Fall 10-2017

Technology Integration and English Language Learners

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Technology Integration and English
Language Learners

by

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October 2017

A Dissertation submitted to the Education Faculty of Lindenwood University in partial fulfillment of the requirements for the degree of

Doctor of Education

School of Education

Technology Integration and English

Language Learners

by

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This Dissertation has been approved as partial fulfillment

of the requirements for the degree of

Doctor of Education

Lindenwood University, School of Education

10-9-2017

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10.9.2017

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Declaration of Originality

I do hereby declare and attest to the fact that this is an original study based solely upon my own scholarly work at Lindenwood University and that I have not submitted it for any other college or university course or degree.

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Acknowledgements

I would like to thank my committee members, Dr. Brad Hanson, Dr. Sherry DeVore, and Dr. Trey Moeller, for their help with the completion of this study. I would also like to thank the participating school district; the ESL Coordinator, Mrs. Daphne Hensley; and the participating staff members for providing the data utilized in this project. This study could not have been completed without everyone's cooperation. I would also like to thank my family, Kyra, Jamie, and Adalynn, for their long-lasting support. Years of early mornings, late nights, and sacrificed weekends went into completing this study, and their belief in me was vital to seeing this project through to the end.

Abstract

The purpose of this study was to examine teachers' levels of mobile device implementation and any measured differences in English Language Learners' (ELLs') performance in each modality of the ACCESS test. Researchers often support the use of mobile devices in the classroom, but this study was unique because of a combination of how it was focused solely on language development in ELLs, how classrooms were placed on the SAMR spectrum, and how student performance was analyzed in each modality measured by the ACCESS test (Budiman, 2014; Donahue, 2014; Marek, 2014; Mulcahy, 2017). Included in this study were 37 classrooms and corresponding teachers of grades kindergarten through four. For the 2016-2017 school year, participants taught in a district with both a one-to-one mobile device ratio and a high ELL population. Based on survey results, teachers' reported instructional methods led to understanding of what levels of the SAMR spectrum students in each classroom were experiencing. The SAMR instructional levels were then compared to student ACCESS scores in each modality using an ANOVA as well as an additional TUKEY test when needed. The study yielded just one statistically significant ANOVA result. In third grade listening, SAMR level one classrooms were statistically different from SAMR level three classrooms but not level four classrooms (SAMR level zero and level two classrooms were not present in the particular data set). No other data set yielded statistically significant results between a SAMR instructional level and ACCESS scores in reading, speaking, listening, or writing modalities as well as students' overall performance.

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Chapter One: Introduction

In recent decades, technology has become such an integral part of education and society that late generations of students born into this tech-rich world are often termed "digital natives" by older generations (Martin & Roberts, 2015). The term suggests these students are somehow gifted with a natural ability to utilize technology appropriately without guidance (Martin & Roberts, 2015). However, being a digital native does not equate to being digitally literate (Martin & Roberts, 2015).

In the January 2015 issue of *Principal,* Martin and Roberts illustrated the difference between a digital native and digital literacy. Martin and Roberts (2015) discussed a particular student trying to find the sum of one-eighth and one-fourth; the student's device quickly offered .375 or 37.5%, and the child then wrote down the correct answer. The authors stressed the importance of today's students being capable of using devices, but also being able to judge the validity of the provided solutions, understanding the processes to find the solutions, and ultimately repeating similar examples without the assistance of devices (Martin & Roberts, 2015).

With the abundance of technology and mobile devices in modern life outside of school, the level to which children are accustomed to using devices, and the positive perception of students toward incorporating devices, school districts should be utilizing mobile devices in their classrooms (Barbour, Grzebyk, & Eye, 2014). Mobile devices bring the opportunity to heighten students' motivation and independence levels, allowing students to take more control of their own development (Roessingh, 2014). In an economy that demands high levels of literacy, classrooms incorporating meaningful work, authentic learning, and carefully designed tasks made possible through the use of devices can lead to accelerated language learning in an increasingly diverse population of learners (Roessingh, 2014).

Chapter One includes a discussion of the presence of standardized testing in schools and a description of the latest technology many teachers and administrators are utilizing to prepare students for assessments. Testing and technology conversation leads to a discussion of the effects standardized testing and technology have on minorities and English language learners (ELLs). Next, the purpose for this study and the guiding research questions are outlined. Limitations and assumptions of this study as well as key terms are also defined for the reader.

Conceptual Framework

As recommended by Romrell, Kidder, and Wood (2014), the substitution, augmentation, modification, redefinition (SAMR) model was used for this study, as it is the ideal framework for evaluating mobile learning programs. Mobile devices are often used simply as replacement tools to complete tasks already possible with the previous materials available to students (Romrell et al., 2014). The SAMR model places device implementation on a spectrum, helping to sort substitution processes from truly transformational implementation strategies (Romrell et al., 2014). Romrell et al. (2014) stated implementation strategies which involve mobile devices to personalize learning and connect students to resources will become transformational learning activities.

The SAMR model organizes the integration process and provides a structure to teachers and administrators seeking the most effective learning environments involving mobile devices in the classroom (Romrell et al., 2014). The SAMR model was developed to encourage teachers to move along a spectrum of improved instructional quality and efficacy when providing instruction via mobile devices (Romrell et al., 2014). Of the 10 SAMR-based studies cited by Romrell et al. (2014), all indicated mobile learning to be at least as effective as other methods of learning (Romrell et al., 2014). The most significant impacts of devices on language learning were found when teachers were implementing strategies at the higher levels of SAMR, modification and redefinition (Romrell et al., 2014).

In an effort to measure any significant differences between each level of SAMR implementation and each modality of English language learning, survey questions for this research project were designed to sort instructional strategies into SAMR levels. Survey questions elicited information about a wide range of instructional topics and situations common to classroom teachers and provided choices corresponding specifically with each SAMR level. It was imperative for teachers of all grade levels to connect each survey question to memories or moments in their classrooms. This allowed teachers to select the choices most similar to the strategies they implemented with students.

Background of the Study

A long history of standardized testing in the United States can be traced through many changes in the timeline of the U.S. educational system (Au, 2014). Before the widely controversial Common Core State Standards (CCSS), the No Child Left Behind Act (NCLB), signed by President Bush in 2001, emphasized growth from all students and was the first program which relied on high-stakes testing as the central mechanism for school reform (Au, 2014). However, prior to NCLB standards were set by organizations such as the National Council of Teachers of Mathematics and ideologies were presented in educational texts such as *A Nation at Risk* from 1983 (Au, 2014). In fact, the origins of standardized testing began with an intelligence test developed by Alfred Binet in 1904, which was originally intended for young children but was later altered by U.S. psychologists such as Goddard, Terman, and Yerkes (Au, 2014).

As is the case for many other assessments, standardized assessments typically rely on students' ability to work through the material independently; therefore, a student's knowledge of language is the very means through which academic knowledge is displayed (Solano-Flores, 2014). Students still developing knowledge of the English language are unable to read and comprehend the English text in order to make connections with their own knowledge and demonstrate their ability (Solano-Flores, 2014). Since accurately translating testing materials into all dialects of all languages to pair with the need of any given student is not a realistic alternative, one can understand why this topic is of much concern parents and educators of ELLs (Solano-Flores, 2014). How can a district ensure its ELL population is represented accurately and therefore reap the necessary data for the decision-making process from standardized test data?

The need to find an accurate and fair data collection system led to the creation of the ACCESS for ELLs assessment and the WIDA consortium (Karlsson, 2015). The WIDA ACCESS for ELLs assessment is a standardized language proficiency test specifically designed to help school leaders determine an ELL's English proficiency (Karlsson, 2015). The test measures social as well as academic language proficiency and offers data to consider when determining whether a student's knowledge of the language has become comparable to that of their English-speaking peers (Karlsson, 2015).

As learning targets and state assessments have been changing, technological advancements have been evolving as well (Thornburg, 2014). Pioneering educational technology programs, such as the Minnesota Educational Computer Consortium in Minneapolis in 1973, were often expensive, purpose-built, specific learning opportunities, but now seem centuries behind in relation to the flexibility of modern one-to-one classrooms where each student has an affordable, extremely capable and flexible device at his or her disposal (Thornburg, 2014). Technological tools available for teachers today include everything from Google Glass to laptops, tablets, and even cellular phones students themselves bring to the classroom (Thornburg, 2014). With the vast number of mobile devices available today, choosing which devices to invest resources in can be difficult for school leaders (Thornburg, 2014).

The recent rise in population of ELLs in schools means teachers must adapt pedagogy and methods to reach a new, diverse group of learners (Seifert, Kulmhofer, Paleczek, Schwab, & Gasteiger-Klicpera, 2017). The use of educational technology develops common, positive themes including improved ownership, teacher praise from administration, enhanced motivation, and teacher skill growth (Grant et al., 2015). Allowing the use of mobile devices in the classroom makes students more eager to learn than in traditional learning circumstances, and students often have a greater opportunity to demonstrate independence through learning options and end-product choice (Murray, 2014).

Statement of the Problem

Technology and its use in the classroom has been an ever-evolving curriculum enhancement tool for decades (Noonoo, 2012). The latest tools in the tech evolution, mobile devices, have created opportunities for teachers to motivate and connect with students in even more effective ways, and researchers have suggested device utilization will revolutionize education yet again (Budiman, 2014; Donahue, 2014; Marek, 2014; Mulcahy, 2017). In 2012, 74% of young adults and 58% of teens owned smartphones, and over 35 billion apps were downloaded from Apple's App Store alone (Concordia Online - Educational Technology, 2015a).

However, adapting classroom teaching methods and modifying curriculum can be stressful and time consuming (Bréhaut, 2015; Dawson, 2012). These changes do not happen immediately and can be expensive and anxiety-inducing (Bréhaut, 2015; Dawson, 2012). With technology advancing so quickly, are school districts making the switch to mobile device-driven classrooms really going to reap the benefits before another advancement in technology proves the current devices outdated? Will a substantially more powerful device change the way technology is implemented in education in the near future? Or will an entirely new strategy or viewpoint on technology integration prove the current mobile device methods ineffective?

Studies on mobile device implementation and its impact on standardized test scores vary widely and are often site-specific (Sung, Chang, & Liu, 2016; Tervalon, 2015). Some researchers have noted devices' game-changing impact with the ability to support a new level of innovative design and differentiated instruction (Grant et al., 2015; Reeves, Gunter, & Lacey, 2017). Other researchers have spoken of districts blindly adding expensive mobile devices because they were the new "must-have" in education (Buchholz, 2015; Tervalon, 2015).

Essential vocabulary and language development happens naturally in children of native-speaking families as they interact with their families (Roessingh, 2014). Two categories of elementary students are likely to have a much more limited vocabulary to lean on as they take the transition from learning-to-read to reading-to-learn in the elementary grade levels – ELLs and poverty-stricken children (Roessingh, 2014). School districts often fail to address these needs with the necessary explicit and intentional vocabulary instruction to advance language development to a level closer to native-speaking peers (Roessingh, 2014). At a time when teachers must make the most of every minute with their disadvantaged students, mobile devices can improve motivation, support collaboration, and help students take control of their own learning (Roessingh, 2014).

The oft-mixed reviews of mobile device implementation were established in the article "Does Math Achievement h'APP'en when iPads and Game-Based Learning are Incorporated into Fifth-Grade Mathematics Instruction?" which largely influenced this research project (Carr, 2012). The results of Carr's (2012) study were not statistically significant enough to prove iPads effective; however, the performance of students in technology-driven classrooms was improving at least as well as those in non-tech classrooms, which led to recommendations for teachers and administrators not to stray from device acquisition and usage. Among Carr's (2012) recommendations for future study were to try "similar analysis among specific populations of students throughout other elementary grade levels," as well as to "include qualitative variables in the research design" (p. 280).

This study was built upon Carr's (2012) suggestions of incorporating qualitative variables by considering the quality of technology implementation based on the SAMR model. It is not the device itself that improves learning, but rather how activities made possible by the devices are effectively embedded into motivating and relevant curriculum (Roessingh, 2014). This study was focused specifically on vocabulary and language development and how multiple exposures, practice, and robust methods of learning new vocabulary through mobile devices can support growth in four modalities (Roessingh, 2014).

Purpose of the Study

The purpose of this study was to examine teachers' levels of mobile device implementation and any measured differences in ELLs' performance. Inquiry within each ELL modality was guided by five research questions. These questions and their associated hypotheses helped organize data gathered concerning the implementation of mobile devices and each specific modality of student performance as measured by the ACCESS for ELLs test. By comparing all aspects of ELL performance from several one-to-one mobile device classrooms in all stages of the SAMR model, educators and school administrators can consider the results of this study when determining whether or not a technology-driven classroom environment would yield effective results for ELLs.

Research questions and hypotheses. The following research questions directed the study:

1. What is the difference, if any, in English language learners' reading performance when classroom teachers implement different technology integration strategies in kindergarten through fourth-grade classrooms?

$H1_0$: There is no significant difference in English language learners' reading performance when classroom teachers implement different technology integration strategies in kindergarten through fourth-grade classrooms.

$H1_a$: There is a significant difference in English language learners' reading performance when classroom teachers implement different technology integration strategies in kindergarten through fourth-grade classrooms.

2. What is the difference, if any, in English language learners' writing performance when classroom teachers implement different technology integration strategies in kindergarten through fourth-grade classrooms?

$H2_0$: There is no significant difference in English language learners' writing performance when classroom teachers implement different technology integration strategies in kindergarten through fourth-grade classrooms.

$H2_a$: There is a significant difference in English language learners' writing performance when classroom teachers implement different technology integration strategies in kindergarten through fourth-grade classrooms.

3. What is the difference, if any, in English language learners' speaking performance when classroom teachers implement different technology integration strategies in kindergarten through fourth-grade classrooms?

$H3_0$: There is no significant difference in English language learners' speaking performance when classroom teachers implement different technology integration strategies in kindergarten through fourth-grade classrooms.

$H3_a$: There is a significant difference in English language learners' speaking performance when classroom teachers implement different technology integration strategies in kindergarten through fourth-grade classrooms.

4. What is the difference, if any, in English language learners' listening performance when classroom teachers implement different technology integration strategies in kindergarten through fourth-grade classrooms?

$H4_0$: There is no significant difference in English language learners' listening performance when classroom teachers implement different technology integration strategies in kindergarten through fourth-grade classrooms.

$H4_a$: There is a significant difference in English language learners' listening performance when classroom teachers implement different technology integration strategies in kindergarten through fourth-grade classrooms.

5. What is the difference, if any, in English language learners' overall performance when classroom teachers implement different technology integration strategies in kindergarten through fourth-grade classrooms?

$H5_0$: There is no significant difference in English language learners' overall performance when classroom teachers implement different technology integration strategies in kindergarten through fourth-grade classrooms.

$H5_a$: There is a significant difference in English language learners' overall performance when classroom teachers implement different technology integration strategies in kindergarten through fourth-grade classrooms.

Significance of the Study

For educators working with ELLs or other limited English proficiency (LEP) students, research suggests mobile devices represent a growing sector of digital language learning, encouraging student collaboration and cooperation while also being extrinsically motivating to students working on their language skills (Alvarado, Coelho, & Dougherty, 2016). Incorporating devices into assignments that could have otherwise become “dull and lifeless” helps keep students interested and working on content rather than attempting to avoid the work (Ness, 2017, p. 2). Dynamic, language-based activities through devices such as iPads encourage students to take responsibility for their own learning in a way not seen before (Alvarado et al., 2016).

An emphasis of this study was the inclusion of a measure of device incorporation, rather than simply analyzing standardized test scores from classrooms with devices available. By placing teachers’ instructional methods on the SAMR spectrum, this research elicited information regarding whether striving for a higher level of incorporation results in more effective vocabulary development among the ELL population. Administrators working with a similar population can consider the results of this study when setting goals for device implementation levels. The findings of this study will support classroom teachers in the search for further evidence to support best pedagogical practice within specific circumstances.

Definition of Terms

For the purpose of this study, the following terms have been defined:

Blended learning. Blended learning is a method of teaching involving classroom seat time as well as online learning (Margolis, Porter, & Pitterle, 2017).

Bring your own device (BYOD). Bring your own device (BYOD) provides an alternative to a one-to-one program where students are allowed or asked to bring their own devices for use in the classroom (Kiger & Herro, 2015). The BYOD program is sometimes used when a district is not capable of providing student devices (Kiger & Herro, 2015).

Digital native. A digital native is an individual born into the post-technology-abundant world in which technology has always been a regular part of life (Neumann, 2016).

eMINTS. eMINTS is an acronym for enhancing Missouri's Instructional Networked Teaching Strategies (Meyers, Molefe, Brandt, Zhu, & Dhillon, 2016).

English as a second language (ESL). English as a second language (ESL) includes appropriate instructional programs tailored to assist ELLs in their learning (Rubinstein-Avila & Lee, 2014).

English language learner (ELL). An English language learner (ELL) is a language-minority student in the process of learning the English language (Rubinstein-Avila & Lee, 2014).

Flipped classroom. A flipped classroom consists of more in-depth activities as students are held responsible for learning the basic knowledge of a lesson prior to coming to class (Gwo-Jen & Chiu-Lin, 2017).

Mobile device. A mobile device is a small personal computing device, such as a tablet or smart phone, designed to be very portable yet powerful (Sevillano-García & Vázquez-Cano, 2015).

One-to-one (1:1). One-to-one (1:1) is a program in a school or district where each student has been provided a mobile device to use in learning (Superville, 2016).

SAMR model. The SAMR model is an acronym for Substitution, Augmentation, Modification, and Redefinition that can be used to classify technology integration methodology (Romrell et al., 2014).

Limitations and Assumptions

The following limitations were identified in this study:

In addition to requiring participating school districts to have a one-to-one mobile device-to-pupil ratio in grades kindergarten through four, as well as a high ELL population, participating districts also needed the ability to organize and anonymously share large amounts of ACCESS data by teacher for the 2016-2017 school year. Only one local district met the requirements of this study. This resulted in a population of approximately 275 students represented by 40 general education teachers who received the survey.

The following assumptions were identified in this study:

The district provided no training on the SAMR model. Teachers completed the survey without extensive knowledge of the SAMR model. Also, all students within each classroom received similar instruction; therefore, when teachers selected instructional strategies utilized in their classrooms, methodologies selected were those experienced by ELLs. Teachers completed the survey based on methodologies used to instruct their entire classrooms, but only ELLs' ACCESS scores were compiled and paired with each type of instruction.

Summary

Considering one specific district with one-to-one device availability and a significant ELL population, this researcher analyzed patterns that might exist between technology implementation and ELL performance. If data collected in this study indicate a strong connection between certain instructional strategies involving devices in the classroom and student performance on the ACCESS test, other districts will have further evidence to suggest mobile devices can be an effective approach in the elementary setting for the ELL subgroup. If the data lack a strong link to ELL performance, districts not yet applying resources for mobile devices for their ELL populations might decide to pursue other strategies in the attempt to improve efficacy of ESL programs.

This chapter included a brief explanation of standardized testing and technology in schools and introduced the challenges faced when testing ELLs. It outlined the purpose of this study and the research questions that guided the process. Limitations, assumptions, and key terms were also identified.

A review of literature including the history of standardized testing in the U.S., technology's influence in America's schools, innovative instructional strategies, and meeting the needs of an increasing ELL population is provided in Chapter Two. Chapter Three includes an outline of the methodology used in this study, followed by data and the results of the study in Chapter Four. Chapter Five is comprised of conclusions drawn after careful analysis of the data and includes recommendations for future studies.

Chapter Two: Review of Literature

In order to discuss the implementation of mobile devices and subsequent differences in student performance, this chapter first includes an examination of the history of technology in schools and its implementation in the U.S. Not only has the technology evolved, but also the methodology and strategies of teaching with technology (Noonoo, 2012). Next, the chapter includes information about why technology is even present in education. Why are devices implemented in modern classrooms, and what is technology's history of implementation? The chapter ends with a discussion of how high-stakes standardized tests became such an integral part of the educational system and whether formal testing has always been used as a major indicator of success in the United States.

Conceptual Framework

Observations of kindergarteners reveal children are naturally self-motivated to learn (Reigeluth, 2016). The loss of self-direction and introduction of irrelevant work gradually reduces student motivation over time (Reigeluth, 2016). Teachers want students to be successful, but students must be engaged and motivated to learn (Reigeluth, 2016). The teacher can work tirelessly, but if a student is not interested, learning simply will not take place (Reigeluth, 2016). Students can only realize their own potential through self-motivation and self-direction applied to relevant and interesting activities (Reigeluth, 2016).

A revolution in instructional theory is needed to transform America's educational system to one designed to maximize learning; this may be possible through the use of instructional technology (Reigeluth, 2016). Teachers must find more meaningful uses for technology ("Districts of Distinction," 2016). Deploying devices such as iPads is a step in the process, but true teacher training is vital to using devices effectively (Aiyegbayo, 2015).

Technology allows students to explore curriculum in ways not possible before its incorporation, but incorporating new technology into instruction can be overwhelming, especially for new teachers (Hartmann & Weismer, 2016). The authors of "Districts of Distinction" (2016) asserted, "The SAMR model is a method for moving through technology implementation gradually to find more practical and meaningful applications" (p. 30). The SAMR model helps teachers make thoughtful choices as to how technology should be integrated in their lessons (Hartmann & Weismer, 2016).

Substitution and augmentation are often referred to as levels of the SAMR model where teachers enhance instruction through technology (Aiyegbayo, 2015). Within these categories, technology is used but the actual assignments are still relatively similar to what students experienced prior to device implementation (Hartmann & Weismer, 2016). For example, rather than utilizing dictionaries or thesauruses, students might refer to digital versions more conveniently accessible (Hartmann & Weismer, 2016). The digital versions might also include features not available in paper resources, making the classroom activities slightly more engaging for students (Hartmann & Weismer, 2016).

Meanwhile, modification and redefinition are said to transform instruction (Aiyegbayo, 2015). In these stages of the SAMR model, students move beyond simply remembering information, and technology is used to demonstrate and communicate learned skills in ways not possible before device implementation (Hartmann & Weismer, 2016). The modification and redefinition stages allow students to become true critical thinkers and communicators (Hartmann & Weismer, 2016).

Education in the United States

Many would agree the public educational system within the United States is based upon the goals of creating opportunity and providing knowledge and skills needed for success to all students (Kornhaber, Griffith, & Tyler, 2014). However, the distribution of financial resources to help accomplish this success in all public schools is a topic of much deliberation not only in the U.S. but for many countries in the modern world (Gannicott, 2016; Kornhaber et al., 2014; Ostrander, 2015; Ould, 2017). There are three central conceptions, or ideologies, of fairly distributing resources in the U.S. today (Kornhaber et al., 2014).

The first and most basic concept of providing an equal educational experience to all students, equal conception, is simply the belief all learners in all settings should be provided with equal educational resources (Kornhaber et al., 2014). Commonly termed democratic equality, equal conception appeals to Americans based on the constitutional right to equal opportunity (Kornhaber et al., 2014). Any differences in student achievement are said to be reflective of either unequal ability or differences in drive or effort (Kornhaber et al., 2014). Equal conception states achievement could even be affected by variables beyond the scope of education such as parental involvement, socioeconomic status, and location (Kornhaber et al., 2014).

Unfortunately for those faithful to equal conception, in 1954 the U.S. Supreme Court, in *Brown v. Board of Education,* ruled segregation, even with equal tangibles, is still a form of deprivation (Frankum, 2017). Simply providing equal assets to all educational institutions did not satisfy the needs of diverse learners (Frankum, 2017). Furthermore, the Education for All Handicapped Children Act of 1975, later revamped as the Individuals with Disabilities Education Act (IDEA) in 1990, required individual students with special needs to be educated in the least restrictive environment (Ganley, 2016). The recent Common Core movement, which will be discussed in detail later, seems to be centered around an equal conception system of providing all students with equal educational opportunities and rigor (Kornhaber et al., 2014).

The next concept of providing resources for education in the United States is the more complex idea of equalizing conception. Believers in equalizing conception know resources must be adjusted based on conscientious efforts to create more equal educational outcomes (Kornhaber et al., 2014). Under this system, students with more disparate backgrounds should have a chance at success similar to those of more fortunate students, thus closing achievement gaps based on a number of variables (Kornhaber et al., 2014). Considering the common analogy of leveling the playing field, equalizing conception would entail "modifying or distributing equipment, rules, and coaches to offset biased teams, caused from uneven physical attributes, experiences, and prior training, so that everyone has an equal likelihood to win" (Kornhaber et al., 2014, p. 7). As stated before, the IDEA would be incorporative of equalizing conception, because it requires accommodations be made for students with special needs to participate meaningfully in the regular education classroom (Kornhaber et al., 2014).

While this system of equalizing resources is obviously a more effective way of supporting students in need, it means the process of distributing educational resources suddenly becomes much more complicated, many obstacles begin to surface, and formulas for fairly and appropriately distributing funds are debated (Kornhaber et al., 2014). The expensive cost to educate certain individuals could conflict with the principle of equality under law (Kornhaber et al., 2014). Since implementing a more equalizing philosophy in education, schools can now see dramatic shifts in funding based on aspects of student populations, and political and legal battles have been ongoing for decades (Kornhaber et al., 2014).

Finally, the most complex perception and what is the most effective approach to public education in the United States is known as the expansive conception (Kornhaber et al., 2014). While based around the same principals as the equalizing conception, the expansive conception incorporates factors from influences outside the boundaries of school districts (Kornhaber et al., 2014). The most needy children do not simply need help with their assignments throughout the school day, but they also need provisions for other aspects of their lives (Kornhaber et al., 2014). Health and social services can reach students at home and assist beyond the classroom (Kornhaber et al., 2014).

Head Start can be used as an ideal example of the implementation of expansive concept (Kornhaber et al., 2014). The Head Start program addresses the needs of young students before they reach school age and includes aspects of education in addition to health, nutrition, emotional needs, and social needs, all to ensure disadvantaged preschoolers will be better positioned to start kindergarten (Kornhaber et al., 2014). Figure 1 compares the three educational conceptions using a visual model (Kornhaber et al., 2014, p. 10).

Conception of Equity → Features ↓	EQUAL	EQUALIZING	EXPANSIVE
Resources	More equal educational resources	Compensatory educational resources	Compensatory resources in and beyond the educational system
Results	Variable, predictable gaps linked to student background	More equal chances of school success, narrowed gaps	More equal chances of school success, narrowed gaps
Sphere of Action	Public education	Public education	Public education, social and health services, prenatal – grade 12
Philosophical/ Legal Basis	Democratic equality/ Constitutional equal protections	Humane justice/ Civil rights laws	Humane justice + ROI/ Still in formation
Funding	Horizontal equity	Vertical equity	Human capital investment equity

Figure 1. Conceptions of equity, comparing the three educational philosophies. Adapted from "It's Not Education by Zip Code Anymore – But What Is It? Conceptions of Equity Under the Common Core," by M. Kornhaber, K. Griffith, and A. Tyler, 2014, *Education Policy Analysis Archives, 22*, p. 4.

Perhaps if the environment in which education takes place would remain constant, the system and its design would eventually adapt to prepare all students equally as well regardless of background; however, society and education change quickly (Noonoo, 2012). America's traditional model of educating the next generation is so deeply rooted in society that it is often unable to keep up with rapid changes such as curricular adjustments, charter schools, an increasingly diverse student population, shrinking budgets, and readily accessible technology (Noonoo, 2012). Noonoo (2012) considered the recent advances in technology the third revolution in education and just as impactful on education as the previous two revolutions, the development of the alphabet and the invention of the printing press. The first and second revolutions fundamentally changed the process for educating future generations, and if the technological revolution is considered an equally-influential third, the known educational process and the way it is viewed by society must once again be reimagined (Noonoo, 2012). Noonoo (2012) suggested educators must consider whether modern technology in the hands of students is being used for a truly creative construction, or are teachers and devices simply helping students to succeed in a system of pre-existing standardized tests? Also, educators must consider whether teachers are using devices to execute old practices in different ways, or are they making sure students are actually doing something that was not possible beforehand? (Noonoo, 2012).

With the ever-evolving equalizing-to-expansive design meant to more effectively impact student lives and with the changing expectations continuously placed upon the educational system by society, one discussion not up for debate is that the complicated mechanism at the core of curriculum, instruction, is yet to be perfected (Burnette, 2017; OECD, 2016; Ujifusa, 2015). Political shifts have the power of changing futures by defining "fair and equitable" redistribution of resources based on a formula, determining what the goals of primary and secondary education shall be, and defining what it means to be ready for success beyond the classroom (Burnette, 2017; OECD, 2016; Ujifusa, 2015).

The equalizing and expansive conceptions within U.S. educational models have led to the need to appropriately distribute funds and resources in differing amounts based on need (Kornhaber et al., 2014). Whether ideal or not, education's current strategy for measuring needs and achievement has evolved into the widespread use of common standardized tests (Noonoo, 2012). This means modern education, to at least some extent, consists of mandatory high-stakes testing for all students (Noonoo, 2012).

Standardized Testing

The modern concept of high-stakes standardized testing can be traced back to its roots in the early 1900s (Au, 2014). The original intelligence test, designed by French psychologist Alfred Binet, was intended to assess young children as a means of identifying slow learners so remedial work could be offered (Au, 2014). The test was later redesigned to fit the political and demographic characteristics of the United States by cognitive psychologists Goddard, Terman, and Yerkes (Au, 2014). This redesigned test set the foundation for sorting and ranking people's intelligence through a standardized test (Au, 2014). By the early 1930s, larger school systems in the U.S. had begun using intelligence tests to place students in different ability groups, and colleges were using them to justify admissions (Au, 2014).

Modern-day high-stakes testing developed from those first implementations of standardized testing through an evolution of strategic and political factors over the next 80 years (Au, 2014). When *A Nation at Risk* was published by President Reagan's office, it lit a spark under American public educators by conveying the perception U.S. schools were failing compared to those in other nations; over 50 state commissions on education published improvement plans within a year (Au, 2014). Within three years, 26 states raised graduation requirements and 35 states implemented comprehensive exams (Au, 2014). A decade later, 43 states had implemented high-stakes, statewide, standardized assessments for elementary grades (Au, 2014). The emphasis on performance was also an eventual driving factor for the Bush Administration to tie finances to students' test scores via Title I funding (Au, 2014).

In 2002, with the support of both political parties, the Bush administration created NCLB, which relied heavily upon high-stakes standardized tests as the central mechanism for school reform (Au, 2014). The NCLB Act required all students to be tested in third through eighth grades and once again in high school, and schools were required to show growth in all subgroups or face consequences including loss of funding (Au, 2014). This meant all students, regardless of ethnic background or socioeconomic status, were expected to perform well on these tests (Au, 2014). But even under intense pressure from requirements built into laws such as NCLB, after nearly 100 years of standardized testing in the United States, results still show virtually the same achievement gaps along lines of race and socioeconomic status (Au, 2014). Test writers' influence in the design of test questions can give an advantage to certain students with specific, similar life experiences, but some believe general genetic differences that exist racially are undeniable (Au, 2014).

Aside from performance gaps that occur naturally due to genetics or differences in background knowledge, standardized assessment results can be discounted further by examining other variables that come into play (Au, 2014). Studies have shown a 50-80% range in a student's standardized test score can be created by random factors (Au, 2014). A large impact on scores can be related to anything from what the student had for breakfast that morning, to distractions at school such as a dog barking outside, or even stressors such as a previous fight at home or with friends (Au, 2014).

With intense pressure put on schools, teachers, and students to perform on standardized tests and the significance of test results, most teachers assume tests are being graded with the closest scrutiny; however, graders are literally looking at hundreds of tests each day (Au, 2014). Usually paid in piece-rate rather than hourly or salary, graders typically score between 30-70 responses per hour (Au, 2014). With the incentive to move through assessments quickly and the monotony of repeating similar reviews many times each day, it is realistic to consider the possibility graders sometimes skew the results in the direction their employing companies desire (Au, 2014).

Considering the circumstances around standardized testing previously described, educators and citizens alike should be asking why (Au, 2014; Lewis & Hardy, 2015). From 100 years of what started as consistent tests designed for specific situations being altered into standardized testing for all, eventually with a high-stakes aspect intertwined, today's students are providing data that are basically unchanged (Au, 2014). In fact, 100 years of consistent results undoubtedly defines racial and socioeconomic inequalities existing within the system (Au, 2014). Why continue down the same path? True change will come "when we honestly confront the present day reality of persistent test-defined race and class-based inequality. An inequality that nearly mirrors the general outcomes of the last 100-plus years of high-stakes, standardized testing in the U.S." (Au, 2014, p. 17).

With increasing pressure to perform on high-stakes tests with each educational movement and political change, many educators and parents recently started asking if too much focus was being directed at testing rather than teaching (Byrd, 2013; Lewis & Hardy, 2015). The Student Success Act of 2012 sought to reform the mandates of

NCLB, which had, especially as goals increased, became more impractical each year closer to the desired 100% proficiency in 2014 (Byrd, 2013). The Student Success Act removed the highly qualified teacher mandate and offered more flexibility for states to design their own school improvement processes and strategies (Byrd, 2013).

Much of society was in favor of these programs, which reduced the burden of high-stakes testing; after all, students and teachers are under a lot of pressure for little predictive validity linked to students' future success (Byrd, 2013). The increase in standardized testing in recent decades has led to a large amount of class time spent testing, not to mention the high cost of testing every student (Byrd, 2013; Lewis & Hardy, 2015). As an alternative to testing all students, the results of using a stratified random sampling method to test 20% of students closely approximates the test performance of the entire population; in fact, testing 25% of a population even resembles the results of entire populations in subgroup performance (Byrd, 2013). Reducing the number of students who take the test would also reduce worrying about the test by teachers, which in turn creates a more innovative and responsive environment to better prepare students for the rigors of life, work, and success (Byrd, 2013).

Other researchers have also found negative effects on schools, teachers, and students as a result of high-stakes tests (Dawson, 2012). In a study analyzing teachers' motivation and beliefs in high-stakes testing, many teachers reported high-stakes tests cause a disruption in their work (Dawson, 2012). Fifty-three percent chose "strongly agree" when prompted with "I feel pressure to make certain students are passing," and 34% selected "agree" (Dawson, 2012). Ultimately, stress on teachers causes them to focus intently on only tested materials, even abandoning their personal and professional philosophies gathered from experience and education (Dawson, 2012). Teachers feel the pressure to maintain their districts' public image as well as their own, and they are relieved after the testing window has passed (Dawson, 2012). A recent attempt to improve how standardized tests are used efficiently to measure achievement has been the widespread, cumulative effort of many educators under the title of the Common Core State Standards (CCSS) (Bidwell, 2014).

The Common Core State Standards

Recently, an educational reform to sweep the United States' educational system was a set of guidelines known as the CCSS (Bidwell, 2014; Ostrander, 2015). The CCSS were different because they were the first large-scale, national program aimed at raising achievement across the country and adopted by a large group of states, rather than states creating their own curriculum (Bidwell, 2014). Even though the CCSS are not a specific curriculum, there has still been plenty of controversy over the program (Ostrander, 2015).

The CCSS can be traced back to the work of former Arizona governor Janet Napolitano (Bidwell, 2014). As chair of the National Governors Association, Napolitano released an education initiative just as every other chair before her had done (Bidwell, 2014). Her plan emphasized a strong focus on improving math and reading instruction in order to create an internationally competitive system in the U.S. (Bidwell, 2014). Napolitano put together a task force of commissioners of education, governors, corporate executives, and experts in education, which released a December 2008 document ultimately serving as the building blocks of the CCSS (Bidwell, 2014). When the CCSS were officially released in June of 2010, they were a set of fewer standards with more involved design to help students be prepared for entry-level college work (Kornhaber et al., 2014).

Why have the CCSS sparked such a significant controversy when they seem to be just another plan to prepare students for college? To understand where issues have arisen, one must look at what makes the CCSS different than educational reforms of the past (Ostrander, 2015). The CCSS are focused on two aspects of learning each skillset: first learning the content itself and then acquiring the "know how" to apply and to converse about each skill with a deeper level of understanding, which leads to successful use and application of each skill (Schoenfeld, 2014). Another difference is the CCSS are not set curriculum, but rather they are an outline of what students should learn at each grade level; no specific curriculum or teaching methods are prescribed (Schoenfeld, 2014). The last and most controversial characteristic that sets the CCSS apart from previous reforms is the fact the majority of states have adopted the standards, which has created the public perception the standards were a creation of the federal government, which is entirely inaccurate (Bidwell, 2014).

Since the first implementation of standardized testing, achievement gaps have presented themselves across variables such as demographics and other influences both within and outside the realm of education (Kornhaber et al., 2014). The CCSS were created as the result of schools not being able to keep up with the performance requirements of the previous attempt at creating equal opportunity for all students (Kornhaber et al., 2014). The outcome of students being college and career-ready is the ultimate goal of the CCSS (Kornhaber et al., 2014). Unfortunately, the CCSS seem to be largely centered around the equalizing conception, which has been proven less effective than the comprehensive expansive conception; therefore, policies with a more expansive philosophy on school and life success together would theoretically be more effective (Kornhaber et al., 2014).

In addition to the equalizing theory behind the CCSS, opposition to the standards have justification for further complaints (Bidwell, 2014). A major fault is the lack of research and field-testing behind the CCSS that should have taken place very strategically (Bidwell, 2014). The CCSS were never benchmarked against the international standards of higher-performing countries (Bidwell, 2014). Teachers themselves are often critics of the movement because of a lack of adequate preparation, training, and resources (Schoenfeld, 2014). Because of the CCSS's expectation of students being able to take acquired skills and turn them into practical knowledge that can be applied and adapted, the traditional model, guided practice, independent practice instructional model does not get students to the level of rigor and understanding described in the standards (Schoenfeld, 2014). The CCSS required a complete redesign of what teaching involves, and because of these new demands, teaching must be taken more seriously and sustained help must be provided for teachers (Schoenfeld, 2014).

Another reason to oppose the CCSS and standardized testing is how the questions and material on the tests are guarded with extreme measures until students are actually taking the tests (Prensky, 2013). Why are students not allowed to study the specific material for standardized tests through a study guide or test preparation program, as is the case for any real-world testing situations? Schools should be allowed to utilize software and applications which allow students to prepare for specific standardized tests, and teachers should know precisely when students are ready to take the standardized assessment because of a successful score on the review (Prensky, 2013).

Whether supporting or opposing the CCSS, one cannot deny the numerous changes that need to be made within the educational system in order to do the standards justice (Schoenfeld, 2014). State assessments need to incorporate critical thinking, problem solving, and reasoning (Schoenfeld, 2014). State assessments should be of such quality that teaching to the test becomes ideal, and tests should require students to demonstrate their true knowledge through constructed response and essay questions (Schoenfeld, 2014).

Unfortunately, statewide standardized assessments simply will not be able to live up to the job required to properly assess an understanding of the CCSS as described and intended; such large-scale assessments need to be easy to grade in order to maintain affordability (Schoenfeld, 2014). Also, considering the legalities behind testing such large, diverse groups of students and trying to objectively assess everyone's understanding through written responses would not be legally safe for any large company (Schoenfeld, 2014). Perhaps the lack of a means to properly assess student knowledge at the depth and rigor explained in the CCSS will be the biggest downfall of the entire movement (Schoenfeld, 2014).

Standardized Testing and English Language Learners

The makeup of the student population in America's schools has changed, with an increasing ELL population (Miller, Moore Mackiewicz, & Correa, 2017; O'Sullivan, 2015). The increased challenge in educating students with limited English proficiency has meant increasing dropout percentages and lower achievement levels (Miller et al., 2017). In fact, Latinos are the largest group of ELLs in schools with the highest dropout rate over any other ethnic group, with scores significantly lower in reading, writing, math, and sciences (Miller et al., 2017).

Generally, LEP students do not perform well on standardized tests because the policies on testing and accommodations are strict and not sensitive to the needs of an ELL (Mitchell, 2017). However, federal law requires additional annual testing for all ELL candidates in the form of a standardized English Language Proficiency (ELP) assessment (Mitchell, 2017). Testing within strict criteria in curricular subjects means standardized tests often do not accurately portray an ELL's listening, speaking, reading, and writing strengths and weaknesses in both the first language as well as in English (Solano-Flores, 2014). Considering all LEP students are tested within the same parameters as their English-speaking peers, the validity of test scores from standardized tests, which are insensitive to the learners' needs, becomes questionable at best (Solano-Flores, 2014). However, teachers would like relevant data related to ELL performance in curricular areas as well ELPs, in order to more effectively determine when ELLs no longer need extra support (Mitchell, 2017). The fact is, many states are still grappling to understand exactly how to ensure ELLs receive the support needed, and determining the correct time for each student when support is no longer necessary is crucial to success in higher-level classes (Mitchell, 2017).

The increased population of Hispanic ELLs in America's schools comes with an increased population of limited English-speaking adults (Alvarado et al., 2016). This means the ability to speak both Spanish and English is becoming a greater asset than ever before for job seekers (Alvarado et al., 2016). Being bilingual in today's world could lead to greater opportunities and possibilities than for monolingual peers (Alvarado et al., 2016).

How can educators accurately display the asset of being bilingual to students and their parents when standardized tests indicate ELL students are struggling? At first, simply translating the test into a student's primary language might seem like the logical solution; however, translating will not work for many reasons (Solano-Flores, 2014). Especially when working with grade-level specific, academic language, a test's language complexities such as vocabulary, syntax, and structure cannot be guaranteed to carry over into all the new languages needed (Solano-Flores, 2014). Even if language complexity could be warranted on standardized tests, matching ideal first languages and dialects to all ELLs is not a feasible process (Solano-Flores, 2014).

A more practical solution is to allow states and districts to continue working with a single, consistent English test but to be more mindful of the questions and texts posed within (Solano-Flores, 2014). After all, every sentence, phrase, or even word printed within a test question could potentially cause an ELL to either miss or make the connection with his or her background knowledge (Solano-Flores, 2014). Ideally, test writing should consist of a bottom-up design process involving experts in each of the disciplines related to language, as well as ELLs themselves to assist when writing test questions (Solano-Flores, 2014). Test questions are less likely to be misleading after several language experts and ELLs with their own priorities in mind have adjusted questions based on those concerns (Solano-Flores, 2014).

In 2003, guided by the U.S. Department of Education Enhanced Assessment Grant, states set out to develop a standards-based assessment system to ensure accountability between districts and ELL populations as outlined by NCLB (Fox & Fairbairn, 2011). As stipulated, districts must require all students not proficient in English to take annual proficiency tests until each student matches in ability with his or her English-speaking peers (Fox & Fairbairn, 2011). Ready for launch in 2005, the WIDA Consortium developed an exam known as Assessing Comprehension and Communication in English State-to-State (ACCESS) for ELLs as a standardized test specifically designed for measuring a student's English language proficiency accurately in the high-stakes testing environment (Fox & Fairbairn, 2011). By 2011, the standards-based assessment consistently measured English proficiency of 840,000 ELLs in K-12 classrooms across the 24 participating states of the WIDA consortium (Fox & Fairbairn, 2011). The ACCESS test measures social and general English proficiency in the four modalities of reading, speaking, listening, and writing and spans academic vocabulary seen within language arts, mathematics, science, and social studies; therefore, the ACCESS test's unique design tests ELLs through thematic folders tied to five standards, one for each of the four content areas described previously and an additional standard for social/general English vocabulary (Fox & Fairbairn, 2011). Illustrations, maps, and photos, often in color, are examples of the frequent visual supports offered within the ACCESS test (Fox & Fairbairn, 2011).

Teachers and administrators facilitating the ACCESS test capture multiple snapshots of data after administering the test (Fox & Fairbairn, 2011). After completing the test, students receive raw scores, which simply indicate the number of correct answers given throughout the test (Fox & Fairbairn, 2011). Scale scores from 100-600 prove to be more useful data, since the scores work in a continuum through grades K-12 (Fox &

Fairbairn, 2011). The final data teachers and administrators receive from ACCESS testing are proficiency level scores, which simply place students on a scale of one to six labeled entering, beginning, developing, expanding, bridging, and reaching (Fox & Fairbairn, 2011). When ELLs achieve level six, reaching, in all four modalities measured by the ACCESS test, students should be on level with their English-speaking peers (Fox & Fairbairn, 2011).

Standardized testing has evolved with education in the U.S. in an attempt to measure how students and schools are performing and to serve as a guide in the fair distribution of resources under equalizing and expansive conceptions of the educational system (Kornhaber et al., 2014). Uncertain of what the future holds for today's students, many believe preparing students for life after the classroom now includes the incorporation of the latest technology into instruction (Xiaoqing, Yuankun, & Xiaofeng, 2013).

Technology's Influence on Education

Not only has technology long been utilized in public education, but it has always been relied upon to transform teacher pedagogy and the way in which education takes place to better facilitate learning (Cheek, 1997). Ever-changing technology has transformed America's schools from the utilization of slates to pen and paper, from early radio and television broadcasts, to the internet and mobile devices of the current information age (Cheek, 1997). Technology of a century ago did not evolve at the same rate as it does today (Cheek, 1997).

The 1940s and 1950s were a docile time in terms of new technology in education (Cheek, 1997). During the 1960s and 1970s, small pockets of schools in different regions experimented with incorporating technology into their curricula (Cheek, 1997). Programs incorporating technology and computers in various ways were just appearing, such as the Jackson's Mill Industrial Arts Curriculum from Ohio State University, which emphasized the design, sociological, and technological aspects of industry (Cheek, 1997). Publications emphasizing technology in education included *Man Made World* by E. Joseph Piel, which was an attempt to blend science and technology and was adopted by some secondary schools on the forefront of education at the time (Cheek, 1997).

Although the 1960s and 1970s revealed evidence of technological interests in specific locations and pockets of schools, the Science, Technology, and Society (STS) movement was the first time larger groups of schools began to emphasize technology in the United States (Cheek, 1997). The STS program originated in the late 1970s within private schools of New York City, and by the early 1980s STS themes could be found within typical middle school science curricula in many states, especially within larger school districts (Cheek, 1997). The rising interests in technology were simultaneously paired with the appearance and evolution of personal computers, as computers were becoming more mobile and powerful and schools were more easily able to utilize them (Cheek, 1997).

These computer programs of early days focused on higher order thinking skills; the drill and practice commonly associated with computer games of today came in later decades (Thornburg, 2014). For instance, in 1973, the Minnesota Educational Computer Consortium in Minneapolis created simulations designed to teach students the importance of budgeting resources and other challenges early pioneers faced (Thornburg, 2014).

This simulation is the program still widely known today as The Oregon Trail (Thornburg, 2014).

Educators began realizing the capacity of computer programs to teach or reinforce a whole gamut of skills (Cheek, 1997). Organizations such as the then International Technology Educators Association, now International Technology and Engineering Educators Association, were formed and publications such as technological journals and magazines like *The Technology Teacher* became increasingly popular (Cheek, 1997). Education was changing, and the standards-based instruction era of education came to be (Cheek, 1997). The new instructional philosophy focused on four key areas of education: curriculum, instruction, assessment, and professional development (Cheek, 1997).

Since the late 1990s, the whole world of computer technology, including educational technology, has been evolving at an unbelievable rate (Noonoo, 2012). Revolutionary devices were developed and released so frequently that schools and teachers suddenly could not keep up (Noonoo, 2012). Students of this era have become experts on devices because of their immersion in electronics outside of school, thus other generations have labeled them with the term digital natives (Noonoo, 2012). No longer do five to 10 or even 20 years pass by without the release of new, game-changing technology (Thornburg, 2014). For instance, the 2010 release of the iPad was followed by the affordable laptop computer, the Chromebook, just a year later, and then again in 2013 the release of Google Glass was followed by the Apple Watch within two years following (Thornburg, 2014). Apple’s newest iPad Pro was intentionally developed to support corporations and government agencies, targeting customers such as schools and teachers as a replacement for the traditional laptop (Guynn, 2015).

The recent and rapid introduction of new technology into education has brought with it a variety of positive and negative impacts (Harrison & West, 2014). On the optimistic side, recent technology has brought to educators and students its flexibility, which leads to better differentiation and a more appropriate and impactful curriculum (Harrison & West, 2014). More interactive exposure to the curriculum and new content through the use of technology means teachers' practices can ultimately be more effective than before (Harrison & West, 2014). However, many believe technology has brought with it negative aspects such as a loss of community among peers and even extra stress for students when communication with instructors is poor (Harrison & West, 2014).

The Integration of Mobile Devices

Is mastering the ability to read with fluency and comprehension still the number one skillset required to be successful later in life? Many believe teaching students the habits needed to become lifelong learners and independent thinkers is more important than mastering specific skills in the classroom, and modern, portable computers (often termed mobile devices) are the gateway to acquiring knowledge in all settings (Meyer, 2015). With the availability of mobile devices in today's world, it would be foolish not to incorporate devices into classrooms (Meyer, 2015).

Technology is ubiquitous in today's world; a recent study at Portland Community College determined nearly 40% of college students were using iPhones to access the internet and 23% percent were using iPads (Budiman, 2014). For the 2012 calendar year, Concordia Online University found 74% of young adults ages 25 to 34 and 58% of teens from 13 to 17 owned smartphones, and both of those numbers continue to climb at a staggering rate (Concordia Online - Educational Technology, 2015a). In 2012, 35 billion apps were downloaded from Apple's app store alone (Concordia Online - Educational Technology, 2015a).

Realizing the need to educate and prepare students to be successful in the very different world in which they will live, a true transformation of learning through incorporation and implementation of technology and self-efficacy is taking place in today's schools (Donahue, 2014). It is important to remember technology is so ubiquitous and evolving it cannot be thought of as a tool but rather a foundation, a foundation that underlies everything today's students will do in their lives (Prensky, 2013). Their future will be a combination of what humans and computers do best (Prensky, 2013).

Think about the children presently entering America's school system. By five years of age, how many devices have they been exposed to? How many devices can they fluently navigate? How many devices can they utilize with greater efficiency than their parents? With all of the technology exposure and opportunities modern preschoolers have, the arrival of mobile devices in schools has been long-anticipated (Young, 2016). Although early educators must sometimes correct habits and explicitly teach how to utilize devices correctly, student motivation and interest is naturally at a higher level with devices involved in the classroom (Concordia Online - Educational Technology, 2015b). Teachers are excited about the devices as well, and well-structured training and thorough lesson planning helps overcome any barriers of concern when devices are introduced (Young, 2016).

Mobile devices are not only changing pedagogical methods and the delivery of curriculum as described above, but they are changing the very curriculum itself (Prensky, 2013). Society will eventually let go and allow computers to be responsible for the computations and simulations for which devices are much more efficient (Prensky, 2013). In turn, education needs to focus on exercising human judgment in complex situations requiring circumstantial problem solving or human emotion such as empathy or compassion (Prensky, 2013). The trend in recent decades is to continue teaching all skills students have learned in past generations, because it is what society finds comfortable, while also incorporating the technological knowledge needed outside of school walls (Prensky, 2013). The result is an overwhelming, unnecessary curriculum that cannot be taught with respectable depth (Prensky, 2013). Prensky (2013) discussed the time in history when citizens with early model automobiles had to make a change. Eventually, because keeping a horse readily available as an alternative to the automobile was no longer necessary, caring for the horse and teaching the next generation how to ride was no longer needed (Prensky, 2013).

If the implementation of technology such as mobile devices is to spark a true change in education, teacher training and a focus on pedagogy must come first (Donahue, 2014). Teachers must collaborate and share their successes with each other, along with their frustrations and failures (Marek, 2014). Mentor-to-mentee teacher relationships should include conversations and exercises centered around technology, since universities struggle to emphasize current technologies within their instruction (Bingimlas, 2009). Oftentimes, both parties can learn from technology-based activities since strong technology skills are often present in the younger generation of teachers (Bingimlas, 2009). The veterans can share expertise in pedagogy while the mentees practice applying skills in the classroom (Bingimlas, 2009). Witnessing a mentee teacher inspire students through the use of technology will sometimes help motivate the mentor to get more technologically involved as well (Bingimlas, 2009).

In order to be effective, teachers and students must both accept and understand new technology while also being provided with the tools and support to get through new situations (Xiaoqing et al., 2013). Even after students use the technology to solve a problem, they must still be able to contemplate and decide if the answer makes sense (Prensky, 2013). Technology in classrooms must not be looked at as adding yet another task for teachers to manage but rather as a resource that serves as an extension of knowledge (Donahue, 2014; Halverson, 2016). If a student has the ability to utilize a device to quickly access information that aids in the decision-making process, the device has actually become part of the student's mental process (Prensky, 2013). Consider the analogy of humans using early writing tools; no longer did information need to be stored and passed through generations orally (Prensky, 2013). Consider the influence of technologies such as paper and calculators on education; devices such as iPads are simply the next revolutionary tool to completely reshape education (Prensky, 2013).

With computers now much more efficient at processes and procedures than humans, some wonder if educators should continue to teach basic processes such as writing, math, and reading which have served as the foundation of the educational system for decades (Karadag & Kayabasi, 2013). The theory of altering the majority of America's elementary curriculum is unnerving at first; however, what other once-essential skills are no longer taught? Society no longer teaches its youth how to hunt or gather food; children are no longer expected to maintain a horse in case their car is out of service (Karadag & Kayabasi, 2013). Modern technology allows an individual to point their handheld device at any text and have it read aloud in any language desired (Prensky, 2013).

The probability of a new device being accepted by students and teachers is based upon four factors: outcome expectancy, task-technology fit, social influence, and personal factors (Xiaoqing et al., 2013). How useful the devices seem to be, what advantages are offered, and how much of an improvement in student performance the devices provide are all considered aspects of outcome expectancy (Xiaoqing et al., 2013). Task-technology fit is as it sounds, a measure of how well the device assists in the type of work taking place in the classroom (Xiaoqing et al., 2013). What an individual believes a device is capable of and how they think a device will be most useful are sculpted by social influence (Xiaoqing et al., 2013). Ultimately personal factors such as self-efficacy and innovation hold heavy influence over whether a device will continue to be accepted by students and teachers alike (Xiaoqing et al., 2013).

The reality is that most students are already on these devices at home more than they are at school, while teachers are on devices more at school than they are at home (Xiaoqing et al., 2013). Factors influencing device utilization are present both inside and outside of the classroom walls, and ultimately, personal factors are most important in determining whether an individual will accept a new technology (Xiaoqing et al., 2013). Understanding the need to create a one-to-one model at school to mirror the one-to-one model probably already present at home is critical (Donahue, 2014).

Could teachers better reach ELLs in their journey to become English proficient through the implementation of technology? In fact, there has been a recent surge in enhancing ELL curriculum and developing English proficiency through mobile devices

(Alvarado et al., 2016). After all, technology allows teachers to meet students on common ground and makes learning more meaningful and relevant (Alvarado et al., 2016). Modern technology permits educators to implement new instructional methods into curriculum (Miller et al., 2017). Through technology, ELLs can create visual presentations to meet speaking and writing requirements, which supports cooperation and communication with peers (Alvarado et al., 2016). Increased engagement results in more significant motivation and a sense of ownership, which ultimately lead to an enhanced ESL program (Izquierdo, de-la-Cruz-villegas, Aquino-Zúñiga, Sandoval-Caraveo, & García-Martínez, 2017). Devices in the hands of students make information available at any time, and learners have the ability to learn anything at their will with the freedom of choice to move at the pace they desire (Alvarado et al., 2016).

Technology allows students to practice language skills collaboratively or independently, at a student's most current proficiency level and in any location (Alvarado et al., 2016). Mobile apps supplement the curriculum classroom teachers cover in their lessons and create opportunities to make learning authentic (Alvarado et al., 2016; Halverson, 2016). Perhaps most significant, devices can incorporate all modalities assessed by the ACCESS test, allowing students to practice and build skills in speaking, reading, listening, and writing (Alvarado et al., 2016).

Implementing a One-to-One Classroom Model

Mobile devices are an integral part of every aspect of the lives of today's youth, even before they reach school age (Mango, 2015). If it were possible to provide all students in every classroom their very own mobile devices to utilize for research and application, would it not be best to provide that opportunity? An educational model where students have their own devices simply makes the most sense (Mango, 2015). However, while students' perceptions of enjoyment, engagement, and involvement improve when devices are incorporated into a one-to-one classroom, a number of concerns become present as well, especially related to distractions (Ditzler, Hong, & Strudler, 2016).

A one-to-one program brings with it many benefits and challenges for both teachers and students (Halverson, 2016; Wyatt, 2017). One-to-one programs provide immediate access to online resources for everyone, enhanced opportunities for individuals to participate in discussions via boards and blogs, and increased self-reliance when students are asked to find answers to their questions independently through their own research (Wyatt, 2017). Benefits can even include unexpected perks such as lighter backpacks (Wyatt, 2017). However, one-to-one programs bring distractions, including students using the devices for online games, social media, and countless other methods of being off-task during instructional time (Wyatt, 2017). With all students having their own devices, teachers have experienced a more difficult time making meaningful connections with students (Wyatt, 2017). Although limited, some research shows unsanctioned laptop use, for activities such as games and mobile chat, decreases with each passing year students utilize devices (Tallvid, Lundin, Svensson, & Lindström, 2015).

The SAMR model is meant to guide teachers through the steps of technology integration as they progress (Hamilton, Rosenberg, & Akcaoglu, 2016). See Figure 2 for a snapshot description of each level of the SAMR model (Hamilton et al., 2016).

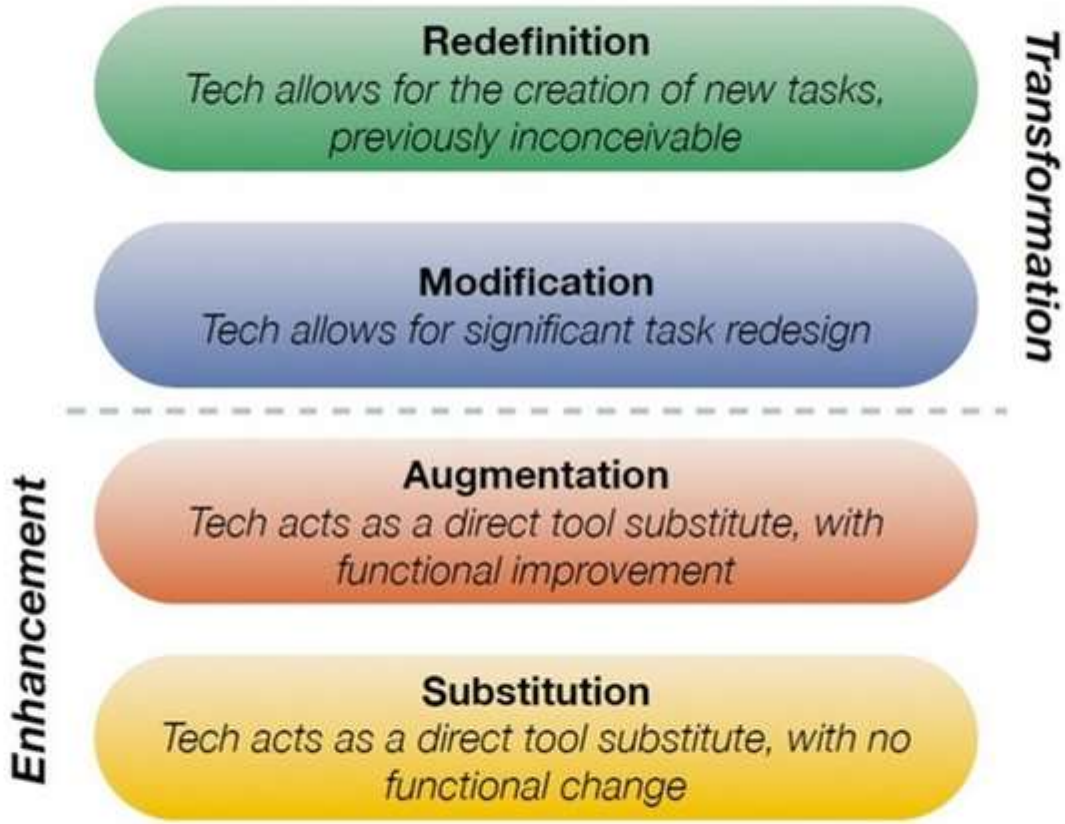

Figure 2. A basic summary of what is included at each level of the SAMR model. Adapted from "The Substitution Augmentation Modification Redefinition (SAMR) Model: A Critical Review and Suggestions for Its Use," by E. Hamilton, J. Rosenberg, and M. Akcaoglu, 2016, *Techtrends: Linking Research & Practice to Improve Learning*, *60*(5), p. 434

Another set of guidelines available to guide application and growth is known as the Technology Integration Matrix (TIM) (Florida Center for Instructional Technology, 2017). Different than the SAMR model in its design, the TIM focuses on how teachers can utilize technology in different aspects of their teaching (Florida Center for Instructional Technology, 2017). According to the Florida Center for Instructional Technology (2017), the TIM outlines five characteristics of a meaningful learning environment: active, collaborative, constructive, authentic, and goal-directed, while also outlining the five levels of technology integration into a curriculum: entry, adoption, adaptation, infusion, and transformation. Figure 3 graphically organizes a brief description of each level of the TIM (Florida Center for Instructional Technology, 2017).

Levels of Technology Integration into the Curriculum

Characteristics of the Learning Environment	Entry	Adoption	Adaptation	Infusion	Transformation
Active	Information passively received	Conventional, procedural use of tools	Conventional independent use of tools; some student choice and exploration	Choice of tools and regular, self-directed use	Extensive and unconventional use of tools
Collaborative	Individual student use of tools	Collaborative use of tools in conventional ways	Collaborative use of tools; some student choice and exploration	Choice of tools and regular use for collaboration	Collaboration with peers and outside resources in ways not possible without technology
Constructive	Information delivered to students	Guided, conventional use for building knowledge	Independent use for building knowledge; some student choice and exploration	Choice and regular use for building knowledge	Extensive and unconventional use of technology tools to build knowledge
Authentic	Use unrelated to the world outside of the instructional setting	Guided use in activities with some meaningful context	Independent use in activities connected to students' lives; some student choice and exploration	Choice of tools and regular use in meaningful activities	Innovative use for higher order learning activities in a local or global context
Goal-Directed	Directions given, step-by-step task monitoring	Conventional and procedural use of tools to plan or monitor	Purposeful use of tools to plan and monitor; some student choice and exploration	Flexible and seamless use of tools to plan and monitor	Extensive and higher order use of tools to plan and monitor

Figure 3. The TIM model's characteristics in an array. Adapted from "The Technology Integration Matrix," by Florida Center for Instructional Technology, 2017. Retrieved from http://fcit.usf.edu/matrix/matrix.php

Regardless of which implementation strategies teachers decide are the best fit for their classrooms, there are a few tips that will keep them focused on moving in the right direction (Ditzler et al., 2016; Halverson, 2016; Mango, 2015). For instance, it is important to remember iPads and other devices will evolve and be phased out; they are tools currently used for learning, but do not represent an endpoint themselves (Mango, 2015). As software applications, devices, and technology evolve, teachers must remember to explicitly show students appropriate ways to utilize technology; students should not be expected to muddle (Marek, 2014). Also, teachers need to ask themselves what benefits each piece of technology brings to improve instructional design to determine whether updating devices or other technologies is necessary (Marek, 2014).

Districts or educators prepared to implement a device-driven environment will be required to make several new decisions and overcome many obstacles (Ditzler et al., 2016; Mulcahy, 2017). Even though computers have become more affordable, purchasing a device for every student could still be out of reach for many districts (Concordia Online - Educational Technology, 2015b). With students today termed digital natives by the rest of society, is it possible the answer districts are looking for could be for students to bring their own devices?

Bring Your Own Device

The concept of the one-to-one classroom model seems to make sense when compared to lifestyles outside of education’s walls, but how can schools justify investing such a large amount of resources into specific devices that will one day, probably very soon, become obsolete (Concordia Online - Educational Technology, 2015b)? Districts contemplating this very situation have come up with a possible solution known as bring your own device (BYOD) (Concordia Online - Educational Technology, 2015b). Students' devices have traditionally been banned from schools, and administrators contemplating the implementation of BYOD have many positive and negative aspects to consider (Concordia Online - Educational Technology, 2015b).

Among the positive aspects of BYOD are the obvious such as being economically advantageous, especially for districts that might not have a budget to support the purchase of the latest devices (Concordia Online - Educational Technology, 2015b). Also, because students already spend much of their time on the devices they bring to school, they are most familiar with their own specific devices (Concordia Online - Educational Technology, 2015b). Allowing students to utilize their own devices also promotes greater student participation; students are motivated to complete assignments and are thus more likely to succeed, and studies have shown BYOD helps create a positive image of the school within the community (Concordia Online - Educational Technology, 2015b).

The BYOD program is often most advantageous for rural school districts (Mulcahy, 2017). Rural teachers have been shown to have a more favorable perception of technology compared to urban school teachers (Mulcahy, 2017). Because of often-limited school budgets, other limited resources, and distance education that can take place with the assistance of mobile devices, the students of rural schools are better positioned to benefit from a technology-driven classroom than others (Mulcahy, 2017).

Negative aspects also exist when deciding to apply BYOD strategies to a school district (Concordia Online - Educational Technology, 2015b). Students on their own devices are more likely to be distracted with social media or other non-educational apps, and tech-savvy students will find ways around filters school districts try to enforce

(Concordia Online - Educational Technology, 2015b). Also, could BYOB increase the socioeconomic divide among students? Most students will have devices and the ability to bring them to school, but what about those who do not? Districts with budgets that would allow the purchase of a limited number of devices could offer them for checkout to students, but classmates would still be able to distinguish those devices and the students using them (Concordia Online - Educational Technology, 2015b). It is also inherent the devices will be abused; students will be on the devices when they are not allowed to be (Concordia Online - Educational Technology, 2015b).

It seems there will always be compatibility issues (Budiman, 2014). Students on different platforms (e.g., Apple, Android, etc.) might not have access to all applications (Budiman, 2014). How will students access paid material and applications, and how/when will students' devices be determined outdated? Also, teachers must make sure curricula and resources previously utilized on computers do not run on Flash or Java-based programs, since most tablets do not support such programs (Budiman, 2014). Tables and charts might not format correctly on all of the different-sized screens of students' mobile devices (Budiman, 2014).

The BYOD initiative will never be successful without the full support of a district's teachers, which can often take time and support to build (Pierce, 2015). Teachers need time to become comfortable and to hone their skills in delivering instruction through the new media (Pierce, 2015). The incorporation of technology also increases the likelihood a lesson could fall apart; aspects such as devices, software, and networks will not always work as planned (Pierce, 2015). Teachers must have an endorsing attitude of incorporating the technology, knowing well a lesson could derail (Pierce, 2015).

Schools considering a modern, technology-driven environment have many options available to them, all with an assortment of positive and negative aspects (Concordia Online - Educational Technology, 2015b). Regardless of which implementation route is taken, administrators and educators alike must have a clear vision of common goals (Concordia Online – Educational Technology, 2015b). Specific strategies on device implementation must be well-understood, and clear policy must be established to guide the process (Concordia Online - Educational Technology, 2015b).

Administration's Role

Regardless of what is being implemented in schools, proper integration methods and strategies must be followed in order to see any real benefits (Machado & Chung, 2015). District leadership and building principals must have a strategic plan to oversee all aspects of implementing mobile technology in order to get the most return on their investment (Machado & Chung, 2015). Principals do believe technology integration to be of utmost importance (Machado & Chung, 2015).

Machado and Chung (2015) found 98% of principals stated technology was important, and 38% stated at least 75% of their teachers were already implementing technology. According to the study, principals also believed teachers' preconceptions sometimes hindered progress, and principals asserted teacher coaches could provide the needed training (Machado & Chung, 2015). Nearly 40% of principals stated teachers were receiving adequate professional development for technology implementation (Machado & Chung, 2015).

The eMINTS program dedicated large amounts of professional development for teachers, typically 250 hours over the course of two years (Martin & Roberts, 2015). School districts investing in mobile technology not only need to plan for extensive professional development for teachers, but they also need be mindful of whether or not teachers will have the necessary time for training (Machado & Chung, 2015). Teachers are often working at their physical and emotional limits, and implementing mobile devices places teachers under additional stress and time constraints (Machado & Chung, 2015). If not handled properly, this can lead to the number one challenge for administrators pushing a new technology – teacher willingness; time and resources for professional development were reported as the second-most difficult challenge (Machado & Chung, 2015).

Another challenge for administration is simply choosing the device best-suited for their districts (Thornburg, 2014). In addition to considering what is obtainable in financial terms for each district, the SWOT acronym can help remind administrators to consider devices' strengths, weaknesses, opportunities, and threats (Thornburg, 2014). Brainstorming the SWOT of available devices while keeping an eye out for devices on the horizon helps ensure the best selection (Thornburg, 2014).

The Future of Education and Technology

Should education embrace the rapid influx of new technologies, or does it threaten society's very way of life? Regardless of how individuals might answer that question, a revolution is happening (Barbour et al., 2014). According to Nadel (2017), "While some of these innovations may take a decade and others might not pan out at all, in 10 years we might look back and wonder how we were able to teach in today's primitive conditions" (p. 70). When device implementation is successful, the new technology allows for more personalized education for students and more flexible instructional time for teachers (Nadel, 2017). In the past 10 years, the number of kindergarten through 12th-grade students engaged in online learning has risen from 50 thousand to more than two million (Barbour et al., 2014). Researchers have elicited positive perceptions from students toward technology-integrated lessons, and the design of many school districts is already changing (Barbour et al., 2014). America is changing from an industrial society to a knowledge society, which is triggering important changes in the teaching-learning process, teacher-student roles, training programs, learning environments, and the equipment needed to make all of this happen (Karadag & Kayabasi, 2013).

So what will education look like in the future? Mobile technology is rapidly changing, and formerly complex tasks will continue to be simplified through new technologies (Meyer, 2015). With that in mind, will schools eventually put away the pencil? Will handwriting skills still be a necessity? The value in being able to write is already declining (Karadag & Kayabasi, 2013). With digital textbooks and mobile devices, will paper textbooks and notebooks be a thing of the past?

As the future becomes the present, the following tips were recommended for educators to keep in mind (Karadag & Kayabasi, 2013):

> Technology is meant to be used as a tool to make one's life easier rather than become one's life. Knowledge will always be information in the mind, not in the tablet. Teachers must always be more informed about usage than students. Parents must be the guides of the new generation in computer usage. Virtual

> addictiveness must be avoided; there is always a right place and a right time. Fields aside from learning with computers must become appealing. Activities with nature must be used more commonly and productively. Using the internet and social media must get separated. (p. 109)

With the internet being so accessible, will students still need to memorize any information beyond the basic skills and abilities needed to utilize and comprehend the resources around them?

Summary

Studying the history of education in the United States leads to the realization and understanding society has not settled on or possibly even discovered what an ideal and fair educational system looks like (Karadag & Kayabasi, 2013). Beliefs, political practices, administration, and pedagogy continue to constantly change (Xiaoqing et al., 2013). Technology has often been a factor in recent decades to drive or at least support those changes (Noonoo, 2012). Will devices prove to be a responsible use of resources by enabling students and teachers to truly change education, or will they just do what so many other political implementations and educational movements have done before, which is simply help teachers do old things in different ways (Noonoo, 2012)?

Chapter Two began with discussion of the philosophies behind the educational system in the United States and the evolution of standardized testing to its current state. The ever-changing technologies utilized in education were reviewed, and their influence on students, including specific populations such as ELLs, was described. Chapter Three presents the research questions, populations, and instrumentation within this study. The chapter also includes descriptions of the data collection and data analysis processes.

Chapter Four includes the data and statistical analysis of the study. Findings, conclusions, implications for practice, and recommendations for future research are explained in Chapter Five.

Chapter Three: Methodology

Problem and Purpose Overview

Technology and its use in the classroom has been an ever-evolving enhancement tool for decades (Noonoo, 2012). Schools and teachers have been adapting their curriculum and pedagogy since the first desktop computers made their way into classrooms in the early 1990s (Noonoo, 2012). The latest tools in the tech evolution, mobile devices, have created opportunities for teachers to motivate and connect with students in even more effective ways, and research suggests mobile device utilization will be significant enough to revolutionize education yet again (Budiman, 2014; Donahue, 2014; Izquierdo et al., 2017; Marek, 2014; Mulcahy, 2017; Prensky, 2013).

Research on mobile device implementation and its impact on standardized test scores varies widely and is often site-specific (Buchholz, 2015; Grant et al., 2015). Most research has verified the devices' game-changing impact with the ability to support a new level of innovative design and differentiated instruction (Grant et al., 2015; Izquierdo et al., 2017). Carr's (2012) recommendations for future study were to try similar analysis among specific populations of students throughout other elementary grade levels, as well as to include qualitative variables in the research design. This study built upon the suggestion of incorporating qualitative variables by considering the quality of technology implementation based on the SAMR model. Also, this researcher studied multiple grade levels while honing in on one specific subgroup of the student population, the ELLs, as recommended by Carr (2012).

The focus on ELLs was driven by research suggesting mobile devices represent a growing sector of digital language learning, encouraging student collaboration and cooperation while also being extrinsically motivating to students working on their language skills (Alvarado et al., 2016). Dynamic, language-based activities encourage students to take responsibility for their own learning in a way not seen before (Alvarado et al., 2016). This research project involved examination of kindergarten through fourth-grade classrooms at all SAMR implementation levels and studied any patterns between SAMR levels of technology integration and ELL performance.

The purpose of this study was to examine teachers' levels of mobile device implementation and subsequent differences in ELL language acquisition. By comparing the ELL performance of many one-to-one mobile device classrooms at all stages of the SAMR model, educators and school administrators can consider the results of this study when determining whether or not a technology-driven classroom environment would yield effective results for their ELL students. If the data collected in this study indicated a strong connection between the utilization of devices in the classroom and student performance on the ACCESS test, all districts would have further evidence the latest approach to technology in education, mobile devices, is an effective approach in the elementary setting for this specific subgroup.

Research questions and hypotheses. The following questions guided the study:

1. What is the difference, if any, in English language learners' reading performance when classroom teachers implement different technology integration strategies in kindergarten through fourth-grade classrooms?

$H1_0$: There is no significant difference in English language learners' reading performance when classroom teachers implement different technology integration strategies in kindergarten through fourth-grade classrooms.

$H1_a$: There is a significant difference in English language learners' reading performance when classroom teachers implement different technology integration strategies in kindergarten through fourth-grade classrooms.

2. What is the difference, if any, in English language learners' writing performance when classroom teachers implement different technology integration strategies in kindergarten through fourth-grade classrooms?

$H2_0$: There is no significant difference in English language learners' writing performance when classroom teachers implement different technology integration strategies in kindergarten through fourth-grade classrooms.

$H2_a$: There is a significant difference in English language learners' writing performance when classroom teachers implement different technology integration strategies in kindergarten through fourth-grade classrooms.

3. What is the difference, if any, in English language learners' speaking performance when classroom teachers implement different technology integration strategies in kindergarten through fourth-grade classrooms?

$H3_0$: There is no significant difference in English language learners' speaking performance when classroom teachers implement different technology integration strategies in kindergarten through fourth-grade classrooms.

$H3_a$: There is a significant difference in English language learners' speaking performance when classroom teachers implement different technology integration strategies in kindergarten through fourth-grade classrooms.

4. What is the difference, if any, in English language learners' listening performance when classroom teachers implement different technology integration strategies in kindergarten through fourth-grade classrooms?

$H4_0$: There is no significant difference in English language learners' listening performance when classroom teachers implement different technology integration strategies in kindergarten through fourth-grade classrooms.

$H4_a$: There is a significant difference in English language learners' listening performance when classroom teachers implement different technology integration strategies in kindergarten through fourth-grade classrooms.

5. What is the difference, if any, in English language learners' overall performance when classroom teachers implement different technology integration strategies in kindergarten through fourth-grade classrooms?

$H5_0$: There is no significant difference in English language learners' overall performance when classroom teachers implement different technology integration strategies in kindergarten through fourth-grade classrooms.

$H5_a$: There is a significant difference in English language learners' overall performance when classroom teachers implement different technology integration strategies in kindergarten through fourth-grade classrooms.

Population and Sample

The district participating in this study was a locally unique, rural district, consisting of over 2,300 students during the 2015-2016 school year, of which nearly 32% were Hispanic and 64% received free or reduced price meals (Missouri Department of Elementary and Secondary Education [MODESE], 2015). The percentage of students considered limited English proficiency (LEP) continues to grow, as its elementary school enrolled nearly 34% Hispanic students (MODESE, 2015). The elementary school's population consisted of over 72% free and reduced-qualified students during the same year (MODESE, 2015).

Making this district even more unique compared to districts in the surrounding area was its belief and support in incorporating the latest technology into instruction and learning. As a result of the district's mission and vision, students in kindergarten through 12th grade reap the benefits of a one-to-one device ratio. Every student in the district has access to his or her own mobile device.

This project incorporated a process known as cluster sampling by inviting all individuals within a specific portion of the population to partake (Bluman, 2017). For this research project, this included 40 kindergarten through fourth-grade classrooms from the surveyed school district. If all 40 teachers were to respond to and complete the survey, approximately 275 ELL students would have been represented. In order to ensure sample responses resembled the entire population, responses needed to be obtained from at least 30 teachers (Bluman, 2017). Of the 40 classroom teachers invited to participate in the technology survey sample, 31 responded. The 31 teachers, when paired with student performance data from the ACCESS tests, represented approximately 215 ELLs.

Instrumentation

This study's survey instrument utilized scenarios originally outlined in the online article "8 Examples of Transforming Lessons Through the SAMR Cycle" by Kelly Walsh (2015). In the article, Walsh (2015) described what each level of the SAMR model might look like throughout several different subject areas. Her descriptions depicted specific teaching strategies teachers can implement in their own classrooms (Walsh, 2015).

Walsh's (2015) descriptions of the SAMR levels of integration were ideal in meeting the needs of this research project since they depict real-life instructional strategies teachers can implement within several classroom disciplines. The situations Walsh (2015) described are general enough so elementary teachers can relate to teaching the common themes; however, each SAMR level is clearly explained through specific detail of what each level looks like in that particular application. The specific description of each SAMR level helped participants in this research project to remember which strategies they implemented under similar circumstances.

The scenarios selected for this study describe typical learning objectives in English language arts, mathematics, social studies, fine arts, student assessment, and technology usage (Walsh, 2015). Including the option not to utilize technology, there were five available choices for each instructional scenario. One choice was representative of a situation where technology was not utilized during the specific situation outlined in the survey question. The remaining four choices each represented one of the four levels of the SAMR model (substitution, augmentation, modification, and redefinition). The survey was programmed to shuffle response choices so teachers were not offered SAMR levels in ascending order. If teachers participating in the survey did not believe any of the available choices accurately represented the activities or strategies they would have used during the scenario outlined in a particular survey question, they had the option of briefly describing what their procedures would have been. The researcher appropriately labeled teachers' descriptive responses into the correct category on the SAMR model.

Two demographic questions were asked within the survey. The identifying information was utilized by the district's ESL coordinator when pairing survey responses with student performance data to be passed along to the researcher. All identifying information was removed from the data before the researcher received it. Participants were asked to provide their names. This demographic question and the first question of the survey helped to organize data from each classroom after they were acquired. This question also served as a safety net in case an invitation to participate was accidently sent to the wrong teacher. The schools' websites could have been out-of-date or other circumstances could have led to a teacher of a different grade level or discipline being inadvertently invited to participate in this study. The second question on the survey asked for participants to select the grade levels they were teaching throughout the applicable school year. This information was another step to ensure the ESL coordinator paired teacher responses to the correct classroom data before identifying information was removed from responses.

The remaining questions of the survey delved into identifying a teacher's SAMR level for use in statistical tests. Results from these questions made up the independent variable for every research question throughout the study. For each question, teachers selected which strategy most resembled their own teaching strategies under specific writing prompt circumstances. If a teacher felt none of the options were an exact fit, an "other" box was available on survey questions three through nine. Teachers could provide their own descriptions of teaching strategies under each specific circumstance, and the researcher placed the teachers' responses in the correct category of the SAMR model. Survey questions four through nine continued similarly to question three, except the circumstances changed to include several other content areas.

The survey was created through Google Forms with the primary goal of collecting specific data to answer the research questions. However, another challenge of maintaining an acceptable response rate to the survey from its participants was present. Both goals helped keep the survey as accurate as possible.

Data Collection

Upon Institutional Review Board approval (see Appendix A), the school district's superintendent signed a letter to allow this study to begin within the district (see Appendix B). Upon receiving approval from the superintendent, kindergarten through fourth-grade teacher contact information was gathered from the participating schools' websites. Kindergarten through fourth-grade teacher participants were simultaneously sent the electronic survey (see Appendix C), participant information form (see Appendix D), and consenting information form (see Appendix E). The survey was sent from the researcher via a link embedded in an informative email describing the purpose of the project and the confidentialities involved. If a teacher chose to participate in the study, he or she selected a link, which redirected that individual to the survey.

As classroom teachers completed the survey, their responses were automatically delivered to the ESL coordinator through the programming of the survey. The ESL coordinator did not attempt to place teachers on the SAMR spectrum. His or her focus was only to remove identifying information from each set of responses and replace the identifying information with an alphanumeric code such as teacher 1a, 1b, etc. After taking note of which teacher was represented by each set of responses, the ESL coordinator then forwarded the responses to the researcher.

Upon receiving sets of coded survey responses, the researcher first labeled any typed responses by teachers at the correct SAMR level. Next, the researcher labeled teachers' overall instructional strategies on the SAMR spectrum by finding the median of their survey responses. After all teachers were placed on the spectrum and their SAMR levels had been determined, the ESL coordinator then sent classroom performance data to the researcher. The ACCESS performance data were gathered separately through a series of reports directly from a software program purchased by the district. The district's ESL coordinator ran a class report of ACCESS performance data for each classroom teacher participating in the survey. Classroom performance data were absent all student and teacher identifying information. Only the same code used on survey responses was present (teacher 1a, teacher 1b, etc.), so the researcher could pair survey responses to classroom performance data.

Data Analysis

Within the survey, teachers selected which instructional strategies most accurately resembled their own teaching practices within seven specific circumstances. The median score of the seven implementation techniques each teacher selected determined the overall SAMR level for each classroom for the original comparison. The highest SAMR level teachers implemented was also stored and used in a second round of comparison. The purpose behind comparing each teacher's median pedagogical method as well as maximum SAMR level used for instruction was to determine if either showed a pattern when compared to student performance. Did students improve due to the one-time, highly-involved SAMR level three or four project a teacher experimented with, or did student performance only improve if teachers were consistently incorporating higher SAMR levels into their instruction?

After sufficient survey responses had been collected, response data were paired with student ACCESS data and analyzed using both descriptive and inferential statistics. Classrooms not utilizing devices in the majority of situations described within the survey were awarded scores of zero for technology implementation. Classrooms simply substituting what could have been done with paper and pencil but now using mobile devices instead were scored at a one and determined to be at the substitution phase of the SAMR model. A classroom improving curriculum and instruction by augmenting assignments via device implementation were considered in the augmentation phase and labeled as a two. Classrooms justifiably using their devices for significant modification of original curriculum and instruction were labeled a three. Any classroom determined to be most often using devices to such an extent as to redefine how learning looks and creating an environment not possible before the introduction of mobile devices in the classroom was labeled as level four on the SAMR model. Ultimately, SAMR levels for each classroom of zero through four were identified and correlated with ACCESS data.

Initially, ACCESS data reports were matched with survey results for each participating classroom. For every grade level, one figure was created for each modality illustrating box-and-whisker plots comparing ACCESS data for classrooms at each SAMR level. For example, “Listening in First Grade” could be the title of a figure showing ACCESS data trends across SAMR levels zero through four of first-grade classrooms. The figures then illustrated any general trends in mean, median, mode, and range across SAMR levels for each modality in each of grade levels.

Next, inferential analysis involving the means calculated previously consisted of calculating *F* scores through analysis of variance (ANOVA) tests in many circumstances throughout this project (Bluman, 2017). Just as the researcher organized data for descriptive analysis figures, for each research question (ACCESS modality), all classrooms of each grade level were grouped by similar SAMR level in order to conduct an ANOVA. The ANOVA, or *F* test, was used for many reasons applicable to this project, such as the comparison of five group means simultaneously, a decreased likelihood of finding a significant difference by chance, and the sample sizes in each category not being equal in size to one another (Bluman, 2017).

For example, for research question one, all listening scaled scores from each kindergarten classroom were averaged and entered into groups (K) representing each SAMR level. An ANOVA was conducted, calculating between-group variance as well as within-group variance (Bluman, 2017). If the means of the groups were not significantly different from one another, the between-group and within-group variances were approximately equal, resulting in an *F* score near 1, and the null hypothesis was not rejected in that particular circumstance (Bluman, 2017). If even one group, or SAMR level, had a significantly different mean, the between-group variance exceeded within-group, the *F* score was higher, and if significant, the null hypothesis was rejected (Bluman, 2017).

A statistically significant *F* score varied per situation and was dependent upon degrees of freedom for both the numerator (*dfN*) and denominator (*dfD*) (Bluman, 2017).

The *dfN* would typically be four unless a SAMR level was not represented in a calculation since $dfN = k - 1$ (k = the number of groups in the calculation) (Bluman, 2017). The *dfD* would typically be four with the exception of third grade, which was three, assuming all participants responded to the survey, since $dfD = N - k$ (N = the sum of the sample sizes in all categories) (Bluman, 2017). In an instance where all participants responded and each SAMR level was represented in teacher feedback, utilizing an alpha level of 0.05, a statistically significant F score would have been considered 23.15 (Bluman, 2017).

Data were organized similarly, and the same ANOVA tests continued in response to research question one for each of the remaining grade levels (one through four). Then the entire process was repeated in response to the remaining four research questions and their corresponding modalities' scaled scores on the ACCESS test. When an ANOVA returned a statistically significant F score, a Tukey HSD test broke down the data further (Lowry, 2017). The calculation revolves around the studentized range statistic (Q) using several of the same variables as the ANOVA (Lowry, 2017). As k = the number of categories represented in the data, comparing each category to every other will involve as many as 10 comparisons (Lowry, 2017). The multiple comparisons of the Tukey test would have identified where any significance in the data is located specifically, such as between categories A and B, B and C, or even among multiple categories, such as A and C or A and D (Lowry, 2017).

Research question five served as the primary analysis link between mobile device implementation and improved standardized test scores for ELLs. Research question five is the composite of all disciplines measured by the ACCESS for ELLs test. Research questions one through four were present to offer additional insight as to whether specific aspects of learning were more significantly impacted by effective mobile device implementation than others.

Summary

While studies on technology integration are less common for rural school districts, especially in the elementary setting, research indicates teachers in rural districts may have more favorable perceptions of technology in the classroom (Mulcahy, 2017). Therefore, students in rural schools could benefit more from a technology integration initiative because of their teachers' positive attitudes (Mulcahy, 2017). If this research holds true, a study on technology integration and its effects on academic performance could have the greatest chance for significance within rural schools such as the studied institution (Mulcahy, 2017).

This research project was designed to determine the difference specific strategies of technology integration have on ELL learning in each of the modalities for grades kindergarten through four. By comparing ACCESS scores from classrooms at different levels of the SAMR model, data indicated if any strategies are more effective than others. An analysis of the data is illustrated in Chapter Four. Conclusions and recommendations for future research are explained in Chapter Five.

Chapter Four: Analysis of the Data

This study included examination of teachers' levels of mobile device implementation and any measurable differences in ELL language acquisition. Research was guided using five research questions and their associated hypotheses. Any trends between the level of implementation of mobile devices and each specific modality were measured through the ACCESS for ELLs test. By comparing all aspects of ELL performance from several one-to-one mobile device classrooms at all stages of the SAMR model, educators and school administrators can consider the results of this study when determining whether or not a technology-driven classroom environment would yield effective results for students learning English as a second language.

Mobile devices have created new opportunities for teachers to immerse students in the curriculum, revolutionizing how teachers motivate and connect with students (Budiman, 2014; Donahue, 2014; Marek, 2014; Mulcahy, 2017; Prensky, 2013). However, adapting curriculum to incorporate mobile devices and accompanying new teaching methods can be stressful and time-consuming for teachers (Dawson, 2012). Also, districts struggling to improve standardized test scores sometimes expand mobile device programs without proper integration and training techniques (Buchholz, 2015). Will the benefits of incorporating today's mobile devices into curriculum be seen before another advancement in technology proves the current evolution obsolete?

This study involved examination of vocabulary and language development and how immersion in language through interactive lessons has been made possible through mobile devices in the four modalities: speaking, listening, reading, and writing (Roessingh, 2014). Also measured in this study was the level to which the devices were utilized based on the SAMR model. The focus is not simply a matter of using the device or not, but rather how motivating and relevant the curriculum can be made through device use (Roessingh, 2014).

In this study, a survey was used to measure teachers' placements on the SAMR spectrum based on how they utilize the devices in their 1:1 classrooms. The survey utilized scenarios originally outlined in the online article "8 Examples of Transforming Lessons Through the SAMR Cycle" by Kelly Walsh (2015). The scenarios in the article fit well into this study, as each SAMR level was identified and examples were given to describe what each level might look like in several different circumstances likely to take place in an elementary classroom throughout the school year (Walsh, 2015). Walsh (2015) depicted specific teaching strategies teachers could identify with as past activities in their own classrooms for each scenario (Walsh, 2015).

Statistical Analysis

After teachers completed the survey, their responses were identified on the SAMR spectrum as scores of zero through four. Teachers' scores in all scenarios outlined in the survey were considered, and median scores were used as each teacher's overall corresponding SAMR level. A teacher's median SAMR level was used in all comparison tests for each of the four modalities as well as in the overall analysis, because it was the median of all device utilization levels students experienced throughout the school year. Also, if teachers were sometimes at a specific, higher SAMR level than their median, a second analysis incorporated those most immersive activities students experienced throughout the year.

Student ACCESS scores were compiled and analyzed using Microsoft Excel. Only considering applicable scores to each research question, the mean (*M*), median (*Mdn*), maximum, minimum, and range were calculated and illustrated in tables. Next, each classroom's mean scores were taken and grouped with other classrooms' scores of similar grade and SAMR levels on the spectrum as determined by survey results. The researcher then organized lists of average scores to compare with those of classrooms of similar grade levels but at different levels on the SAMR spectrum.

Using the classroom averages applicable to each research question, an ANOVA was conducted to determine if the between-group variance exceeded within-group variance through measure of an F score (Bluman, 2017). If calculations found the F score significant ($p < = .05$) and there were more than two SAMR levels represented in the data, the Tukey was also carried out in order to identify where the significant difference in scores was present (Bluman, 2017).

Reading

Kindergarten. The seven participating kindergarten teachers' placements on the SAMR spectrum by median, class means (*M*), medians (*Mdn*), maximums, minimums, and ranges are shown in Table 1. Descriptive analysis revealed only two SAMR levels were represented in the data: zero and one. The top three means and top two medians were achieved in level zero classrooms. The level one classroom had the fourth-highest mean and median of the data set.

Table 1

Median SAMR Placement and Reading ACCESS Scores in Kindergarten

Kindergarten Teacher Number	SAMR Level	Mean	Median	Maximum	Minimum	Range
Teacher 4	0	275.71	280	290	260	30
Teacher 15	0	226	240	280	100	180
Teacher 23	0	234.9	241	280	162	118
Teacher 26	0	200	205	280	100	180
Teacher 27	0	300.5	319.5	336	217	119
Teacher 34	0	199.83	213.5	222	132	90
Teacher 36	1	229.33	260	280	100	180

Using the kindergarten classroom reading averages, an ANOVA was conducted to determine if the between-group variance exceeded within-group variance through measure of an *F* score (Bluman, 2017). The ANOVA resulted in an *F* score of 0.05 with a *p* value of .83. The *p* value of .83 indicated the figures in this test had an 83% probability of happening by chance. When observing median SAMR level exposure, considering kindergarten reading ACCESS scores, the data resulted in a failure to reject the null hypothesis.

The seven participating kindergarten teachers' placements on the SAMR spectrum by maximum, class means (*M*), medians (*Mdn*), maximums, minimums, and ranges are shown in Table 2. Descriptive analysis revealed three SAMR levels were represented in the data: zero, two, and four. The top mean and median were achieved in a level two classroom. The most consistent class, with the lowest range, was also a level two classroom.

Table 2

Maximum SAMR Placement and Reading ACCESS Scores in Kindergarten

Kindergarten Teacher Number	SAMR Level	Mean	Median	Maximum	Minimum	Range
Teacher 4	2	275.71	280	290	260	30
Teacher 15	2	226	240	280	100	180
Teacher 23	0	234.9	241	280	162	118
Teacher 26	4	200	205	280	100	180
Teacher 27	2	300.5	319.5	336	217	119
Teacher 34	4	199.83	213.5	222	132	90
Teacher 36	4	229.33	260	280	100	180

Using the kindergarten classroom reading averages, an ANOVA was conducted to determine if the between-group variance exceeded within-group variance through measure of an *F* score (Bluman, 2017). The ANOVA resulted in an *F* score of 2.9 with a *p* value of .17. The *p* value of .17 indicated the figures in this test had a 17% probability of happening by chance. When observing maximum SAMR level exposure, considering kindergarten reading ACCESS scores, the data resulted in a failure to reject the null hypothesis.

First grade. The seven participating first-grade teachers' placements on the SAMR spectrum by median, class means (*M*), medians (*Mdn*), maximums, minimums, and ranges are shown in Table 3. Descriptive analysis revealed two SAMR levels were represented in the data: zero and one. The three highest means and medians were both achieved in SAMR level zero classrooms. The highest individual scores were also achieved in SAMR level zero classrooms.

Table 3

Median SAMR Placement and Reading ACCESS Scores in First Grade

First-Grade Teacher Number	SAMR Level	Mean	Median	Maximum	Minimum	Range
Teacher 6	0	304	318.5	366	191	175
Teacher 12	0	252.83	259	289	205	84
Teacher 19	0	267.5	266.5	299	247	52
Teacher 25	1	294.83	279	354	252	102
Teacher 28	0	304.14	315	391	191	200
Teacher 33	0	319.43	320	373	226	147
Teacher 37	1	277.71	277	294	248	46

Using the first-grade classroom reading averages, an ANOVA was conducted to determine if the between-group variance exceeded within-group variance through measure of an *F* score (Bluman, 2017). The ANOVA resulted in an *F* score of 0.02 with a *p* value of .89. The *p* value of .89 indicated the figures in this test had an 89% probability of happening by chance. When observing median SAMR level exposure considering first-grade reading ACCESS scores, the data resulted in a failure to reject the null hypothesis.

The seven participating first-grade teachers' placements on the SAMR spectrum by maximum, class means (*M*), medians (*Mdn*), maximums, minimums, and ranges are shown in Table 4. Descriptive analysis revealed three SAMR levels were represented in the data: one, two, and four. The three highest means and medians were achieved in SAMR level one classrooms. The highest individual score was achieved in a SAMR level four classroom.

Table 4

Maximum SAMR Placement and Reading ACCESS Scores in First Grade

First-Grade Teacher Number	SAMR Level	Mean	Median	Maximum	Minimum	Range
Teacher 6	2	304	318.5	366	191	175
Teacher 12	4	252.83	259	289	205	84
Teacher 19	4	267.5	266.5	299	247	52
Teacher 25	4	294.83	279	354	252	102
Teacher 28	4	304.14	315	391	191	200
Teacher 33	1	319.43	320	373	226	147
Teacher 37	4	277.71	277	294	248	46

Using the first-grade classroom reading averages, an ANOVA was conducted to determine if the between-group variance exceeded within-group variance through measure of an F score (Bluman, 2017). The ANOVA resulted in an F score of 1.89 with a p value of .26. The p value of .26 indicated the figures in this test had a 26% probability of happening by chance. When observing maximum SAMR level exposure considering first-grade reading ACCESS scores, the data resulted in a failure to reject the null hypothesis.

Second grade. The eight participating second-grade teachers' placements on the SAMR spectrum by median, class means (*M*), medians (*Mdn*), maximums, minimums, and ranges are shown in Table 5. Descriptive analysis revealed three SAMR levels were represented in the data: zero, one, and two. The highest class mean and median were achieved in a SAMR level two classroom. The highest individual score was achieved in the same level two classroom.

Table 5

Median SAMR Placement and Reading ACCESS Scores in Second Grade

Second-Grade Teacher Number	SAMR Level	Mean	Median	Maximum	Minimum	Range
Teacher 9	2	353.4	345	406	303	103
Teacher 10	0	321.29	316	365	278	87
Teacher 14	0	311.43	308	345	277	68
Teacher 16	1	325.62	314.5	397	282	115
Teacher 18	0	306.17	310.5	329	266	63
Teacher 20	0	312.8	302.5	372	290	82
Teacher 24	1	319.17	309.5	365	291	74
Teacher 29	2	307	295	360	278	82

Using the second-grade classroom reading averages, an ANOVA was conducted to determine if the between-group variance exceeded within-group variance through measure of an F score (Bluman, 2017). The ANOVA resulted in an F score of 0.86 with a p value of .48. The p value of .48 indicated the figures in this test had a 48% probability of happening by chance. When observing median SAMR level exposure considering second-grade reading ACCESS scores, the data resulted in a failure to reject the null hypothesis.

The eight participating second-grade teachers' placements on the SAMR spectrum by maximum, class means (M), medians (Mdn), maximums, minimums, and ranges are shown in Table 6. Descriptive analysis revealed two SAMR levels were represented in the data: levels three and four. The highest class mean and median were achieved in a SAMR level four classroom. The highest individual score was achieved in the same level four classroom.

Table 6

Maximum SAMR Placement and Reading ACCESS Scores in Second Grade

Second-Grade Teacher Number	SAMR Level	Mean	Median	Maximum	Minimum	Range
Teacher 9	4	353.4	345	406	303	103
Teacher 10	3	321.29	316	365	278	87
Teacher 14	4	311.43	308	345	277	68
Teacher 16	4	325.62	314.5	397	282	115
Teacher 18	3	306.17	310.5	329	266	63
Teacher 20	4	312.8	302.5	372	290	82
Teacher 24	4	319.17	309.5	365	291	74
Teacher 29	4	307	295	360	278	82

Using the second-grade classroom reading averages, an ANOVA was conducted to determine if the between-group variance exceeded within-group variance through measure of an *F* score (Bluman, 2017). The ANOVA resulted in an *F* score of 0.36 with a *p* value of .57. The *p* value of .57 indicated the figures in this test had a 57% probability of happening by chance. When observing maximum SAMR level exposure considering second-grade reading ACCESS scores, the data resulted in a failure to reject the null hypothesis.

Third grade. The five participating third-grade teachers' placements on the SAMR spectrum by median, class means (*M*), medians (*Mdn*), maximums, minimums, and ranges are shown in Table 7. Descriptive analysis revealed three SAMR levels were represented in the data: levels zero, one, and two. Both level one classrooms had the highest means. The level two classroom had the lowest mean of this data set.

Table 7

Median SAMR Placement and Reading ACCESS Scores in Third Grade

Third-Grade Teacher Number	SAMR Level	Mean	Median	Maximum	Minimum	Range
Teacher 3	1	339.78	343	388	282	106
Teacher 8	1	350.8	341	387	332	55
Teacher 11	2	323.89	323	355	271	84
Teacher 13	0	330.29	326	397	282	115
Teacher 22	0	339.43	241	280	162	118

Using the third-grade classroom reading averages, an ANOVA was conducted to determine if the between-group variance exceeded within-group variance through measure of an *F* score (Bluman, 2017). The ANOVA resulted in an *F* score of 3.11 with a *p* value of .24. The *p* value of .24 indicated the figures in this test had a 24% probability of happening by chance. When observing median SAMR level exposure considering third-grade reading ACCESS scores, the data resulted in a failure to reject the null hypothesis.

The five participating third-grade teachers' placements on the SAMR spectrum by maximum, class means (*M*), medians (*Mdn*), maximums, minimums, and ranges are shown in Table 8. Descriptive analysis revealed three SAMR levels were represented in the data: levels one, three, and four. The level one classroom had the highest mean. The same classroom also had the highest minimum score, resulting in the lowest range of all classes.

Table 8

Maximum SAMR Placement and Reading ACCESS Scores in Third Grade

Third-Grade Teacher Number	SAMR Level	Mean	Median	Maximum	Minimum	Range
Teacher 3	3	339.78	343	388	282	106
Teacher 8	1	350.8	341	387	332	55
Teacher 11	4	323.89	323	355	271	84
Teacher 13	3	330.29	326	397	282	115
Teacher 22	4	339.43	241	280	162	118

Using the third-grade classroom reading averages, an ANOVA was conducted to determine if the between-group variance exceeded within-group variance through measure of an *F* score (Bluman, 2017). The ANOVA resulted in an *F* score of 3.11 with a *p* value of .24. The *p* value of .24 indicated the figures in this test had a 24% probability of happening by chance. When observing maximum SAMR level exposure considering third-grade reading ACCESS scores, the data resulted in a failure to reject the null hypothesis.

Fourth grade. The four participating fourth-grade teachers' placements on the SAMR spectrum by median, class means (*M*), medians (*Mdn*), maximums, minimums, and ranges are shown in Table 9. Descriptive analysis revealed only two SAMR levels were represented in the data: levels one and two. The level two classrooms in the data offered the lowest means; however, the level two classrooms were also the most consistent with the lowest range among students.

Table 9

Median SAMR Placement and Reading ACCESS Scores in Fourth Grade

Fourth-Grade Teacher Number	SAMR Level	Mean	Median	Maximum	Minimum	Range
Teacher 5	1	337.13	338	368	292	76
Teacher 7	2	335.71	340	360	313	47
Teacher 21	1	359.75	361.5	381	326	55
Teacher 32	1	341.11	335	395	277	118

Using the fourth-grade classroom reading averages, an ANOVA was conducted to determine if the between-group variance exceeded within-group variance through measure of an *F* score (Bluman, 2017). The ANOVA resulted in an *F* score of 0.54 with a *p* value of .54. The *p* value of .54 indicated the figures in this test had a 54% probability of happening by chance. When observing median SAMR level exposure considering fourth-grade reading ACCESS scores, the data resulted in a failure to reject the null hypothesis.

The four participating fourth-grade teachers' placements on the SAMR spectrum by maximum, class means (*M*), medians (*Mdn*), maximums, minimums, and ranges are shown in Table 10. Descriptive analysis revealed only two SAMR levels were represented in the data: levels three and four. A level four classroom offered the highest mean and median. All level four classrooms also had much less range than the level three classroom.

Table 10

Maximum SAMR Placement and Reading ACCESS Scores in Fourth Grade

Fourth-Grade Teacher Number	SAMR Level	Mean	Median	Maximum	Minimum	Range
Teacher 5	4	337.13	338	368	292	76
Teacher 7	4	335.71	340	360	313	47
Teacher 21	4	359.75	361.5	381	326	55
Teacher 32	3	341.11	335	395	277	118

Using the fourth-grade classroom reading averages, an ANOVA was conducted to determine if the between-group variance exceeded within-group variance through measure of an *F* score (Bluman, 2017). The ANOVA resulted in an *F* score of 0.04 with a *p* value of .86. The *p* value of .86 indicated the figures in this test had an 86% probability of happening by chance. When observing maximum SAMR level exposure considering fourth-grade reading ACCESS scores, the data resulted in a failure to reject the null hypothesis.

Writing

Kindergarten. The seven participating kindergarten teachers' placements on the SAMR spectrum by median, class means (*M*), medians (*Mdn*), maximums, minimums, and ranges are shown in Table 11. Descriptive analysis revealed only two SAMR levels were represented in the data: zero and one. The top two means and medians were achieved in level zero classrooms. The level one classroom had the third-highest mean and median of the data set.

Table 11

Median SAMR Placement and Writing ACCESS Scores in Kindergarten

Kindergarten Teacher Number	SAMR Level	Mean	Median	Maximum	Minimum	Range
Teacher 4	0	296.57	305	339	246	93
Teacher 15	0	186	213	271	100	171
Teacher 23	0	220.5	218	271	177	94
Teacher 26	0	210.57	213	288	100	188
Teacher 27	0	270.17	267.5	311	238	73
Teacher 34	0	163	166	223	100	123
Teacher 36	1	238.83	228.5	339	177	162

Using the kindergarten classroom writing averages, an ANOVA was conducted to determine if the between-group variance exceeded within-group variance through measure of an F score (Bluman, 2017). The ANOVA resulted in an F score of 0.01 with a p value of .80. The p value of .80 indicated the figures in this test had an 80% probability of happening by chance. When observing median SAMR level exposure considering kindergarten writing ACCESS scores, the data resulted in a failure to reject the null hypothesis.

The seven participating kindergarten teachers' placements on the SAMR spectrum by maximum, class means (*M*), medians (*Mdn*), maximums, minimums, and ranges are shown in Table 12. Descriptive analysis revealed three SAMR levels were represented in the data: zero, two, and four. The top mean and median were achieved in a level two classroom. The highest individual score was also within the same classroom.

Table 12

Maximum SAMR Placement and Writing ACCESS Scores in Kindergarten

Kindergarten Teacher Number	SAMR Level	Mean	Median	Maximum	Minimum	Range
Teacher 4	2	296.57	305	339	246	93
Teacher 15	2	186	213	271	100	171
Teacher 23	0	220.5	218	271	177	94
Teacher 26	4	210.57	213	288	100	188
Teacher 27	2	270.17	267.5	311	238	73
Teacher 34	4	163	166	223	100	123
Teacher 36	4	238.83	228.5	339	177	162

Using the kindergarten classroom writing averages, an ANOVA was conducted to determine if the between-group variance exceeded within-group variance through measure of an *F* score (Bluman, 2017). The ANOVA resulted in an *F* score of 0.69 with a *p* value of .55. The *p* value of .55 indicated the figures in this test had a 55% probability of happening by chance. When observing maximum SAMR level exposure considering kindergarten writing ACCESS scores, the data resulted in a failure to reject the null hypothesis.

First grade. The seven participating first-grade teachers' placements on the SAMR spectrum by median, class means (*M*), medians (*Mdn*), maximums, minimums, and ranges are shown in Table 13. Descriptive analysis revealed two SAMR levels were represented in the data: zero and one. The highest mean and median were both achieved in a SAMR level zero classroom. The highest individual score was achieved in a separate SAMR level zero classroom.

Table 13

Median SAMR Placement and Writing ACCESS Scores in First Grade

First-Grade Teacher Number	SAMR Level	Mean	Median	Maximum	Minimum	Range
Teacher 6	0	275.3	273	346	231	115
Teacher 12	0	255	264	311	193	118
Teacher 19	0	267.5	266.5	299	247	52
Teacher 25	1	277	248.5	357	234	123
Teacher 28	0	269.57	270	329	231	98
Teacher 33	0	300.43	299	371	238	133
Teacher 37	1	246.29	238	270	234	36

Using the first-grade classroom writing averages, an ANOVA was conducted to determine if the between-group variance exceeded within-group variance through measure of an F score (Bluman, 2017). The ANOVA resulted in an F score of 0.64 with a p value of .46. The p value of .46 indicated the figures in this test had a 46% probability of happening by chance. When observing median SAMR level exposure considering first-grade writing ACCESS scores, the data resulted in a failure to reject the null hypothesis.

The seven participating first-grade teachers' placements on the SAMR spectrum by maximum, class means (*M*), medians (*Mdn*), maximums, minimums, and ranges are shown in Table 14. Descriptive analysis revealed three SAMR levels were represented in the data: one, two, and four. The highest mean and median were both achieved in a SAMR level one classroom. The highest individual score was achieved in the same SAMR level one classroom.

Table 14

Maximum SAMR Placement and Writing ACCESS Scores in First Grade

First-Grade Teacher Number	SAMR Level	Mean	Median	Maximum	Minimum	Range
Teacher 6	2	275.3	273	346	231	115
Teacher 12	4	255	264	311	193	118
Teacher 19	4	267.5	266.5	299	247	52
Teacher 25	4	277	248.5	357	234	123
Teacher 28	4	269.57	270	329	231	98
Teacher 33	1	300.43	299	371	238	133
Teacher 37	4	246.29	238	270	234	36

Using the first-grade classroom writing averages, an ANOVA was conducted to determine if the between-group variance exceeded within-group variance through measure of an F score (Bluman, 2017). The ANOVA resulted in an F score of 3.96 with a p value of .11. The p value of .11 indicated the figures in this test had an 11% probability of happening by chance. When observing maximum SAMR level exposure considering first-grade writing ACCESS scores, the data resulted in a failure to reject the null hypothesis.

Second grade. The eight participating second-grade teachers' placements on the SAMR spectrum by median, class means (*M*), medians (*Mdn*), maximums, minimums, and ranges are shown in Table 15. Descriptive analysis revealed three SAMR levels were represented in the data: levels zero, one, and two. The highest class mean and median were achieved in a SAMR level two classroom. The highest individual score was achieved in a level one classroom.

Table 15

Median SAMR Placement and Writing ACCESS Scores in Second Grade

Second-Grade Teacher Number	SAMR Level	Mean	Median	Maximum	Minimum	Range
Teacher 9	2	341	352	367	300	67
Teacher 10	0	314	317	335	270	65
Teacher 14	0	290.59	285	341	199	142
Teacher 16	1	325.5	329	381	270	111
Teacher 18	0	302.83	300.5	335	262	73
Teacher 20	0	310.3	314.5	346	270	76
Teacher 24	1	312	306	335	290	45
Teacher 29	2	292	280	352	279	73

Using the second-grade classroom writing averages, an ANOVA was conducted to determine if the between-group variance exceeded within-group variance through measure of an *F* score (Bluman, 2017). The ANOVA resulted in an *F* score of 0.54 with a *p* value of .61. The *p* value of .61 indicated the figures in this test had a 61% probability of happening by chance. When observing median SAMR level exposure considering second-grade writing ACCESS scores, the data resulted in a failure to reject the null hypothesis.

The eight participating second-grade teachers' placements on the SAMR spectrum by maximum, class means (*M*), medians (*Mdn*), maximums, minimums, and ranges are shown in Table 16. Descriptive analysis revealed two SAMR levels were represented in the data: levels three and four. The highest class mean and median were achieved in a SAMR level four classroom. The highest individual score was achieved in a separate level four classroom.

Table 16

Maximum SAMR Placement and Writing ACCESS Scores in Second Grade

Second-Grade Teacher Number	SAMR Level	Mean	Median	Maximum	Minimum	Range
Teacher 9	4	341	352	367	300	67
Teacher 10	3	314	317	335	270	65
Teacher 14	4	290.59	285	341	199	142
Teacher 16	4	325.5	329	381	270	111
Teacher 18	3	302.83	300.5	335	262	73
Teacher 20	4	310.3	314.5	346	270	76
Teacher 24	4	312	306	335	290	45
Teacher 29	4	292	280	352	279	73

Using the second-grade classroom writing averages, an ANOVA was conducted to determine if the between-group variance exceeded within-group variance through measure of an *F* score (Bluman, 2017). The ANOVA resulted in an *F* score of 0.06 with a *p* value of .81. The *p* value of .81 indicated the figures in this test had an 81% probability of happening by chance. When observing maximum SAMR level exposure considering second-grade writing ACCESS scores, the data resulted in a failure to reject the null hypothesis.

Third grade. The five participating third-grade teachers' placements on the SAMR spectrum by median, class means (*M*), medians (*Mdn*), maximums, minimums, and ranges are shown in Table 17. Descriptive analysis revealed three SAMR levels were represented in the data: levels zero, one, and two. Class means were consistent in this data set. A level one classroom narrowly had the highest mean. One level one classroom had a range of only 35.

Table 17

Median SAMR Placement and Writing ACCESS Scores in Third Grade

Third-Grade Teacher Number	SAMR Level	Mean	Median	Maximum	Minimum	Range
Teacher 3	1	335.89	341	371	279	92
Teacher 8	1	332.2	323	352	317	35
Teacher 11	2	314.78	317	346	279	67
Teacher 13	0	324.71	341	362	270	92
Teacher 22	0	330.29	335	367	279	88

Using the third-grade classroom writing averages, an ANOVA was conducted to determine if the between-group variance exceeded within-group variance through measure of an F score (Bluman, 2017). The ANOVA resulted in an F score of 11.06 with a p value of .08. The p value of .08 indicated the figures in this test had only a 08% probability of happening by chance. When observing median SAMR level exposure considering third-grade writing ACCESS scores, the data resulted in a failure to reject the null hypothesis.

The five participating third-grade teachers' placements on the SAMR spectrum by maximum, class means (*M*), medians (*Mdn*), maximums, minimums, and ranges are shown in Table 18. Descriptive analysis revealed three SAMR levels were represented in the data: levels one, three, and four. The highest mean and median were achieved in a level three classroom. A level one classroom narrowly had the highest mean. Another level one classroom had the second-highest mean of the data set.

Table 18

Maximum SAMR Placement and Writing ACCESS Scores in Third Grade

Third-Grade Teacher Number	SAMR Level	Mean	Median	Maximum	Minimum	Range
Teacher 3	3	335.89	341	371	279	92
Teacher 8	1	332.2	323	352	317	35
Teacher 11	4	314.78	317	346	279	67
Teacher 13	3	324.71	341	362	270	92
Teacher 22	4	330.29	335	367	279	88

Using the third-grade classroom writing averages, an ANOVA was conducted to determine if the between-group variance exceeded within-group variance through measure of an F score (Bluman, 2017). The ANOVA resulted in an F score of 0.48 with a p value of .68. The p value of .68 indicated the figures in this test had a 68% probability of happening by chance. When observing maximum SAMR level exposure considering third-grade writing ACCESS scores, the data resulted in a failure to reject the null hypothesis.

Fourth grade. The four participating fourth-grade teachers' placements on the SAMR spectrum by median, class means (*M*), medians (*Mdn*), maximums, minimums, and ranges are shown in Table 19. Descriptive analysis revealed only two SAMR levels were represented in the data: levels one and two. Two level two classrooms in the data offered the highest means. The highest median was provided by the level two classroom.

Table 19

Median SAMR Placement and Writing ACCESS Scores in Fourth Grade

Fourth-Grade Teacher Number	SAMR Level	Mean	Median	Maximum	Minimum	Range
Teacher 5	1	269.25	289.5	328	270	58
Teacher 7	2	313.56	328	366	245	121
Teacher 21	1	326.13	320	372	306	66
Teacher 32	1	317	320	333	295	38

Using the fourth-grade classroom writing averages, an ANOVA was conducted to determine if the between-group variance exceeded within-group variance through measure of an *F* score (Bluman, 2017). The ANOVA resulted in an *F* score of 0.07 with a *p* value of .82. The *p* value of .82 indicated the figures in this test had an 82% probability of happening by chance. When observing median SAMR level exposure considering fourth-grade writing ACCESS scores, the data resulted in a failure to reject the null hypothesis.

The four participating fourth-grade teachers' placements on the SAMR spectrum by maximum, class means (*M*), medians (*Mdn*), maximums, minimums, and ranges are shown in Table 20. Descriptive analysis revealed only two SAMR levels were represented in the data: levels three and four. The level three classroom scored second in mean and median but offered the lowest range.

Table 20

Maximum SAMR Placement and Writing ACCESS Scores in Fourth Grade

Fourth-Grade Teacher Number	SAMR Level	Mean	Median	Maximum	Minimum	Range
Teacher 5	4	269.25	289.5	328	270	58
Teacher 7	4	313.56	328	366	245	121
Teacher 21	4	326.13	320	372	306	66
Teacher 32	3	317	320	333	295	38

Using the fourth-grade classroom writing averages, an ANOVA was conducted to determine if the between-group variance exceeded within-group variance through measure of an *F* score (Bluman, 2017). The ANOVA resulted in an *F* score of 0.17 with a *p* value of .72. The *p* value of .72 indicated the figures in this test had a 72% probability of happening by chance. When observing maximum SAMR level exposure considering fourth-grade writing ACCESS scores, the data resulted in a failure to reject the null hypothesis.

Speaking

Kindergarten. The seven participating kindergarten teachers' placements on the SAMR spectrum by median, class means (*M*), medians (*Mdn*), maximums, minimums, and ranges are shown in Table 21. Descriptive analysis revealed only two SAMR levels were represented in the data: zero and one. The top two means were achieved in level zero classrooms. The level one classroom had the third-highest mean and median of the data set.

Table 21

Median SAMR Placement and Speaking ACCESS Scores in Kindergarten

Kindergarten Teacher Number	SAMR Level	Mean	Median	Maximum	Minimum	Range
Teacher 4	0	349.71	392	392	230	162
Teacher 15	0	247	250	392	123	269
Teacher 23	0	345.9	370.5	392	250	142
Teacher 26	0	246.57	211	392	123	269
Teacher 27	0	246.67	252	303	201	102
Teacher 34	0	277	270	392	169	223
Teacher 36	1	308.67	325	392	211	181

Using the kindergarten classroom speaking averages, an ANOVA was conducted to determine if the between-group variance exceeded within-group variance through measure of an *F* score (Bluman, 2017). The ANOVA resulted in an *F* score of 0.19 with a *p* value of .68. The *p* value of .68 indicated the figures in this test had a 68% probability of happening by chance. When observing median SAMR level exposure considering kindergarten speaking ACCESS scores, the data resulted in a failure to reject the null hypothesis.

The seven participating kindergarten teachers' placements on the SAMR spectrum by maximum, class means (*M*), medians (*Mdn*), maximums, minimums, and ranges are shown in Table 22. Descriptive analysis revealed three SAMR levels were represented in the data: zero, two, and four. The highest mean and median were from the same level two classroom. The same maximum individual score was achieved by students in classrooms of all SAMR levels.

Table 22

Maximum SAMR Placement and Speaking ACCESS Scores in Kindergarten

Kindergarten Teacher Number	SAMR Level	Mean	Median	Maximum	Minimum	Range
Teacher 4	2	349.71	392	392	230	162
Teacher 15	2	247	250	392	123	269
Teacher 23	0	345.9	370.5	392	250	142
Teacher 26	4	246.57	211	392	123	269
Teacher 27	2	246.67	252	303	201	102
Teacher 34	4	277	270	392	169	223
Teacher 36	4	308.67	325	392	211	181

Using the kindergarten classroom speaking averages, an ANOVA was conducted to determine if the between-group variance exceeded within-group variance through measure of an *F* score (Bluman, 2017). The ANOVA resulted in an *F* score of 0.85 with a *p* value of .49. The *p* value of .49 indicated the figures in this test had a 49% probability of happening by chance. When observing maximum SAMR level exposure considering kindergarten speaking ACCESS scores, the data resulted in a failure to reject the null hypothesis.

First grade. The seven participating first-grade teachers' placements on the SAMR spectrum by median, class means (*M*), medians (*Mdn*), maximums, minimums, and ranges are shown in Table 23. Descriptive analysis revealed two SAMR levels were represented in the data: zero and one. The highest mean and median were both achieved in a SAMR level one classroom. The highest individual score was achieved in a SAMR level zero classroom; however, the highest individual score was achieved in a level one classroom.

Table 23

Median SAMR Placement and Speaking ACCESS Scores in First Grade

First-Grade Teacher Number	SAMR level	Mean	Median	Maximum	Minimum	Range
Teacher 6	0	271.4	265.5	334	201	133
Teacher 12	0	245	253	308	161	147
Teacher 19	0	248.5	258.5	314	151	163
Teacher 25	1	246.33	255.5	279	174	105
Teacher 28	0	282	286	314	235	79
Teacher 33	0	254.14	265	303	187	116
Teacher 37	1	278.71	265	344	241	103

Using the first-grade classroom speaking averages, an ANOVA was conducted to determine if the between-group variance exceeded within-group variance through measure of an *F* score (Bluman, 2017). The ANOVA resulted in an *F* score of 0.02 with a *p* value of .89. The *p* value of .89 indicated the figures in this test had an 89% probability of happening by chance. When observing median SAMR level exposure considering first-grade speaking ACCESS scores, the data resulted in a failure to reject the null hypothesis.

The seven participating first-grade teachers' placements on the SAMR spectrum by maximum, class means (*M*), medians (*Mdn*), maximums, minimums, and ranges are shown in Table 24. Descriptive analysis revealed three SAMR levels were represented in the data: one, two, and four. The highest mean and median were both achieved in a SAMR level four classroom. The highest individual score was achieved in a SAMR level zero classroom; however, the highest individual score was achieved in a level four classroom.

Table 24

Maximum SAMR Placement and Speaking ACCESS Scores in First Grade

First-Grade Teacher Number	SAMR Level	Mean	Median	Maximum	Minimum	Range
Teacher 6	2	271.4	265.5	334	201	133
Teacher 12	4	245	253	308	161	147
Teacher 19	4	248.5	258.5	314	151	163
Teacher 25	4	246.33	255.5	279	174	105
Teacher 28	4	282	286	314	235	79
Teacher 33	1	254.14	265	303	187	116
Teacher 37	4	278.71	265	344	241	103

Using the first-grade classroom speaking averages, an ANOVA was conducted to determine if the between-group variance exceeded within-group variance through measure of an *F* score (Bluman, 2017). The ANOVA resulted in an *F* score of 0.23 with a *p* value of .80. The *p* value of .80 indicated the figures in this test had an 80% probability of happening by chance. When observing maximum SAMR level exposure considering first-grade speaking ACCESS scores, the data resulted in a failure to reject the null hypothesis.

Second grade. The eight participating second-grade teachers' placements on the SAMR spectrum by median, class means (*M*), medians (*Mdn*), maximums, minimums, and ranges are shown in Table 25. Descriptive analysis revealed three SAMR levels were represented in the data: levels zero, one, and two. The highest class mean was achieved in a SAMR level two classroom. The highest median was achieved in a level one classroom. The highest individual score was achieved in a level zero classroom.

Table 25

Median SAMR Placement and Speaking ACCESS Scores in Second Grade

Second-Grade Teacher Number	SAMR Level	Mean	Median	Maximum	Minimum	Range
Teacher 9	2	272.2	275	287	250	37
Teacher 10	0	244.43	238	275	224	51
Teacher 14	0	274	275	381	113	268
Teacher 16	1	260.56	275	331	126	205
Teacher 18	0	271.83	274.5	299	248	51
Teacher 20	0	258.2	250	320	156	164
Teacher 24	1	276.83	281	310	228	82
Teacher 29	2	274	262	320	228	92

Using the second-grade classroom speaking averages, an ANOVA was conducted to determine if the between-group variance exceeded within-group variance through measure of an F score (Bluman, 2017). The ANOVA resulted in an F score of 0.66 with a p value of .56. The p value of .56 indicated the figures in this test had a 56% probability of happening by chance. When observing median SAMR level exposure considering second-grade speaking ACCESS scores, the data resulted in a failure to reject the null hypothesis.

The eight participating second-grade teachers' placements on the SAMR spectrum by maximum, class means (*M*), medians (*Mdn*), maximums, minimums, and ranges are shown in Table 26. Descriptive analysis revealed two SAMR levels were represented in the data: levels three and four. The highest four class means were achieved in SAMR level four classrooms. The highest individual score was achieved in a level four classroom.

Table 26

Maximum SAMR Placement and Speaking ACCESS Scores in Second Grade

Second-Grade Teacher Number	SAMR Level	Mean	Median	Maximum	Minimum	Range
Teacher 9	4	272.2	275	287	250	37
Teacher 10	3	244.43	238	275	224	51
Teacher 14	4	274	275	381	113	268
Teacher 16	4	260.56	275	331	126	205
Teacher 18	3	271.83	274.5	299	248	51
Teacher 20	4	258.2	250	320	156	164
Teacher 24	4	276.83	281	310	228	82
Teacher 29	4	274	262	320	228	92

Using the second-grade classroom speaking averages, an ANOVA was conducted to determine if the between-group variance exceeded within-group variance through measure of an F score (Bluman, 2017). The ANOVA resulted in an F score of 1.64 with a p value of .25. The p value of .25 indicated the figures in this test had a 25% probability of happening by chance. When observing maximum SAMR level exposure considering second-grade speaking ACCESS scores, the data resulted in a failure to reject the null hypothesis.

Third grade. The five participating third-grade teachers' placements on the SAMR spectrum by median, class means (*M*), medians (*Mdn*), maximums, minimums, and ranges are shown in Table 27. Descriptive analysis revealed three SAMR levels were represented in the data: levels zero, one, and two. A level one classroom represented in the data offered the highest mean. The two level one classrooms offered the lowest and the highest ranges.

Table 27

Median SAMR Placement and Speaking ACCESS Scores in Third Grade

Third-Grade Teacher Number	SAMR Level	Mean	Median	Maximum	Minimum	Range
Teacher 3	1	285	287	367	126	241
Teacher 8	1	293.4	299	320	262	58
Teacher 11	2	281.56	274	342	248	94
Teacher 13	0	288.56	287	342	250	92
Teacher 22	0	278.29	270.5	392	250	142

Using the third-grade classroom speaking averages, an ANOVA was conducted to determine if the between-group variance exceeded within-group variance through measure of an *F* score (Bluman, 2017). The ANOVA results are illustrated in Table 28. The ANOVA resulted in an *F* score of 0.58 with a *p* value of .63. The *p* value of .63 indicated the figures in this test had a 63% probability of happening by chance. When observing median SAMR level exposure considering third-grade speaking ACCESS scores, the data resulted in a failure to reject the null hypothesis.

The five participating third-grade teachers' placements on the SAMR spectrum by maximum, class means (*M*), medians (*Mdn*), maximums, minimums, and ranges are shown in Table 28. Descriptive analysis revealed three SAMR levels were represented in the data: levels one, three, and four. The level one classroom represented in the data offered the highest mean. The two level four classrooms offered the lowest means.

Table 28

Maximum SAMR Placement and Speaking ACCESS Scores in Third Grade

Third-Grade Teacher Number	SAMR Level	Mean	Median	Maximum	Minimum	Range
Teacher 3	3	285	287	367	126	241
Teacher 8	1	293.4	299	320	262	58
Teacher 11	4	281.56	274	342	248	94
Teacher 13	3	288.56	287	342	250	92
Teacher 22	4	278.29	270.5	392	250	142

Using the third-grade classroom speaking averages, an ANOVA was conducted to determine if the between-group variance exceeded within-group variance through measure of an F score (Bluman, 2017). The ANOVA resulted in an F score of 10.93 with a p value of .08. The p value of .08 indicated the figures in this test had an 8% probability of happening by chance. When observing maximum SAMR level exposure considering third-grade speaking ACCESS scores, the data resulted in a failure to reject the null hypothesis.

Fourth grade. The four participating fourth-grade teachers' placements on the SAMR spectrum by median, class means (*M*), medians (*Mdn*), maximums, minimums, and ranges are shown in Table 29. Descriptive analysis revealed only two SAMR levels were represented in the data: levels one and two. The level two classroom offered the highest means. The same class provided the highest median.

Table 29

Median SAMR Placement and Speaking ACCESS Scores in Fourth Grade

Fourth-Grade Teacher Number	SAMR Level	Mean	Median	Maximum	Minimum	Range
Teacher 5	1	308.38	305.5	365	244	121
Teacher 7	2	325	319	365	247	118
Teacher 21	1	313.5	306	375	183	92
Teacher 32	1	279.89	283	354	190	164

Using the fourth-grade classroom speaking averages, an ANOVA was conducted to determine if the between-group variance exceeded within-group variance through measure of an *F* score (Bluman, 2017). The ANOVA resulted in an *F* score of 1.36 with a *p* value of .36. The *p* value of .36 indicated the figures in this test had a 36% probability of happening by chance. When observing median SAMR level exposure considering fourth-grade speaking ACCESS scores, the data resulted in a failure to reject the null hypothesis.

The four participating fourth-grade teachers' placements on the SAMR spectrum by maximum, class means (*M*), medians (*Mdn*), maximums, minimums, and ranges are shown in Table 30. Descriptive analysis revealed only two SAMR levels were represented in the data: levels three and four. The level three classroom offered the lowest mean. The level four classrooms had higher means, medians, and maximum individual scores.

Table 30

Maximum SAMR Placement and Speaking ACCESS Scores in Fourth Grade

Fourth-Grade Teacher Number	SAMR Level	Mean	Median	Maximum	Minimum	Range
Teacher 5	4	308.38	305.5	365	244	121
Teacher 7	4	325	319	365	247	118
Teacher 21	4	313.5	306	375	183	92
Teacher 32	3	279.89	283	354	190	164

Using the fourth-grade classroom speaking averages, an ANOVA was conducted to determine if the between-group variance exceeded within-group variance through measure of an *F* score (Bluman, 2017). The ANOVA resulted in an *F* score of 13.22 with a *p* value of .07. The *p* value of .07 indicated the figures in this test had a 7% probability of happening by chance. When observing maximum SAMR level exposure considering fourth-grade speaking ACCESS scores, the data resulted in a failure to reject the null hypothesis.

Listening

Kindergarten. The seven participating kindergarten teachers' placements on the SAMR spectrum by median, class means (*M*), medians (*Mdn*), maximums, minimums, and ranges are shown in Table 31. Descriptive analysis revealed only two SAMR levels were represented in the data: zero and one. The top three means were achieved in level zero classrooms. Higher medians were also present in several of the level zero classrooms.

Table 31

Median SAMR Placement and Listening ACCESS Scores in Kindergarten

Kindergarten Teacher Number	SAMR Level	Mean	Median	Maximum	Minimum	Range
Teacher 4	0	327.43	318	363	279	84
Teacher 15	0	272.4	303	333	114	219
Teacher 23	0	311.7	318	363	215	148
Teacher 26	0	271.43	279	333	215	118
Teacher 27	0	351.67	357	389	287	102
Teacher 34	0	277.83	286	318	224	94
Teacher 36	1	293.5	318	333	215	118

Using the kindergarten classroom listening averages, an ANOVA was conducted to determine if the between-group variance exceeded within-group variance through measure of an *F* score (Bluman, 2017). The ANOVA resulted in an *F* score of 0 with a *p* value of 1.00. The *p* value of 1.00 indicated the figures in this test were 100% likely to have happened by chance. The data exhibited no pattern. When observing median SAMR level exposure considering kindergarten listening ACCESS scores, the data resulted in a failure to reject the null hypothesis.

The seven participating kindergarten teachers' placements on the SAMR spectrum by maximum, class means (*M*), medians (*Mdn*), maximums, minimums, and ranges are shown in Table 32. Descriptive analysis revealed three SAMR levels were represented in the data: zero, two, and four. The highest mean and median were scored in a level two classroom. The highest individual score was from a separate level two classroom.

Table 32

Maximum SAMR Placement and Listening ACCESS Scores in Kindergarten

Kindergarten Teacher Number	SAMR Level	Mean	Median	Maximum	Minimum	Range
Teacher 4	2	327.43	318	363	279	84
Teacher 15	2	272.4	303	333	114	219
Teacher 23	0	311.7	318	363	215	148
Teacher 26	4	271.43	279	333	215	118
Teacher 27	2	351.67	357	389	287	102
Teacher 34	4	277.83	286	318	224	94
Teacher 36	4	293.5	318	333	215	118

Using the kindergarten classroom listening averages, an ANOVA was conducted to determine if the between-group variance exceeded within-group variance through measure of an *F* score (Bluman, 2017). The ANOVA resulted in an *F* score of 1.19 with a *p* value of .39. The *p* value of .39 indicated the figures in this test were 39% likely to have happened by chance. When observing maximum SAMR level exposure considering kindergarten listening ACCESS scores, the data resulted in a failure to reject the null hypothesis.

First grade. The seven participating first-grade teachers' placements on the SAMR spectrum by median, class means (*M*), medians (*Mdn*), maximums, minimums, and ranges are shown in Table 33. Descriptive analysis revealed two SAMR levels were represented in the data: zero and one. The highest mean and median were both achieved in a SAMR level one classroom. The highest individual score was achieved in a SAMR level zero classroom. Also, one particular level one classroom was very consistent, with a much smaller range than the level zero classrooms.

Table 33

Median SAMR Placement and Listening ACCESS Scores in First Grade

First-Grade Teacher Number	SAMR Level	Mean	Median	Maximum	Minimum	Range
Teacher 6	0	336.2	351	389	254	135
Teacher 12	0	325.5	335.5	389	205	184
Teacher 19	0	346.83	356.5	389	270	119
Teacher 25	1	330.5	326.5	404	250	154
Teacher 28	0	336.86	362	419	232	187
Teacher 33	0	342	362	389	266	123
Teacher 37	1	353.86	362	374	331	43

Using the first-grade classroom listening averages, an ANOVA was conducted to determine if the between-group variance exceeded within-group variance through measure of an *F* score (Bluman, 2017). The ANOVA resulted in an *F* score of 0.36 with a *p* value of .57. The *p* value of .57 indicated the figures in this test had a 57% probability of happening by chance. When observing median SAMR level exposure considering first-grade listening ACCESS scores, the data resulted in a failure to reject the null hypothesis.

The seven participating first-grade teachers' placements on the SAMR spectrum by maximum, class means (*M*), medians (*Mdn*), maximums, minimums, and ranges are shown in Table 34. Descriptive analysis revealed three SAMR levels were represented in the data: one, two, and four. The highest mean and median were both achieved in a SAMR level four classroom. The highest individual score was achieved in a separate SAMR level four classroom.

Table 34

Maximum SAMR Placement and Listening ACCESS Scores in First Grade

First-Grade Teacher Number	SAMR Level	Mean	Median	Maximum	Minimum	Range
Teacher 6	2	336.2	351	389	254	135
Teacher 12	4	325.5	335.5	389	205	184
Teacher 19	4	346.83	356.5	389	270	119
Teacher 25	4	330.5	326.5	404	250	154
Teacher 28	4	336.86	362	419	232	187
Teacher 33	1	342	362	389	266	123
Teacher 37	4	353.86	362	374	331	43

Using the first-grade classroom listening averages, an ANOVA was conducted to determine if the between-group variance exceeded within-group variance through measure of an *F* score (Bluman, 2017). The ANOVA resulted in an *F* score of 0.06 with a *p* value of .94. The *p* value of .94 indicated the figures in this test had a 94% probability of happening by chance. When observing maximum SAMR level exposure considering first-grade listening ACCESS scores, the data resulted in a failure to reject the null hypothesis.

Second grade. The eight participating second-grade teachers' placements on the SAMR spectrum by median, class means (*M*), medians (*Mdn*), maximums, minimums, and ranges are shown in Table 35. Descriptive analysis revealed three SAMR levels were represented in the data: levels zero, one, and two. The highest class mean and median were achieved in a SAMR level two classroom. The highest minimum score was achieved in the same level two classroom.

Table 35

Median SAMR Placement and Listening ACCESS Scores in Second Grade

Second-Grade Teacher Number	SAMR level	Mean	Median	Maximum	Minimum	Range
Teacher 9	2	368.2	377	418	314	104
Teacher 10	0	342.56	355	432	257	175
Teacher 14	0	332	366	390	186	204
Teacher 16	1	353.75	355	404	257	147
Teacher 18	0	313	307.5	345	289	56
Teacher 20	0	357.1	371.5	404	295	109
Teacher 24	1	336.5	333.5	390	282	108
Teacher 29	2	342.29	355	390	247	143

Using the second-grade classroom overall averages, an ANOVA was conducted to determine if the between-group variance exceeded within-group variance through measure of an *F* score (Bluman, 2017). The ANOVA resulted in an *F* score of 1.88 with a *p* value of .25. The *p* value of .25 indicated the figures in this test had a 25% probability of happening by chance. When observing median SAMR level exposure considering second-grade listening ACCESS scores, the data resulted in a failure to reject the null hypothesis.

The eight participating second-grade teachers' placements on the SAMR spectrum by maximum, class means (*M*), medians (*Mdn*), maximums, minimums, and ranges are shown in Table 36. Descriptive analysis revealed two SAMR levels were represented in the data: levels three and four. The highest class mean and median were achieved in a SAMR level four classrooms. In fact, the SAMR level three classrooms had the lowest means in the data set.

Table 36

Maximum SAMR Placement and Listening ACCESS Scores in Second Grade

Second-Grade Teacher Number	SAMR Level	Mean	Median	Maximum	Minimum	Range
Teacher 9	4	368.2	377	418	314	104
Teacher 10	3	342.56	355	432	257	175
Teacher 14	4	332	366	390	186	204
Teacher 16	4	353.75	355	404	257	147
Teacher 18	3	313	307.5	345	289	56
Teacher 20	4	357.1	371.5	404	295	109
Teacher 24	4	336.5	333.5	390	282	108
Teacher 29	4	342.29	355	390	247	143

Using the second-grade classroom overall averages, an ANOVA was conducted to determine if the between-group variance exceeded within-group variance through measure of an *F* score (Bluman, 2017). The ANOVA resulted in an *F* score of 2.75 with a *p* value of .15. The *p* value of .15 indicated the figures in this test had a 15% probability of happening by chance. When observing maximum SAMR level exposure considering second-grade listening ACCESS scores, the data resulted in a failure to reject the null hypothesis.

Third grade. The five participating third-grade teachers' placements on the SAMR spectrum by median, class means (*M*), medians (*Mdn*), maximums, minimums, and ranges are shown in Table 37. Descriptive analysis revealed three SAMR levels were represented in the data: levels zero, one, and two. A level one classroom represented in the data offered the highest mean; however, a level two classroom offered the top median score. The most consistent class, with the least range, was a level zero classroom.

Table 37

Median SAMR Placement and Listening ACCESS Scores in Third Grade

Third-Grade Teacher Number	SAMR level	Mean	Median	Maximum	Minimum	Range
Teacher 3	1	356.33	366	418	257	161
Teacher 8	1	381	377	446	315	131
Teacher 11	2	366.44	390	418	269	149
Teacher 13	0	360.86	363	404	324	80
Teacher 22	0	365.86	366	432	306	126

Using the third-grade classroom listening averages, an ANOVA was conducted to determine if the between-group variance exceeded within-group variance through measure of an *F* score (Bluman, 2017). The ANOVA resulted in an *F* score of 0.09 with a *p* value of .02. The *p* value of .92 indicated the figures in this test had a 92% probability of happening by chance. When observing median SAMR level exposure considering third-grade listening ACCESS scores, the data resulted in a failure to reject the null hypothesis.

The five participating third-grade teachers' placements on the SAMR spectrum by maximum, class means (*M*), medians (*Mdn*), maximums, minimums, and ranges are shown in Table 38. Descriptive analysis revealed three SAMR levels were represented in the data: levels one, three, and four. The level one classroom represented in the data offered the highest mean; however, a level four classroom offered the top median score. The most consistent class, with the least range, was a level three classroom.

Table 38

Maximum SAMR Placement and Listening ACCESS Scores in Third Grade

Third-Grade Teacher Number	SAMR Level	Mean	Median	Maximum	Minimum	Range
Teacher 3	3	356.33	366	418	257	161
Teacher 8	1	381	377	446	315	131
Teacher 11	4	366.44	390	418	269	149
Teacher 13	3	360.86	363	404	324	80
Teacher 22	4	365.86	366	432	306	126

Using the third-grade classroom listening averages, an ANOVA was conducted to determine if the between-group variance exceeded within-group variance through measure of an *F* score (Bluman, 2017). The ANOVA resulted in an *F* score of 32.09 with a *p* value of .03. The *p* value of .03 indicated the figures in this test had only a 3% probability of happening by chance. When observing maximum SAMR level exposure considering third-grade listening ACCESS scores, the null hypothesis was rejected.

Because of the *F* score of 32.09 and $p<.05$, a Tukey USD test was carried out in order to measure where the significant difference occurred. In this scenario, SAMR level one proved statistically significant over SAMR level three but not level four. Neither SAMR level three nor SAMR level four proved significant over any other levels.

Fourth grade. The four participating fourth-grade teachers' placements on the SAMR spectrum by median, class means (*M*), medians (*Mdn*), maximums, minimums, and ranges are shown in Table 39. Descriptive analysis revealed only two SAMR levels were represented in the data: levels one and two. Two of the level one classrooms represented in the data offered the highest means. The lowest individual score was achieved by a student in the level two classroom.

Table 39

Median SAMR Placement and Listening ACCESS Scores in Fourth Grade

Fourth-Grade Teacher Number	SAMR Level	Mean	Median	Maximum	Minimum	Range
Teacher 5	1	356.33	366	418	257	161
Teacher 7	2	389.14	414	468	247	221
Teacher 21	1	411.5	419.5	438	363	75
Teacher 32	1	415.33	414	484	366	118

Using the fourth-grade classroom overall averages, an ANOVA was conducted to determine if the between-group variance exceeded within-group variance through measure of an *F* score (Bluman, 2017). The ANOVA resulted in an *F* score of 0.02 with a *p* value of .90. The *p* value of .90 indicated the figures in this test had a 90% probability of happening by chance. When observing median SAMR level exposure considering fourth-grade listening ACCESS scores, the data resulted in a failure to reject the null hypothesis.

The four participating fourth-grade teachers' placements on the SAMR spectrum by maximum, class means (*M*), medians (*Mdn*), maximums, minimums, and ranges are shown in Table 40. Descriptive analysis revealed only two SAMR levels were represented in the data: levels three and four. The level three classroom provided the highest mean of the group; however, one of the level four classrooms offered the highest median.

Table 40

Maximum SAMR Placement and Listening ACCESS Scores in Fourth Grade

Fourth-Grade Teacher Number	SAMR Level	Mean	Median	Maximum	Minimum	Range
Teacher 5	4	356.33	366	418	257	161
Teacher 7	4	389.14	414	468	247	221
Teacher 21	4	411.5	419.5	438	363	75
Teacher 32	3	415.33	414	484	366	118

Using the fourth-grade classroom overall averages, an ANOVA was conducted to determine if the between-group variance exceeded within-group variance through measure of an *F* score (Bluman, 2017). The ANOVA resulted in an *F* score of 0.86 with a *p* value of .45. The *p* value of .45 indicated the figures in this test had a 45% probability of happening by chance. When observing maximum SAMR level exposure considering fourth-grade listening ACCESS scores, the data resulted in a failure to reject the null hypothesis.

Overall

Kindergarten. The seven participating kindergarten teachers' placements on the SAMR spectrum by median, class means (*M*), medians (*Mdn*), maximums, minimums, and ranges are shown in Table 41. Descriptive analysis revealed only two SAMR levels were represented in the data: zero and one. The highest mean and median were both achieved in a SAMR level zero classroom. The highest individual score was achieved in a SAMR level one classroom.

Table 41

Median SAMR Placement and Overall ACCESS Scores in Kindergarten

Kindergarten Teacher Number	SAMR Level	Mean	Median	Maximum	Minimum	Range
Teacher 4	0	301.86	306	319	274	45
Teacher 15	0	230	265.5	283	106	177
Teacher 23	0	258.10	262	294	206	88
Teacher 26	0	221.43	220	292	121	171
Teacher 27	0	289.5	298.5	321	249	72
Teacher 34	0	210.17	220	254	155	99
Teacher 36	1	254.17	257	323	176	19

Using the kindergarten classroom overall averages, an ANOVA was conducted to determine if the between-group variance exceeded within-group variance through measure of an *F* score (Bluman, 2017). The ANOVA resulted in an *F* score of 0 with a *p* value of 1.00. The *p* value of 1.00 indicated the figures in this test were 100% likely to have happened by chance. The data exhibited no pattern. When observing median SAMR level exposure considering kindergarten overall ACCESS scores, the data resulted in a failure to reject the null hypothesis.

The seven participating kindergarten teachers' placements on the SAMR spectrum by maximum, class means (*M*), medians (*Mdn*), maximums, minimums, and ranges are shown in Table 42. Descriptive analysis revealed three SAMR levels were represented in the data: zero, two, and four. The highest mean and median were both achieved in a SAMR level two classroom. The highest individual score was achieved in a SAMR level zero classroom.

Table 42

Maximum SAMR Placement and Overall ACCESS Scores in Kindergarten

Kindergarten Teacher Number	SAMR Level	Mean	Median	Maximum	Minimum	Range
Teacher 4	2	301.86	306	319	274	45
Teacher 15	2	230	265.5	283	106	177
Teacher 23	0	258.10	262	294	206	88
Teacher 26	4	221.43	220	292	121	171
Teacher 27	0	289.5	298.5	321	249	72
Teacher 34	4	210.17	220	254	155	99
Teacher 36	4	254.17	257	323	176	19

Using the kindergarten classroom overall averages, an ANOVA was conducted to determine if the between-group variance exceeded within-group variance through measure of an *F* score (Bluman, 2017). The ANOVA resulted in an *F* score of 1.45 with a *p* value of .37. The *p* value of .37 indicated the figures in this test were 37% likely to have happened by chance. When observing maximum SAMR level exposure considering kindergarten overall ACCESS scores, the data resulted in a failure to reject the null hypothesis.

First grade. The seven participating first-grade teachers' placements on the SAMR spectrum by median, class means (*M*), medians (*Mdn*), maximums, minimums, and ranges are shown in Table 43. Descriptive analysis revealed two SAMR levels were represented in the data: zero and one. The highest mean and median were both achieved in a SAMR level zero classroom. The highest individual score was achieved in a separate SAMR level zero classroom. Also, the level one classrooms had a smaller range than the level zero classrooms.

Table 43

Median SAMR Placement and Overall ACCESS Scores in First Grade

First-Grade Teacher Number	SAMR Level	Mean	Median	Maximum	Minimum	Range
Teacher 6	0	293.6	304	345	218	127
Teacher 12	0	276.71	179	357	209	148
Teacher 19	0	272.86	285	316	191	125
Teacher 25	1	286.5	269.5	347	238	109
Teacher 28	0	293.86	29	362	249	113
Teacher 33	0	306.43	317	348	239	109
Teacher 37	1	278.43	276	289	270	19

Using the first-grade classroom overall averages, an ANOVA was conducted to determine if the between-group variance exceeded within-group variance through measure of an *F* score (Bluman, 2017). The ANOVA resulted in an *F* score of 0.35 with a *p* value of .58. The *p* value of .58 indicated the figures in this test had a 58% probability of happening by chance. When observing median SAMR level exposure considering first-grade overall ACCESS scores, the data resulted in a failure to reject the null hypothesis.

The seven participating first-grade teachers' placements on the SAMR spectrum by maximum, class means (*M*), medians (*Mdn*), maximums, minimums, and ranges are shown in Table 44. Descriptive analysis revealed three SAMR levels were represented in the data: one, two, and four. The highest mean and median were both achieved in a SAMR level one classroom. The highest individual score was achieved in a SAMR level four classroom.

Table 44

Maximum SAMR Placement and Overall ACCESS Scores in First Grade

First-Grade Teacher Number	SAMR Level	Mean	Median	Maximum	Minimum	Range
Teacher 6	2	293.6	304	345	218	127
Teacher 12	4	276.71	179	357	209	148
Teacher 19	4	272.86	285	316	191	125
Teacher 25	4	286.5	269.5	347	238	109
Teacher 28	4	293.86	29	362	249	113
Teacher 33	1	306.43	317	348	239	109
Teacher 37	4	278.43	276	289	270	19

Using the first-grade classroom overall averages, an ANOVA was conducted to determine if the between-group variance exceeded within-group variance through measure of an *F* score (Bluman, 2017). The ANOVA resulted in an *F* score of 3.96 with a *p* value of .11. The *p* value of .11 indicated the figures in this test had an 11% probability of happening by chance. When observing maximum SAMR level exposure considering first-grade overall ACCESS scores, the data resulted in a failure to reject the null hypothesis.

Second grade. The eight participating second-grade teachers' placements on the SAMR spectrum by median, class means (*M*), medians (*Mdn*), maximums, minimums, and ranges are shown in Table 45. Descriptive analysis revealed three SAMR levels were represented in the data: levels zero, one, and two. The highest class mean and median were achieved in SAMR level two classroom. Similar to previous tests, the level zero classrooms had the highest ranges.

Table 45

Median SAMR Placement and Overall ACCESS Scores in Second Grade

Second-Grade Teacher Number	SAMR Level	Mean	Median	Maximum	Minimum	Range
Teacher 9	2	339	338	370	307	63
Teacher 10	0	310.43	312	341	269	72
Teacher 14	0	301.43	310	347	211	136
Teacher 16	1	319.88	323.4	355	251	104
Teacher 18	0	300.67	307.5	320	265	55
Teacher 20	0	310.4	312	346	279	67
Teacher 24	1	312.83	314	336	292	44
Teacher 29	2	302.14	293	349	273	76

Using the second-grade classroom overall averages, an ANOVA was conducted to determine if the between-group variance exceeded within-group variance through measure of an *F* score (Bluman, 2017). The ANOVA resulted in an *F* score of 1.08 with a *p* value of .41. The *p* value of .41 indicated the figures in this test had a 41% probability of happening by chance. When observing median SAMR level exposure considering second-grade overall ACCESS scores, the data resulted in a failure to reject the null hypothesis.

The eight participating second-grade teachers' placements on the SAMR spectrum by maximum, class means (*M*), medians (*Mdn*), maximums, minimums, and ranges are shown in Table 46. Descriptive analysis revealed two SAMR levels were represented in the data: levels three and four. The highest class mean and median were achieved in a SAMR level four classroom. The highest individual score was achieved in the same level four classroom.

Table 46

Maximum SAMR Placement and Overall ACCESS Scores in Second Grade

Second-Grade Teacher Number	SAMR Level	Mean	Median	Maximum	Minimum	Range
Teacher 9	4	339	338	370	307	63
Teacher 10	3	310.43	312	341	269	72
Teacher 14	4	301.43	310	347	211	136
Teacher 16	4	319.88	323.4	355	251	104
Teacher 18	3	300.67	307.5	320	265	55
Teacher 20	4	310.4	312	346	279	67
Teacher 24	4	312.83	314	336	292	44
Teacher 29	4	302.14	293	349	273	76

Using the second-grade classroom overall averages, an ANOVA was conducted to determine if the between-group variance exceeded within-group variance through measure of an *F* score (Bluman, 2017). The ANOVA resulted in an *F* score of 1.06 with a *p* value of .35. The *p* value of .35 indicated the figures in this test had a 35% probability of happening by chance. When observing maximum SAMR level exposure considering second-grade overall ACCESS scores, the data resulted in a failure to reject the null hypothesis.

Third grade. The five participating third-grade teachers' placements on the SAMR spectrum by median, class means (*M*), medians (*Mdn*), maximums, minimums, and ranges are shown in Table 47. Descriptive analysis revealed three SAMR levels were represented in the data: levels zero, one, and two. The level one classrooms represented in the data offered the highest means and the top median score. The top-scoring students from each class were all within 10 points of each other.

Table 47

Median SAMR Placement and Overall ACCESS Scores in Third Grade

Third-Grade Teacher Number	SAMR Level	Mean	Median	Maximum	Minimum	Range
Teacher 3	1	334.11	341	366	254	112
Teacher 8	1	345.83	347	368	323	45
Teacher 11	2	320.78	324	359	286	73
Teacher 13	0	327.25	332	369	283	86
Teacher 22	0	331	337	363	285	78

Using the third-grade classroom overall averages, an ANOVA was conducted to determine if the between-group variance exceeded within-group variance through measure of an *F* score (Bluman, 2017). The ANOVA resulted in an *F* score of 3.56 with a *p* value of .22. The *p* value of .22 indicated the figures in this test had a 22% probability of happening by chance. When observing median SAMR level exposure considering third-grade overall ACCESS scores, the data resulted in a failure to reject the null hypothesis.

The five participating third-grade teachers' placements on the SAMR spectrum by maximum, class means (*M*), medians (*Mdn*), maximums, minimums, and ranges are shown in Table 48. Descriptive analysis revealed three SAMR levels were represented in the data: levels one, three, and four. The level one classroom represented in the data offered the highest means and the top median score. The top-scoring students from each class were all within 10 points of each other.

Table 48

Maximum SAMR Placement and Overall ACCESS Scores in Third Grade

Third-Grade Teacher Number	SAMR Level	Mean	Median	Maximum	Minimum	Range
Teacher 3	3	334.11	341	366	254	112
Teacher 8	1	345.83	347	368	323	45
Teacher 11	4	320.78	324	359	286	73
Teacher 13	3	327.25	332	369	283	86
Teacher 22	4	331	337	363	285	78

Using the third-grade classroom overall averages, an ANOVA was conducted to determine if the between-group variance exceeded within-group variance through measure of an *F* score (Bluman, 2017). The ANOVA resulted in an *F* score of 3.55 with a *p* value of .22. The *p* value of .22 indicated the figures in this test had a 22% probability of happening by chance. When observing maximum SAMR level exposure considering third-grade overall ACCESS scores, the data resulted in a failure to reject the null hypothesis.

Fourth grade. The four participating fourth-grade teachers' placements on the SAMR spectrum by median, class means (*M*), medians (*Mdn*), maximums, minimums, and ranges are shown in Table 49. Descriptive analysis revealed only two SAMR levels were represented in the data: levels one and two. A level one classroom represented in the data offered the highest mean. The top two individual scores were also from level one classrooms.

Table 49

Median SAMR Placement and Overall ACCESS Scores in Fourth Grade

Fourth-Grade Teacher Number	SAMR Level	Mean	Median	Maximum	Minimum	Range
Teacher 5	1	322.75	316.5	357	299	58
Teacher 7	2	345.83	347	368	323	45
Teacher 21	1	349	349.5	373	320	53
Teacher 32	1	334.67	340	372	298	74

Using the fourth-grade classroom overall averages, an ANOVA was conducted to determine if the between-group variance exceeded within-group variance through measure of an *F* score (Bluman, 2017). The ANOVA resulted in an *F* score of 0.02 with a *p* value of .89. The *p* value of .89 indicated the figures in this test had an 89% probability of happening by chance. When observing median SAMR level exposure considering fourth-grade overall ACCESS scores, the data resulted in a failure to reject the null hypothesis.

The five participating fourth-grade teachers' placements on the SAMR spectrum by maximum, class means (*M*), medians (*Mdn*), maximums, minimums, and ranges are shown in Table 50. Descriptive analysis revealed only two SAMR levels were represented in the data: levels three and four. A level four classroom represented in the data offered the highest mean. The top two individual scores were also from level two classrooms.

Table 50

Maximum SAMR Placement and Overall ACCESS Scores in Fourth Grade

Fourth-Grade Teacher Number	SAMR Level	Mean	Median	Maximum	Minimum	Range
Teacher 5	4	322.75	316.5	357	299	58
Teacher 7	4	345.83	347	368	323	45
Teacher 21	4	349	349.5	373	320	53
Teacher 32	3	334.67	340	372	298	74

Using the fourth-grade classroom overall averages, an ANOVA was conducted to determine if the between-group variance exceeded within-group variance through measure of an F score (Bluman, 2017). The ANOVA resulted in an F score of 0.07 with a p value of .82. The p value of .82 indicated the figures in this test had an 82% probability of happening by chance. When observing maximum SAMR level exposure considering fourth-grade overall ACCESS scores, the data resulted in a failure to reject the null hypothesis.

Summary

Data analyses were presented in Chapter Four. Separate data sets were provided for each classroom and modality to examine the any trends connecting each teacher’s median level of device implementation based on the SAMR model and ELL performance in reading, speaking, listening, writing, and overall. A second round of data analysis was also provided comparing each classroom and each modality to examine any different outcomes connecting a teacher’s maximum level of device implementation in the SAMR model and the four ACCESS modalities as well as an overall score. Additional data were analyzed via Tukey tests in the event of ANOVA findings proving significant. The

ANOVA examined the differences between teachers' levels of implementation and ELL performance. The Tukey indicated between which levels the difference in means became significant. A review the findings, conclusions based on data analysis, implications for practice, and recommendations for future study are offered in Chapter Five.

Chapter Five: Summary and Conclusions

Mobile devices are abundant in life outside of school (Barbour et al., 2014). It makes sense for schools to incorporate these real-life tools into classrooms, and many students have a positive perception of incorporating devices into learning (Barbour et al., 2014). However, in a society that demands high levels of literacy, classrooms utilizing mobile devices must ensure meaningful, authentic learning is taking place through the use of these modern tools (Roessingh, 2014).

While definitive results are not perfectly defined, trends were present in the data in favor of utilizing iPads in the classroom. Carr's (2012) study guided administrators not to stray from mobile devices in classrooms, as do the data in this research project. In addition, this study also included consideration of the quality of technology implementation based on the SAMR model as a means of measuring how significantly mobile devices are changing education for students. In specific scenarios, one SAMR level did stand out from the others.

Furthermore, this researcher honed in on language development among ELLs without looking at other standardized reading and mathematics scores. The study only involved measurement of how new activities made possible by the incorporation of mobile devices can support growth in the four modalities of reading, speaking, writing, and listening, as well as overall language scores. While trends were sometimes present across all modalities, the listening modality did seem to be the most directly affected.

Findings

Research question one. What is the difference, if any, in English language learners' reading performance when classroom teachers implement different technology integration strategies in kindergarten through fourth-grade classrooms?

Based on teachers' median device implementation levels according to the SAMR model and reading ACCESS scores, ANOVA tests resulted in *F* scores of .05, .02, .86, 3.11, and .54 in grades kindergarten through four, respectively. All *F* scores failed to meet levels of significance. The results of research question one indicated there was not a statistically significant difference between teachers' median levels of device implementation and ELL reading scores on the ACCESS test.

Based on teachers' maximum device implementation levels according to the SAMR model and reading ACCESS scores, ANOVA tests resulted in *F* scores of 2.9, 1.89, .36, 1.54, and .04 in grades kindergarten through four, respectively. All *F* scores failed to meet levels of significance. The results of research question one indicated there were not statistically significant differences between teachers' maximum levels of device implementation and ELL reading scores on the ACCESS test. For research question one, the null hypothesis was not rejected.

Research question two. What is the difference, if any, in English language learners' writing performance when classroom teachers implement different technology integration strategies in kindergarten through fourth-grade classrooms?

Based on teachers' median device implementation levels according to the SAMR model and writing ACCESS scores, ANOVA tests resulted in *F* scores of .07, .64, .54. 11.06, and .07 in grades kindergarten through four, respectively. All *F* scores failed to meet levels of significance. The results of research question one indicated there were not any statistically significant differences between teachers' median levels of device implementation and ELL writing scores on the ACCESS test.

Based on teachers' maximum device implementation levels according to the SAMR model and writing ACCESS scores, ANOVA tests resulted in *F* scores of .69, 3.96, .06, .48, and .17 in grades kindergarten through four, respectively. All *F* scores failed to meet levels of significance. The results of research question one indicated there were not any statistically significant differences between teachers' maximum levels of device implementation and ELL writing scores on the ACCESS test. For research question two, the null hypothesis was not rejected.

Research question three. What is the difference, if any, in English language learners' speaking performance when classroom teachers implement different technology integration strategies in kindergarten through fourth-grade classrooms?

Based on teachers' median device implementation levels according to the SAMR model and speaking ACCESS scores, ANOVA tests resulted in *F* scores of .19, .02, .66, .58, and 1.36 in grades kindergarten through four, respectively. All *F* scores failed to meet levels of significance. The results of research question three indicated there were not any statistically significant differences between teachers' median levels of device implementation and ELL speaking scores on the ACCESS test.

Based on teachers' maximum device implementation levels according to the SAMR model and speaking ACCESS scores, ANOVA tests resulted in *F* scores of .85, .23, 1.64, 10.93, and .07 in grades kindergarten through four, respectively. All *F* scores failed to meet levels of significance. The results of research question three indicated there were not any statistically significant differences between teachers' maximum levels of device implementation and ELL speaking scores on the ACCESS test. For research question three, the null hypothesis was not rejected.

Research question four. What is the difference, if any, in English language learners' listening performance when classroom teachers implement different technology integration strategies in kindergarten through fourth-grade classrooms?

Based on teachers' median device implementation levels according to the SAMR model and listening ACCESS scores, ANOVA tests resulted in *F* scores of .06, .36, 1.88, .09, and .02 in grades kindergarten through four, respectively. All *F* scores failed to meet levels of significance. The results of research question four indicated there were not any statistically significant differences between teachers' median levels of device implementation and ELL listening scores on the ACCESS test.

Based on teachers' maximum device implementation levels according to the SAMR model and listening ACCESS scores, ANOVA tests resulted in *F* scores of 1.19, .06, 2.75, 32.09, and .86 in grades kindergarten through four, respectively. *F* scores failed to meet levels of significance in kindergarten, first, second, and fourth grades. The results of research question four indicated there were not any statistically significant differences between teachers' maximum levels of device implementation and ELL listening scores on the ACCESS test for kindergarten, first, second, and fourth grades. For research question four, the null hypothesis was not rejected for the applicable grades; however, the *F* score of 32.09 was statistically significant and the null hypothesis was rejected for third grade when placing teachers on the SAMR continuum based on their maximum indicated SAMR levels. A Tukey was completed because of the

ANOVA results, and SAMR level one proved statistically significant over SAMR level three but not level four. Neither SAMR level three nor SAMR level four proved significant over any other levels.

Research question five. What is the difference, if any, in English language learners' overall performance when classroom teachers implement different technology integration strategies in kindergarten through fourth-grade classrooms?

Based on teachers' median device implementation levels according to the SAMR model and overall ACCESS scores, ANOVA tests resulted in F scores of .00, .35, 1.08, 3.56, and .02 in grades kindergarten through four, respectively. All F scores failed to meet levels of significance. The results of research question five indicated there were not any statistically significant differences between teachers' median levels of device implementation and ELL overall scores on the ACCESS test.

Based on teachers' maximum device implementation levels according to the SAMR model and overall ACCESS scores, ANOVA tests resulted in F scores of 1.45, 3.96, 1.06, 3.55, and .07 in grades kindergarten through four, respectively. All F scores failed to meet levels of significance. The results of research question five indicated there were not any statistically significant differences between teachers' maximum levels of device implementation and ELL overall scores on the ACCESS test. For research question five, the null hypothesis was not rejected.

After completing analysis for each ACCESS modality of reading, speaking, listening, and writing as well as an overall ACCESS score for each grade level from kindergarten through fourth grade, one data set offered more substantial results than others. When considering students' maximum exposure on the SAMR spectrum, third grade listening ANOVA results were significant. Also, considering students' median SAMR level of exposure to device-driven activities, third-grade writing scores, while not statistically significant, narrowly missed the significance mark. In addition, third-grade listening scores were nearly significant, with a similar *F* score as writing.

Research question three, listening, showed significance through the ANOVA. Similar to the writing example, students of the level one classroom outperformed students from both level three classrooms and level four classrooms. A Tukey was run, and the level one classroom was statistically significant over level three classes but not level four classes. Neither level three nor level four classrooms held significance over any other levels in the data set.

Research question two offered nearly significant results in third-grade writing. The *F* score was not quite statistically significant; however, based on median SAMR level, students from level one classrooms outperformed students from both level zero and level two classrooms. Based on maximum exposed SAMR levels, the level one classroom held the second-highest score compared to the two level three classrooms and two level four classrooms. Also, research question four nearly showed significance in third grade when considering the maximum SAMR levels students had experienced in speaking. While near the statistically significant alpha level (p=.08, F=10.93), students from the level one classroom again outperformed both level three and level four classrooms.

The improved performance of students in third-grade classrooms at the first SAMR level regardless of median SAMR level or maximum SAMR level prompted further investigation into research questions one and five, the reading modality and overall scores. For research question one, reading, the third-grade *F* score was nowhere near significant based on either median or maximum SAMR levels; however, the level one classroom did outperform the level three classrooms and level four classrooms when considering maximum SAMR level exposure. When considering the median SAMR level exposure, both level one classes outperformed the three remaining level zero and level two classrooms. For research question five, overall ACCESS scores, when considering median SAMR level exposure, both level one classrooms outperformed the level zero and level two classrooms. When considering maximum SAMR level exposure, the level one classroom outperformed level three and level four classrooms.

While sometimes statistically significant and sometimes not, third-grade classrooms at a level one consistently outperformed classrooms at all other levels. The trend is present whether considering the median SAMR level of device-driven activities throughout the year or by looking at the maximum, most immersive device-driven activities. Throughout all data sets, 15 classrooms were identified as level one in third grade. Of those 15 classrooms, 14 were the highest-scoring (or second-highest if behind another level one classroom) in the data. In the remaining data set, a level zero classroom upset the trend, barely scoring second-highest, between the two level one classrooms at first-highest and third-highest. For all involved grade levels other than third grade, the data yielded no significant trends. The true explanation of the trend present in third grade is unknown but several are possible.

Conclusions

In some aspects, this study yielded similar results to what others have described. As iPads were incorporated, “instruction became modern and motivating… students became self-sufficient in their iPad fluency work" (Ness, 2017, p. 4). New activities made possible by mobile devices are often more motivating and relevant in nature than more traditional instructional methods (Roessingh, 2014). Perhaps the iPad's ability to provide immediate feedback was beneficial to students' motivation and performance (Ness, 2017). Following this principle, mobile devices as a substitute for pencil and paper or other tools utilized prior to devices appear to be substantially more motivating to students of a specific age; however, as teachers move further up the SAMR spectrum, key strategies required to support vocabulary growth are reduced (Ness, 2017; Roessingh, 2014).

A more detailed picture of what could have been taking place in the more successful SAMR level one classrooms can be attained through consideration of the activities most likely to have been taking place. Elementary teachers often use devices during centers and independent work time (McDermott & Gormley, 2016). The devices are often simply direct replacements for student workbooks and storybooks (McDermott & Gormley, 2016). Although technology has directly replaced basal readers with online versions, teachers state digital programs were often "integrated with slideshows, audio, and video files that engaged and likely deepened children's understanding of the lesson concepts" (McDermott & Gormley, 2016, p. 140).

So, if simple substitutions were more engaging for students and therefore improved scores, then why were classrooms functioning at the higher SAMR levels not improving ACCESS scores among ELLs as well as level one classrooms? Considering this study focused solely on ELLs and language scores on a standardized test where students demonstrate their knowledge by reading and responding to text, fluency is key in the transition from learning to read to reading to learn, especially in the later elementary grades (Shore, Sabatini, Lentini, Holtzman, & McNeil, 2015). Heavily structured and repeated readings are the most effective practices for improving fluency and comprehension among elementary students making that transition (Shore et al., 2015). Classroom activities in the higher SAMR levels involve more critical thinking and approaching topics and skills in ways not possible before device implementation (Roessingh, 2014). Perhaps the proven practice and repetition of traditional texts had become less of a focus in the classrooms reaching to the SAMR level three and four activities.

Implications for Future Practice

Carr's 2012 article "Does Math Achievement h'APP'en when iPads and Game-Based Learning are Incorporated into Fifth-Grade Mathematics Instruction?" revealed trends favoring technology-driven classrooms (Carr, 2012). Similar findings have been indicated in elementary reading and writing (Carr, 2012; Shore et al., 2015). Both the morale and motivation of students as well as the quality of student writing have shown improvement through the use of iPads (Sessions, Kang, & Womack, 2016).

This researcher took a more specific look at a target student population, but also broke down the levels of device incorporation. Patterns were sought between levels of device utilization based on the SAMR model and improved ACCESS scores in ELLs. While overall the two variables did not seem to show a relationship, one specific grade level, third, showed some differences in the data. While sometimes statistically significant and sometimes not, classrooms at a level one on the SAMR model consistently outperformed classrooms at all other levels regardless of median or maximum SAMR level students experienced.

The data showed teachers and administrators, when considering language development of their ELL population, need not focus on the exact SAMR level at which activities are organized but rather on sound instructional practices including an evolution of incorporating iPads. The data in this research project indicated teaching third graders through mobile devices at SAMR level one, substitution, is the most effective level for language development, but the trend is not present throughout other grade levels. Districts should implement devices, and teachers should be encouraged to use the devices as a replacement for traditional media such as pencil and paper while still incorporating the pedagogy they know to be effective. In addition, teachers who wish to advance to higher levels of the SAMR spectrum should do so with caution and be sure to maintain a focus on traditional best practices for effective instruction and student performance across all disciplines.

Recommendations for Future Research

Future research projects involving mobile devices and their effect on learning could benefit from making several changes apart from this study. This study was limited in sample size, and because of the recent implementation of a one-to-one device program, long-term data. This study also did not take into consideration the frequency of device use. It is also important to remember figures in this research project are only representative of English language learning, not the application of academic skills or learning overall.

The sample size was limited in this study because of the size of the district involved. A larger district with a high percentage of ELLs could provide more classes of data to use in the ANOVA tests. It would also reduce the probability of classes containing a higher-performing group of students than others of similar grade levels. While class lists were created as equally as possible, the results of this study could be disregarded if it were found just a few teachers received an unintentionally higher-performing group of students.

Future research could benefit from incorporating another variable involving the frequency devices were used in the classroom. The survey instrument utilized in this study did not inquire about frequency of device use; therefore, it is possible for students of classrooms placed at the same SAMR levels to have different experiences on the iPads. Measuring the frequency of use would help isolate another of the many variables involved.

Another recommended tweak in structure from this study would be to look at scores outside the realm of language acquisition. This study displayed analyses and results of only one discipline learned in the elementary grades, English language vocabulary scores. While the results of this study serve as a guide for more effective language learning, a study incorporating mathematics or other language arts skills could yield very different results. Therefore, a more inclusive study could yield a more complete picture.

A final recommendation for future studies could be the most involved and require more long-term planning. The ELL students involved in this study were exposed to specific levels of the SAMR spectrum with their same classroom teachers for the majority of one year before completing the ACCESS test. For future studies, the effects of teachers' most common SAMR levels might be more visible if students were to spend multiple years with the same teacher or teachers who often operated on the same SAMR levels. An ongoing longitudinal study of the same district would clarify whether the significant differences currently present in third grade shifted up with the students through grade levels, remained at the third-grade level, or disappeared entirely.

Summary

Chapter One included an explanation of the purpose of this research project and a description of how patterns between technology implementation and ELL performance were to be measured. The chapter provided the benefits of carrying out the study, which include possibly uncovering more information on useful strategies to improve language development in ELLs in rural school districts. Five research questions were also introduced in the chapter, which served as central guides for the project.

Chapter Two focused on the ever-changing history of America's educational system and presented the concept of despite over 100 years of trying to create a fair educational system, the ideal formula is still undiscovered (Karadag & Kayabasi, 2013). The chapter included a discussion of technology's infusion into the system in recent years and questioned whether it would be a true game-changer in the world of education. High-stakes standardized testing, its origin, and present reputation were discussed, and various philosophies behind the long-evident minority and cultural differences in standardized test scores were argued.

The purpose of the study and research questions were reviewed in Chapter Three. The population and sample were defined. The survey instrument was also described, and data collection and analysis requirements were given. The chapter also included information on the belief technology integration within rural schools can show a more significant impact than in urban schools (Mulcahy, 2017). Because of technology's relative scarcity in rural schools when compared to urban districts, some believe it could therefore create a more favorable perception among rural staff and students (Mulcahy, 2017). The chapter also stressed a focus of this study in comparing the depth of specific teaching strategies incorporating mobile devices using the SAMR model rather than simply measuring whether or not there was device usage at all.

Raw statistical analyses were illustrated in Chapter Four. Instructional SAMR levels were given as well as classroom mean scores from the ACCESS for ELLs assessment. Data sets in each scenario were examined for any trends using both descriptive and inferential statistical methods. ANOVA and Tukey tests were completed, finding one statistically significant set of data in third-grade listening, in favor of classrooms at SAMR level one. Descriptive statistics showed other third-grade skills of speaking, writing, and reading followed a similar trend.

Chapter Five assimilated the findings and conclusions of the study. Implications for future research and recommendations for future practice were also explained. The unsuspected trends revealed upon analysis of this study were in specific circumstances; simple substitution practices were the most effective in developing an understanding of the English language. In this study, simple SAMR substitution activities were found to be the most impactful on language learning.

Appendix A

IRB Approval Letter

LINDENWOOD

LINDENWOOD UNIVERSITY ST. CHARLES, MISSOURI

DATE:	March 9, 2017
TO:	Joshua Carter
FROM:	Lindenwood University Institutional Review Board
STUDY TITLE:	[1035794-1] Technology Implementation and English Language Learners
IRB REFERENCE #:	
SUBMISSION TYPE:	New Project
ACTION:	DETERMINATION OF EXEMPT STATUS
DECISION DATE:	March 9, 2017
REVIEW CATEGORY:	Exemption category # *1*

Thank you for your submission of New Project materials for this research study. Lindenwood University Institutional Review Board has determined this project is EXEMPT FROM IRB REVIEW according to federal regulations.

We will put a copy of this correspondence on file in our office.

If you have any questions, please send them to IRB@lindenwood.edu. Please include your project title and reference number in all correspondence with this committee.

This letter has been electronically signed in accordance with all applicable regulations, and a copy is retained within Lindenwood University Institutional Review Board's records.

Appendix B

Site Permission Letter

(Participating District)
(Phone Number)

2/26/17

Dear LU IRB,

Based on my review of the proposed research by Josh Carter, I give permission for him to conduct the study entitled Technology Integration and English Language Learners within the [redacted] School District. As part of this study, I authorize the researcher to survey staff, collect ACCESS data, and publish the results of the study. Individuals' participation will be voluntary and at their own discretion.

We understand our organization's responsibilities include allowing communication from researcher to staff through email, as well as data to be compiled containing the district's ACCESS data utilizing MATRIX software. We reserve the right to withdraw from the study at any time if our circumstances change.

We understand the research will include an electronic survey of typical classroom integration methodologies.

This authorization covers the time period of April 1, 2017, to March 30, 2018.

I confirm that I am authorized to approve research in this setting.

I understand the data collected will remain entirely confidential and may not be provided to anyone outside of the research team without permission from the Lindenwood University IRB.

Sincerely,

(Name), Superintendent

Appendix C

Teacher Survey

Technology Implementation in the Elementary Classroom

1. Please provide your name.

2. Please select the grade you are teaching for the 2016-2017 school year.

    A. Kindergarten

    B. First

    C. Second

    D. Third

    E. Fourth

3. When participating in a writing prompt, students:

    A. use a pencil and paper to complete the writing activity.

    B. type their responses in a word processor rather than writing by hand.

    C. use a word processor and text-to-speech function.

    D. create a document with a word processor and text-to-speech function to share on a blog where feedback could be received and incorporated to help improve the writing.

    E. convey analytic thought using multimedia tools rather than writing in paragraph form.

4. When studying a location, students:

   A. create an overview of hand-written content supplemented with cut-and-pasted magazine clippings.
   B. use presentation software (such as PowerPoint, Prezi, or Google Slides) to construct an overview presentation.
   C. create a presentation incorporating interactive multimedia (such as audio, video, and hyperlinks) to make the product more engaging to the viewer.
   D. explore the locale with Google Earth, then conducted interviews with people who have visited the locale.
   E. create a digital travel brochure incorporating multimedia and student-created video.

5. When studying a famous artist, such as Dr. Seuss, students:

   A. read and discuss a Dr. Seuss story from their textbooks.
   B. digitally read and discuss a Dr. Seuss story read from their devices.
   C. use online activities, guides, and informative sites to supplement reading a Dr. Seuss story.
   D. use multimedia resources like text, audio, and video tools to jointly construct knowledge, learning, and understanding of a story or a character as a group project.
   E. use a concept mapping tool and book creator app to construct their own short stories demonstrating similar key elements through words and images.

6. When taking an assessment, students:

    A. take the quiz with answers handwritten in a printed form.
    B. fill in answers on their devices through an online assessment tool.
    C. fill in answers on their devices through an online assessment tool and receive immediate feedback.
    D. are asked to write an essay around a relevant theme. The written essay can then be narrated and captured as vocal recording.
    E. are asked to create a documentary video answering an essential question related to important concepts.

7. When drawing an assigned picture to represent a character or situation in a story, students:

    A. draw a picture using traditional brush, paint, and paper.
    B. use a digital drawing/painting program to draw/paint the picture.
    C. use a tool that allows the creation of several illustrations to be "played back" (such as Educreations).
    D. pull a background image to use as a "canvas" (such as a digital image scanned and sent to students to use as a background).
    E. create artwork collaboratively using a collaborative online whiteboard (such as Twiddla).

8. When learning appropriate tech usage, such as email etiquette, students:

    A. review printed copies of email etiquette concepts and guidelines.
    B. read an online article discussing email etiquette concepts and guidelines.

C. read an online article discussing email etiquette concepts and guidelines that includes links to examples, and students offer comments online indicating their top 5 favorite tips.

D. watch a video discussing email etiquette concepts and guidelines and after reviewing the guidelines, post to a classroom sharing site (such as seesaw) their top 5 tips.

E. watch the guidelines video, then assess examples of email etiquette 'violations' and indicate which guidelines should be applied to correct/improve on the examples.

9. When learning a new math skill, such as fractions, students:

A. show understanding of fractions on a worksheet by coloring in fractional sets.

B. use a digital worksheet to "color fill" fractional sets.

C. use a digital worksheet to "color fill" fractional sets, while the teacher simultaneously monitors all student screens and offers immediate feedback.

D. use Google sheets and have access to online examples and supplementary learning materials for areas they might struggle with.

E. use an interactive fractions app which gamifies fractions learning.

Appendix D

Participant Information Email

Date:
Title of Project: Technology Integration and English Language Learners
Principal Investigator: Josh Carter, Lindenwood University, Department of Education

You are invited to participate in a study concerning classroom technology integration techniques and English language learning. As a participant in this study, you will be asked to complete a questionnaire through which you will be presented with instructional scenarios for several of the teaching disciplines. For each scenario, you will be asked to select which methodology most closely mirrors your own instructional practices. If no selection closely matches the instructional practices in your classroom, an “other” box will also be provided for you to describe your own practice under such circumstances.

Participation in this study is voluntary and will take approximately 10 minutes of your time. There are no personal benefits to participation. You may decline to answer any questions presented during the study if you so wish. Further, you may decide to withdraw from this study at any time by cancelling the submission of your survey and may do so without any penalty.

All information you provide is considered completely confidential; your name will only be used by the ESL coordinator to tie ELL students to your feedback. The ESL coordinator will code all teacher and student identifying information before forwarding data sets to the primary investigator. The primary investigator will receive a coded list of survey responses paired with ELL ACCESS data from the ESL coordinator. The investigator will never be informed which teachers participated in the study.

You will not be identified individually in any way in any written reports of this research. Data collected during this study will be retained in a locked filing cabinet to which only researchers associated with this study have access. There are no known or anticipated risks associated with participation in this study.

I would like to assure you that this study has been reviewed and approved by the Institutional Review Board at Lindenwood University. However, the final decision about participation is yours. For more information, please see the attached “Adult Consent Form.”

Thank you for your assistance in this project.
Josh Carter, Principal Investigator

Appendix E

INFORMED CONSENT FOR PARTICIPATION IN RESEARCH ACTIVITIES

"Technology Integration and English Language Learners"

Principal Investigator ___Joshua Carter___________________________
Telephone: (phone number) E-mail: (email address)

Participant _______________________ Contact info__________________________

1. You are invited to participate in a research study conducted by Joshua Carter under the guidance of Dr. Brad Hanson. The purpose of this research is to examine the difference, if any, between teachers' levels of mobile device implementation and more significant ELL language acquisition.

2. a) Your participation will involve completing a short survey inquiring about the teaching methodologies used in common learning situations within your classroom.

   b) The amount of time involved in your participation will be between five and 15 minutes.

   Approximately [40] teachers will be involved in this research.

3. There are no anticipated risks associated with this research.
4. There are no direct benefits for you participating in this study. However, your participation will contribute to the knowledge about technology integration and English language learners and may help society.
5. Your participation is voluntary and you may choose not to participate in this research study or to withdraw your consent at any time. You may choose not to answer any questions that you do not want to answer. You will NOT be penalized in any way should you choose not to participate or to withdraw.

6. We will do everything we can to protect your privacy. As part of this effort, your identity will not be revealed in any publication or presentation that may result from this study and the information collected will remain in the possession of the investigator in a safe location.

7. If you have any questions or concerns regarding this study, or if any problems arise, you may call the Investigator, Joshua Carter, at [redacted] or the Supervising Faculty, Dr. Hanson, at [redacted]. You may also ask questions of or state

concerns regarding your participation to the Lindenwood Institutional Review Board (IRB) through contacting Dr. Marilyn Abbott, Provost, at mabbott@lindenwood.edu or 636-949-4912.

I have read this consent form and have been given the opportunity to ask questions. I will also be given a copy of this consent form for my records. I consent to my participation in the research described above.

___________________________________ ___________________________

Participant's Signature Date Participant's Printed Name

___________________________________ ___________________________

Signature of Principal Investigator Date Investigator Printed Name

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Vita

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