words. From Silverman's work it would appear that very young children respond well to the teaching of both decoding and vocabulary simultaneously during read-aloud time. This finding was alluded to by Biemiller and Boote (2006) when they discovered that students who made the most gains in vocabulary were in first grade where their teachers not only taught words but wrote them on a word wall to refer to and read with the children throughout the instructional day. Overall, best practices for vocabulary learning with young children appear to be conducted primarily through read-aloud events as young children are unable to access sophisticated written text in any other way.

Summary of early literacy intervention. Decades of reading research converge with the Simple View of Reading to show the vital importance of both decoding and language comprehension to support overall reading comprehension with explicit and systematic early intervention being the key to overcoming weaknesses in either area. Such intervention is conducted either in small group or one-to-one settings for maximum benefit as instruction must target the specific developmental needs of each student. In addition, an intervention that is comprehensive in addressing the essential components of literacy and delivered in partnership with solid classroom instruction has been found to be most successful. In the next section we turn to a discussion of the specific literacy development challenges of English language learners.

Early Literacy Intervention for English Language Learners

With the significant demographic shift taking place in the United States (Shin & Kominski, 2007) and with the National Assessment of Educational Progress (NAEP) assessment results from 1992 to 2009 showing only a modest reduction in numbers of language minorities scoring below the basic level (National Center for Education Statistics, 2009), the achievement gap between monolingual and language minority students perseveres. English language learners who begin formal schooling in English without commensurate native language literacy are the most challenging group of ELLs to teach (Snow et al., 1998). As such, these students tend to be disproportionately represented in special education programs during their elementary school years unless they receive culturally sensitive, intensive, and early intervention (Klingner, Artiles, & Barletta, 2006).

Published in 2006, the Report of the National Literacy Panel on Language-Minority Children and Youth examined the research to date that impacts the literacy development of language-minority children. Though the research base was severely limited in comparison to the research base identified by the NRP (1800 vs. 100,000, respectively), the results suggest that what works for monolingual children is also effective for language-minority children with modification (August & Shanahan, 2006). In fact, English language learners are able to use first language skills as a foundation for learning the second language though the rate of acquisition is often slow. In addition, English language learners learn to decode as quickly as their mono-lingual peers; though they tend to lag behind in their comprehension of what they read due to large gaps in their oral language proficiency, including oral vocabulary knowledge, awareness of cognates, listening comprehension, oral storytelling skills, and syntactic skills (Geva, 2006; Lesaux & Geva, 2006). The Simple View framework lends support for the assertion that the variable of language comprehension is the most likely source of their academic delay. In this section, we will examine in greater detail each of the variables of decoding and vocabulary learning in early literacy intervention for English language learners.

Early decoding intervention for ELLs. As previously stated, English language learners generally learn to decode as quickly as monolingual students. In the area of phonemic awareness and phonics, only five studies of the National Literacy Panel on Language-Minority Children and Youth target English language learners, but all are consistent with solid findings of first-language research confirming clear benefits to explicit instruction in phonemic awareness and phonics on reading development. Hus

(2001), for example, conducted an experiment with 68 language-minority students in four kindergarten classes and 50 language-minority students in two first grade classes. The experimental groups were taught with an explicit phonics program called "Jolly Phonics" for nine weeks. The control groups received no systematic phonics instruction. The conclusion from the study was that explicit phonics is critical to benefit young language-minority students.

The work of Lesaux and Siegel (2003) reminds teachers of the importance of targeting phonological awareness skills during early literacy instruction. In their longitudinal study of kindergarten students who received targeted intervention in small groups for at least 20 minutes daily until second grade, they found that phonological processing was the single best predictor of second grade word reading ability. They further suggested using measures of phonological awareness as a predictor of the reading development of language-minority children rather than using measures of oral language skills, because phonological awareness skills possessed by children in their first language will transfer readily to English and support reading acquisition in English. In addition, Lesaux and Siegel showed that early balanced literacy instruction with small group intervention targeting phonological awareness is as effective for English language learners as it is for monolingual children in the early grades—especially when it begins early and is of sufficient duration and intensity to achieve desired results.

Several years following the research of Lesaux and Siegel, an extensive review of the literature confirmed similar findings: Phonological awareness, orthographic awareness, and alphabetic knowledge are the most significant factors correlated with later reading achievement for English language learners (Klingner, et al., 2006). Giambo and

McKinney (2004) further showed that phonological training also supports oral language proficiency for English language learners in kindergarten and is critical to include in addition to targeted vocabulary training in the context of children's literature. When teachers use assessments of phonology, orthography, and alphabetic knowledge to guide identification of students in need of early intervention, and then conduct interventions that are of sufficient duration and intensity, many language-minority students appear to be able to achieve grade-level proficiency in decoding and avoid the all-too-frequent referral to special education.

Early vocabulary intervention for ELLs. In the area of vocabulary learning, the National Literacy Panel on Language-Minority Children and Youth (August & Shanahan, 2006) discovered a dearth of research on its effect for language-minority children. Only three studies were available from which to tentatively conclude that deep processing of word meanings and repetition and use of words in different contexts supports learning. From the findings of this limited database of explicit instruction in specific literacy components for English language learners, Shanahan and Beck (2006) concluded the following: (a) oral language proficiency is needed to benefit from literacy instruction;(b) teachers must adjust their instruction for ELLs; and (c) what works for native speakers generally appears to work with English language learners, though much more research is needed to discover exactly what adjustments are necessary in order for ELL's literacy growth to be accelerated. Ultimately, for language minority literacy success "it may be that what is needed is sound reading instruction combined with simultaneous efforts to increase the scope and sophistication of these students' oral language proficiency" (p. 448).

One way to increase the vocabulary proficiency of young English language learners is to provide extensive time for students to engage in meaningful literacy events (Shanahan & Beck, 2006). As noted previously, such literacy events at the primary level typically revolve around the teacher read aloud. Students with limited vocabularies need to participate in read-aloud or shared book reading for at least 30 minutes daily to build oral vocabulary (Graves, 2008). Studies involving the Kamehameha Early Education Project (KEEP) designed to improve the literacy achievement of children of Hawaiian ancestry found that increasing the amount of time children spent listening, speaking, reading, and writing was critical to their academic outcomes (Tharp, 1982). Following more than a decade of success with the approach used by Tharp and colleagues (see Peregoy & Boyle, 1993), Au and Carroll (1997) found that extended time in reading and writing was even more critical than listening and speaking to improve literacy outcomes for these children. Vaughn, Mathes, Linan-Thompson, and Francis (2005) also found that daily story retelling, vocabulary building through language support activities, repetitive language and routines, modeling, dialogue with teacher, and multiple practice opportunities are essential components of strong literacy intervention for ELLs.

Explicit and targeted vocabulary instruction is another critical element of oral language development for English language learners. Comprehension of text is disrupted if too many words are unknown. This is especially significant for English language learners, making vocabulary learning a serious issue for them (Anderson & Roit, 1996; Calderon, August, Slavin, Madden, & Snow, 2005; Garcia, 1991). In a naturalistic study of a first grade classroom over a period of one year, Fitzgerald and Noblit (2000) found that even though the ELL students (who comprised half the class) made similar progress

to their monolingual peers in basic decoding skills, they scored at the bottom of the class in vocabulary learning. Researchers acknowledged that it is critical to have a specified plan for vocabulary development for the English language learners in the classroom. It would appear that a major route to academic language proficiency is through targeted vocabulary instruction. Vaughn, Mathes, Linan-Thompson, Cirino, Carlson, Pollard-Durodola, et al. (2006) conducted an experiment of targeted intervention with 48 struggling English language learners in first grade. This study was designed similar to the study of two theoretically different intervention approaches described earlier in Mathes et al. (2005), but with the addition of a vocabulary, listening comprehension, and language development component that added an additional 10 minutes daily to the intervention. Of significance is the fact that the struggling readers in the intervention groups made gains not only in phonological processing but also in reading comprehension, suggesting that the additional 10 minutes per day boosted vocabulary and language achievement for these language-minority students.

Most important, however, may be the role of the classroom teacher to boost levels of oral language and vocabulary knowledge of English language learners. Graves, Gersten, and Haager (2004) observed the instructional practices of 14 first grade teachers of ELLs over a period of 2 years. Teachers whose students had the strongest reading achievement over time were observed to engage daily in practices that focused on vocabulary development such as: "use of facial gestures and pictures to help define words, encouragement for elaborate and meaningful responses, and structured student opportunities to speak English thus creating an environment where students feel comfortable speaking in a second language" (p. 270). Such teacher expertise and focus on

vocabulary development appears to be a critical feature of early reading instruction for English language learners.

  Summary of best intervention practices for ELLs. Intensive intervention beginning in kindergarten is not only beneficial, it may be essential for students who arrive in school without the English language skills needed for early literacy success, though more research is needed to determine how best to design intervention programs for ELL success (Snow, 2006). Gottardo and Mueller (2009) suggest that it is the combination of solid instruction in decoding and oral language skills that leads to reading success for language-minority children. When decoding interventions known to be successful with monolingual students are combined with focused oral language instruction targeting vocabulary learning and delivered in comprehensible ways to English language learners, then both language comprehension and decoding skills are boosted and grade level reading comprehension success may be achieved by the end of second grade.

Computer Assisted Instruction for Early Literacy

  In 1998, Snow, Burns, and Griffin verbalized a most perplexing dilemma regarding the use of computers in instruction as they concluded that "software can promote learning only to the extent that it engages students' attention—yet software that engages students' attention may or may not promote learning" (p. 265). Since the NRP noted the limited availability of research on computers with respect to early literacy issues (see NICHHD, 2000), an increasing number of studies attempting to determine the effects of computer assisted instruction in this area have emerged. In this section, we will examine the research base for using computers to support the Simple View variables of

decoding and vocabulary, knowing the importance of simultaneously building children's oral vocabularies as they learn the decoding process in order to influence long-term comprehension success. In addition, we will explore the effects of comprehensive computer assisted instruction programs, known as integrated learning systems, on the general outcomes of reading achievement as this is the type of software under investigation in the current study of ILE.

Effects of CAI on decoding. From multiple lines of research we know that phonemic awareness and phonics are two critical pillars of literacy that impact early reading success (Ehri, 2005; NICHHD, 2000). In findings from their meta-analysis of phonemic awareness instruction, Ehri et al. (2001) noted that the use of CAI to teach phonemic awareness was effective, though not as effective as direct teacher instruction, a finding consistent with research reviewed in previous sections that emphasizes the need for strong teacher-led interventions to impact reading outcomes. It would appear that phonological instruction via computer may be a strong supplement to quality teacher instruction, but could not and should not replace it. Reitsma and Wesseling (1998) confirm this finding in one of the most substantially effective CAI studies of phonological instruction included in the Blok et al. (2002) meta-analysis of early literacy CAI programs. Participants in this study were 98 Dutch kindergarten children with no previous reading experience. Fifty-three students were assigned to one of two experimental conditions: one condition supported blending of CVC words integrated with learning the meanings of those words, and the other condition supported exercises to learn meanings of new words only. All instruction took place on computers for 10 minutes twice weekly over a period of 12 weeks with pictures used to support word

meanings. A control group received regular classroom instruction. Findings showed that the blending CVC group outperformed the new word only group on tests of phonemic awareness following training. In addition, the long-term effects were that the students in the two experimental conditions also outperformed their peers in beginning reading tasks in first grade. The authors concluded that CAI when used well in kindergarten can assist teachers with phonological training, though CAI certainly cannot replace direct instruction from the teacher.

In a more recent study examining the long-term effects of a CAI intervention of phonological development of native and immigrant children, Segers and Verhoeven (2005) looked at one hundred children in their second year of kindergarten in the Netherlands using three different schools, two control group schools and one experimental group school with 44 students. Students in the experimental group used a set of CD-ROMS with nine learning and discovery games targeting early phonological tasks. During a 40-week period, children played these games once a week for 15 minutes. On average, the total time with the CD-ROMS was 8.5 hours with time split fairly equally between discovery and learning games. Students in the control schools did not have access to this software. Assessments were administered at the end of kindergarten and in the middle of first grade to determine the long-term effects of the intervention.

Results at the end of kindergarten showed that the intervention had significant positive effects on rhyming tasks for the immigrant children such that they were able to catch up to the native children in this regard. In addition, there was a significant positive effect for orthographic knowledge for both the native and immigrant children due to the presence of computer games involving letters. However, the intervention did not directly

affect either native or immigrant children's auditory blending or their ability to segment phonemes. In terms of the effect of the intervention on first grade literacy, the program appeared to facilitate children's process of learning to read as they scored slightly higher in auditory blending, phonemic segmentation, and orthographic knowledge than control students when tested four months into first grade, though the effect size was not as large as hoped. Researchers suspect this modest result was due, in part, to the variety of games that targeted multiple abilities rather than focusing on just one or two, and to the fact that the software was not adaptive to students' increasing skill so time may have been wasted on skills that students already knew rather than teaching new skills. A potential advantage appears to exist from an emphasis on software that provides explicit instructional feedback if it is to be optimally effective in supporting literacy skills.

In addition to building phonological awareness skills, the computer may be helpful in supporting the decoding of actual text. Wood (2005) looked at using the computer as a "teaching surrogate" during small group literacy instruction where students must work independently while the teacher is with a small group. Eighty kindergarten and first grade participants from the same school were split in two groups. In one experimental group, researchers tested the effects of using electronic talking books to assist with decoding for early readers. The other group received one-on-one decoding support from an adult. The same books were used with both interventions that lasted 15 minutes for six sessions over a period of several weeks. Results found no significant differences in outcomes between the two interventions. The computer-based format for reading was found to be comparable to an adult tutor to support phonological processing.

The implication is that such computer software can be helpful to provide decoding feedback when not enough adult support is available.

In terms of effects of CAI on the phonological development of at-risk students, there are several notable studies. Mioduser, Tur-Kaspa and Leitner (2000) compared CAI with teacher instruction and textbooks for early reading skills acquisition in Hebrew. Forty-six children aged 5-6 at high risk for learning disabilities from six special education kindergartens participated. Students were assigned to one of three study groups: intervention with computer, intervention with printed materials, and no intervention. The computer intervention resulted in significant improvement in phonological awareness, word recognition, and letter naming skills compared to the other two groups. Components of the computer-based program that seemed to make the biggest difference were the extensive use of sound, touch-screen interface, information presented with text, still and animated images, content structured progressively, variety of learning modes (e.g., exercises, tutorials, practice games), and the teacher role in determining skill and difficulty level to be practiced. The authors concluded that "the technology by itself means only the necessary infrastructure upon which should be built robust pedagogical solutions to real learning problems" (p. 61).

Regtvoort and Van der Leij (2007) used a randomized experimental design to attempt to minimize the effects of dyslexia on children prior to starting school. Students and their families were provided with computer-based intervention materials for use in their homes prior to entrance in kindergarten. While the children who used the materials did better than their peers upon entrance to kindergarten, these effects diminished in first and second grade. The authors hypothesized that it may be necessary for such at-risk

readers to get intensive intervention support throughout the learning-to-read years in order to maintain whatever early advantage the CAI provided. Though unable to replace direct instruction from the teacher, well-structured CAI programs appear to be able to deliver the kind of intensive practice required for struggling readers to develop their literacy skills.

Macaruso and Walker (2008) conducted a randomized study of a CAI that included nine phonics-based activities. Six classrooms of half-day kindergarten students were involved which eliminated the effects of teacher on treatment and control conditions as each of three teachers taught both a morning and an afternoon class which were divided as such. Treatment classes used the software for six months several days each week for 15-20 minutes. Though both control and treatment students performed well on end-of-year tests due to a strong phonics curriculum in the regular program, the most at-risk students were most successful with the CAI program because of the extra practice opportunity it provided.

Most recently, Wild (2009) conducted a randomized study of the effects of practicing with CAI on the phonological skills of beginning readers. A total of 127 children across six primary schools in the United Kingdom participated. Two intervention groups used the same phonological practice program but one was delivered on the computer and the other in a paper-based format. A third control group used a math practice program instead. Interventions lasted a total of 6 weeks for 15-20 minutes daily. Results were that students using the computers did better on tests of phonological skills and application than students using a paper-based practice format (.25 overall effect size with $p<.01$), though the effect size was not unlike the effect sizes of studies found in the

Blok et al. (2002) meta-analysis of many years previous. Researchers surmise that such minimal effect sizes are due, in part, to the relatively small sample sizes used in this and most CAI beginning reading experiments.

Finally, CAI for young English language learners was investigated by Poulsen, Hastings, and Allbritton (2007) who assessed the value of a reading tutoring program called LISTEN (Literacy Innovation that Speech Technology Enables) on a group of English language learners from grades two, three, and four. They wanted to find out the extent to which the LISTEN program accelerated decoding skills for this range of learners. In the study, 34 Hispanic students spent 25 minutes daily for 1 month in each of two conditions: independent silent reading and CAI using the LISTEN program. LISTEN uses automated speech recognition to "listen" to children read aloud, providing both spoken and graphical feedback. LISTEN produced significant learning gains on several measures of fluency with effect sizes ranging from 0.55 to 1.27. These dramatic results from a one-month treatment indicate this technology may have much to offer English language learners, though the sample size was small and the intervention of short duration. The researchers suggested that future modifications of the software should include more illustrations and more culturally-sensitive text to benefit English language learners. In addition, the speech recognition technology may have great potential to enhance literacy learning for multiple subgroups of at-risk students.

In summary, research reports value in the use of CAI to support the phonological skills development of beginning readers, though the intention is that such support must not replace direct teacher instruction. This value appears most significant for at-risk populations when feedback is immediate, relevant to their learning needs, and provided in

the form of guided or independent practice opportunities following direct teacher instruction in the needed skills. Significant limitations to the studies of CAI in literacy instruction, however, affect the ability to draw more than tentative conclusions from the research to date due to small sample sizes and short durations of most studies.

Effects of CAI on vocabulary. Although the NRP report reported on only two studies of vocabulary learning with computers, and one of them was with eleventh grade students (Kolich, 1991), one of the eight specific findings of the NRP was that computer technology can be used to effectively teach vocabulary (NICHHD, 2000). Since 2000, there have been several studies focused on this issue.

As noted in previous sections, the use of reading aloud to children is a powerful tool to increase oral language and vocabulary. Research also concludes that wide reading has the potential to impact vocabulary learning in substantial ways (Cunningham & Stanovich, 1998). In recent years, several studies have been published combining vocabulary learning with the reading of and interaction with electronic texts to extend young children's oral language learning. Boling, Martin, and Martin (2002) conducted an experiment involving 25 first graders from a single classroom during DEAR (Drop Everything and Read) time. Half the class was the experimental group who used CAI while the other half was the control group who used books and tapes during their 20 minutes of silent reading. The computer group had access to the same books as the control group but in addition to hearing the stories read to them on computer, they were able to click on unknown words to hear definitions and receive added contextual information. New words could also be stored in individualized word banks and then used during a computerized writing component. All students were pre- and post tested with

each reading session using six words selected by the researchers from the assigned story that day. Following 6 weeks of instruction, results showed that the CAI students made greater gains than control students in recall of new vocabulary words.

Segers and Verhoeven (2003) conducted an extensive study of software designed to increase vocabulary knowledge of young immigrant children (see also Segers & Verhoeven, 2002). The goal of the study was to determine the extent to which intensive vocabulary training on a computer can enhance young children's vocabulary learning and thus reduce the vocabulary gap between native and non-native speakers. The participants were 164 kindergarten children in the Netherlands, with the experimental group from one school being compared to control groups at two other schools. Children in the experimental group (half the total number of subjects) used the CD-ROMs twice weekly for 15 minutes over a period of 15 weeks. During this time these children had individualized access to 150 vocabulary words taught in the context of stories on each of three CD-ROMs that constituted the program. Curriculum-dependent testing showed positive effects for all students who used the computer program implying that while the intervention did not close the vocabulary achievement gap between native and immigrant children, it did provide an extra boost to the vocabulary acquisition of targeted students. Curriculum-independent tests of vocabulary growth showed a trend towards a significant effect for the older children in the study. This trend may have become significant except that the older children reported becoming bored with the CD-ROMs in the second half of the year. Had these children used even more of the CD-ROMS and spent more time on each, they may have experienced even greater success with vocabulary acquisition.

The use of electronic texts to replace paper-based texts in the younger grades is another aspect of CAI that may or may not be supportive of language and literacy development. Underwood (2000) considered the use of "talking books" to support literacy. Her findings indicated that adding visual stimuli to a narration increases comprehension for young children, making talking computer books at least as good as television. Similarly, Ricci and Beal (2002) compared audio-only story presentation, audiovisual presentation (television), interactive presentation on computer with the child clicking on "hot spots" in the story pictures, and children observing the interactive computer group. Researchers found that the inclusion of visual stimuli had additional value for story comprehension and recall over the audio-only presentation. However, no differences were found between the three groups of children receiving direct visual input. In fact, the children receiving the computer version were neither hindered nor helped by the interactive 'hot spots." This finding is in contrast to Trushell, Burrell, and Maitland (2001) who observed 5-year-old students during the reading of interactive storybooks and concluded that students' recall was affected by the many interactive features of the electronic book.

Jong and Bus (2002) also considered what emergent readers internalize from repeated readings of books that are similar in illustrations and story content but differ in format (regular vs. electronic). Forty-eight kindergarten children from four classes at the same school in the Netherlands were grouped by high, medium, and low literacy skills from which individual random assignment to treatment groups was made. The regular book group read the paper version only. One computer book group was restricted to reading or listening to the text read from the computer only. Another computer book

group was unrestricted and could access any supplementary, interactive material that was available for each story. The last group was the control. The results indicated that children were more intrigued by the iconic facets of the electronic book than the story text. This was particularly poignant for the most at-risk students. When games were accessible to all literacy levels, they distracted everyone equally. The regular book format was found to be most supportive of comprehension of story content and phrasing as the children actually listened to the story multiple times as opposed to only a few times in the electronic formats.

More recently, Korat and Shamir (2007) conducted a study in Israel with 128 kindergarten-age students from both low and middle social economic status (SES) groups. Random assignment was made to one of three subgroups. Two intervention groups participated in three book reading sessions each, with one group individually interacting with an electronic book and the other group being read a printed version of the same book by an adult. The control group received the regular kindergarten program with no supplementary book reading intervention. The post test vocabulary scores of both interventions improved over the control group as did the comprehension scores, though phonological awareness and word recognition remained unchanged, leading researchers to consider that in order for computers to successfully support beginning readers, the target skills area must be very clear and precisely focused to see effects.

In summary, the use of electronic interactive books can be a helpful way to support vocabulary learning, particularly for emergent and other struggling readers, but caution must be taken to select e-books that are appropriate for the audience. When too many "bells and whistles" are involved, the learning benefits of the text can be

diminished. In addition, students must be placed appropriately with software that will further their learning and not simply entertain in order for results to be significant. More recent voice recognition technology makes increasingly more feasible the use of computers to supplement teacher instruction and provide effective tutoring for young children.

Effects of comprehensive CAI programs. An integrated learning system (ILS) describes CAI software programs that provide sequential instruction for students over several grades while keeping extensive records of student progress. Most ILS programs use tutorial instruction as a basic teaching methodology, and most provide instruction in the basic skill areas of reading and mathematics. This section will examine the benefits of ILS programs in reading only. In a review of the research on ILS programs, Kulik (2003) found that studies done in the 1990s showed no significant effect from students' use of ILS. However, Kulik also noted that effectiveness improves if students spend adequate time on the program and the ILS instruction is integrated with classroom instruction. Kulik cautions educators to pay close attention to social factors when implementing the ILS as students seem to perform better when given the opportunity to work in pairs rather than alone. Van Dusen and Worthen (1994) also reviewed numerous studies of ILS programs and found that schools with weak implementation of the ILS showed no effect on achievement, but schools with strong implementation showed larger effects on achievement.

Miller, DeJean, and Miller (2000) considered the challenge of curricular incongruence between an ILS and the existing curriculum in their study of *Success Maker*, an ILS published by Computer Curriculum Corporation (CCC). Using

information gathered from teacher surveys and classroom observation, they documented areas where the curricula embedded in the ILS was congruent with teachers' normal curricula and pedagogical practices, but they also found numerous instances of incongruity as in the case of phonics instruction where there were discrepancies between normal practice and computer-based learning. Such differences in content, presentation sequence and instructional practices raise issues about the appropriate relationship between computer-based instruction and teachers' normal practices.

In response to the challenge of curricular incongruence, Nicholson, Fawcett, and Nicholson (2000) designed an ILS program known as RITA (Reader's Interactive Teaching Assistant) to serve as a computerized instructional assistant where the teacher has central control. "To be viable in schools, the computer must be an integral part of the teaching process rather than as an un-integrated afterthought," (p. 196). Teachers use the RITA system to identify and program target areas for individualized instruction according to assessment results. The study involved an intervention group from one school and a comparable control group from another school. All students were approximately 6 years of age. The intervention included two weekly sessions of 30 minutes for 10 weeks as part of the normal instructional day. It is unclear what kind of instruction the control group received as it was referred to as merely "traditional intervention." RITA produced strong results for most students, though the at-risk students were not as successful. Researchers hypothesized that this group of children needed more time with the intervention in order to be successful. They also found the most notable advantage to RITA to be the significantly high levels of enthusiasm and commitment from its users.

Van Daal and Reitsma (2000) considered kindergarten students' use of an ILS (Leescircus) that provided assessment, feedback, and placement in the program at multiple stages. Twenty-one children from two classes were randomly assigned to either the ILS experimental condition or the control condition which was regular classroom instruction without use of the technology. They found that kindergarten readers learned in up to 16 hours of computer practice as much as is normally attained in the first 3 months of formal reading instruction in the classroom. A second study of reading-disabled students ages 8-12 involved their use of the spelling component of the ILS for five minutes daily three times per week for a half year. Not only did students' spelling improve as a result of the intervention, but their non-task directed behavior decreased as well.

The *Waterford Early Reading and Literacy* ILS program has met with mixed reviews from multiple sources. The *What Works Clearinghouse* (Institute of Education Sciences, 2007) conducted extensive research on the program. They examined multiple studies, but found only one that showed a moderate positive effect for the program. All others showed no effect. Paterson, Henry, O'Quin, Ceprano, and Blue (2003) conducted a one-year study of the effectiveness of the *Waterford Early Reading* Program on kindergarten and first graders in a large urban district in New York. Comparisons were made between eight classrooms that used it and eight classrooms that did not. Results from observations, surveys, and interviews with teachers indicated no significant difference between *Waterford* and non-*Waterford* classrooms. They concluded that *Waterford* is missing the social interactions needed for early literacy growth. Cassady and Smith (2005), on the other hand, attributed the lack of difference to the fact that the study

did not use a strong causal design. Though it was a quasi-experimental design it did not provide enough information to establish that the comparison group and the intervention group were composed of comparable students. The selected intervention classrooms were the lowest performing in the schools and the teachers of those students depended on the *Waterford* program to "fix" everything.

Cassady and Smith (2005) conducted their own study of the impact of the *Waterford Early Literacy* program on first grade students' reading gains. Standardized tests of reading achievement were used to determine the success of the program. Two cohorts of students entering first grade over 2 years were compared. Each cohort was taught by the same three teachers, with the only significant difference between the cohorts being that one cohort used the *Waterford* program. Results showed that the students at most risk were the students who benefitted the most from the program. The key difference attributed to their success was the teacher involvement in monitoring student progress, aligning exercises based on student need, and providing supplemental instruction in addition to that provided by the program. It would appear that ILS programs have the potential to be highly effective supplementary literacy tutors if well implemented, but do little to support learning if implementation is minimal. In addition to ensuring that students spend sufficient time with the program, teachers must also be involved in monitoring and supporting progress by integrating the instruction from the computer with instruction in the classroom.

In summary, evidence mounts to support the use of the computer as tutor both in specific literacy components and as integrated learning systems that support a range of literacy components at once. However, caution must be taken that the computer is

supplementing, not supplanting, direct teacher instruction in the critical literacy components. Struggling students tend to benefit the most from such computer assistance as it generally offers extended practice opportunities, though care must be taken to ensure that the program balances the entertainment and educational objectives so that the "bells and whistles" do not distract from learning. Finally, limited research to date on vocabulary learning via computer suggests that this critical literacy area offers a wealth of opportunity for further study. The next section will examine the components of the ILE program as they relate to the requirements of early literacy instruction to determine its potential as an early literacy intervention tool.

<div align="center">What is Imagine Learning English?</div>

Summary of Features Needed For Effective Literacy Intervention Using CAI

Based on the preceding literature review, there are a number of components that should be present in any CAI program that seeks to support the development of early literacy skills. First, the program should emphasize one or more of the following: phonological awareness, alphabet knowledge, systematic phonics, decodable text, comprehension, oral language, and vocabulary building. If it is an integrated learning system it should emphasize all aspects of early literacy—particularly the skills that lead to the ability to decode and the skills that support oral language development and vocabulary learning. If the program targets ELLs, the language and vocabulary component should emphasize academic language along with opportunities to listen, speak, read, and write in English. The decoding component should include text that is culturally sensitive and well illustrated to ensure comprehension. Second, the program should be integrated and aligned with classroom instruction, reinforcing skills previously

taught directly by the classroom teacher, and providing multiple practice and re-teaching opportunities. Third, the program should be implemented with fidelity and monitored carefully by teachers to ensure that students are receiving all the potential benefits of the CAI. Fourth, the CAI should carefully balance the engaging graphics, games, and other "bells and whistles" with targeted instruction in multiple literacy skill areas. Finally, the assessment component of the CAI should provide explicit instructional feedback and placement based on individual student performance over time.

Instructional Components of ILE

Imagine Learning English is designed as a comprehensive language and literacy software program with a variety of instructional components, each one contributing to the total program by varying amounts: literacy (39%), vocabulary (30%), listening (11%), speaking (9%), writing (5%), grammar (1%), and a few miscellaneous curriculum items (4%) (see ILE Training Guide, 2010). ILE is designed in two instructional levels: one that focuses on everyday vocabulary, listening, speaking, emergent literacy and school readiness; and the other that focuses on academic vocabulary development and literacy. Each component is taught through engaging activities, strategic sequencing, and targeted English language development instruction. The speaking component is developed through reading and singing along with the computer and participating in opportunities to record and play back one's voice. The writing component is developed through printouts accompanying specified lessons to include story sequencing, summarizing, and journal response opportunities.

"Literacy" is the largest component of the total ILE curriculum. Sequenced instruction is provided in phonemic awareness (4% of total literacy lessons), letter

recognition (18%), phonics (39%), and decodable/leveled text (39%). Comprehension instruction and assessment are integrated within both the decodable and leveled texts. As students gain proficiency in one area they are moved level by level to increasingly more difficult literacy activities and texts. In a daily 30-minute session on ILE, a student is likely to be engaged in literacy activities and/or texts for approximately 12 minutes.

The second largest instructional component of ILE is "vocabulary". Vocabulary instruction is also embedded both directly and indirectly in several other instructional components. In the literacy component, there are 932 total activities, 32 of which target specific story vocabulary. The listening component has 250 activities, 26 of which build pre-reading vocabulary. In essence, by calculating the percentage of the total number of curriculum activities in the program that directly attend to vocabulary, we see that vocabulary learning actually comprises nearly 33% of the program's emphasis. Thus, a student who spends 30 minutes daily using the ILE program could, theoretically, be involved in vocabulary learning for almost 10 minutes of that session.

The ILE program is designed to be used four to five times weekly with the target goal of 40 hours of instruction distributed evenly over a school year to receive maximum benefit (C. A. Wakefield, personal communication, May, 2010). Students in kindergarten and first grade are encouraged to use the program for a minimum of 20 minutes per session, while older students in second grade and higher are encouraged to use the program for 30 minutes each session. Students begin using the program by participating in a placement test embedded in ILE that places students in the lesson sequence according to results. Formative assessment is then conducted automatically throughout a student's use of the curriculum. Teachers are informed of student progress in the

curriculum through real-time reports that can be accessed as needed. Along with usage reports, the program provides in-depth summaries of individual progress in all curriculum areas. Voice recordings can also be accessed and analyzed by teachers as an ongoing assessment of progress.

ILE Research Base

Limited research has been conducted to date that targets the assessment outcomes of the ILE software. Studies commissioned by the developers of the program and prepared by ClearVue Research Inc. (2007), examined the program's use among kindergarteners and first graders in two school districts in Illinois and California. Using a quasi-experimental design, researchers compared students who used the ILE program with students who did not. In Illinois 326 children in kindergarten and first grade participated, but only 24 kindergarteners and 14 first graders belonged to the ILE treatment group. In California, 34 kindergarten students participated with 17 receiving the ILE treatment. Results from both states suggested a strong benefit for students who participated in the ILE intervention as measured by end of year state wide assessment results. In fact, claims of the program's ability to significantly close the achievement gap were strong in both studies. Unfortunately, in addition to small sample sizes in both studies, no descriptive statistics were used to define either the control or the target groups nor was the curriculum for the control group defined in order to allow reasonable comparisons to be made.

A third study completed by JointStrategy Consulting (2008) examined the program's use in Chula Vista School District of California using 45 ILE participants and 114 non-ILE control students across grades K-6. Once again, results suggested that ILE

participants showed greater improvements on standardized tests than non-ILE controls. And once again, descriptive statistics were not used to define either the intervention or the control participants nor was there any description of the instruction being provided outside of ILE to either group. Thus, results from these limited studies provide weak evidence concerning the superior performance by ILE participants. Needed are carefully controlled experimental studies that clearly describe both control and intervention participants and that carefully delineate the instructional programs of both groups so that reasonable comparisons on outcomes measures may be made.

Summary

   Imagine Learning English is designed to be an efficient, state-of-the-art computer-based method of providing quality early literacy intervention instruction for at-risk students. The program includes all of the components of quality CAI for early literacy development as identified by the current literature base. However, results from the only studies conducted to date are tenuous at best as none of the studies provides solid research design and methodology to allow for unambiguous interpretation of results. A comprehensive evaluation study of the effectiveness of ILE in its two largest component areas of literacy decoding and vocabulary learning is in order to better inform decision-makers who must determine how to allocate limited educational dollars to programs and practices that make the most difference in accelerating the early achievement of at-risk students.

Research Questions

The current study couples current knowledge about best practices in language and literacy learning for English language learners and other young learners with computer assisted instruction to evaluate the effectiveness of a specific CAI program, *Imagine Learning English*, on their literacy learning. This study is relevant to the question of how limited educational funding should be spent to have the greatest impact on early literacy achievement for a range of learners. While there is no doubt that direct instruction either in small groups or one-to-one from highly trained teachers using research-based best practices is the most powerful form of intervention for struggling students, the use of well-designed and carefully implemented computer programs to supplement such instruction may have substantial benefits as well.

ILE, an integrated learning system, is purported to specifically increase early language and literacy achievement for a range of entering kindergarten learners when used consistently over time. Since it is already being implemented widely in classrooms across the United States and beyond, data that support its ongoing use is essential.

Two main research questions guided this study. First, how do the decoding skills for kindergarten students, including English language learners and monolingual children who receive instruction using ILE compare with the decoding skills for these groups of learners who receive other classroom instruction? Second, how do the vocabulary skills of kindergarten students of the same populations who receive instruction using ILE compare with the vocabulary skills for those who receive other classroom instruction?

CHAPTER 2

METHODOLOGY

The purpose of the study was to assess the impact of *Imagine Learning English* (ILE), a computer assisted instruction software program, on the language and literacy development of kindergarten students. The research questions posed expressly examined the program's utility in supporting the two major components of the Simple View of Reading—the decoding skills and the language comprehension skills of a range of kindergarten students including English language learners and monolingual children.

Research Design

The study used a 2 x 2 cross-over design, with 2 treatments and 2 periods. In this design, whole classes were assigned to receive two different treatments, the ILE treatment (i.e., treatment A) and an "other" classroom instruction treatment (i.e., treatment B); however, the sequencing of the treatments differed. Some classes received the ILE treatment during the fall semester followed by the "other" classroom treatment during the spring semester (i.e., AB sequence); and some classrooms received the "other" classroom treatment in the fall semester followed by the ILE treatment during the spring semester (i.e., BA sequence). During the fall semester, four classes received the ILE intervention while three classes received the "other" classroom instruction. During the spring semester the assignments were reversed, with three classes receiving the ILE intervention and four classes receiving the "other" classroom instruction (see Table 1).

Table 1   Demographic Data and Assignment of Classes to Treatment Conditions in Fall and Spring Semester

School	Teacher	Session	Average Class Size	Gender		English Language Learners	Languages Spoken in Home		Fall Treatment Condition	Spring Treatment Condition
				Girls	Boys		Spanish	Other		
E (Title 1)	1	am	20	15	5	8	5	Vietnamese (2) Tongan (1)	Other	ILE
		pm	18	7	11	9	7	Samoan (1) Arabic (1)	ILE	Other
A	2	am	19	10	9	4	3	Laotian (1)	Other	ILE
		pm	19	6	13	2	2	0	ILE	Other
C	3	am	20	9	11	0	0	0	ILE	Other
		pm	21	11	10	3	3	0	Other	ILE
F	4	am	16	4	12	5	5	0	Other	ILE
		pm	16	8	8	2	2	0	ILE	Other
A	5	am	17	12	5	1	1	0	Other	ILE
		pm	18	7	11	4	3	Maay (1)	ILE	Other
D (Title 1)	6	am	23	12	11	12	9	Marshalese (2) Tongan (1)	ILE	Other
		pm	23	13	10	6	4	Vietnamese (2)	Other	ILE
B	7	am	27	12	15	9	8	Vietnamese (1)	ILE	Other
		pm	27	15	12	4	3	Swahili (1)	Other	ILE
DEMOGRAPHIC TOTALS			284	141	143	69	55	14		

The cross-over design is a powerful research design that is often used in clinical trials. The distinguishing feature of the cross-over design is that each participant is measured pre- and post treatment for each of the two periods; therefore, there is a within-subject design within each treatment and across treatments. The design allows for the performance of each participant to be measured with both treatments, and the relative difference between treatments can then be compared.

There are several advantages to the cross-over design: (a) all students have the opportunity to receive the potential benefits of both interventions, (b) the effects of the intervention can be studied over a longer range of development, with students in the spring semester receiving the treatment at a more advanced literacy developmental stage than students who received the treatment in the fall semester; (c) rather than in most quasi-experimental designs in which one group receives a treatment and one does not, in the cross-over design, all participating students are able to receive the treatment of interest; and (d) each teacher provides both the "other" classroom instruction and the ILE intervention, thereby increasing generalizability of the potential benefits of the intervention and providing greater internal validity to the study. As to the last point, each teacher taught the ILE treatment and the "other" classroom instruction in both semesters. Therefore, teachers served as their own controls in the instruction of the two treatments.

To more fully understand the cross-over design, consider the following equation for each participant's score:

$$Y_{ijk} = \mu + \pi_j + \tau_{d[i, j]} + s_{ik} + e_{ijk}$$

Y_{ijk} = score of subject k, in period j, in sequence i

μ = y-intercept or the grand mean of performance

πj = effect associated with period j

$\tau_{d[i, j]}$ = treatment effect of the treatment applied in period j of sequence i

s_{ik} = sequence effect associated with subject k in sequence i

e_{ijk} = random effect for subject k, in period j, in sequence i

Table 2 illustrates that each student's score received during a treatment contributes to a mean score for each period within a given sequence of treatments (i.e., $\bar{Y}_{11.}$, $\bar{Y}_{12.}$, $\bar{Y}_{21.}$, $\bar{Y}_{22.}$). A mean score is then generated for each sequence (i.e., $\bar{Y}_{1..}$, $\bar{Y}_{2..}$) each period (i.e., $\bar{Y}_{.1.}$, $\bar{Y}_{.2.}$), and for all scores (i.e., $\bar{Y}_{...}$).

Table 2   Layout of the Mean Scores for the 2 x 2 Cross-Over Design

	Period 1	Period 2	
Sequence A B	$\bar{Y}_{11.}$ (mean score of students in treatment A, period 1)	$\bar{Y}_{12.}$ (mean score of students in treatment B, period 2)	$\bar{Y}_{1..}$ (mean score of students in sequence AB, across periods)
Sequence B A	$\bar{Y}_{21.}$ (mean score of students in treatment B, period 1)	$\bar{Y}_{22.}$ (mean score of students in treatment A, period 2)	$\bar{Y}_{2..}$ (mean score of students in sequence BA, across periods)
	$\bar{Y}_{.1.}$ (mean score of students in period 1 across sequences)	$\bar{Y}_{.2.}$ (mean score of students in period 2, across sequences)	$\bar{Y}_{...}$ (mean of all scores)

Analysis

In the analysis of the data, there are three effects that are statistically tested using t-tests: sequence effects (carry-over effects), period effects, and treatment effects. A sequence or carry-over effect is a potential disadvantage to the cross-over design, that is, a particular treatment received first in the sequence may have a differential impact on the treatment received second in the sequence. Similarly, a period effect also is a potential disadvantage, that is, regardless of what treatment is received in the first period, the fact that a treatment was received may have a differential impact on treatments received in the second period. The possibility of a sequence or period effect must be eliminated before a treatment effect can be unambiguously identified.

A sequence effect is tested by summing students' scores across the two treatments they received (i.e., with A = ILE and B = "other" instruction, this is A + B for both groups) and then testing the mean of the scores with a t-test, using sequence as the independent variable). A period effect is tested by subtracting each student's score received on treatment B from the score received on the treatment A (i.e., with A = ILE and B = "other" instruction, this is A – B for both groups) and then testing the mean differences with a t-test, using sequence as the independent variable. Finally, the treatment effect is tested by subtracting the score each student received on the treatment received second from the score received on the treatment received first (i.e., with A = ILE, and B = "other" instruction, this is A – B for the AB group and B – A for the BA group) and then testing the mean differences with a t-test, once again using sequence as the independent variable. Because the three effects are orthogonal to one another, no

adjustment (e.g., Bonferroni) is needed to be made to the alpha level. Therefore, the alpha level can be kept at .05 for each t-test.

<div align="center">Participants</div>

Schools

Six elementary schools (K-6) currently using the ILE program within a large suburban school district in the western United States were selected for participation. The ILE program had been implemented in numerous elementary schools within the district since 2007. ILE was originally adopted by district officials for use in schools with high numbers of English language learners, but with the purchase of the program by the state legislature for use with English language learners state-wide in 2010, ILE has been readily available on at least some computers in all 63 elementary schools throughout the district. Four of the six schools operated on a traditional 9-month schedule. Two schools were on a year-round schedule with approximately 3 week breaks following nine weeks of instruction throughout the duration of the study. Two of the six schools also were identified as Title I based on a high percentage of students who qualified for free or reduced-priced meals. All schools were located within a radius of less than 10 miles from one another. Table 3 further details each school's relevant demographic data as reported in January, midway through the year-long study.

The selection of these six schools was based primarily on each principal's willingness to participate in the study and the ability to adjust master schedules to accommodate entire kindergarten classes using ILE daily in a computer lab for at least 20 minutes. The year-round schools were included because they both had two sessions of kindergarten on the D track schedule which best aligned with the September start date of

Table 3   Demographics for Each Participating School

	Enroll-ment	Ethnicity			Limited English Proficient	Qualify for Free or Reduced Price Meals
		Caucasian	Hispanic	Other		
School A	595	61%	29%	10%	28%	55.5%
School B	597	51.5%	37%	11.5%	30%	49%
School C	596	54%	34.5%	11.5%	27.5%	58%
School D (Title 1)	692	29%	54%	17%	52%	86%
School E (Title 1)	700	32.5%	48.5%	19%	55%	80%
School F	743	48%	39%	13%	35%	57%

the study. All of the participating schools followed the district-recommended daily schedule and used the SRA *Imagine It!* reading program school-wide, thus ensuring that students in each kindergarten classroom were receiving consistent, research-based classroom literacy instruction throughout the duration of the study regardless of which treatment condition was assigned.

Classroom Teachers

Six kindergarten teachers, one at each school who taught both a morning and afternoon session, were identified for participation based on a recommendation from the school's principal and their willingness to comply with study requirements. A seventh teacher was added to the study at her request due to the collaborative partnership in using ILE between her and the selected kindergarten teacher from that school. All teachers were veteran female teachers with a combined average of 17 years teaching experience,

with 14 of those years having been spent in the kindergarten classroom. All teachers held

degrees and/or endorsements in early childhood education. In addition, two teachers held

Master's Degrees in education, and one teacher came to the profession as an ARL

(alternate route to licensure) having a previous degree in a field outside of education.

Three of the seven teachers held ESL endorsements, while one teacher held a Math

endorsement, and another teacher a Reading Level 1 endorsement. All teachers had used

the ILE software at least one year previously with their students and expressed interest in

participating in the study as a way to quantitatively verify the program's effects on

student achievement.

Students

All kindergarten students enrolled in the classrooms of the seven participating

teachers were part of the study. This included 306 students in September, dropping

slightly to 300 in January. By May, the number of students who had been involved in the

study for at least one full semester fell to 284 students due to mobility issues. At midyear,

parents of students in each classroom were given an informational letter about the study

and invited to inquire further if they had any questions or concerns. No parents expressed

concerns; hence, at the outset of the study, 284 students participated. Of this total number

of students, 143 were girls and 141 were boys. English language learners comprised 24%

of the total participants and 80% of those were Spanish speakers. The other 20% of ELL

participants represented eight additional languages (Laotian, Maay, Vietnamese, Swahili,

Tongan, Marshalese, Samoan, and Arabic) (see Table 1).

ELL students were further categorized according to their September performance

on the Ballard and Tighe 2004 version of the IDEA Oral Proficiency Test or IPT, a

nationally normed and individually administered test of oral English proficiency that assesses the general areas of grammar/syntax, morphology, lexicon, and phonology in developmental levels (Barrett, Cho, Dalton, Luoma, Seritis, & Stevens, 2006). The IPT is administered uniformly across the district to incoming students who identify a language other than English as primarily spoken in the home. The test assists schools in determining students' levels of oral English proficiency upon entrance to kindergarten. Of the 68 students in the study who were tested on the IPT, 16% were categorized as NES (Non English Speaker), 49% as LES (Limited English Speaker), and another 15% as FES (Fluent English Speaker).

<div align="center">Outcome Measures</div>

Both quantitative and qualitative data were collected in the assessment of the ILE intervention. Quantitative measures included benchmark assessment of literacy acquisition using the Dynamic Indicators of Basic Early Literacy Skills (DIBELS) Next and the Peabody Picture Vocabulary Test (PPVT) 4th Edition. Qualitative data included teacher surveys and observation notes collected by the principle investigator during each of three visits to classrooms during the course of the study.

Quantitative Measures

DIBELS Next benchmark assessment.   Components of the DIBELS Next benchmark measure were used to determine growth in the area of literacy decoding. The DIBELS Next is routinely administered by school personnel in all elementary schools throughout the district three times yearly—beginning, middle, and end of year. Its purpose is to economically and efficiently assess student progress toward long-term

literacy goals. The DIBELS Next is comprised of a set of standardized, individually administered subtests targeting early literacy skills with a student's composite score representing the sum of scores for all subtests administered during a given assessment period. The DIBELS Next is based on ongoing literacy research of the DIBELS 6th Edition assessment which was developed and used across the United States from 2002 until 2010 (Good, Kaminski, Dewey, Wallin, Powell-Smith, & Latimer, 2011). A key difference between DIBELS Next and the DIBELS 6th Edition is that composite scores from the subtests are used as the indicator of a student's probability of reaching the next marker of literacy achievement. The composite score "provides the best overall estimate of the student's early literacy skills and/or reading proficiency" (Dynamic Measurement Group, Inc., 2010, p. 2).

The kindergarten DIBELS Next consists of four subtests, all of which are given at least twice during the year; however, all four subtests are administered together only at mid-year (see Table 4). Since the 2 x 2 cross-over design required the use of comparable measures over time, results from only one of the subtests (LNF) could be included in the study as an outcome measure. Each of the other subtests, however, contributes to the composite score and is therefore described in Table 4.

Letter Naming Fluency (LNF) assesses a student's ability to recognize and name letters of the alphabet as they are presented randomly in upper and lower case forms. The number of letters named in one minute becomes the score on this first subtest. LNF is the only subtest administered at beginning, middle, and end of year. It also differs from the other subtests in that it has no benchmark goals like the other subtests due to the fact that LNF is an indicator of risk rather than an instructional target. However, it is a strong

Table 4   DIBELS Subtests and Time of Year for Administration

Time of Year	Subtests Administered			
Beginning	First Sound Fluency (FSF)	Letter Naming Fluency (LNF)		
Middle	First Sound Fluency (FSF)	Letter Naming Fluency (LNF)	Phoneme Segmentation Fluency (PSF)	Nonsense Word Fluency (NWF)
End		Letter Naming Fluency (LNF)	Phoneme Segmentation Fluency (PSF)	Nonsense Word Fluency (NWF)

predictor of later reading success, and for this reason it is administered three times per year in kindergarten.

First sound fluency (FSF) measures a student's ability to identify the first sound in a one syllable word as the ability to isolate the first phoneme of a word is highly related to later reading success. The assessor says a word and asks the student to identify the first sound in that word. The student is given 1 minute to identify as many first phonemes in words as possible. FSF is administered at beginning and middle of kindergarten as an early indicator of student development in phonemic awareness.

The third kindergarten subtest, phoneme segmentation fluency (PSF) directly measures a more sophisticated level of phonemic awareness as it assesses a student's fluency in segmenting a spoken word into its component parts. The assessor says a word and asks the student to restate the word in segments of sound. The score on the PSF represents the total number of correct segments of words a student can identify in one

minute. The PSF, which is administered at the middle and end of year, represents the next developmental phase of phonemic awareness once first sounds are well established.

The fourth and final subtest, the nonsense word fluency (NWF) test with its accompanying correct letter sounds (CLS) and whole words read (WWR) elements given at mid and end of year, assesses a student's knowledge of letter-sound correspondence and the ability to orally blend sounds into words. This measure uses phonetically regular nonsense words that follow the consonant-vowel-consonant (CVC) and vowel-consonant (VC) patterns in order to measure student progress in learning to apply grapheme-phoneme knowledge in the process of decoding text. Students are shown a page of one syllable words and asked to decode as many as they can in 1 minute, either by reading whole words or by saying any sounds they know from the words presented. The assessor tallies each whole word read without first distinguishing sounds, but also gives points to all correct letter sounds produced in one minute. The advantage of using both nonsense word fluency elements of correct letter sounds (CLS) and whole words read (WWR) is that student development in the alphabetic principle and basic phonics can be monitored at the same time.

Alternate form reliability estimates for each of the four kindergarten DIBELS Next subtests range from .70 on PSF to .97 on the NWF (Good, et al., 2011). Predictive and criterion-related validity for each of the four kindergarten DIBELS Next subtests range from moderate to strong, with the DIBELS Next composite score strongly predicting future DIBELS Next composite scores. It is important to note, however, that composite scores are not intended to be used as measures of individual growth over time nor to compare results at various times of year; rather, "the percent of students at or

above benchmark can be compared, even though the mean scores are not comparable"
(p. 33). Total testing time is about 5 minutes or less per student.

Inasmuch as the DIBELS Next assessment is part of the regularly scheduled
assessment plan for all kindergarten students in the district, I was provided district-level
access to the databases for each school from which to pull all assessment data needed for
analysis. This included data for each of the above-named subtests at each of the three
benchmark assessment periods, along with corresponding composite scores.

Peabody Picture Vocabulary Test. The Peabody Picture Vocabulary Test 4th
Edition (PPVT-4) also was administered to all subjects in the study at beginning, middle,
and end of year in conjunction with DIBELS benchmark testing as a measure of receptive
vocabulary. The PPVT-4 scale specifically measures understanding of the spoken word in
standard American English and thus assesses vocabulary acquisition. The test content
covers a broad range of receptive vocabulary levels and is developmentally appropriate
for kindergarten children. The test samples 20 language content areas (e.g., actions,
vegetables, tools) and parts of speech (nouns, verbs, or attributes) across all levels of
difficulty. It is individually administered and is appropriately used with students for
whom English is not a primary language as well as with English dominant students. The
PPVT-4 has undergone extensive standardization for use with persons from a full range
of abilities, ages, ethnicities, socioeconomic status and geographic regions (Dunn &
Dunn, 2007). Two forms of the PPVT-4, Form A and Form B are currently in use.
Alternate-form reliability estimates record a correlation mean of .89 with an average test-
retest correlation of .93. These high reliability scores may be due to the fact that "…the
test assesses acquired knowledge and makes minimal demands of the examinee…"

(Dunn & Dunn, 2007, p. 56). Validity with other vocabulary measures for children report a correlation range from moderate to strong. When correlated with measures of expressive vocabulary, the PPVT-4 mean is .82. When correlated with measures of oral language, the PPVT-4 mean of .79 is considered high for examinees of elementary-school age, with the preschool-age sample showing only moderate correlations (range = .41 to .54). The authors suggest that the lower correlation on oral language measures with preschool may be due, in part, to "…the difficulty in obtaining reliable test scores from young children on expressive language tests" (p. 61).

The district wherein the current study was conducted typically administers the PPVT-4 as part of a battery of assessments only for students in the special education referral or re-evaluation process. There is currently no regularly administered assessment of vocabulary development for kindergarten students. For this reason, the assessment was individually administered to each kindergarten student in the study by an assessment team made up of the PI and several undergraduate assistants. During administration, a picture flipbook was used with four pictures on each page, from which students were asked to simply point to the picture that represented the isolated word stated by the assessor. Typically, students are at ease during the administration of this test as they only need to point to a single picture on each page, and they are allowed to move through the pages at their own pace. Starting and ending places in the test are determined based on student age and the number of words identified correctly in any given set. Testing requires between 5-15 minutes per student, depending on the language skills of the participant. Both Form A and Form B of the PPVT-4 were used to ensure that students were not "learning" the test as this assessment was conducted at three intervals during the

school year: September—Form A, January—Form B, and May—Form A. Individual student protocols were purchased using district funds for the purpose of this study.

Qualitative Measures

Surveys of teachers were administered in January and again at the conclusion of the study to document teachers' perceptions and experiences regarding the usefulness of computer assisted instruction in general and ILE specifically to support early literacy acquisition. Questions for teachers were presented using a combination of both Likert-type scales and open-ended formats. They included the following categories: (a) self assessment of ILE implementation practices, (b) beliefs about computer assisted instruction, (c) observations of students in both control and treatment during the period of the study, and (d) reflections of impact of study outcomes. I also kept brief personal observations of visits to classrooms during each of the three assessment periods, noting classroom organization, procedures, and activities of students and teachers in both morning and afternoon sessions.

<div align="center">Procedures</div>

Classroom Literacy Instruction

Effective school year 2010-11, all students in kindergarten through sixth grade across the district received core language arts instruction using the SRA 2007 edition of Open Court, the *Imagine It!* core reading program. Though a number of schools had already been using this program for several years, the district adopted it in every school in an effort to provide consistent literacy instruction to its highly mobile student population. The SRA *Imagine It!* program was selected for implementation due to its

comprehensive curriculum aligned with state core standards and its provision of instruction in all five essential elements of reading that have been identified by the National Reading Panel (NICHHD, 2000). During a typical three-hour kindergarten day, teachers are expected to devote at least 95 minutes to literacy instruction. This guideline translates into a minimum of 50 minutes of whole group core literacy instruction using the *Imagine It!* program followed by 45 minutes of differentiated small group literacy instruction to reinforce, re-teach, or extend the content of whole group core instruction, depending on individual student needs. Center time is embedded within the small group time such that students engage independently in literacy activities while waiting for their turn with the teacher. The most at-risk students work daily in small groups with the teacher, while the most advanced students may work with the teacher only two or three times weekly. Another 40 minutes of the instructional day is for mathematics instruction with the last 45 minutes of instructional time reserved for recess and integrated core activities (science/social studies/art/music/P.E.). Table 5 summarizes the recommended kindergarten instructional schedule for the district.

Whole group literacy instruction from the *Imagine It!* program emphasizes the components of reading comprehension and vocabulary through scripted read-aloud events from the identified week's lesson, followed by interactive writing and a morning message also scripted from *the Imagine It!* lesson plan. Phonemic awareness and

Table 5   District-Recommended Daily Kindergarten Instructional Schedule

Whole Group Literacy	Small Group Literacy	Mathematics	Recess	Integrated Core
50 minutes	45 minutes	40 minutes	15 min	30 minutes

alphabetic knowledge are the final components that are taught to the whole class using the sound-spelling card system from the program followed by word games and handwriting practice. Each instructional component is essential to support comprehensive literacy development, though the amount of time dedicated to each one will vary based on teacher expertise in delivering the content and student language and literacy needs. During whole group literacy instruction students with special needs are expected to participate as fully as possible so that they have the opportunity to benefit from grade level curriculum along with their peers, even though there may be additional personnel in the classroom at this time to assist identified students.

Small group literacy instruction generally consists of 10-15 minutes daily with the teacher, and not more than six students who share similar academic needs. Teachers rotate students among a number of independent literacy activities, or centers, while they are working with their designated small group. Due to time constraints, at-risk students are expected to receive small group instruction daily from the teacher while normally progressing students may receive such instruction every other day. In addition, any tutoring available through a reading specialist, special education teacher, or para-professional takes place during small group time in addition to the small group instruction provided by the classroom teacher. Thus, at-risk students may receive two doses of small group literacy instruction from both the classroom teacher and another resource, foregoing some of the independent literacy activities being participated in by normally progressing students.

Although all teachers are required to use the same core reading program, they vary significantly in their delivery of it. The materials provided with the program, if used

with fidelity, would require a full-day of instruction to implement successfully; therefore, teachers must use their professional judgment concerning which materials will be used to meet the specific needs of their students. Half-day kindergarten teachers must carefully orchestrate their instruction so that all essential pieces are included each day; however, there is wide variation in the delivery of even a common basal reading program from teacher to teacher and from school to school. To assist teachers in maintaining a consistent implementation schedule, the district provides a pacing map for teachers to follow as they plan for instruction over the course of the year. All teachers are expected to complete all of the units in the program according to this pacing map so that all students have the opportunity to receive maximum exposure to the comprehensive literacy components contained in the SRA *Imagine It!* reading curriculum.

The ILE Intervention

Students in both the control and intervention groups received daily literacy instruction following district guidelines and the procedures of the *Imagine It!* literacy curriculum throughout the entire school year. The one component that differentiated control classes from intervention classes was that the latter received the ILE intervention in addition to the components of the SRA *Imagine It!* curriculum while the control classes received "other" classroom instruction in addition to the components of the SRA *Imagine It!* curriculum.

During each semester, kindergarten classrooms receiving the ILE intervention spent up to 30 minutes daily in the school computer lab working with the ILE curriculum with a target goal of achieving 1200 minutes of total intervention time for each student during the semester. While in the lab, students received customized instruction in all the

components of ILE, including strong emphasis on literacy and vocabulary. Within the literacy component, sequenced instruction was provided in phonemic awareness, letter recognition, phonics, and decodable/leveled text (according to student skill level). During the first few ILE sessions, students were presented an initial placement test to determine individual starting points in the curriculum. Following the placement test, students worked individually and were assessed by the ILE program which moved them forward through the individually assigned curriculum.

During each ILE session, classroom teachers provided technical monitoring to ensure that each student could clearly hear and interact with the program. In addition, teachers provided verbal promptings and encouragement to ensure that students were actively engaged with the lessons. Teachers also monitored student progress by examining ILE reports periodically.

As previously described, the district-recommended amount of time per day to be dedicated to literacy instruction in kindergarten is 95 minutes, with 50 minutes for whole class instruction and an additional 45 minutes for differentiation in which students receive literacy instruction during small groups with the teacher and independent centers. In order to maintain fidelity of implementation of the core literacy curriculum, the ILE daily lab sessions were conducted outside the literacy block and within the 30 minutes of integrated core (science, social studies, music, art, physical education) time. This meant that student access to the integrated core curriculum was abbreviated for one semester so that students in the ILE intervention could receive 20-30 minutes of additional individualized literacy instruction daily in the school computer lab. By making such adjustments teachers were able to embed the additional ILE literacy instructional period

in the computer lab without eliminating any of the essential elements of classroom

literacy instruction. This was a condition imposed by district officials who did not want

to risk loss of any core literacy instruction for kindergarten students during the study.

Students who were identified to receive special services, such as resource, ESL, or

reading specialist support, continued to receive their scheduled specialized instruction in

addition to that provided by the classroom teacher in the classroom and in the ILE lab.

Table 6 provides a summary comparison of instructional schedules when classes were

designated as either ILE intervention or control classes.

Fidelity of Intervention Implementation

In order to monitor fidelity of implementation of the ILE curriculum, I monitored

time on the program through periodic review of school usage reports. In addition,

periodic emails, phone calls, and site visits were conducted to address questions,

concerns, and procedures in the lab. Technical support was provided by ILE support staff

as needed throughout the year in a manner typically provided to any school that used

their product, including site visits, phone calls, and email exchanges with customer

Table 6   Instructional Schedule Comparison for Classes Assigned to Treatments

ILE Treatment	Whole Group Literacy	Small Group Literacy	Mathematics	Recess	ILE
	50 minutes	45 minutes	40 minutes	15 min	30 minutes
Control Treatment	Whole Group Literacy	Small Group Literacy	Mathematics	Recess	"Other" Instruction
	50 minutes	45 minutes	40 minutes	15 min	30 minutes

support. Table 7 provides the cumulative average minutes of ILE usage by class over the course of each semester. Note that this information does not reflect individual student usage over time, which will be reported later.

       The expectation was that classes would spend a minimum 80 minutes weekly using ILE during the period of intervention so that the goal of 1200 minutes by the end of the semester could be reached. However, multiple factors (e.g., unforeseen scheduling conflicts, school events, technical difficulties, student mobility, and absenteeism) impeded the ability for most classes to meet this expectation. Ultimately, only one of seven teachers (Teacher 6) was able to ensure that all intervention students received the required 1200 minutes of ILE instruction each semester. As a teacher at a Title 1 school, Teacher 6 had sufficient technology resources to provide extensive computer lab time managed by a computer lab assistant where technological difficulties were greatly minimized. Teacher 1 was limited during the second semester in her access to the school's computer lab. Though also from a Title 1 school, Teacher 1 was denied regular access to a computer lab due to pressure to use the school labs in other ways that were perceived to be more aligned with adjusted school goals based on recent Title 1 school sanctions. The other teachers varied widely in the number of students who achieved the 1200 minute goal, though some students in five of seven classes did reach at least 1020 minutes or 85% or more of the goal on the ILE program (see Table 8). Monitoring of usage reports for the first ILE group began in the third week of September and ended the third week of January (mid February for year round schools). Monitoring of usage reports for the second ILE group began the fourth week of January and concluded the third week of May (mid June for year round schools).

Table 7   Cumulative Average Minutes of ILE Usage by Teacher, Semester,

and Week

Teacher	Semester	Week 2	Week 6	Week 10	Week 14
1	Fall	75	324	557	732
1	Spring	0	48	351	394
2	Fall	182	415	600	851
2	Spring	128	399	1035	1173
3	Fall	179	344	719	945
3	Spring	99	480	725	955
4	Fall	112	277	618	961
4	Spring	160	384	902	1043
5	Fall	139	319	497	689
5	Spring	92	296	786	863
6	Fall	406	804	1170	1563
6	Spring	264	686	1436	1720
7	Fall	210	460	699	920
7	Spring	206	711	902	1176

Table 8 Number of Students Out of Total

Number of Students in a Classroom by Teacher

Achieving a Minimum of 1020 Minutes or

More on ILE

	Semester 1	Semester 2
Teacher 1	0/18	0/20
Teacher 2	8/19	16/19
Teacher 3	13/20	8/21
Teacher 4	6/16	14/16
Teacher 5	0/18	14/17
Teacher 6	21/23	23/23
Teacher 7	7/27	23/27
Totals	55/141 39%	98/143 69%

"Other" Classroom Instruction

During the last 30 minutes of the instructional day, students received either the ILE instruction or "other" instruction. "Other" instruction was intended to represent exclusively the integrated core instruction, which includes science, social studies, music, art, and physical education. However, due to variations in individual teacher interpretation of the schedule, "other" instruction encompassed a range of activities including science/social studies core instruction as well as extended literacy or math

experiences with some limited practice on computers either in the lab or in the classroom using interactive games. Any number of these activities took place in control classes while intervention classes were receiving their daily ILE instruction in the computer lab; hence, the term "other" is being used to describe the instruction received by the control groups.

Significant variation occurred in terms of how teachers used the integrated core time in their instructional day. Four of the seven teachers ensured that control classes participated in the integrated core curriculum while intervention classes were in the computer lab. The other three teachers used their integrated core period for extended literacy or math activities for control classes while intervention classes were in the computer lab. One teacher specified that both control and intervention classes received the full integrated core curriculum each semester regardless of whether they belonged to the control or intervention group. Nonetheless, it can be noted that all teachers were consistent in ensuring that control classes did not use ILE at all during the semester that they were in the control condition. All teachers also confirmed that any designated computer time for the control class was spent on mathematics practice activities or other non-tutorial literacy games. Appendix A provides individual teachers' self-reported use of "other" instructional time for the control group during each semester in which the intervention group was in the lab using ILE.

CHAPTER 3

RESULTS

This study sought to assess the impact of a specific computer assisted instructional program, *Imagine Learning English*, on both the receptive vocabulary and early literacy skills of kindergarten students, including English language learners using a 2 x 2 cross-over research design over a period of a full school year. The null hypothesis for this study states that the effects from ILE treatment do not differ from the effects from "other" classroom instruction on the language and literacy skills of kindergarten students as measured by the PPVT-4 for receptive vocabulary and DIBELS Next for early literacy skills. Both quantitative and qualitative outcome measures were used in a search for evidence sufficient to reject this hypothesis, including results from assessments administered to children at beginning, middle, and end of year, as well as results from teacher surveys collected at the conclusion of each semester.

Quantitative Data Analysis

Gain Scores

There were four scores used in the analysis of ILE versus "other" instruction: PPVT-4 standard score, PPVT-4 GSV, DIBELS Next LNF, and DIBELS Next composite score. The scores at the beginning of the year served as a baseline measure for students before any treatment was introduced. The scores at the middle of the year served as the end score for the treatments administered during the fall semester and as the baseline

measure for the treatments administered during the spring semester. The scores at the end of the year served as the end score for the treatments administered during the spring semester.

Gain scores were calculated for each of the four measures by subtracting the beginning scores from the middle scores and subtracting middle scores from end scores. For the DIBELS Next LNF and PPVT-4 GSV scores, gain scores indicated the amount of growth students experienced after the fall and spring treatments. For the PPVT-4 standard score, gain scores indicated students' placements in relation to national norms. Scores closer to zero indicated that students remained on a par in relation to national norms, scores above zero indicated that students gained above the national norms, and scores below zero indicated that students decreased below the national norms. Individual students' composite scores from the DIBELS Next subtests were used to calculate the percentage of students in each class who were at or above benchmark standards as determined by DIBELS Next. Positive gain scores on the composite scores indicated that the percentage of students at or above benchmark standards increased during the treatment period, and negative gain scores indicated that the percentage of students at or above benchmark standards decreased during the treatment period.

Carryover, Treatment, and Period Effects

Table 9 shows the results of the *t*-tests for the carryover, treatment, and period effects for the PPVT-4 standard score and GSV and the DIBELS Next LNF. Differences in the degrees of freedom and in the *n*s in the descriptive statistics in this and in subsequent analyses were due to incomplete data on students who did not complete all tests. Only the treatment effect for the PPVT-4 standard score was significant though

small (effect size .26) in favor of the ILE treatment, and none of the carryover or other treatment effects were significant. Only the period effects were significant for each of the three variables. The period effects are further illustrated in Figure 1 and can be estimated by examining the means in the diagonals for each measure shown in Table 10. For example, the mean PPVT-4 standard score for the AB group for the ILE treatment (i.e., the period 1 treatment) was 4.55, and the mean PPVT-4 standard score for the BA group for the "other" classroom treatment was 2.16 (i.e., the period 1 treatment). These two means can be compared with the period 2 means for the AB group (.46) and the BA group (1.65). Therefore, for each measure, the treatment that was administered during period 1 (i.e., either ILE or "other" classroom instruction) had a more positive effect on student literacy learning than the treatment that was administered during period 2. The effects sizes for the period effects were small-to-moderate for both of the PPVT-4 scores but large for the DIBELS Next LNF score.

Inasmuch as both treatment and period effects were significant for the PPVT-4 standard score, further analysis of treatment by period effects were warranted. I examined each period separately, with groups of students being assigned to either ILE or "other" instruction. Each teacher taught an ILE intervention class and an "other" instructional class. For period 1, three of the seven teachers chose to start with ILE in the morning and end with "other" instruction in the afternoon; four chose to start with "other" instruction in the morning and end with ILE in the afternoon. This was reversed for period 2. In addition, to examine whether teacher had an impact on PPVT-4 standard score gains, teacher was entered into the analysis as a random variable. Results of the analysis showed that group was significant, $F(1, 252), = 6.87, p = .04$, partial eta squared $= .52$, teacher

Table 9   Results of T-Tests for Carryover (Sequence), Treatment, and Period Effects

for PPVT-4 Standard and GSV Scores and DIBELS Next LNF Score, with Effect Sizes

for Period (Cohen d)

Effect	PPVT-4 Standard Score	PPVT-4 Growth Scale Value	DIBELS Next Letter Naming Fluency
Carryover	$t(250) = .89, p = .38$	$t(250) = .86, p = .39$	$t(264) = -.66, p = .51$
Treatment	$t(250) = 2.00, p = .046$ $d = .26$	$t(250) = 1.54, p = .12$	$t(264) = .01, p = .99$
Period	$t(250) = 2.56, p = .01$ $d = .32$	$t(250) = 3.12, p = .002$ $d = .40$	$t(264) = 10.06, p < .001$ $d = 1.25$

Table 10   Means, (Standard Deviations), and Cell Size for Each Sequence Group for

the PPVT-4 Standard and GSV Scores, and the DIBELS Next LNF Score

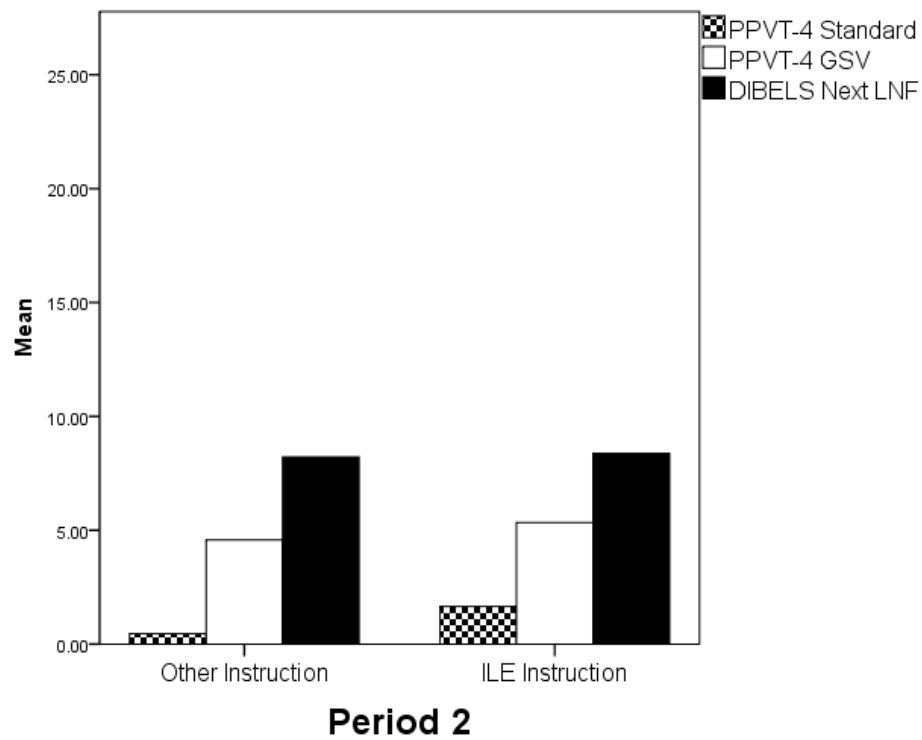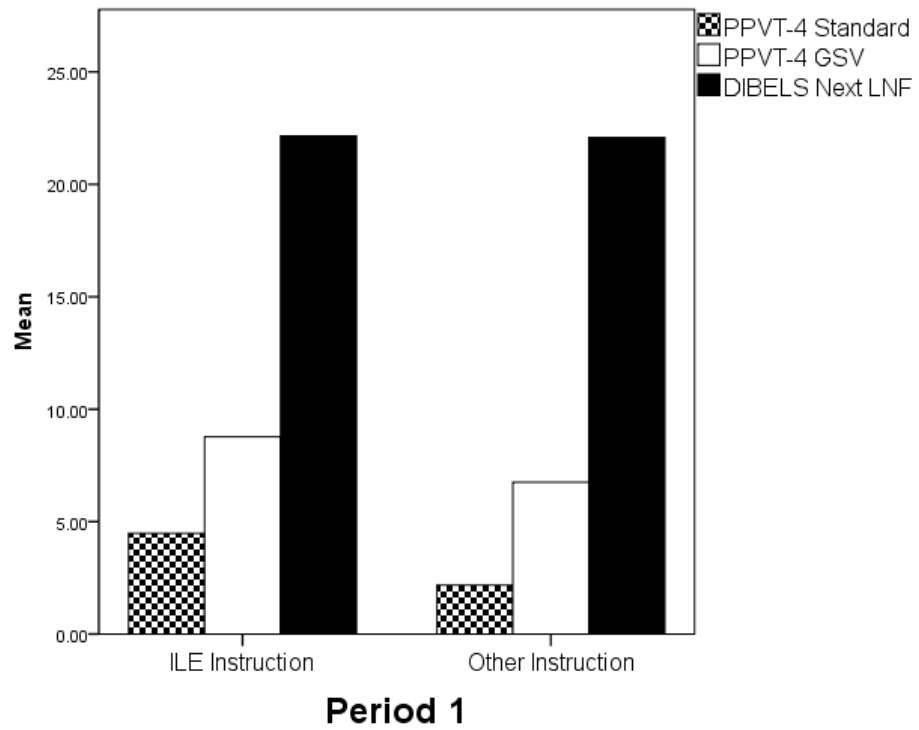| Group	PPVT-4 Standard Score		PPVT-4 Growth Scale Value		DIBELS Next Letter Naming Fluency	
	ILE	Other	ILE	Other	ILE	Other
AB	4.55 (9.24) n = 131	.46 (9.29) n = 134	8.60 (9.17) n = 131	4.57 (8.88) n = 134	21.55 (13.33) n = 134	7.98 (12.03) n = 137
BA	1.65 (8.32) n = 133	2.16 (8.00) n = 135	5.34 (7.99) n = 133	6.73 (8.31) n = 135	8.43 (12.26) n = 139	21.94 (14.90) n = 139

Figure1   Means for each of the dependent variables in period 1 versus period 2

was not significant ($p = .06$), and group x teacher was not significant ($p = .64$). The group means were 4.72 (SE = .75) for the ILE groups and 2.38 (SE = .74) for the "other" instruction groups.

The same analysis was conducted with the period 2 PPVT-4 standard score data. Results indicated there were no main effects or interaction: group, $p = .34$; teacher, $p = .56$, group x teacher, $p = .14$. The group means were 1.66 (SE = .76) for the ILE groups and .25 (SE = .76) for the "other" instruction groups. Therefore, the treatment effect with PPVT-4 standard score was restricted to only period 1.

English Language Learners

Because ILE has been intended to be used in instruction for English language learners, I conducted the same analyses just described but for English language learners who have been classified as either non English speaker or limited English speaker on the IPT. Table 11 shows the results of the t-tests for the carryover, treatment, and period effects for each of the three measures, and Table 12 shows the descriptive statistics.

Similar to the results obtained for the entire sample of students, the English language learners showed no significant carryover or treatment effects. For the period effects, the PPVT-4 standard score was not significant; however, the p-value approached significance, and Cohen's d was .54, indicating a moderate effect. The PPVT-4 GSV and the DIBELS LNF were both significant. Therefore, for the PPVT-4 GSV score and the LNF score, the treatment that was administered during period 1 (i.e., either ILE or "other" instruction) had a more positive effect on student literacy learning than the treatment that was administered during period 2. The effects sizes for the period effects were small-to-moderate for the PPVT scores but large for the DIBELS LNF score.

Table 11   English Language Learners: Results of T-Tests for Carryover (Sequence),

Treatment, and Period Effects for PPVT-4 Standard and GSV Scores and DIBELS Next

LNF Score, with Effect Sizes for Period (Cohen d)

Effect	PPVT-4 Standard Score	PPVT-4 Growth Scale Value	DIBELS Next Letter Naming Fluency
Carryover	$t(44) = -.58, p = .56$	$t(44) = -.87, p = .39$	$t(49) = -.37, p = .71$
Treatment	$t(44) = 2.86, p = .78$	$t(44) = .32, p = .75$	$t(49) = -1.56, p = .12$
Period	$t(44) = 1.78, p = .08$ $d = .54$	$t(44) = 2.11, p = .04$ $d = .64$	$t(49) = 3.83, p < .001$ $d = 1.15$

Table 12   English Language Learners: Means, (Standard Deviations), and Cell Size for

Each Sequence Group for the PPVT-4 Standard and GSV Scores, and the DIBELS Next

LNF Score

Group	PPVT-4 Standard Score		PPVT-4 Growth Scale Value		DIBELS Next Letter Naming Fluency	
	ILE	Other	ILE	Other	ILE	Other
AB	6.93 (6.87) n = 28	3.50 (9.83) n = 30	11.89 (7.76) n = 28	7.50 (11.19) n =30	19.45 (15.72) n = 29	11.67 (12.09) n = 30
BA	3.52 (9.24) n = 21	6.05 (8.22) n = 22	7.90 (10.47) n = 21	11.36 (9.34) n = 22	6.61 (13.55) n = 23	24.04 (15.69) n = 25

ILE Instructional Time

The participating teachers varied considerably in how much time their students used the ILE program: mean = 1103.64 min (standard deviation = 445.51), range = 2179 min (minimum = 142 min, maximum = 2321 min). To test whether these "dosage" effects influenced the outcomes on the three dependent variables measured, with greater dosages of ILE instruction associated with greater gains on the three measures, I calculated Pearson's r correlations with amount of time each student used ILE with his or her gain score on each of the three measures. The correlation between ILE time and PPVT-4 standard score gain was .014, PPVT-4 GSV gain score, .033, and DIBELS Next LNF gain score, -.046. None of the correlations were significant, and all were essentially zero.

DIBELS Next Composite Scores

The last quantitative analysis I conducted examined the DIBELS Next composite scores. These scores were used similarly to determine carryover, treatment, and period effects for the two treatments administered to students. Recall that each student's composite score from each of the DIBELS Next subtests was used to calculate the percentage of students who were performing at or above the benchmark standard established by DIBELS Next during each benchmark period.

Table 13 shows the results of the t-tests for the carryover, treatment, and period effects. Only the period effect was significant, with a very large effect size. The mean gain scores for the two treatments are shown in Table 14. For period 1, both treatment groups showed similar gains in the percentage of students at or above benchmark. For the ILE groups, the percentage of students at or above benchmark increased by about 21;

Table 13   Results of T-Tests for

Carryover (Sequence), Treatment, and

Period Effects for DIBELS Benchmark

Score, with Effect Sizes for Period

(Cohen d)

Effect	DIBELS Benchmark Score
Carryover	$t(12) = .15$, $p = .88$
Treatment	$t(12) = -.39$, $p = .71$
Period	$t(12) = 3.16$, $p = .008$ $d = 4.42$

Table 14   Means, (Standard

Deviations), and Cell Size for Each

Sequence Group for the DIBELS

Next Composite Score

Group	DIBELS Next Composite Score	
	ILE	Other
AB	20.86 (23.91) n = 7	-1.71 (14.38) n = 7
BA	-5.57 (13.34) n = 7	23.29 (17.25) n = 7

for the "other" groups, this percentage increase was about 23 (the difference between the groups was not significant). However, for period 2, both groups showed no increases in the percentages of students at or above benchmark. In fact, there were slight decreases for both groups. To further illustrate the period effect, Figure 2 shows the percentage of all students performing at or above benchmark at the beginning, middle, and end of the school year.
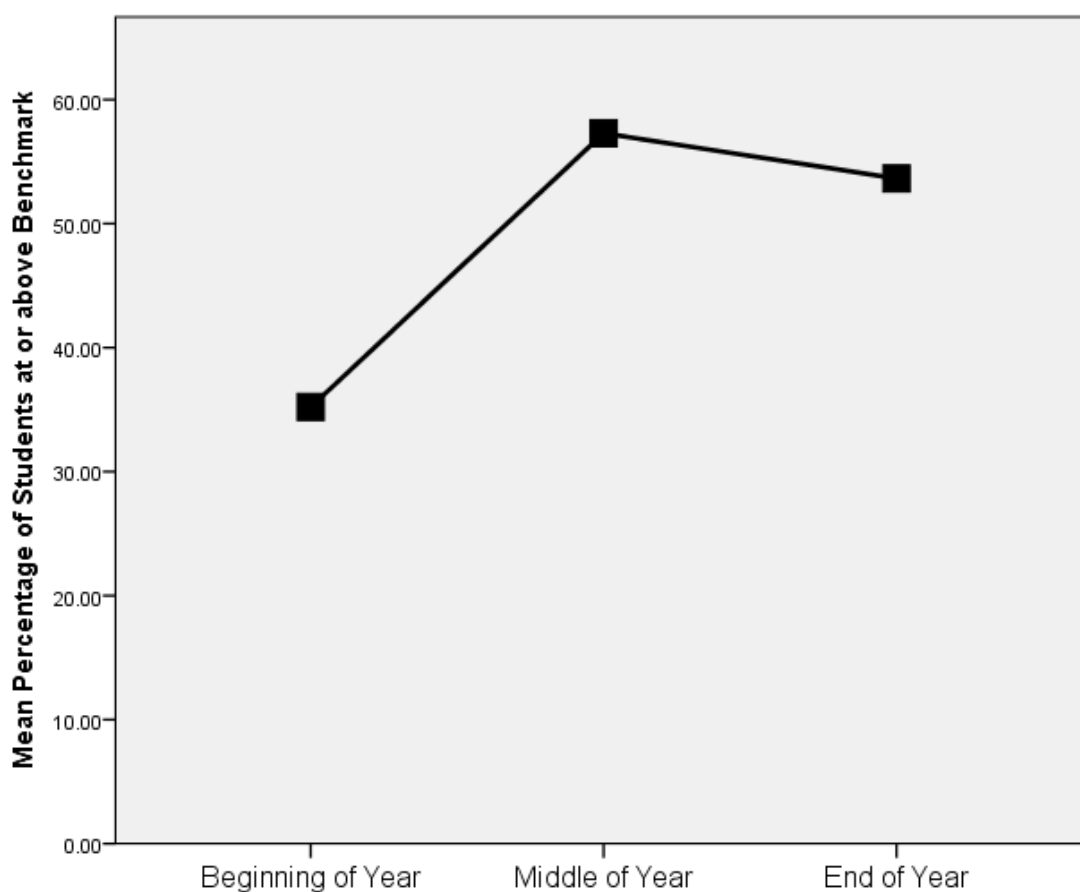

Figure 2   Mean percentage of students at or above benchmark at the beginning, middle, and end of the school year.

Qualitative Data Analysis

Fidelity of implementation of the ILE intervention was assessed using written surveys completed by each participating teacher at the conclusion of each semester. Teachers also documented activities engaged in by their classes when they were not part of the ILE treatment. In addition, I gathered personal observation data on the instructional activities and environment in each classroom and school during visits to conduct PPVT-4 testing over the course of the year. All teachers also were interviewed by phone following the year-long study. The following results synthesize teacher perceptions of their abilities and interests with technology and their assessment of implementation of the ILE study parameters.

Likert-Type Scale Data

Teachers responded following each semester to 18 questions which used a Likert-type scale from 1 to 6 to document responses. Four questions addressed teacher beliefs about technology, eight questions addressed specific teacher actions/practices while students were using the ILE intervention, and another eight questions examined teacher perceptions of students as they were engaged in the ILE intervention. Recall that teachers were selected to participate in the study based on their perception and the perception about them from their principals that technology was important—even in kindergarten. This is verified by the positive responses across both semesters to the four questions related to teacher beliefs about computers and their ability to use them to support instruction. On a Likert-type scale of 1 to 6, with 6 representing strong agreement, all teachers reported agreement at a level 4 or higher with the following statements: (a) I feel confident in my ability to use computers to support instruction; (b) Computers help

students engage in learning; (c) Computers are useful in providing individualized differentiated instruction. Six of seven teachers also reported agreement with the belief that they were more effective when they used computer assisted instructional technology to support their classroom instruction, with one teacher reporting a moderate disagreement with the same statement. At the conclusion of semester two, however, five of seven teachers reported a slight decrease (one interval) in the level of their positive agreement with the same statements.

In terms of teacher actions/practices with the ILE program, all seven teachers reported that they regularly (almost daily) monitored student usage of the program by walking around during the sessions and/or providing encouragement and verbal prompting as needed; however these were the only consistently performed practices of all participating teachers. Four of seven teachers reported consistently encouraging students to share what they learned from the program with their families. Two other teachers reported that they attempted to track student completion of printout worksheets, share individual progress with parents, and use ILE data to inform literacy instruction during the first semester, but both teachers also reported having reduced their efforts significantly in these regards during semester two, moving from weekly to either never or only once or twice during the entire semester. Teacher Six was the only teacher who reported weekly adherence in both semesters to all ILE recommendations such as listening to student recordings, providing/monitoring/encouraging the sharing of follow-up printout worksheets with family, reporting progress to parents, and using ILE data as part of ongoing literacy assessment. This teacher also had the highest class average for total minutes on the program (1563 minutes Semester 1, 1720 minutes Semester 2), well

above the expected 1200 minutes per semester. Being in a Title 1 school, Teacher Six also had sufficient resources (financial and personnel) to support ongoing maintenance of headphones with speakers so that students could record their voices at the appropriate times as recommended by the ILE program. Two of seven teachers reported that broken microphones on the headsets eliminated the ability to record voices. No other teachers reported headphone difficulties though only one teacher, Teacher Six, reported using the voice recording aspects of the program.

Teachers were also asked to report their observations of students as they interacted with the ILE program each semester on a Likert-type scale of 1 to 6, with 6 representing strong agreement. All teachers reported consistent positive agreement with statements about student engagement and excitement to attend the ILE lab across both semesters. No teachers reported negative feedback from students as they participated in the ILE treatment. In addition, more than half the teachers reported agreement with statements that students talked about what they were learning outside the lab (64%) and that parents commented positively about what their children were learning in the lab (57%) during each semester. One question regarding teacher perception of students' willingness to leave what they were doing in the classroom to attend the ILE lab produced the widest range of responses from 1 to 6. This question may have been misunderstood, however, as it included a confusing double negative. (Full response data is provided in Appendix B.)

Open-Ended Response Data

Nine open-ended questions (see Appendix C), posed at the end of each semester, elicited additional information from teachers about their experiences with computer

assisted instruction in general and the ILE program specifically, resulting in a total of 18 free responses from each of seven teachers. Both opportunities and challenges in working with the ILE program emerged from an analysis of the entire set of 126 responses which were coded and grouped according to the following three themes: training and support, curriculum pacing, and perceived value.

Most teachers reported the need for additional training or ongoing support to better use the technology available to them through ILE. Specifically, five of seven teachers noted a desire to improve their ability to access and use the various ILE reports to inform their own instruction and to provide feedback to parents about student progress. Two teachers expressed a desire to have more support for students when they first started going to the lab to help them get logged on to the computers. One teacher praised her school's efforts to provide strong technology support for teachers. This same teacher also reported difficulty in carrying out the ILE program as intended due to problems with broken computers, headphones and microphones. Two other teachers also noted hardware difficulties with the computers. Four teachers asked for support in finding sufficient time to use the technology to its fullest. "I wish we had more time in the school day so they could go (to the computer lab) more frequently."

Curriculum pacing of the ILE program itself was another theme that emerged from the open-ended questions, with feedback from teachers representing a diversity of observations and practices. When asked what they felt were the least effective aspects of the program, four of seven teachers reported that the pacing of the curriculum presented by the program was not quite right; one said it was too fast, another reported that the letter work did not help students enough and that there should have been more practice

with blending words, two teachers expressed concern about the placement test itself not being accurate. Three other teachers, however, felt that students were placed well in the curriculum and that they progressed appropriately in it. However, during a phone interview at the conclusion of the study, four of seven teachers reported feeling comfortable about the placements of their students in the ILE curriculum. The other three teachers re-iterated the concerns already expressed in the open-ended questions in that some students seemed to be in material that was too hard or too easy and added that they were not quite sure what to do about it.

The last theme of perceived value was consistently distinguished by teachers either in terms of individualized instruction or engagement or both. Overwhelmingly, all teachers praised the program's ability to differentiate instruction for the range of student learners. In response to the question, "What are the most effective aspects of the ILE program?" five of seven teachers consistently reported that the program's ability to individualize instruction, reinforcing what the teacher has already taught, were the most effective aspects. Two teachers indicated that student engagement with the program was its most effective aspect. When asked if there was anything else they wanted to share about their experience with ILE, five of seven teachers reported how much they and their students enjoyed working with the program because of the individualization and/or engagement it provided.

The range of perceptions about the curriculum and the perceived value of the ILE program also are seen from two specific teacher incidents. One teacher expressed during the final phone interview that she felt her students were well placed and productive with the curriculum with one exception, an ELL student who had recently qualified for special

education. The teacher did not think that ILE had helped her. Another teacher, early in the spring semester requested that her lowest achieving student be taken out of the study in order to spend extra time on the ILE program during second semester. She felt that he was benefitting more from the ILE instruction than anything else and wanted him to continue to have that benefit for the duration of the school year.

Overall, a positive difference in favor of computer assisted instruction emerged from each teacher's qualitative data between the first and second semesters. In terms of time, most teachers reported a higher percentage of time willing to devote to computer assisted instruction at the end of year than at midyear. The average amount of time willing to devote to computer use in the kindergarten classroom grew from 78 minutes per week at midyear to 101 minutes per week at the end of year across all teachers. This average was calculated from teacher responses to the question, "How much instructional time would you be willing to commit to using computer assisted instruction with your students?" Teachers also recorded very little difference in ratings on the Likert-type scale questions between fall and spring semesters with most scores highly favorable toward computer assisted instruction and ILE. Seventy-one percent of teacher final comments at the conclusion of the study were positive toward ILE and computer assisted instruction. The other 29% of comments were requests for study results or more training to better use the program.

Synthesis of "Other" Instructional Activities

At the end of each semester, teachers described the activities engaged in by students who were not part of the ILE treatment. The transcription of their responses is included in Appendix A. Although the study was designed to embed the ILE treatment

during the integrated core (science, social studies, music, art, physical education) portion of the kindergarten schedule, only four of the seven teachers adhered to this plan by ensuring that their classes in the control condition participated in the integrated core activities instead of using ILE in the computer lab. Table 15 provides a synthesis of the various "other" activities teachers reported using with their control classes by category.

Table 15   Synthesis of the Range of "Other" Instructional Activities Engaged In By Students in the Control Condition

Teacher	Math Practice in Centers	Math Practice on Computer	Literacy Games on Computer (not ILE)	Extra Literacy Small Group or Centers	Extra Literacy Whole Group	Integrated Core (science, social studies, music, art, P.E.)	Recess
1	✓	✓		✓	✓		
2		✓	✓	✓	✓		
3	✓	✓		✓	✓		
4	✓	✓	✓			✓	✓
5		✓	✓			✓	
6	✓	✓	✓			✓	
7			✓			✓	

CHAPTER 4

DISCUSSION

Computer assisted instruction has become an increasingly essential complement to instruction provided by classroom teachers with all stakeholders hopeful that the investment of time and resources to incorporate such instruction yields significant results—particularly for at-risk populations. The purpose of the current study was to assess the impact of a specific computer assisted instruction software program, *Imagine Learning English* (ILE), on both the language and literacy development of kindergarten students. Specifically, the study sought to answer two questions: (a) How do the literacy skills of kindergarten students, including English language learners and mono-lingual children, who receive instruction using ILE compare with the literacy skills of kindergarten students who receive "other" classroom instruction; (b) how do the vocabulary skills of the same kindergarten students who receive instruction using ILE compare with the vocabulary skills of those who receive "other" classroom instruction?

All seven participating teachers expressed a strong willingness to participate in this study to "show" quantitatively what they intuitively believed to be true—that the ILE program was making a substantial difference in terms of language and literacy achievement for their students. Each teacher made a commitment to ensure that one class at a time had access to ILE for a full semester, while the other class continued "other" classroom instruction during the same period. As one teacher stated, "Students have

really enjoyed using the computers daily. When my morning class could no longer do it they were very disappointed."

Surprisingly, the results of this study did not align with their expectations. Rather than finding a strong treatment effect in favor of ILE during either semester, the results showed a strong period effect, meaning that regardless of the kind of instruction (i.e., ILE or "other"), the instruction that was delivered in the participating classrooms during the first semester had a more substantial impact on literacy and vocabulary skills than instruction that was delivered during the second semester. In general, the academic gains of students in the ILE treatment did not differ from the academic gains of students in the "other" treatment in either semester. This chapter will discuss the significance of these findings and their implications. In addition, limitations of the study and recommendations for future research will be considered.

<div align="center">Significance of the Findings</div>

Impact of Treatment and Period Effects

Quantitative results showed that the ILE treatment did not differ from the "other" treatment on three of the four outcomes intended to measure literacy and vocabulary skills. Although there was a significant but small effect on the gain score for the PPVT-4 standard score, there were no significant differences on the gain scores for the PPVT-4 GSV, the gain scores for the DIBELS Next LNF scores, or the DIBELS Next Composite scores. The amount of time spent with the ILE program during either semester also showed no relation to gains on any of the outcome measures, with correlations between ILE time and gains being essentially zero. Regardless of how much time was spent on the ILE program, gains remained essentially the same. Even English language learners for

whom the program was originally intended adhered to the same pattern of no significant treatment effect. The only effect that was consistently salient with all measures used was the period effect. The first semester was the most impactful on literacy and vocabulary development for kindergarten students (English language learners included) regardless of the treatment condition. The period effect was small to moderate for the PPVT-4 standard score and the PPVT-4 GSV score, respectively, strong for the DIBELS LNF score, and very strong for the DIBELS Next Composite score—the score that "provides the best overall estimate of the student's early literacy skills and/or reading proficiency" (Dynamic Measurement Group, Inc., 2010, p. 2). Finally, the one treatment effect shown using the PPVT-4 standard score was restricted to only the first semester, and as mentioned earlier was small (Cohen's d = .26). The standard score indicated that both groups were above the national norm on vocabulary skill, but the ILE group was slightly higher than the "other" group.

Further clarification on each of the measures used and what the analyses of the measures showed may provide additional insights into what little differential impact the ILE program had on children's learning as compared to "other" instruction that was delivered to students. When all students are considered together, their gain scores on the PPVT-4 standard and GSV scores and on the DIBELS Next LNF score showed that they did in fact gain in literacy and vocabulary skills across each semester. All of the gain scores were positive. For the PPVT-4 standard score, gains scores of 0 or more indicate that students are performing on a par with or above the national norms. Thus, kindergarten children in the participating schools were gaining in receptive vocabulary knowledge at a rate equal to or higher than children across the country. They also were

individually gaining in receptive vocabulary as indicated by the PPVT-4 GSV score. Positive gain scores on the DIBELS Next LNF indicated that kindergarten children gained in their ability to identify letters of the alphabet. Finally, the percentage of kindergarteners at or above benchmark as determined by the DIBELS Next Composite score also showed gains. These gains in vocabulary and literacy skills reflect positively on overall language development in the participating kindergarten classrooms. In sum, teachers' literacy instruction was positively impacting students' learning.

What is imperative to understand, however, was that the positive impacts on literacy and vocabulary learning could not be attributed to the ILE program, but rather, were associated with instructional timing, that is, the strongest gains occurred in the first semester of the kindergarten year, regardless of ILE or "other" instruction, with gains in the second semester considerably reduced, or in the case of the DIBELS Next Composite score, becoming essentially flat. The lower levels of learning during the second semester also occurred regardless of ILE or "other" instruction. These results are clear and yet perplexing. What is clear is that overall, the instructional impact of the ILE program did not differ from the "other" instruction that teachers delivered. What is perplexing is why literacy and vocabulary growth differed so markedly from first to second semester?

Explanations for the Period Effect

There are several explanations that separately or collectively could provide insights into this strong period effect for the literacy learning of kindergarteners. These include the nature of the DIBELS Next LNF measure, overall district trends in the DIBELS Next composite score, and instruction that was mismatched with children's literacy development during the second semester.

Nature of DIBELS Next LNF. The PPVT-4 GSV and standard scores are reliable measures that have proven track records in measuring individual student growth and normative growth, respectively. However, the DIBELS Next LNF subtest measures a finite skill set that may not be a good measure of continued growth. With only 26 letters of the alphabet (52 when both lower and upper case letters are used), there is a ceiling effect in terms of the ability to identify letters fluently once mastery is achieved. The primary focus of first semester instruction in kindergarten is the alphabetic principle, and letter identification is essential to this focus. Not surprisingly, the mean LNF gains score for students was significantly higher in first semester than in second semester. Kindergarteners appear to learn much of the alphabet in the first semester, leaving much less to be learned in the second semester. The dramatically reduced gain scores for the LNF in the second semester could simply have resulted from the fact that there was not as much to learn in the second semester.

DIBELS Next composite score. For the students participating in the present study, the DIBELS Next composite score, the best overall estimate of student's early literacy skills, showed good gains during the first semester but flat during the second semester. Although these are results that could reflect specifically on the literacy programs implemented in the fourteen participating classrooms, they are in fact reflective of a district and nationwide pattern.

Figure 3 presents the comparison of this district's students (green lines) who were assessed on DIBELS Next with students across the nation (blue line) who were similarly assessed using the mCLASS:DIBELS Next recording system from *Wireless Generation*. While other kindergarten students across the nation showed continued growth on all
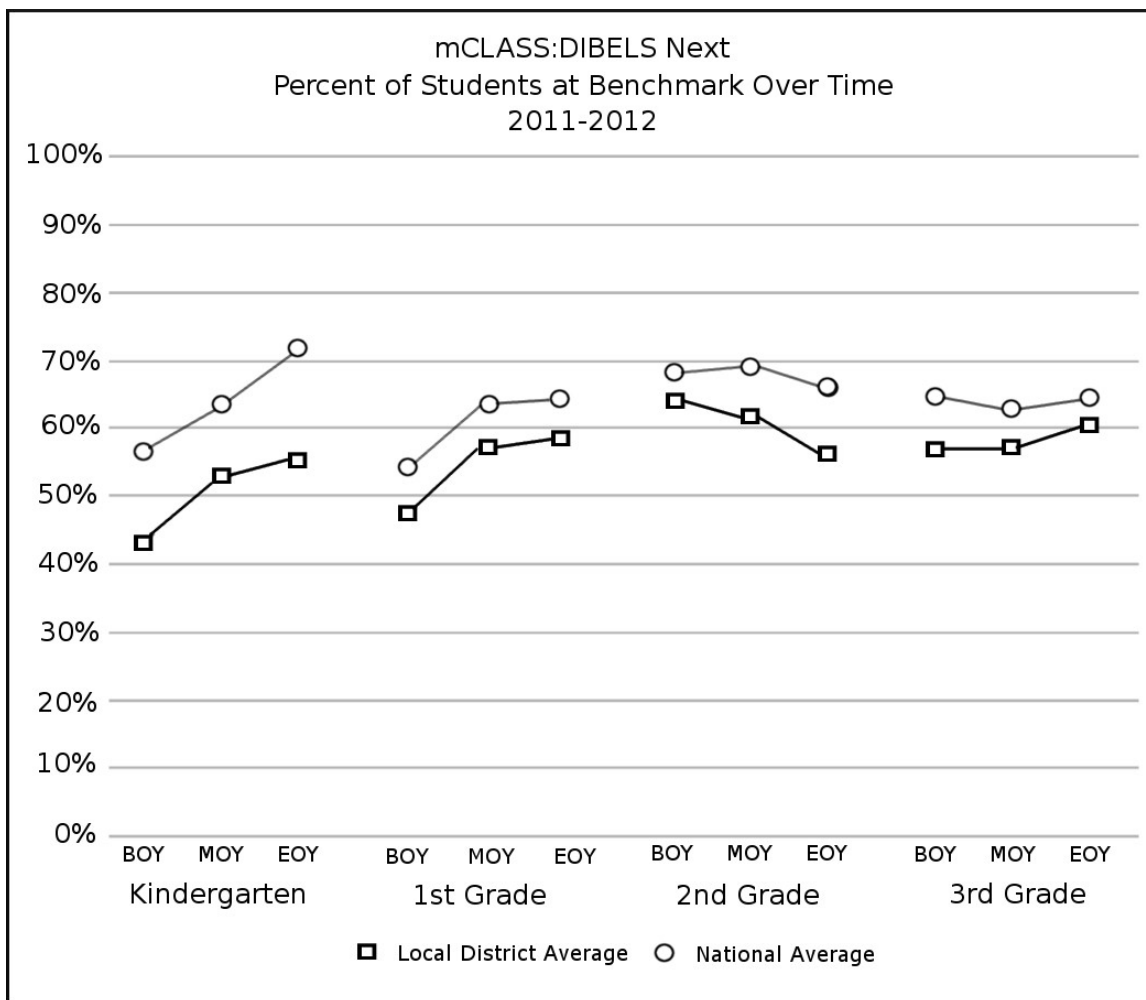
Figure 3   Percentage of kindergarten through third grade students at or above benchmark over time compared to national average on DIBELS Next.

DIBELS Next measures over time, the kindergarten students in this district showed a marked reduction in the trajectory of achievement from first semester to second semester. These district results coincide with and corroborate the outcomes of the present study in that the first semester was the most significant period of learning for all kindergarten students whether they used ILE or not. This district pattern is again seen in first grade, where, in this case, it is mirrored by the national data. The second and third grade data at the district and national levels are even more disconcerting in that growth across the

entire school year is flat or negative. Therefore, although this is not an explanation for the reduced rates of growth in the second period of the study, this is an indication that the present results are part of an overall district trend during kindergarten and may be part of an overall trend extending beyond kindergarten to third grade.

Instructional mismatch with children's literacy development.   An obvious explanation for the period effect is that something is missing instructionally in kindergarten classrooms across the district during the second semester. Whatever it is that kindergarteners need developmentally to extend their literacy growth is not being delivered in the classrooms or is being delivered but to insufficient amounts. One possibility is that between the middle and end of the year, teachers are attempting to provide kindergarten students with extensive practice on the specific phonics skills being assessed by tests administered later in the year. This preparation for testing may not be focusing on the broader range of skills required of students in order to be successful in their literacy and vocabulary development.

In this preparation for testing, there is an added focus given to the DIBELS Nonsense Word Fluency (NWF) subtest, which begins to be assessed in the middle of kindergarten and extends through the beginning of second grade. On it, students say as many correct letter sounds in phonetically regular CVC or VC nonsense words as possible in one minute. To increase success on this subtest between middle and end of year, teachers may be emphasizing the reading of nonsense words with students rather than staying focused on the regular progression of skills that lead to being able to "sound out" any word placed in front of students—including nonsense words. Such intense focus on this unnatural reading of nonsense words during the instructional day in place of other

instruction focused on more natural vocabulary development may inhibit the natural progression of learning to read.

A more likely explanation for instructional mismatch in the second semester may be a result of the unpreparedness of the kindergarten teachers themselves in implementing the district's adopted comprehensive literacy program, SRA *Imagine It!*. As the progression of literacy skills become increasingly complex in the second half of the kindergarten year, teachers may require more professional development and mentoring to improve success in teaching these skills using the district-approved instructional materials. The SRA *Imagine It!* program has only been implemented district wide for 2 years. Most teachers only received a 1-day introduction to the program and its component parts prior to beginning implementation. District wide mentoring and support have been limited. When faced with new policy mandates such as implementation of a uniform core reading program, research shows that teachers vary widely in their response patterns, from superficial implementation, to picking and choosing components based on preexisting beliefs and practices, to full implementation (Coburn, Pearson, & Woulfin, in press). While outside the parameters of this study, issues of comprehensive literacy program implementation fidelity may be impeding student growth in the second semester.

Regardless of the possible explanations for the reduced achievement trajectory during second semester, what is clear is that efforts must be made to identify and respond to this significant period effect. Kindergarten students can ill-afford to have their literacy development put "on hold" for one-half of the school year. Additional work needs to be done to investigate more fully the slowed learning of literacy skills in the second half of

the school year. The kinds of instruction now being delivered, CAI or otherwise, obviously are not meeting the needs of these students.

Reconsidering "Other" Instruction

Before further discussing the findings beyond the impact of the period effects, a thorough understanding of the differences between ILE instruction and "other" instruction is essential. By design, the ILE treatment was never intended to (and never did) replace any portion of the 95-minute district-mandated literacy instructional component using the SRA *Imagine It!* comprehensive literacy program in whole group and small group settings. Students in both the "other" groups and the ILE groups received these 95 minutes of literacy instruction. Instead, the ILE treatment was designed to take place within the 30 minutes allotted to integrated core instruction, which each day was to include science, social studies, physical education (P.E.), art, music, or library. To varying degrees, students in the "other" groups received this integrated core; students in the ILE groups did not. Students who received the ILE treatment did, however, receive extra and consistent language and literacy practice using ILE during this 30-minute, integrated core period while students in the "other" treatment did not.

Upon examination of teachers' self reports about how their control classes spent their time during the integrated core period while ILE treatment classes were in the lab, it is apparent that teachers engaged these students in a variety of activities constituting a "hodge-podge" of instructional curriculum, ranging from integrated core activities to extra literacy practice in the classroom and on computers to even a recess period when their classes were not in the ILE treatment. Inasmuch as all seven teachers varied significantly in their utilization of the 30 minutes allocated for integrated core

curriculum, "other" instruction must be interpreted as a "hodge-podge" of instructional curriculum that may or may not have included extra literacy instruction in addition to the 95 minutes of literacy instruction required for all kindergarten students. The results of this study must be considered in light of this understanding of "other" instruction. That said, what is surprising is that the daily and consistent use of ILE was found to have no more effect on the language and literacy outcomes of kindergarten children than the "hodge-podge" of other instructional activities engaged in by students when they were in the control condition.

ILE Compared to Other CAI Programs

This study was designed to compare ILE to "other" classroom instruction in an effort to determine what effect, if any, would emerge for a range of kindergarten students, including English language learners, following extended time on the CAI program. Results showing no effect on student outcomes in early literacy appear to contradict other similar CAI studies that report at least a small benefit—particularly for at-risk students (Ehri et al., 2001; Macaruso & Walker, 2008; Reitsma & Wesseling, 1998; Segers & Verhoeven, 2005; Van Daal & Reitsma, 2000; Wild, 2009). Results of this study also contradict studies which show that CAI has an impact on early vocabulary development (Boling, Martin, & Martin, 2002; Korat & Shamir, 2007; Segers & Verhoeven, 2003).

Differences between the current study and these other CAI studies of early literacy and vocabulary may be due to several factors. In many cases, the aforementioned early literacy or vocabulary studies did not specify what other instruction students were receiving during the instructional day when they were using the computer treatment, limiting the strength of the argument that it was the CAI intervention that produced an

effect. Many of these studies compared different students in different treatment conditions over time, resulting in potentially invalid comparisons. Often, these studies included relatively small sample sizes, making results difficult to generalize. In contrast, the 2 x 2 cross-over design of the current study significantly reduced the number of uncontrolled variables by comparing the same students when they were using the treatment to when they were not using it and minimizing the teacher differences inherent in many studies that compare one instructional approach to another by having each teacher serve as her own control. In addition, the fact that the study lasted an entire school year with over 250 participants provides further validity to the results. While other studies found small effect sizes in favor of the CAI treatments under investigation, this study of ILE found little or no effect.

The general lack of a treatment effect from implementation of a CAI in the instructional day is not unusual, however. Other integrated learning systems or comprehensive CAI programs have shown similar results to those found in the current study (Institute of Education Sciences, 2007; Kulik, 2003; Paterson, Henry, O'Quin, Ceprano, & Blue, 2003) with one notable exception—Cassidy and Smith (2005) whose experimental study of the Waterford literacy CAI found significant positive effects from long-term use. Notwithstanding this promising result, in a recent meta-analysis of computer use in schools that target high poverty populations, Judge, Puckett, and Bell (2006) showed that more frequent use of computers—particularly by students of poverty—was not associated with academic gains and was, in fact, negatively correlated with academic achievement across multiple studies. This evidence, that the more computer assisted instruction is used to support literacy development with at-risk students

the further behind academically they may become, presents a sobering appraisal of the use of CAI in early literacy instruction. While the current study does not extend beyond one year of data, the results found by Judge and colleagues suggest the possibility that extended time on the ILE program may indeed have little positive effects on students' future academic progress.

ILE Compared to Kindergarten Classroom Instruction

In comparing the implementation of ILE to the instruction provided by classroom teachers throughout this year-long study, several notable considerations emerge. These considerations have both positive and negative connotations for the use of CAI. On the positive side is the role of perceived value that teachers had concerning the impact of ILE on language development. In addition, the lack of differences between CAI and non-CAI instruction highlight important aspects of language learning. The negative side includes the possible negative effects of teachers relinquishing control of their literacy instruction to the CAI program and monetary costs of the program compared to use of other resources.

Role of perceived value. Teachers' attitudes, beliefs, and practices about ILE and computer assisted instruction, in general, remained consistently positive throughout the duration of the study even when outcome differences visible to the teachers themselves did not emerge between students who used the program and students who did not. Teachers liked having their students use the program because they said it provided practice of new skills and it differentiated instruction to address individual student needs. They believed their students liked using it as well because it was engaging and fun. All teachers planned to incorporate the ILE program into their practice again in the future. It

may be that teachers value computers when used for CAI, as a personal teaching assistant, adding variety to the school routine, and giving the teacher a small portion of the instructional day free from the details of lesson planning and delivery. In addition, CAI appears to be a very entertaining activity for young children. In the end, while use of the ILE program did not improve student learning outcomes beyond what the regularly scheduled activities of the classroom could do, it was a fun and engaging language and literacy activity that teachers wanted to continue to use with their students.

Impact of ILE on language learning. The lack of differences between using and not using the ILE program needs to be further discussed relative to what was also occurring in the classrooms in which ILE was embedded. In terms of literacy learning, all teachers had directly instructed students on literacy's essential components for 95 minutes daily, regardless of whether or not students received additional literacy instruction via ILE on the computer or participated in the "hodge-podge" of other classroom learning. Clearly, students were deliberately and directly taught the essential skills needed for early literacy to emerge regardless of whether they participated in the ILE intervention in addition to that instruction.

In terms of language learning, however, the near absence of an effect on language learning from use of the ILE program may offer an unexpected, but helpful, insight into the nature of vocabulary development in young children. Students received direct instruction of potentially new words on the ILE program for approximately one-third of each session when they were in the ILE treatment condition. Much of this focus was on new vocabulary learning, not just practice or reinforcement of skills. In contrast, classroom teachers using "other instruction" were not directly teaching potentially new

words to students. Their focus was on a combination of activities including reinforcement of the early literacy skills needed to decode text (phonemic awareness, letter identification, phonics), supplemental math instruction, integrated core activities (art, music, P.E., science, social studies), and recess. If teachers were not deliberately teaching new words, then students were most likely acquiring receptive vocabulary simply from exposure to whatever was in their surroundings (e.g., listening to or discussing a story, learning new science content, or interacting with peers on the playground). Cunningham (2005) found that such incidental word learning from context is possible for all ages and abilities. Findings from the current study suggest that incidental language learning contributes to ongoing inquiry in the area of vocabulary development in that children may, indeed, learn at least as many new words from incidental exposure during the instructional day as they learn from direct instruction, albeit via computer.

Teachers relinquishing control. One negative connotation regarding the use of ILE was that teachers appeared to relinquish a portion of their instructional leadership in the process of turning over one-sixth of the instructional day to this comprehensive computer assisted instructional program. Over the course of the year, teachers demonstrated high confidence that the program would be beneficial to their students by diligently striving to provide adequate time on the program. Such dedication to time on the program appeared to conflict with their sense of responsibility to personally ensure that students were receiving exactly the right curriculum during their daily ILE sessions.

Even though teachers were present in the lab during student sessions and monitored student use of the program, other qualitative data suggest that the monitoring of student progress may have been limited to mere observations that students were using

the machine. Four of seven teachers reported via the open-ended survey questions that the curriculum pacing was not quite right for at least some of their students. Three teachers reported via the final phone interview at the end of the year that they were not sure what to do when they determined that a student was not receiving the appropriate material. All teachers reported a desire to learn how to better use the student reports to inform instruction. But, there is a lack of evidence to suggest that the teachers sought answers to their instructional concerns during the course of the year-long study. It was as if teachers relinquished at least some of their responsibility as educators to the computer—a potentially disconcerting side-effect of the infusion of technology in instruction.

Monetary costs of the program. A second negative effect of implementing a computer assisted instructional program such as ILE in the kindergarten curriculum may be a financial one. If the assessment outcome of "other" classroom instruction is not different from the outcomes of the ILE instruction, is the cost of allowing kindergarten teachers to allocate one-sixth of their instructional day and the cost of funding licenses worth the investment? Currently, the ILE program costs $150 per license per year. One license is required for each child who uses the program. On average the kindergarten classrooms in the study held 20 students each, making total cost per year for one classroom of students to have access to the program an estimated $3000. While hardware costs are not being considered because the computers themselves are not used exclusively for ILE, the headphones with microphones must be considered as an added expense with the program as they are integral to the voice-recording feature and range in price from under $10 to over $40. Young children can be destructive of the headsets, and so schools must typically purchase new headphones yearly in order to fully implement the ILE

program. With a base cost of at least $160 per year per student to use ILE ($3200 minimum for a class of 20 students), in the end, it is not reasonable for schools, districts, or states to provide either the funding or the time away from potentially more effective instruction for students to use computers for computer assisted instruction that does not substantially accelerate academic achievement. Even the argument that ILE might yet be an engaging independent learning center while the teacher works with a small group is insufficient to warrant the expense required to place it in the kindergarten classroom. A listening center, a set of puzzles or other literacy games or activities may be equally effective for independent learning times at a fraction of the cost.

Finally, let us compare monetarily the daily use of the ILE computer program to the daily instructional support of a well-trained para-professional in the kindergarten classroom during small group instruction and literacy center time. Research has well established that small group intervention provided by trained para-professionals can significantly and positively impact early literacy achievement (Elbaum, et al., 2000; Iverson, et al., 2005; Mathes, 2003; Torgeson, et al., 1999; Torgeson, 2004; Vellutino, et al., 2006). For $3200 per year, a para-professional could support literacy instruction in each kindergarten class currently using ILE for more than one hour daily for less money than the cost of the ILE program in each of those same classrooms. Such a trained assistant, working in tandem with a competent classroom teacher, would ensure even more children the opportunity to receive targeted literacy instruction on a daily basis and thus reach critical reading benchmarks.

Study Limitations

Implementation Fidelity

In order to ensure careful adherence to both treatment conditions, both the "other" instructional program and the ILE intervention program needed to have been more carefully monitored throughout the duration of the study. With the exception of some personal observational data obtained during the three testing windows, fidelity of implementation was not monitored beyond what emerged from teacher survey data and periodic personal communications. Had more close monitoring occurred, the technical and training issues of individual classroom teachers might have been discovered and addressed more efficiently. At the outset of the study, the assumption was made that teachers were familiar enough with the ILE program, having used it at least one year previously, to monitor student progress and address any placement concerns immediately. Such was not the case. More frequent communication may have helped address any concerns or questions about the ILE program that arose such that placement and other technical adjustments could have been made in a timely fashion.

Though the total number of students was large enough to produce robust effect sizes, students, in general, did not spend as much time on the ILE program as was anticipated. This difficulty was due in part to competing pressures for time in the computer lab. Most schools do not have sufficient resources to allow full kindergarten classes to use the labs on a daily basis. This was made painfully evident during the study. Both principals and teachers alike found it difficult to maintain their commitments to the allocation of resources required to fulfill the goal of 1200 minutes per student in each semester.

Fidelity of implementation of the ILE system itself may have also had an impact on study outcomes. Only one of the seven teachers reported using all the features of the program with fidelity throughout the school year (though even her students' data did not show differences between ILE and "other" instruction). In addition, headphones with microphones needed for voice recordings did not work well or broke down midyear. Teachers did not use the reports well to inform their instruction. Parent letters and homework printouts were used sparsely.

Limited Sensitivity of DIBELS Next Outcome Measure

The outcome measure for literacy provided by DIBELS Next may not have been sensitive enough to detect incremental changes in the literacy development of each kindergarten child. Significant results may have been found had students been assessed on a more comprehensive literacy test specifically designed for young children rather than a universal screening measure such as DIBELS Next. For example, the *Observation Survey of Early Literacy Achievement* (Clay, 1993) may have been more sensitive to the changes in the literacy skills of young children. In this assessment, a teacher makes careful note of a range of literacy skills as an individual student engages with a variety of reading and writing tasks. This assessment, however, requires an extensive number of minutes to individually administer to each student. Unfortunately, both time and resources were insufficient to allow such an extensive assessment to be conducted on nearly 300 students at three different intervals during the school year. In addition, the school district required the use of existing assessment measures as there were concerns expressed about the amount of time taken away from instruction to conduct extra assessments of students. Obtaining approval and administering even one additional

assessment, such as the PPVT-4, to kindergarten students required significant time and resources to accomplish. Overall, however, given the limited time allocation for testing and the large number of students included in the study, the DIBELS Next was the best literacy measure available.

<u>Study Design Concerns</u>

The original study was intended to be conducted within the entire literacy component of the instructional day rather than just the integrated core curriculum portion of it. However, district authorities, uncomfortable with a design that might limit student access to any portion of the core literacy program and thus have a potential negative impact on achievement, imposed the placement of the ILE intervention within the integrated core (science, social studies, music, art, physical education). Had the entire literacy component of the school day been compared and no differences found between students who used ILE and students who participated in regularly scheduled literacy instruction, greater clarity about the viability of ILE as a supplementary literacy support to accompany direct instruction by classroom teachers may have resulted. Instead, the comparison of the results of the current study must be restricted to the instruction that students received during the 30-minute integrated core curriculum period.

In addition, although "true experiments" are considered by many as the gold standard for drawing inferences and conclusions about instructional interventions, conducting true experiments in "real" instructional settings is difficult and rare. Stake holders in curriculum design are likely not going to consent to withhold an instructional intervention from a control group of students when that intervention is assumed a priori to be beneficial for students. The risk that any experimental research might have a

negative impact on achievement prevents the full implementation of many potentially informative experimental designs.

However, the use of the 2 x 2 cross-over design has definite advantages over a true experiment. First, rather than being assigned to only a treatment or control condition, each student in the current study received both. This allowed for the direct within-subject comparisons of students' literacy learning with and without the intervention of interest. Second, the 2 x 2 crossover design added additional internal validity to the study in that each teacher taught both instructional interventions. Each teacher taught an ILE classroom and an "other" classroom each semester. Finally, the 2 x 2 crossover design provided a greater number of students who received the intervention of interest. The greater number of students provided greater diversity in the demographic profiles of the participants and greater diversity in the developmental trajectories of their literacy development.

<u>Recommendations for ILE Improvement</u>

Since its initial introduction to the schools within my district, the ILE company has been striving to improve its product. Each year, new versions have been designed in an effort to make the program increasingly user friendly and more effective with added curriculum to address the needs of a wider range of students. Based on the findings of this study, there are modifications that could be made to the ILE program that potentially could add to its effectiveness. First, the assessment system needs significant improvement. Strong assessment begins with a strong placement test that absolutely must be accurate. If students are not placed correctly in the curriculum from the very beginning, it does not matter how meticulously the curriculum has been designed,

achievement will not be accelerated and students will waste time in material that is either too easy or too hard. Second, the program needs to provide ongoing assessment that moves students forward or backward or sideways in the curriculum based on student responses to critical questions. Students must be working in the zone of proximal development (ZPD) in order to learn (Vygotsky, 1978). Without human intervention, by itself a computer program designed to work within a student's ZPD may not be feasible. An accurate placement test along with ongoing assessment of progress and adjustments in curriculum based on those results are essential.

Another recommendation is to restructure the ILE system such that teachers themselves are empowered with the ability to not only adjust student placement in the curriculum but to assign the specific skills to be practiced that are perceived to be most critical. Teachers too easily relinquish their instructional responsibility when they perceive that a computer program is providing everything their students need to be successful—even when that computer program is not accurately addressing student needs. Rather than promoting the ILE program as a comprehensive system, the company needs to provide a menu of instructional activities from which teachers can design an individualized instructional program based on their own assessment of student needs.

Customer support must also become an intimate partner with classroom teachers by regularly monitoring both teachers and students who are using the system and responding to anticipated questions and concerns even before they are asked, thus ensuring that the program is being used as efficiently and effectively as possible. Though the company provides multiple types of reports designed to show student progress to stakeholders, these reports are neither well-understood nor effectively used to show

student growth. Customer support could increase its communication efforts and professional development opportunities to ensure that no classroom teacher is without the tools and expertise needed for optimal success.

Finally, the ILE company would be well served to collaborate in an ongoing partnership with experts in both language and literacy development and instruction to ensure that the materials being produced are not only visually appealing, engaging, and entertaining, but are grounded in the most salient findings of current research. The only way that computer assisted instruction will become a viable early literacy intervention that is of the caliber required to accelerate achievement is through ongoing research and evaluation of its own products in partnership with independent research agencies.

<div align="center">Recommendations for Future Research</div>

Replication of the present study with students beyond kindergarten age is important to determine if the finding of no difference between ILE and "other" classroom instruction can be further substantiated or refuted. Investigations of CAI programs such as ILE involving older English language learners with very limited English may provide additional insight into ways that CAI is assisting or hindering language and literacy development for this difficult-to-serve population. Educational research that assesses the impact of CAI on student achievement needs to be well designed and rigorous in order to more fully and conclusively address the questions that have been asked now for nearly two decades about its effects on student achievement. Such research must be conducted independent of the CAI program developers to ensure unbiased product evaluations.

Conclusion

Though computer assisted instruction has been a hallmark of technology use since the installation of the first computers in schools, its place within the instructional arena has not been clearly determined. Even as school decision makers use limited financial resources to bring in innovative and engaging new CAI programs, they continue to be haunted by the dilemma originally expressed by Snow, Burns, and Griffin (1998) that "software can promote learning only to the extent that it engages students' attention—yet software that engages students' attention may or may not promote learning" (p. 265). Decisions about the appropriate use of computer assisted instructional programs must be based on consistent findings from sound research rather than based on perceived value and affective appeal.

This study of ILE to increase the vocabulary and literacy skills of kindergarten students within the instructional day adds empirical support that such computer assisted instructional programs are not yet ready to replace portions of the instruction provided by classroom teachers in a typical kindergarten day—especially not for students most at-risk of educational failure (Ehri et al., 2001; NRP, 2000; Reitsma & Wesseling, 1998). Limited funding is better directed toward intervention support that emphasizes the use of human resources to assist classroom teachers in providing essential literacy instruction. Even with the advancements of integrated learning systems such as ILE, the fact that such comprehensive instruction should not replace any portion of the day-to-day instruction normally provided by classroom teachers is further clarified by this study even though some have argued otherwise (Cassady & Smith, 2005). In the end, there appears to be no compelling reason to use programs such as ILE to reinforce early language and

literacy skills during the kindergarten instructional day. Further research is essential, however, to determine if this finding extends also to the use of ILE by older students during their instructional day.

State and local decision-makers could be informed by the findings of this study before future decisions are made about the infusion of computer assisted instructional technology into early elementary classrooms. Rather than replacing any portion of limited instructional time with computer assisted instruction during the school day, CAI products must be shown to be effective by independent reviewers. Young children most at risk of school failure require more instructional time to accelerate achievement and need to be the continuing target of research on computer assisted instructional programs that may eventually become sophisticated enough to address their needs with or without additional teacher interaction. For now, such programs are not at the point where they can replace any of the essential direct teacher instruction and intervention critically needed by young learners to accelerate literacy achievement and long term academic success.

APPENDIX A

TEACHER SELF-REPORT OF OTHER CLASSROOM ACTIVITIES

ADMINISTERED TO CONTROL CLASSES DURING

FALL AND SPRING SEMESTERS

	Activities Engaged in By Control Classes Fall Semester	Activities Engaged in By Control Classes Spring Semester
Teacher 1	Success Maker Math in computer lab (30 min. per week), *Imagine It!* activities, whole group reading comprehension activities.	Success Maker Math in computer lab (30 min. per week), whole group literacy extension, extra time for small group rotations & centers, literacy games & use of math manipulatives.
Teacher 2	Extended time for small group literacy and whole group literacy, DIBELS progress monitoring while students were in centers, various math and literacy computer games (not differentiated) 3 days per week in lab for short sessions (10-15 min).	Whole group literacy instruction (slower group so it took longer than the morning class), computer activities in lab such as ABC Mouse games and some Star Fall activities, 2-3 days per week for 10-15 min.
Teacher 3	Literacy activities including more teacher time in small group, extra center time, never went to computer lab, sometimes did math activities on computers in classroom (10 min every 2 weeks), No change in Science/Soc Studies curriculum for control and intervention groups. All got both of these all year.	Literacy centers, math computer activity once a week (in class), book studies (read extra story and an activity with it), hands on activities using various manipulatives in math (like extra math center).
Teacher 4	More math activities, math in computer lab twice weekly, science/social studies activities, got recess more often, used computers in the classroom during centers--played Math game, Star Fall, Jump Start kindergarten, other online games.	They got recess, more social studies/science, music, more math activities, twice a week computers in classroom during centers to play math and literacy games.
Teacher 5	Computer lab 3 days per week for 20 min to go to internet sites--ABC mouse, Star Fall, UEN Interactives, extra art time sometimes related to science and social studies.	Went to computers less often (always one less day per week), used ABC Mouse, reading, math activities, UEN sites, extra class time on science and social studies activities.
Teacher 6	Kindergarten math practices (based on whole group lesson), social studies lessons, Health, PE activities, art studies, once a week in computer lab doing Star Fall and other varied practice activities.	Kindergarten math practices, social studies lessons, Health, PE activities, art studies, literacy/math practicing on ipads and in computer lab once a week only.
Teacher 7	Extra story based on social studies or science unit, art activity or other activities to go with unit, occasional use of computers in classroom during centers (Star Fall), did not go to lab.	Extra social studies, science, and writing activities, did not take them to the lab, occasional use of computers in classroom (Star Fall).

APPENDIX B

RESULTS OF LIKERT-TYPE SCALE SURVEY QUESTIONS BY

TEACHER AT CONCLUSION OF EACH SEMESTER

	Tchr 1		Tchr 2		Tchr 3		Tchr 4		Tchr 5		Tchr 6		Tchr 7	
	Sem		Sem		Sem		Sem		Sem		Sem		Sem	
	1	2	1	2	1	2	1	2	1	2	1	2	1	2
ILE PRACTICES 1 = Never 6 = daily														
1. I monitored student use of the program by physically moving around the lab.	5	4	5	4	6	6	6	6	6	6	6	6	6	6
2. I provided verbal prompting to encourage active engagement with the program.	5	4	6	6	6	6	6	6	6	6	6	6	6	6
3. I listened to student recordings and provided feedback.	1	2	1	1	3	2	1	1	1	2	5	5	1	1
4. I provided students with follow-up printouts according to program directions.	3	1	2	1	5	2	1	1	1	1	6	6	6	1
5. I tracked student completion of printouts.	3	3	1	3	1	2	2	1	1	2	5	5	1	1
6. I encouraged students to share what they were learning with their families.	3	3	1	1	5	4	5	5	6	4	5	6	1	1
7. I shared individual progress reports with parents.	2	2	1	1	3	2	1	1	2	1	5	3	5	1
8. I used ILE data as part of ongoing assessment of student literacy growth.	3	3	2	3	4	3	3	2	2	2	4	3	1	1
BELIEFS 1 = Strongly disagree 6 = Strongly agree														
1. I feel confident in my ability to use computers to support instruction.	5	4	6	6	6	4	6	5	6	5	5	5	4	4
2. Computers help students engage in learning.	5	5	6	6	6	4	6	6	6	6	6	6	5	4
3. Computers are useful in providing individualized differentiated instruction.	6	5	6	6	6	5	6	6	6	6	6	6	5	5
4. I am a more effective teacher when I use computer assisted instructional technology to support classroom instruction.	5	5	6	6	4	5	6	6	6	6	5	6	3	2

ILE OBSERVATIONS 1 = strongly disagree, 6 = strongly agree														
1. Students were actively engaged throughout their sessions.	5	5	6	6	5	5	6	5	6	6	5	5	5	5
2. Students did not want to stop working in the classroom to go to the ILE lab.	3	4	1	1	2	2	1	1	6	6	3	1	2	2
3. Students were excited to go to the ILE lab.	5	4	6	6	5	5	6	6	6	6	5	6	5	5
4. Students talked about what they were learning outside the lab.	4	3	3	3	4	5	6	4	4	5	4	5	3	3
5. Parents commented positively about what their children were learning in the ILE lab to me or others.	5	3	2	2	4	4	3	4	3	4	4	5	4	2
6. Parents commented negatively about what their children were learning in the ILE lab to me or others.	1	1	1	1	1	1	1	1	1	1	3	1	2	2

APPENDIX C

OPEN-ENDED QUESTIONS ASKED OF PARTICIPANTS AT

CONCLUSION OF EACH SEMESTER

Teacher Survey Open-Ended Questions

1. What do you wish you had done differently with the ILE intervention during the time you used it with your students?

2. What are the most effective aspects of the ILE program?

3. What are the least effective aspects of the ILE program?

4. What would you like to change about the ILE program?

5. How do you think that computers can best be used for literacy instruction?

6. What additional support do you feel you need to better use computers as part of literacy instruction?

7. What, if anything, will you change about your own instructional practice as a result of participating in this ILE study?

8. How much instructional time would you be willing to commit to using computer assisted instruction with your students in the future?

9. Is there anything else you would like to share about your experience in using ILE in the classroom?

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