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INCORPORATING ISTATION INTO EARLY CHILDHOOD CLASSROOMS TO IMPROVE READING COMPREHENSION

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ABSTRACT

Aim/Purpose	IStation is an adaptive computer-based reading program that adapts to the learner's academic needs. This study investigates if the Istation computer-based reading program promotes reading improvement scores as shown on the STAR Reading test and the IStation test scaled scores for elementary school third-grade learners on different reading levels.
Background	Prior literature provided a limited evidence base for incorporating computer-adaptive learning technologies to improve reading comprehension in the context of early childhood education.
Methodology	Using a mixed-method case study research approach, this study purports to investigate the effects of IStation and examine the perspectives of teachers and students. Supported by survey and interview data, this case study employed a sample of 98 public school third-grade students in an urban elementary school in the southeastern United States as well as the three classroom teachers.
Findings	The results of this study show a strong correlation between the usage of IStation and the rise of STAR reading scores during the time IStation was integrated. There were differing opinions regarding the effectiveness of IStation between students and teachers, as well as between low and high achieving students. Teachers recognized that intervening variables of teachers' whole and small group lessons individualized for each class, as well as students' practice sessions both at home and at school, could have also resulted in improved STAR reading scores.
Recommendations for Practitioners	There is no one-size-fits-all solution when implementing such technology to a diverse array of learners on different reading levels, such as Tier 1 (high reader),

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	Tier 2 (medium average benchmark reader), and Tier 3 (low reader). It is essential to provide professional development and training opportunities for teachers. Teachers can also train and elevate the higher achieving students with using IStation to monitor their own progress as well as set their own individual learning goals.
Recommendation for Researchers	We recommend studies with a larger sample size that would likely yield more definitive and generalizable results, studies using a randomized control group that would have teased out extraneous factors and truly measuring the effects of IStation alone on STAR, as well as longitudinal studies examining the long-term effects of IStation.
Contribution	This study has provided a) additional data to show evidence for the effectiveness of a computer-based reading program, IStation, by using the students' and teachers' viewpoints as well as reading comprehension test scores data; and b) recommendations for practitioners and researchers regarding professional development for IStation implementation.
Keywords	computer-adaptive learning technologies, reading intervention, early childhood education, IStation

INTRODUCTION

Reading is one of the fundamental skills for students to master in order to achieve academic success in all disciplines. To become an effective reader with good reading comprehension skills, the reader must show an understanding of the text content by connecting that new information to his or her own background knowledge and experiences. This is commonly known as schema (Ertmer & Newby, 2013). Reading comprehension as an essential skillset requires more than just the reading of words. Information processing theories posit students need be able to think critically about the words and attach meaning to text during the process of cognitive activities (Jonassen, Campbell, & Davidson, 1994; Pikulski & Chard, 2005). Prior research has evidenced that quality reading experiences and practices at an early age exert pervasive effects on literacy outcomes (Bowman, Donovan, & Burns, 2001; Strickland & Shanahan, 2004).

In early childhood education, the teaching of reading skills needs to be a child-centered, developmentally appropriate practice that matches the child's developmental stage (Charlesworth, 1998). In recent years, adaptive computer-based reading programs such as the IStation program have been adopted in K-12 schools, as they can adapt to a learner's academic needs by providing personalized learning paths and a variety of reading strategies. Elementary school students who used the IStation program have shown significant growth in their reading comprehension and literacy skills (Florida Center for Reading Research, 2006; IStation, 2004; IStation, 2006; IStation, 2010; IStation, 2013; Patarapichayatham, Fahle, & Roden, 2014). Despite such promising results, challenges do exist. Some teachers may not know how to best integrate technology into their classrooms, which is precisely what the effectiveness of such technology hinges on (Cheung & Slavin, 2012; Ertmer, OttenbreitLeftwich, Sadik, Sendurur, & Sendurur, 2012). Many researchers have recommended continuing research in this area (Biancarosa & Griffiths, 2012; Cheung & Slavin, 2012; Marin, 2015; Schwartz, 2015). Responding to this call, this study purported to provide an explicit delineation and examination of the implementation of IStation in three third-grade public elementary school classrooms. We utilized a mixed method study that gathered both qualitative and quantitative data sources. Specifically, our study aim to examine effects of IStation by evaluating 98 third grade students' STAR test results and provide insights into the perspectives of third grade teachers and students regarding the IStation implementation. This paper begins with a review of the literature on adaptive computer-based technologies for reading, including a detailed introduction to the IStation program and pertinent studies conducted prior to this study. The study's method, procedure, data collection and analysis were explained subsequently. Results and discussion section provide detailed

findings of the study and recommendations to practitioners and researchers regarding professional development for IStation implementation.

REVIEW OF LITERATURE

READING STRATEGIES

The development of reading comprehension skills at an early age is essential for children as it is closely associated with subsequent developmental skills in reading, writing, or spelling (West, Denton, & Reaney, 2000). As young children enter the doors of a school for the first time, they often vary greatly in their developmental levels and literacy skills (Ackerman & Barnett, 2005). Variable, differentiated, and personalized instruction that employs a variety of instructional techniques and strategies can help address issues across different skill areas such as phonemic awareness, phonics, fluency, vocabulary, as well as reading comprehension (Kelcey & Carlisle, 2013). For example, children with lower reading levels should be demonstrated with explicit reading strategies and abundant practices while those with high reading performers should be given more flexibility and freedom to explore their own reading interests and materials. More research about which precise strategies should be taught to Tier 1 (high level), Tier 2 (benchmark on level), and Tier 3 (below level) students may be necessary to fully comprehend how to improve all students' reading levels.

Some effective natural reading strategies involve previewing a story's cover to identify its genre, skimming the pages of the text to identify the text structure, and reading actively to construct and revise predictions in order to understand vocabulary in context (Al-Momani, Hussin, & Hamat, 2014). As important as it is to possess reading strategies and automatically utilize them while reading independently, it is invaluable for the reader to have been explicitly taught and introduced to these reading strategies. One commonly used reading intervention is passage previewing, which means that a fluent reader reads a passage aloud with the struggling reader following the text reading it silently (Rathvon, 2008). Observing good reading behavior is a type of vicarious learning that helps the struggling reader imitate the successful reader. According to Duffy (2002), the instructor should model and demonstrate the reading process by using think-aloud and guided practice with the students. In this researcher's own classroom experience, students need to hear and see a proficient reader think aloud in order to know how to mimic this same behavior. With practice, students continue to independently exemplify proper reading behavior without much teacher modeling. Guiding the students with the use of graphic organizers is part of understanding the text. Some scholars believed that graphic organizers is especially useful for students with learning disabilities to aid them in achieving reading comprehension success (Ae-Hwa, Vaughn, Klingner, Woodruff & Reutebuch, 2006). It is commonplace for teachers to model filling out a graphic organizer once the teacher has read a text with the students. The teacher can ask students questions to fill out the graphic organizer together as a class concerning the text that was just read. Eventually, students will work in pairs or individually to fill out these graphic organizers. Burns, Riley-Tillman, and VanDerHeyden (2012) introduced another method providing the struggling reader with corrective feedback when an error is made so that the reader can learn from his or her errors quickly by not repeating them. Research showed that repeated reading is a method in which the struggling reader reads aloud along with a fluent reader or teacher who is able to provide immediate correction (Rathvon, 2008; Samuels, 1979). The goal is for the struggling reader to learn from his or her reading miscues and improve accuracy and speed of reading to enhance comprehension. Many of these strategies can be achieved via a computer-based adaptive learning program.

ADAPTIVE COMPUTER-BASED TECHNOLOGIES FOR READING

It is crucial to utilize variable reading strategies and interventions to improve reading comprehension. Several studies demonstrate that incorporating interactive, adaptive, computer-based technologies has been an effective intervention supporting reading comprehension and literacy (Barton & Woolley, 2017; Khezrlou & Ellis, 2017; Leu, Kinzer, Coiro, & Cammack, 2004). Such computer-based reading

programs can provide visual aids by seamlessly inserting images and photographs as well as modifying layout and presentation of content based on the particular needs of a student. This largely helps struggling readers compensate for their limitations of prior knowledge, therefore enriching learning experience for all readers regardless of skill level (Reinking & ChanLin, 1994).

Adaptive computer-based reading technologies can also provide individualized support that facilitates personalized learning (Baker et al., 2017; Hutchison, Beschoner, & Schmidt-Crawford, 2012; Hutchison & Beschoner, 2015). These tools possess many built-in functions that allow students to actively engage in reading activities and assessments that incorporate diverse reading strategies and interventions as mentioned above (Shute & Rahimi, 2017). For example, text-to-speech, automated tutors, and individualized levels of support are common and effective ways to meet learners' disparate needs.

Additionally, adaptive computer-based reading tools often incorporate assessment mechanisms useful for gathering student data. For instance, STAR (Standardized Test for the Assessment of Reading) is a computer adaptive assessment system created by Renaissance Learning, Inc. that measures learners' reading skills in Grades 1 through 12. The adaptive nature of the program allows successive questions to become more or less challenging based on the student's correct or incorrect responses. If a student answers a question incorrectly, a less difficult question will follow to adjust to the student's ability level. Upon finishing the test, the students' grade level abilities and other learning abilities are measured in a report that the teacher can interpret and then review with the parents.

THE ISTATION READING PROGRAM

IStation is an adaptive computer-based reading program that adapts to the learner's academic needs. It assesses each student's particular deficits in phonemic awareness, phonics, fluency, vocabulary, and comprehension (IStation, 2015). The program will then teach upcoming lessons to address the student's deficits, consequently assessing each learner's comprehension of the taught material. The student's learning is enhanced by the different lessons the program offers which propels the student to achieve strong reading gains in all of the aforementioned five reading components (Connor, Alberto, Compton, & O'Connor, 2014; Kamil et al., 2008). Some examples of IStation lessons are shown in the weekly Priority Report informing the teacher logging on to IStation that certain students in their class need more remediation in any of the five aforementioned areas. The teacher can choose to utilize the suggested IStation lesson plans as well as continue to allow students to progressively learn from IStation's lessons. The program incorporates captivating, interactive characters and animations that guide students through the reading materials and questions.

Since its inception in 2010, IStation has been utilized by over three million students in more than 37 states in the U.S., and six countries worldwide to improve their reading skills (Patarapichayatham & Roden, 2014). The Texas Education Agency (TEA) adopted IStation for the 2014-15 academic years to aid third-graders in improving their Language TEKS (Texas Essential Knowledge and Skills) test scores. Results correlated directly with the IStation interactive lessons and activities which promoted decoding, vocabulary, fluency, as well as oral and written conventions (Patarapichayatham & Roden, 2014). In a study prepared by Mathes (2016), after 35,000 students in four Dallas elementary schools were tested, IStation's Indicators of Progress (ISIP™) were more predictive of the TAKS (Texas Assessment of Knowledge and Skills) reading assessment scores than other traditional standardized tests like DIBELS Oral Reading Fluency (Good, Kaminski, & Dill, 2002). Another study showed that the end-of-year reading scores were higher than the middle of the year scores for students in Grades 3-8 (Patarapichayatham et al., 2014). Their STAAR (State of Texas Assessments of Academic Readiness) reading assessment scores also rose when using IStation. High correlations were exemplified in the ISIP Reading and STAAR reading assessments, which suggests that the ISIP scores highly predict STAAR reading scores. In a descriptive study concerning the use of IStation in Louisiana, Bugbee (2011) found clear improvements among students using IStation reading software in each grade without claiming causation.

Meanwhile, a mixed result existed in other studies. Schwartz (2015) found in a dissertation study that the data did not show a significant correlation between the average students' STAAR reading scores and the time students spent following the IStation curriculum. The results of a study by Marin (2015) showed evidence of a significant improvement between the control group and comparison group only on the Texas state standardized reading category 2. Understanding and Analysis of Literary Texts still failed at all other categories of reading assessments. The study suggested that despite the fact that IStation offers a wide variety of resources, they were rarely properly implemented due to the lack of time and effort teachers devoted to appropriately training students or allowing them to practice using the program (Marin, 2015). This does not discredit the role of technology in reading intervention; instead, it reiterates the fact that the effectiveness of such applications largely hinges on how and to what extent such technological applications are implemented appropriately by educators.

PURPOSE OF THE STUDY

Along with other studies on adaptive computer-based reading instruction, researchers recommend more studies to determine if such technology programs are an effective intervention and instruction method across all instructional tiers (Cheung & Slavin, 2012; Marin, 2015; Melhado, 2010; Schwartz, 2015). In a systematic review of 20 empirical studies examining instructional technology utilized to improve the reading comprehension of elementary students, Cheung and Slavin (2012) stated that "there is a limited evidence base for the use of technology applications to enhance the reading performance of struggling readers in elementary schools" (p. 296). The researchers firmly believe that technology integration is essential to the improvement of reading comprehension skills, thus calling for ongoing future research to "build a stronger evidence base" (Cheung & Slavin, 2012, p. 297).

In this study, we aimed to provide an explicit delineation and examination of the implementation of IStation in three third-grade public elementary school classrooms. Using a mixed method study incorporating both qualitative and quantitative data sources, our purpose was to: (a) investigate the effects of IStation by evaluating 98 third grade students' STAR test results, and (b) examine the perspectives of third grade teachers and students regarding the IStation implementation. The following research questions were used to guide this study:

1. Did students' STAR scores improve during IStation's implementation?
2. Was there a significant correlation between IStation scores and STAR Reading Test scores?
3. What were students' perceptions towards IStation as a tool to support reading comprehension?
4. What were the instructor's perceptions towards IStation as a tool to support reading comprehension?

METHOD

RESEARCH DESIGN

This study was conducted using a mixed-method case study research approach (Creswell & Clark, 2007; Yin, 2009) involving a quantitative correlational analysis investigating the effects of the IStation's implementation as well as an in-depth qualitative analysis of student and instructor perceptions towards IStation as a tool for supporting reading comprehension. The study was designed to examine changes in students' STAR scores during IStation's implementation, as well as the relationship between students' performance on the STAR Reading Test and the IStation reading score.

PARTICIPANTS

The participants were 98 public school third-grade students in an urban elementary school in the southeastern United States. Their reading abilities and skills were quite varied; students were catego-

rized as special needs or gifted, falling into either a high, medium, or low category. This was a convenience sample consisting of 51 girls and 47 boys. Nine students had special needs (5 boys and 4 girls), and 19 students were categorized as gifted. The categorization of students as high (Tier 1), medium (Tier 2), or low (Tier 3) was primarily based on the students' September STAR reading test score. Prior to the implementation of IStation, the three tiers from high to low consisted of 18, 37, and 43 students, respectively.

A stratified sample of nine students selected across all three classes were invited to participate in student interviews. Researchers chose one Tier 3, Tier 2, and Tier 1 student from each of the three different classes to interview. Three classroom teachers participated in this study. Two of the teachers, M and A, have five years of third grade teaching experience in reading and writing. Teacher C has nine years of first grade teaching experience, and just over a year's experience teaching third grade. Teachers M and A are Caucasian females in their early 30s while Teacher C is a Hispanic female in her late 30s. All three teachers possess a Bachelor's degree, teacher M is pursuing her Master's degree, and teachers A and C already possess Master's degrees in education. All three teachers were previously trained by IStation trainers and are familiar with online IStation training materials.

PROCEDURES

The public school administration mandated that all students participate in the IStation reading program as part of their normal education during the implementation of this study. Therefore, students of the three participating teachers participated in the study as a class requirement. The IStation program was pre-installed on each computer for students to log in and learn. The STAR Test was accessible from any computer with Internet access. Students completed one 30-min IStation lesson per day at a minimum. Activities included brief quizzes as pre-assessments and intermittent ongoing quizzes as practice and formative assessments. The school administration also mandated that the STAR Reading Test be taken on a monthly basis to gauge students' probable success on state-level standardized tests, such as the Virginia Standards of Learning (SOL) tests. Computers for each student were located in a computer lab or classroom and available for monthly STAR Tests or daily work with the IStation program.

Prior to IStation's implementation, teachers received an hour-long, on-site, face-to-face training session from IStation representatives. Resources were also readily available on IStation websites for teachers to explore and read. Teachers were also provided professional development workshop hours to practice, ideate, and plan the integration of IStation into their classrooms. A pre-survey for teachers was conducted to examine their initial interest and belief before the program's implementation. During the implementation, teachers often logged onto the website, IStation.com, to run reports and to view student performance on a periodic basis. Teachers received suggested lessons from IStation that were tailored to their students based on student performance data and reports. Accordingly, teachers designed small group reading interventions using these suggested lessons and recorded them in IStation reports. Teachers were also able to choose their own materials and activities to supplement suggested lessons, further tailoring to the particular needs of each individual student.

Upon completion of the study, the teachers were surveyed again and interviewed with the hope of gaining greater insight into their perceptions of both the positive and negative effects that the IStation program had on their students' reading comprehension abilities. Interview protocols were disseminated and shared with the three teachers prior to the interview and each face-to-face interview lasted one hour (see Appendix A). Teachers' personal attitudes toward IStation implementation and the program's suggested reading comprehension instructional lessons were also noted at this time. The researchers also conducted nine semi-structured interviews with students to understand their personal perceptions and experiences. Each student interview lasted approximately ten minutes and took place during the students' lunchtime when students were most available.

DATA COLLECTION AND ANALYSIS

Data collected included test scores from the STAR Reading Test and the IStation program, teacher surveys, as well as student and teacher interviews following the conclusion of the experiment. SPSS descriptive statistical analysis was used to examine changes in STAR Reading Test scores from September to January when IStation was implemented. Paired sample t-tests were used to determine if there was any significant improvement in students' test scores from September to October, October to November, and November to January. December test scores were not captured due to an administrative directive that the test be delayed until January. A correlational analysis was also conducted to examine whether or not there is a clear relationship between students' STAR Reading Test scores and their reported performance in IStation.

At the beginning of the study, the researchers had administered surveys to all three teachers involved. An end-of-semester survey was also disseminated in order to examine their perceptions regarding their implementation of IStation in their class. The survey was composed of seven, five-point Likert-scale items ranging from strongly disagree to strongly agree seeking the teachers' beliefs as to how effective IStation was in helping their students improve reading and comprehension levels. In-depth interviews with the three teachers were conducted both face-to-face and via email. During informal interviews at the end of the semester, students were asked to elaborate about: (a) feedback they received from IStation when they made progress; (b) feedback they received from IStation when they made errors; (c) reasons for liking IStation; and (d) reasons for disliking IStation.

Both instructor and student interviews were recorded, transcribed, and analyzed using an open-coding approach (Patton, 2002). One researcher extracted patterns and themes within the discourse of the interviews and further organized the data into meaningful categories. Common themes in the teacher interviews were formed based on the frequency of similar wording that teachers used to comment about the interview questions. Quotations from the interviews were selected to provide further insight into students' perceptions regarding the IStation program. A second researcher then met with the first to review and discuss the coding process. The second researcher coded a sample of raw interview data and compared with the first researcher. The two reviewers discussed about the disagreements and made decisions on the final themes to be included in the paper. The coding process for the teacher and student interviews can be found in Appendix B and C.

At the conclusion of data analysis, a third researcher served as external auditor to refine and finalize the interpretation and analysis of the data in the light of each piece of data as well as its overall thematic structure. Data gleaned from the teacher and student interviews was used to compare and contrast with findings from quantitative statistical analysis. All data sources were triangulated to enhance trustworthiness, thus safeguarding the rigor of this case study research (Newman & Hitchcock, 2011; Patton, 2002).

RESULTS

RQ1: DID STUDENTS' STAR SCORE IMPROVE DURING ISTATION'S IMPLEMENTATION?

The descriptive statistics of STAR scores for the months of September, October, November, and January showed that the students' average performance was improving overall. There was a slight setback in the scores seen in the October tests, as the mean scores dropped from September to October (see Table 1 and Figure 1). In the September and October tests, the mean score was at approximately the 45th percentile nationally. In November, the mean score rose to 372.22, rose again in January reaching 401.01, thus remaining above the 50th percentile, according to STAR's winter benchmark scaled score values.

Table 1. Monthly average STAR scores

	N	Mean	SD
SEPSTAR	98	346.58	117.590
OCTSTAR	98	328.46	126.686
NOVSTAR	98	372.22	122.434
JANSTAR	98	401.01	122.710

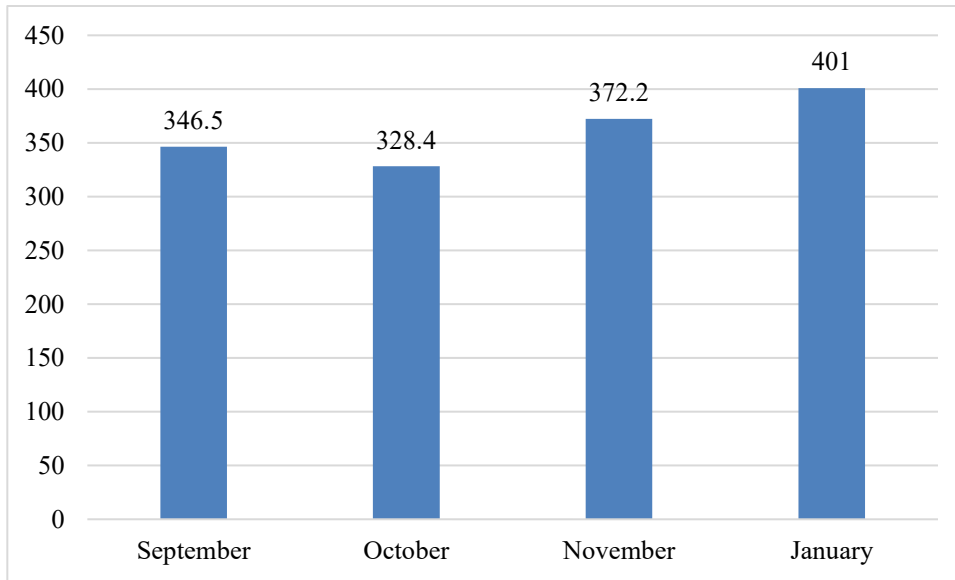


Figure 1. The means of STAR Reading Scaled Scores from September to January

It seems that positive results exist in the fall months of September to November as shown with the increase in the number of Tier 1 students and Tier 2 students alongside a noted decrease in the number of Tier 3 students (see Table 2). During this time, the Tier 1 student group increased 6%, and the Tier 2 group enjoyed a 7% increase. The Tier 3 students dropped from 44% to 31%, a commendable 13% decrease. However, from November to January there was a less notable increase in the percentage of Tier 1 and 2 students (see Table 2 and Figure 2). The number decrease from November to January was in part due to the fact that STAR benchmark score in January was markedly higher than the one in November. The passage of winter break in December may have also caused a decline in students' retention of vocabulary and reading ability. From September to January there was a 4% increase in Tier 1 students, a 3% increase in Tier 2 students, and a 7% decrease in Tier 3 students.

Table 2. Comparing changes in Tiers 1, 2, and 3 Students over time

	Sep.	Oct.	Nov.	Jan.
Tier 1	18 (18%)	20 (20%)	24 (24%)	22 (22%)
Tier 2	37 (38%)	30 (31%)	44 (45%)	40 (41%)
Tier 3	43 (44%)	48 (49%)	30 (31%)	36 (37%)

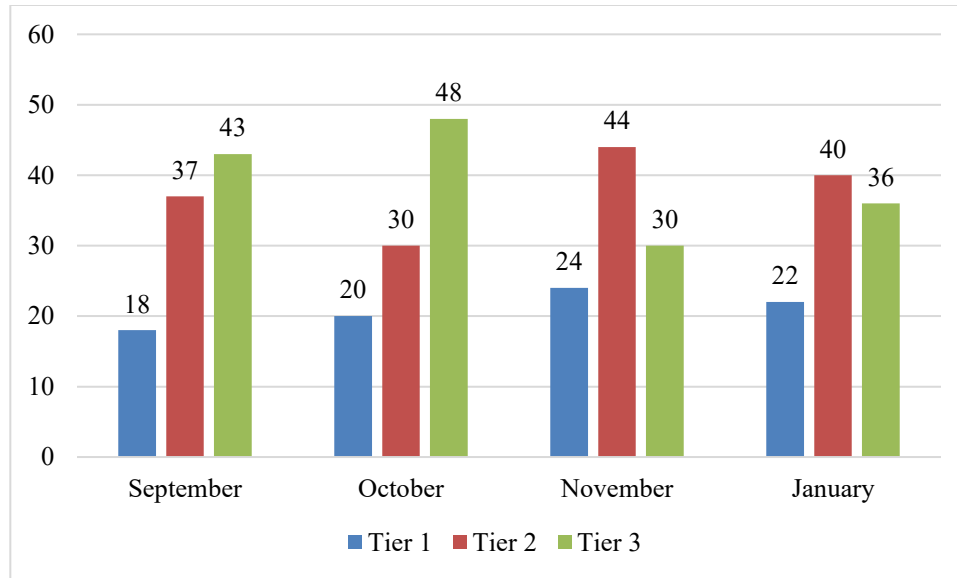


Figure 2. Number of Tier 1, 2, and 3 students based on star reading test

Paired T-tests were conducted to examine whether or not statistically significant score growth exists over time. Comparing September and October STAR Tests, there was no statistically significant difference in score jumps, reflecting a decrease in mean scores, with $t(97) = 2.547, p < 0.0005$. When comparing October and November STAR Tests, the score results displayed statistically significant growth, with $t(97) = -5.115, p < 0.0005$. The comparison between November and January STAR Test scores shows that there is a statistically significant growth in scores, with $t(97) = -3.713, p < 0.0005$. Comparing September and January STAR Test scores, there is a statistically significant difference, with $t(97) = -7.454, p < 0.0005$.

RQ2: WAS THERE A SIGNIFICANT CORRELATION BETWEEN ISTATION SCORES AND STAR READING TEST SCORES?

The correlation between the IStation and STAR scores is shown to be highly significant. After student participants used IStation in October, it was noted that their October STAR scaled scores were significantly correlated, with $r = .470, p < .001$. November IStation score appeared to have a significant correlation with November STAR scaled scores with $r = .710, p < .001$. December IStation score also appeared to have a significant correlation with January STAR scaled scores with $r = .578, p < .001$. It can be concluded that IStation may have had some positive effect on increasing subsequent STAR Test scores; if the students had not had the extra online reading remediation this may not have been seen.

RQ3: WHAT WERE STUDENTS' PERCEPTIONS TOWARDS ISTATION AS A TOOL TO SUPPORT READING COMPREHENSION?

Overall, students held a positive outlook for IStation use. One major theme across all students' responses was that they had a lot of fun interacting with the animated IStation characters. Five students from both Tier 1 and Tier 3 categories commented that the characters enhanced the learning experience with their amusing commentary. As one student noted, "I liked the colors and the way the characters moved around and made me laugh. It helped me a lot when I read with it [as if] I had a buddy on the computer to make reading fun again." Other features that attributed to a more enjoyable student experience included the highlighting feature; the program will highlight words as it reads them aloud. It was adaptive enough to detect students' mistakes and give them hints to guide them to the

correct solution. A student commented, “It was always ready to give me help when I needed it.” IStation also contained a large amount of positive reinforcement that served to motivate students, and they reported that they liked the fact that they received a large amount of praise and compliments if they performed well on the program (i.e. Good job! Awesome! Stupendous! Keep it up!). They believed that the complimentary remarks given to them by the characters were helpful in their progression through the reading activities on IStation. Likewise, they also liked receiving encouraging feedback if they did poorly on IStation, such as “You can do it!”, “Keep trying!”, and “Don't give up!”.

When asked about what the students disliked about IStation, there exists some variability among their responses depending on their reading skill level. Tier 1 students had the tendency to overachieve, believing that the IStation practice tests were not challenging their abilities. As one student commented, “It was kind of babyish because the characters talked to me like I was dumb.” They also reported that they became easily bored by the repetitive and seemingly duplicated questions in that the knowledge students already had and what they were being tested on was mismatched. Students noted that reviewing repeated content became mundane and uninteresting as time passed. On the contrary, Tier 2 and 3 students, were often overwhelmed with the amount of practice that was demanded of them on IStation. One believed that IStation characters retaught too much information and gave too many hints when the student wanted to answer the question independently. Oftentimes, as with the Tier 1 students, Tier 2 and 3 students also encountered repeated questions, and were forced to complete them over and over again. One student said, “I was always busy doing more and more lessons. It never ended!”

RQ4: WHAT WERE THE INSTRUCTORS’ PERCEPTIONS TOWARDS ISTATION AS A TOOL TO SUPPORT READING COMPREHENSION?

Pre- and Post-surveys

We compared teachers’ ratings in the pre-surveys and post-surveys with the same set of questions to determine whether there was a perception change regarding the use of IStation. Table 3 displays the means of teachers’ ratings before and after the IStation implementation.

Table 3. Teachers’ ratings in the pre-survey and post-survey

Statements	Pre-test	Post-test
1. All students will succeed in improving their reading levels after using IStation.	5	4.67
2. Students’ reading comprehension levels will increase dramatically after using IStation	4	3
3. Students will perform better on the STAR reading assessment after using IStation.	5	4
4. Students need IStation in order to improve their Lexile reading levels.	4.67	4.3
5. It will require a lot of teacher work to get the students interested in working on IStation program.	2	2
6. Students will love continuing to use IStation.	4.3	3.6
7. The administration’s mandate for students to use IStation is the main reason my students will use the program.	2	3.3

1= strongly disagree; 2 = disagree; 3 = neutral; 4 = agree; 5 =strongly agree

As the survey items indicated, most teachers believed that students would perform better on the STAR reading assessment after using IStation, that they genuinely enjoyed using IStation, and that they needed the program in order to improve their reading levels. We found that the perceptions of two of the teacher participants regarding IStation integration remained relatively the same in the

post-survey, while that of the third was slightly more negative, which caused the slight decrease in the mean of ratings on the post-test. Prior to its implementation, teachers did not believe that it would require a lot of effort to raise students' interest level with the program. Generally, the opinions of all teacher participants varied as to whether the administration's mandate for the students to use IStation was the primary driving force for its implementation. However, they were neutral on IStation's ability to increase student reading comprehension levels dramatically. In the post-study survey, one teacher became more critical of IStation's ability to improve students' reading skills. Two teachers shifted their belief, agreeing that the administration *was* the principal cause of their students using IStation.

Interviews

Instructor interviews indicated that the way they used and implemented IStation-tailored lessons varied, this could be attributed to differences in their perceptions of the program and how their students performed with it in their classes. Teacher A reported that she used the Tier levels to group her students, using some of the tailored lessons, while Teacher M asserted that the detailed IStation reports provided great guidance for the creation of her small group lessons. Teacher C included the IStation-suggested lessons in her small group reading plans, based on the program's weekly reports. While Teacher A reported that many of her students did not enjoy the IStation reading program (primarily the Tier 1 students), Teacher M and Teacher C believed that their students enjoyed working on IStation.

The teachers agreed that the STAR scores rose over time as students continued to use IStation regularly. Teacher M commented that "most of my students enjoy the layout and game-like graphics." However, teachers noted that some Tier 1 students decried the constant need to work with the IStation program as they grew bored of it, preferring other literacy activities such as workbooks or other online reading mediums. Additionally, teachers believed that students preferred to be engaged in any kind of online activity. As Teacher C stated, "I don't think they need any incentives. They are always eager to go online." In conversations with the two other teachers, they attributed the rise of STAR Test scores to other ongoing literacy activities, such as whole and small group reading.

Teachers reported several challenges in IStation implementation. First, they did not believe that they received adequate training on using IStation. When asked which features of IStation they believed were most effective in obtaining improved results, Teacher M responded, "I really don't know many features because there was very little training." They also reported that more feedback should be given in addition to the standardized lessons. While IStation did identify which small group reading plans should be re-taught, it did not provide enough in-depth, quality information for teachers to use when writing their own small group lesson plans. Teacher C commented that "there was a disconnection between what the students are learning in their online lessons and the feedback the teacher received from IStation." Teacher C also questioned the effectiveness of some adaptive features of IStation: "Some [students] complained that it talked to them like they were a baby. These were lower level students. So, I'm assuming the character changed its voice (perhaps the speed it spoke?) depending on the level of the child."

DISCUSSION

With regard to the effects of the IStation program, we believe it helped students improve their reading skills during its implementation. Similar to many other computer-based adaptive technologies, IStation reading is a research evidence-based literacy program created to augment effective reading instruction while providing educators with adaptive suggestions and resources, real-time monitoring of student performance, and a leveled system of support that can tailor the lessons to meet each student's individual needs (Baker et al., 2017; McNerney & Elledge, 2013; Shute & Rahimi, 2017). There was some growth in STAR Test scores over time during the implementation of IStation, which cor-

related with improvements seen in IStation scores. Teachers mostly believed that IStation had a positive effect on improving reading comprehension levels among their students. Students were also generally in favor of IStation integration. As a current study empirically examining IStation implementation, our study supported findings from prior literature, concluding that a strong correlation existed between IStation and STAR Reading Test scores (Marin, 2015; Patarapichayatham, 2014).

As this study did not address causal relationships or experimental design we recognize that due to extraneous factors such as individual teacher lesson plans for whole and small group reading as discussed in the qualitative data, varying proportions of Tier 1, 2, and 3 students in each of the three classes, and parental or tutoring support, IStation usage alone may not be the direct cause of the increase in STAR scores. We believe that it is more likely that STAR Test score improvements were the result of effective teacher instruction beyond the scope of what IStation envisioned. Students' engagement in daily reading activities within the classroom as well as at home could have also contributed to this STAR test score increase. This result once again echoes that various other interventions provided by teachers or other school resources might have been a greater contributor to the increase of standardized test scores (Bugbee, 2011; Marin, 2015). Additionally, our findings concur with Marin's study (2015) that teachers were unable to maximize IStation's benefits due to a lack of proper training they received. It appears that this same feeling of lack of substantial teacher training affected two of the three teacher participants in this study implementing the IStation reading intervention lessons in their own classroom. The issue of turning IStation's lengthy lessons into smaller chunks to fit into 15 minute reading blocks likely could have impeded teachers' usage of these lessons.

We offer several recommendations to future researchers and practitioners that intend to integrate adaptive learning technologies similar to IStation into their learning environments. First, our study suggested that there is no one-size-fits-all solution when implementing such technology to a diverse array of learners on different reading levels. Even with the variety of adaptive and adjustable features that IStation affords, it is still critical to design instructional activities geared towards individual learners while carefully and consistently monitoring student behavior. As IStation was primarily designed to help struggling learners, teachers need to design alternative tasks for proficient learners to maintain their interest and motivation. Secondly, it is essential to provide professional development and training opportunities to assist teachers with the familiarization of the program's use because of the evidence in a lack of training seen in this study as well as in prior literature (Marin, 2015). Therefore, teachers are more adept at making sense of the data and reports generated from IStation, and thus become more able to use the data to create personalized lesson plans and activities tailored to their specific students. Many computer-based adaptive learning technologies often yield large amounts of data that are not properly used or even understood by classroom teachers. Professional development opportunities exploring adaptive learning technologies may also take the form of an informal seminar where a group of teachers share what they do with the technology program, offering them an opportunity to collaboratively work out solutions for problems that they encounter. Thirdly, teachers may also train and elevate the higher achieving students with using IStation to monitor their own progress as well as set their own individual learning goals for a myriad of literacy tests, maximizing the program's potential. If home access to the program is possible, it would be a great asset for parents as they would have the ability to monitor students' time on the program.

CONCLUSION

The results of this study show that a strong correlational relationship exists between the usage of IStation and the rise of STAR reading scores over a period of several months. However, the intervening variables of teachers' whole and small group lessons individualized for each class as well as students' practice sessions both at home and at school could have also resulted in improved STAR reading scores. IStation is helpful to teach many areas within reading comprehension including phonological awareness, vocabulary, as well as reading fluency by reading and simultaneously highlighting

words for the struggling reader to follow along with. Great caution still needs to be exercised when implementing this type of technological program to account for variabilities in student reading level and interest, as well as activities that may be encountered outside of the classroom.

We believe that there is an ever increasing, ongoing need for quality research on IStation and other computer-based adaptive technologies used to improve students' reaching comprehension skills. Since the context of this study resided in a single case with 98 students and three teachers, we recommend studies with a larger sample size that would likely yield more definitive and generalizable results. Using a randomized control group would have improved the internal validity of this study, teasing out extraneous factors and truly measuring the effects of IStation alone on STAR or other reading literacy test scores. Since time spent on the program is a critical factor, perhaps large-sized, longitudinal studies would be beneficial in examining the long-term effects of IStation. We also recommend qualitative studies that help to uncover issues and concerns with the implementation of the program, as well as to understand the ways that teachers, students, and other possible stakeholders can work together to optimize the use of such computer-based adaptive learning technologies available today.

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APPENDIX A. TEACHER INTERVIEW PROTOCOL

Direction: Please provide detailed responses to the following questions. You may cite specific examples and comments from your students, parents, and colleagues.

1. Was IStation useful for your students? Why or why not?
2. Describe the teacher's IStation training as detailed as you can.
3. Describe the usefulness of the teacher's IStation training. Could the teacher's IStation training be improved? Why or why not?
4. Looking at the students' STAR performance scores from September to now, do you feel that their IStation growth followed the same trajectory? Why or why not?
5. How has your reading instruction changed based on the students' IStation performance and the suggested lesson plans?
6. What were the rewards or incentives given to the students to participate in IStation? Were these rewards useful? Why or why not?
7. Which aspects of IStation do you believe are most effective in obtaining improved results?
8. What were issues and challenges of using IStation?
9. Describe the students and the parents' opinion of using IStation.
10. Are there any comments that you would like to add concerning IStation?

APPENDIX B. CODING PROCESS FOR TEACHER INTERVIEWS

SAMPLE RAW DATA	CATEGORY	PRELIMINARY CODES	FINAL THEMES
<p>Question 1. Was IStation useful for your students? Why or why not?</p> <p>Teacher A: "Some made growth, however some did not. My high kids tend to do worse on IStation."</p> <p>Teacher M: "It is hard to say because of the other variables like small group reading and whole group. My students enjoyed working on IStation."</p> <p>Teacher C: "It is hard to determine because there were many factors affecting their reading level throughout the school year, IStation being one of them. I think that the Tier 3 and Tier 2 students benefitted most because they felt more engaged using the online program."</p>	Usefulness of IStation for students	<p>IStation may or may not be effective; many extraneous variables were involved.</p> <p>IStation may be more effective for Tier 2 and 3 students.</p>	<p>1. Teachers believed that IStation may or may not improve students' reading. Variability exists depending on the level of the individual student and how IStation was implemented.</p> <p>2. STAR performance scores during implementation grew, but it cannot be all attributed to IStation implementation.</p>
<p>Question 2&3. Describe the teacher's IStation training as detailed as you can. Describe the usefulness of the teacher's IStation training. Could the teacher's IStation training be improved? Why or why not?</p> <p>Teacher A: "Yes, we did not receive that much [training on IStation]."</p> <p>Teacher M: "Yes, because there was very little training."</p> <p>Teacher C: "More feedback should be given besides just the repeated small group reading plans."</p>	Teachers' IStation training and whether or not it can be improved.	More teacher training are needed.	<p>3. IStation helped teachers in different manners as the way in which IStation impacted teachers' instruction varied.</p> <p>3. Many challenges of implementation exist. All teachers believed that more teacher training and professional development opportunities about using IStation should have been given.</p>
<p>Question 4. Looking at the students' STAR performance scores from September to now, do you feel that their IStation growth followed the same trajectory? Why or why not?</p> <p>Teacher A: "It depends on the student."</p> <p>Teacher M: "More or less yes. Some of my students' performance varies day to day."</p> <p>Teacher C: "I think the more improved IStation scores, the better their STAR scores."</p>	Relationship between STAR performance scores and IStation growth and practice	<p>Generally teachers agreed that the STAR scores rose over time as students continued to use IStation regularly.</p> <p>Effectiveness depends on the individual student.</p>	
<p>Question 5. How has your reading instruction changed based on the students' IStation performance and the suggested lesson plans?</p> <p>Teacher A: "I implemented the tiers when grouping students and used a few lessons in areas of weakness."</p> <p>Teacher M: "Priority reports point out the struggling students and give detailed information about what areas they need help in."</p> <p>Teacher C: "I include the IStation suggested plans in my small group reading plans, based on weekly reports."</p>	How IStation impacted teachers' reading instruction	<p>IStation Tiers helped me create reading groups.</p> <p>IStation reports gave specific lessons for me to use to teach my students.</p>	

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<p>Question 6: What were the rewards or incentives given to the students to participate in IStation? Do you think students need more incentives to participate in IStation? Why or why not?</p> <p>Teacher A: “Yes, many don’t enjoy reading on IStation. However, they enjoy math.”</p> <p>Teacher M: “No, most of my students enjoy the layout and game like graphics [in IStation].”</p> <p>Teacher C: “I don’t think they need any incentives. They are always eager to go online.”</p>	<p>Rewards or incentives for students and whether or not incentives are necessary</p>	<p>Opinions varied. Some students need incentives to read using IStation, while others need no incentives to read using IStation.</p>	
<p>Question 7. Which aspects (features) of IStation do you believe are most effective in obtaining improved results?</p> <p>Teacher A: “Not sure. I haven’t received true training on the features.”</p> <p>Teacher M: “I really don’t know many features because there was very little training.”</p> <p>Teacher C: “I really don’t know because we were never really given access to the student view. When the students were using the program themselves, the teacher was working with other students in small group. I know that my students liked the cartoon feel of the program. It made it feel like more of a game to them.” “I like the resources and lesson plans. The reports tell me which students need help.”</p>	<p>Effective features in IStation</p>	<p>A lack of training impedes the evaluation of effectiveness of IStation.</p> <p>Some IStation features such as game-like interface, resources, and lesson plans are useful.</p>	
<p>Question 8: What were issues and challenges of using IStation?</p> <p>Teacher A: “We received very little training.”</p> <p>Teacher C: “There was a disconnection between what the students are learning in their online lessons and the feedback the teacher received from IStation.”</p>	<p>Challenges of using IStation</p>	<p>A lack of training. Difficulties in implementing feedback received from IStation</p>	
<p>Question 9: Describe the students and the parents’ opinion of using IStation.</p> <p>Teacher C: “My students opinion of IStation varied. Some loved it, others not so much. Some complained that it talked to them like they were a baby. These were lower level students. So, I’m assuming the character changed its voice (perhaps the speed it spoke?) depending on the level of the child. My students that did like it, did not have much to say, but they would complain if they missed their computer time.”</p>	<p>Opinions of using IStation</p>	<p>Student opinions varied depending on the achievement level of the student.</p>	

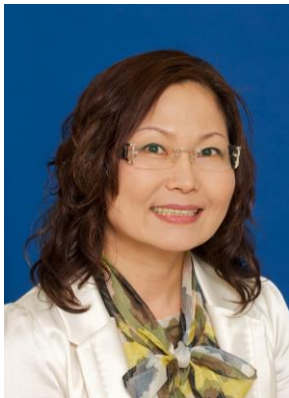
APPENDIX C. CODING PROCESS FOR STUDENT INTERVIEWS

RAW DATA	PRELIMINARY CODES	FINAL CODE	FINAL THEMES
<p>1. IStation Feedback for Student Progress.</p> <p>Tier 3: A. Good job! Keep it up! B. Great! C. Wow!</p> <p>Tier 2: A. Super! B. Awesome! C. Stupendous!</p> <p>Tier 1: A. Super job! B. Good job! C. Wow!</p>	<p>One word praises</p> <p>Positive phrases.</p>	<p>6 instances of one word positive phrases.</p> <p>4 instances of positive phrases.</p>	<p>1. Students had a lot of fun interacting with the animated IStation characters.</p> <p>2. Regarding what student dislike about Istation, variability exists among their responses depending on their reading skill level.</p>
<p>2. IStation Feedback for Student Errors.</p> <p>Tier 3: A. You can do it! B. Keep trying! C. Don't give up!</p> <p>Tier 2: A. Try harder! B. Don't give up! C. Keep trying!</p> <p>Tier 1: A. Try again! B. You can do it! C. Don't give up!</p>	<p>You can do it!</p> <p>Try phrases</p> <p>"Don't give up!"</p>	<p>"You can do it" said twice.</p> <p>Try phrases said four times. "Don't give up!" said three times.</p>	
<p>3. Reasons for liking IStation.</p> <p>Tier 3:</p> <p>A. "I liked that IStation characters made it fun to learn. I had help from a friend."</p> <p>B. "It helped me read better."</p> <p>C. "Reading was more fun with the funny things they [characters] said."</p> <p>Tier 2:</p> <p>A. "I liked the highlighting [of the words] when it read it out loud."</p> <p>B. "I got hints when I was making mistakes. Then I read better."</p> <p>C. "It was always ready to give me help when I needed it."</p> <p>Tier 1:</p> <p>A. "I liked the colors and the way the characters moved around and made me laugh."</p> <p>B. "It helped me a lot when I read with it [IStation]."</p> <p>C. "I had a buddy on the computer to make reading fun again."</p>	<p>IStation characters were fun helpful friends who helped me read.</p> <p>IStation characters help me read and they were engaging.</p>	<p>All students of Tiers 1, 2, and 3 agreed that the characters helped them read.</p>	
<p>4. Reasons for disliking IStation.</p> <p>Tier 3:</p> <p>A. "I kind of didn't like IStation because there was a lot of work that I already did and I had to do it again."</p> <p>B. "I was always busy doing more and more lessons. It never ended!"</p> <p>C. "It was a little annoying because of it always talked to me."</p> <p>Tier 2:</p> <p>A. "It made me review things I already knew."</p> <p>B. "It was treating me like I didn't know anything when I just made a simple mistake."</p> <p>C. "It gave me hints but sometimes I wanted to do it myself."</p> <p>Tier 1:</p> <p>A. "It thinks I don't know a lot, but I do."</p> <p>B. "It was kind of babyish because the characters talked to me like I was dumb."</p> <p>C. "Sometimes I got tired of doing almost the same work again."</p>	<p>IStation lessons were repeated for students.</p> <p>IStation characters' dialogue with students was basic, repetitive or unnecessary.</p>	<p>IStation lessons were repetitive when students did not feel they needed these lessons again for all three Tier 3 students and one Tier 2 and one Tier 1 student.</p> <p>Two Tier 2 and two Tier 3 students felt that the IStation characters said basic information that was either repetitive or unnecessary.</p>	

BIOGRAPHIES



Dr Tian Luo is an assistant professor in the Instructional Design & Technology program at Old Dominion University. She received her degree in Instructional Technology from Ohio University in 2014. Formerly, she had worked as an instructional design professional in both higher education and corporate settings. Her research interests center on using social media to facilitate student learning in both formal and informal contexts, and designing collaborative and authentic learning environments supported and enhanced by emerging technologies. Her work has been published in peer-reviewed journals, such as, *British Journal of Educational Technology*, and *Journal of Computing in Higher Education*.



Dr Guang-Lea Lee is a professor of literacy education and director of the Tidewater Writing Project in the Department of Teaching and Learning at Old Dominion University. She has taught 24 years in the higher education field after earning her PhD degree from the University of Minnesota in 1993. Her professional interests and expertise include literacy education, culturally responsive instruction, and educational issues of underrepresented students globally. She has authored/edited more than 80 articles and book chapters. Her co-authored textbook, “Multicultural Education of Children and Adolescents,” was published in 2017. Her articles have been published in *Childhood Education*, *Multicultural Education*, *Kappa Delta Pi Record*, *Journal of Research in Childhood Education*, and *International Journal of Early Childhood Education*. In addition, she has made over 90 national/international presentations, including AERA, ILA, ACEI, NAEYC, NAECTE, OMEP, CRA, LRA, NCTE, NWP, KICCE, World Congress on Reading, and Pan African Reading for All conferences.



Cynthia Molina is a second grade teacher at Tanners Creek Elementary School in Norfolk, Virginia. She has taught first, second, and third grade classes in Norfolk Public Schools since 2005. She has a Masters in Elementary Education from Liberty University and is currently a doctoral student at Old Dominion University studying Curriculum and Instruction.